



National Unit Specification: general information

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

CODE F5DS 12

SUMMARY

This Unit is designed to give students a basic knowledge of electronics as applied to audio equipment and systems. This will involve being able to identify components in physical and symbolic form, and provide a brief description of their operation. Candidates will have the opportunity to analyse current flow in simple circuits, and then apply their analysis to basic audio circuits. In addition, candidates will have an opportunity to acquire electronic construction and testing skills using common test equipment.

This Unit is an optional Unit within the National Certificate in Sound Production (SCQF level 6), but can also be taken as a free-standing Unit.

This Unit is suitable for candidates with an interest in electronics contextualised in an audio setting.

OUTCOMES

- 1 Identify and describe passive and active components.
- 2 Analyse resistive d.c. networks.
- 3 Describe a.c. signal performance in audio circuits.
- 4 Build audio circuits.

RECOMMENDED ENTRY

While entry to this Unit is at the discretion of the centre, it would be beneficial if candidates had attained Mathematics and either Technological Studies or Physics at SCQF level 5, or equivalent National Units.

Administrative Information

Superclass: XL

Publication date: February 2009

Source: Scottish Qualifications Authority

Version: 01

© Scottish Qualifications Authority 2009

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged.

Additional copies of this Unit Specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre, telephone 0845 279 1000.

National Unit Specification: general information (cont)

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

CREDIT VALUE

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

**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.

The Unit provides opportunities for candidates to develop aspects of the following Core Skills:

- ◆ Information Technology
- ◆ Numeracy
- ◆ Working with Others

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

National Unit Specification: statement of standards

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

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

Identify and describe passive and active components.

Performance Criteria

- (a) Identify components in physical form.
- (b) Identify EN60617 circuit symbols for components.
- (c) Describe the basic operation of each component.

OUTCOME 2

Analyse resistive d.c. networks.

Performance Criteria

- (a) Determine the relationship between supply current and branch currents.
- (b) Determine the relationship between applied voltage and the series potential differences.
- (c) Calculate the resultant resistance.
- (d) Determine the relationship between current, voltage and resistance.
- (e) Calculate power values for simple resistive networks.

OUTCOME 3

Describe a.c. signal performance in audio circuits.

Performance Criteria

- (a) Explain the characteristics of a.c. signals.
- (b) Determine the relationship between frequency and reactance.
- (c) Analyse simple audio circuits.

OUTCOME 4

Build audio circuits.

Performance Criteria

- (a) Select components according to a schematic.
- (b) Connect circuits correctly according to the layout diagram.
- (c) Carry out pre-power checks.
- (d) Verify circuit operation according to a given specification.
- (e) Satisfy Health and Safety requirements.

National Unit Specification: statement of standards (cont)

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

EVIDENCE REQUIREMENTS FOR THIS UNIT

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

For Outcomes 2, 3 and 4 evidence can be gathered in a real or virtual environment.

For Outcome 1 candidates are required to identify the following components in both physical form and their associated EN60617 symbol:

- ◆ colour coded resistor
- ◆ wirewound resistor
- ◆ non-polarised capacitor
- ◆ polarised capacitor
- ◆ variable resistor
- ◆ inductor
- ◆ fuse
- ◆ switch
- ◆ connectors
- ◆ earth
- ◆ cable
- ◆ diode
- ◆ transistor
- ◆ integrated circuit

In addition, candidates should be able to provide a description of the operation of each component and identify if it is a passive or active component. Written and/or oral evidence for this Outcome must be obtained under closed-book supervised conditions on one assessment occasion.

For Outcome 2 written and/or oral evidence must be obtained which shows that the candidate can calculate current, voltage, resistance and power values for combined series-parallel resistive d.c. networks and then verify the results by measuring branch currents, supply currents and series potential differences.

Candidates should use the following expressions for calculation purposes:

- ◆ $V=IR$
- ◆ $P=VI$
- ◆ $P=I^2R$
- ◆ $P=V^2/R$

Candidates should be assessed on two different d.c. networks which should consist of at least four resistances of known values with a known d.c. supply.

This evidence will be generated under supervised open-book conditions at appropriate points in the Unit.

National Unit Specification: statement of standards (cont)

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

For Outcome 3 candidates must produce written and/or oral evidence giving an explanation of the following characteristics: sinusoidal and non sinusoidal waveforms; amplitude; period; frequency; peak to peak; r.m.s.; phase; reactance; impedance.

Candidates should use the following expressions for calculation purposes:

- ◆ $X_L = 2\pi fL$
- ◆ $X_C = 1/(2\pi fC)$

Candidates should analyse and graph the following simple a.c. circuits: Hi Pass Filter, Low Pass Filter, Band Pass Filter, Band Stop Filter which are made up from L, C and R components.

This evidence will be generated under supervised open-book conditions at appropriate points in the Unit.

For Outcome 4 performance evidence, supplemented by an Assessor Observation Checklist, is required which shows that the candidate can successfully and safely assemble working circuits.

