## National Unit Specification: general information

**UNIT** Soldering and Circuit Assembly Techniques (SCQF level 5)

**CODE** F5JW 11

### SUMMARY

The Unit provides candidates with little or no prior knowledge of analogue or digital electronic circuit construction an opportunity to develop soldering techniques and practical assembly skills while gaining knowledge of electronic components in a practical workshop/laboratory setting. The emphasis is on the practice of soldering techniques and the assembly of working circuits. This Unit is suitable for candidates wishing to embark upon a career in electronic engineering. It is also suitable for candidates studying other branches of engineering, science, computing or technology

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

### OUTCOMES

1 Carry out soldering and de-soldering of electronic components.
2 Assemble and verify a working analogue electronic circuit.
3 Assemble and verify a working digital electronic 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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## National Unit Specification: general information (cont)

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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 Skills:

- Problem Solving (SCQF level 5)
- Communication (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

## UNIT Soldering and Circuit Assembly Techniques (SCQF level 5)

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

Carry out soldering and de-soldering of electronic components.

### Performance Criteria

(a) Soldering of specified components is carried out correctly.
(b) De-soldering of specified components is carried out correctly.
(c) Soldering and de-soldering equipment is maintained correctly.

### OUTCOME 2

Assemble and verify a working analogue electronic circuit.

### Performance Criteria

(a) Interpret correctly a given analogue circuit diagram to produce a layout diagram.
(b) Component selection and placement is correct.
(c) Component soldering is correct.
(d) The assembled circuit operation is correctly verified.

### OUTCOME 3

Assemble and verify a working digital electronic circuit.

### Performance Criteria

(a) Interpret correctly a given digital circuit diagram to produce a layout diagram.
(b) Component selection and placement is correct.
(c) Component soldering is correct.
(d) The assembled circuit operation is correctly verified.

## National Unit Specification: statement of standards (cont)

**UNIT** Soldering and Circuit Assembly Techniques (SCQF level 5)

### EVIDENCE REQUIREMENTS FOR THIS UNIT

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

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

An assessor observation checklist must be used to record the candidates performance in all Outcomes during the given tasks and be retained by the centre.

The required evidence, for all outcomes, is as follows:

**For Outcome 1:**

- bare wire links are soldered correctly
- insulated wires/links are soldered correctly without damage to insulation
- resistors are soldered correctly without damage to component
- capacitors are soldered correctly without damage to component
- inductors are soldered correctly without damage to component
- electrolytic capacitors are orientated and soldered correctly without damage to device
- diodes are orientated and soldered correctly without damage to device
- Light Emitting Diodes (LEDs) are orientated and soldered correctly without damage to device
- transistors are orientated and soldered correctly without damage to device
- transistors are orientated and soldered correctly without damage to device
- Dual In Line (DIL) packages are orientated and soldered correctly without damage to device
- Insulation Displacement Connector (IDC) connectors are orientated and soldered correctly without damage to device

**For Outcomes 2 and 3:**

From given Analogue and Digital circuit diagrams:

- correctly pin assigned layout diagram with connectors and tracks which are fit for purpose including power, signal lines and appropriate test points
- all components are placed and oriented correctly
- all joints are soldered correctly
- there is no damage to wire insulation and component packages
- analogue circuit is correctly constructed on prototyping board or Printed Circuit Board (PCB) artefact
- digital circuit is correctly constructed on prototyping board or PCB artefact
- analogue circuit works as specified

## National Unit Specification: statement of standards (cont)

**UNIT** Soldering and Circuit Assembly Techniques (SCQF level 5)

- digital circuit works as specified

Of the two artefacts required above as evidence, there must be one circuit constructed using strip board or similar and one circuit constructed using PCB.

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

## National Unit Specification: support notes

## UNIT Soldering and Circuit Assembly Techniques (SCQF level 5)

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 restricted core Unit within the National Certificate in Electronic Engineering at SCQF level 5 but can also be taken on a free-standing basis. It is intended that this Unit should develop further a student's interest and enthusiasm for electronics; the emphasis is largely practical construction of both analogue and digital circuits but with the underlying theoretical and organisational issues addressed. The circuits used need not be trivial. Candidates should be reminded of the relevance of electronic construction using modern examples such as MP3/4 players, iPods, Mobile phones, DVDS, HDMI TFT and plasma displays, laptop computers, PDAS, internet technology, satellite TV, DAB radios etc. The social and beneficial aspects of electronics should also be emphasised with references to the wide range of application areas such as environment, medical, transport, communications, education, navigation, energy, security, governmental applications and industrial applications as well as entertainment.

The practical exercises may be conducted in an informal atmosphere but within a formal laboratory/workshop setting while adhering to relevant safety practices. Bought-in or in-house kits could be used for the initial formative exercises. It is preferable that the assembly process be well supported in the initial stages possibly with the use of paper based worksheets to enable students to work independently and at their own pace, but progress should be made towards construction from a given circuit diagram.

An extensive range of components, including surface mount, can be used throughout for example:

Sockets Pins and Connectors: SIL, DIL, strip board pins, IDC etc
Switches: DIL, toggle, micro, slide, reed, rotary etc
Resistors: Carbon film, LDRs,
Capacitors: Power supply smoothing electrolytic, timing, ceramic, tantalum etc
Inductors: Surge suppressors, coils and transformers etc
Diodes: Small signal, rectifiers, bridge rectifiers, zener, LEDs etc
Transistors: Small signal, power, bipolar, FETs, voltage regulators etc
MSI Analogue: Operational amplifiers, PLLs, radio modules etc
Logic Gates: AND, OR, NAND, NOR, XOR, XNOR
Digital MSI devices: Counters, shift registers, MUX, arithmetic, PLDs etc
Digital Programmable Devices: Pic microcontrollers etc
Display Devices: LEDs, seven segment displays, LCD displays
Output Devices: Lamps, relays, motors, solenoids etc
Power Sources: NiCd battery, NmHd battery, PV Cells, electronic regulated

## National Unit Specification: support notes (cont)

**UNIT** Soldering and Circuit Assembly Techniques (SCQF level 5)

### GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The approach to learning and teaching in this Unit is through practical activities, discussion and demonstration. A workbook should be kept where the candidate records the results of their activities; hence indicating their progress and providing a record of work carried out. The workbook should clearly indicate exercises that are of sufficient merit to count towards summative assessment. The workbook should also demonstrate the full range of work carried out, both good and bad that has contributed to the candidates understanding.

Outcome 1 is intended to develop an expertise in soldering and this is best achieved by practice. A wide range of through hole components can be made available in which candidates practices their soldering technique starting with straight wire links moving progressively through, insulated links on to passive and active components and finally DIL chip bases. Various mediums could be used such as strip board, PCB etc. It is expected that a range of electronic construction tools could be used throughout the unit such as long nose pliers, snips, wire strippers, soldering iron, tip cleaner, de-soldering tool, lead straightener, small screwdrivers etc.

In Outcomes 2 and Outcome 3 the ability to prepare a layout diagram from a given circuit diagram is developed. Using worksheets a selection of practical analogue and digital circuits are built — each of a comparable level of constructional difficulty. Candidates would be able to choose a circuit that interests them to build.

Initially examples of circuit diagrams and associated layout diagrams could be included in the worksheets to illustrate the relationship between them, after sufficient practice of following the construction of circuits using prepared layout diagrams candidates can then progress to developing their own directly from given circuit diagrams.

Consequently candidates progress to constructing their own circuits using layout diagrams they have developed themselves from a give circuit diagram.

### 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 learn soldering techniques and practical assembly skills. Methods for preventing damage to electronic components have to be considered, materials and equipment selected and safe working practices identified. A working digital electronic circuit has to be assembled correctly. Group investigations and discussions, with assessor feedback, would support reflective approaches to the processes as the Unit is undertaken.

Accuracy in calculation and measurement is integral to achievement. *Numeracy* skills are naturally developed as candidates interpret and translate a circuit diagram, produce a layout diagram and assemble a working circuit. Formative activities should be designed to develop accuracy and confidence in using number and graphics in an electronic engineering context.

## National Unit Specification: support notes (cont)

## UNIT Soldering and Circuit Assembly Techniques (SCQF level 5)

### 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).*

The required evidence can be generated throughout by means of practical activities covering all three outcomes developed over the course of the Unit. The activities carried out during the practical exercises being recorded in the workbook. With a folio of representative work selected from the workbook being submitted near the end with sufficient time for feedback and remediation.

Worksheets should be used where candidate record their progress made during for the assigned analogue and digital circuits and added to their workbook when completed. The practical exercises should be conducted within a formal laboratory/workshop setting while adhering to relevant safety practices.

The assessment for Outcome 1 could result from a series of practical soldering exercises, candidates gaining achievement when they have demonstrated their ability to solder and de-solder to the given specification.

For Outcomes 2 and Outcome 3 a workbook could be kept where candidates record their progress developed through the assigned construction exercises.

The workbook could contain device pin-out diagrams, pin assigned circuit diagrams, construction layout diagrams, extracts from relevant datasheets etc. All relevant construction details, test method used and results for each circuit constructed could be included.

Each candidate covering the Performance Criteria for Outcomes 1, 2 and 3 could present a folio. The folio could comprise a selection of artefacts, written and graphical work drawn from their workbook representative of the standard they have attained.

Worksheets issued to the students could be used to record the student’s progress as well as providing evidence of the final record of successful completion and functional testing of each circuit.

## National Unit Specification: support notes (cont)

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### Outcome 1

(a) Graphical worksheets can be provided where student selects correct component as specified on the worksheet layout diagram.

(b) Candidates de-solder selected components indicated on the worksheet.

### Outcome 2 and 3

(a) Layout diagrams accurately reflect the content of the analogue or digital circuit diagram.

(b) Assembly instructions could be provided that leads the student through the assembly process with reference to a labelled layout diagram.

(c) Soldered joints should be mechanically and electrically sound with a smooth bright finish; however some slight imperfections should be tolerated in a small quantity of joints if the circuit tests correctly.

### 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**