Candidates must construct one of the following types of circuit:

- ◆ oscillator or noise generator
- ◆ amplifier or preamplifier
- ◆ filter or crossover

The operation of the system should be verified using an oscilloscope, a multi-meter, or a logic probe, as appropriate. The evidence for Outcome 4 can be produced over an extended period of time under supervised conditions, but the assessor must authenticate that the evidence produced is the candidate's own work. The assessor must ensure that the candidates adopt safe working practices throughout the undertaking of this Unit. An Assessor Observation Checklist is required which authenticates that candidates have completed the above tasks. An assessor must endorse each candidate checklist with their name, signature and date.

National Unit Specification: support notes

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

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 Unit is an optional Unit within the National Certificate in Sound Production (SCQF level 6), but can also be taken as a free-standing Unit.

This Unit is designed to provide a basic understanding of audio electronics as applied to audio circuits and systems.

This Unit gives candidates the opportunity to develop skills in:

- ◆ reading and interpreting electronic-circuit and layout diagrams, creating a component listing and selecting components from stock
- ◆ assembling electronic circuits, while taking into account component pin connections and polarity
- ◆ applying pre-power-up checks and fault-finding techniques and taking appropriate remedial action
- ◆ from a specification, developing a layout diagram and a component listing
- ◆ constructing a fully functioning electronic system and confirming its operation to specification, using test equipment
- ◆ adhering to safe working practices at all times

Possible test equipment that could be used includes multi-meters, oscilloscopes or signal generators.

In Outcome 1 candidates should be able to identify a range of common components in both physical form and the related EN60617 symbol. In addition, they should be able to describe or select from a list the basic operation of each component. This is in no way an in-depth analysis of each component but more a recognition of why such a component might exist in a simple audio circuit such as a loudspeaker network or crossover circuit.

Outcome 2 is designed to allow candidates to develop a basic understanding of current flow around a circuit, and its effect on potential difference and power on branches within a simple resistive network. Networks should consist of varying combinations of series and parallel circuits. Candidates are given the opportunity to confirm their calculations by physically measuring values on the networks, which should allow candidates to better understand the simple network theory presented here.

In Outcome 3 candidates are given an opportunity to apply some of the theory from Outcome 2 in a specific audio context. By comparing the properties of a.c. and d.c. candidates will gain an understanding of how simple audio circuits process simple sinewave audio waveforms. Passive filter circuits and their components, inductors and capacitors, should be explored through measurement and graphing techniques. The basic properties of sinewaves should also be explored.

Where possible, the filters analysed in Outcome 3 should consist of a mix of first, second and third order designs.

National Unit Specification: support notes (cont)

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

In Outcome 4 candidates are not expected to design their own circuits but to implement the design and layouts of a given specification. If time permits, candidates may be encouraged to design and construct their own printed circuit board (PCB) layouts using appropriate tools. Circuits in Outcome 4 can be constructed using any method including prototype boards, strip or PCBs. It would be preferable if candidates are given the opportunity to use more than one method of construction.

There is scope for integration of elements of Outcome 3 of this Unit with *Sound: Understanding the Signal Path* (SCQF level 6), where the concept of the decibel for audio signal representation is covered and where simple audio systems have to be assembled. The use of online Flash-based circuit and measurement techniques could help to visually reinforce the candidate's understanding of sinewaves, filters and how audio signals are processed.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is recommended that Outcome 1 is delivered prior to the other Outcomes, as the knowledge contained in Outcome 1 is relevant to the successful and safe completion of the remaining Outcomes.

It is possible that candidates could gain skills in testing other candidates' circuits. It is important, however, that if working in groups each candidate clearly demonstrates their own skills in testing circuits.

Although audio signals clearly contain a.c. signals, Outcome 2 considers d.c. networks to allow candidates to acquire skills and knowledge in the basics of signal theory in a simpler context. Outcome 3 allows the more practical applications of signal theory to be then applied in a specific audio environment.

In Outcome 4 it would be preferable that candidates use the oscillator/noise generator that they build to act as the sound source for the other circuits that they build to allow them to explore any interfacing issues that might arise.

It would be expected that Outcome 4 will take up the majority of the teaching time for this Unit given the extensive knowledge and skills that will be required to complete the construction of the requisite number of circuits using skills as follows:

Reading and interpreting circuit diagrams and selecting components

Candidates should be introduced to colour coding of resistors, and know how to recognise values of other components such as capacitors. Identification of components in the initial stages would be aided greatly by suitable, clearly marked storage systems, for example small drawer units.

Assembling electronic circuits, while taking into account component pin connections and polarity

Candidates with no experience of electronic circuit construction should initially be provided with layout diagrams with only a few components, and should build circuits from these, starting with prototype boards followed by soldering on stripboard. In the early stages, candidates could be guided as to which technique would be appropriate for a particular circuit.

Applying pre-power-up checks and fault-finding techniques and taking appropriate remedial action

An important routine in building circuits is the pre-power-up checking, fault-finding and rectification procedures, before testing for operation to specification.

National Unit Specification: support notes (cont)

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

Constructing a fully functioning electronic system and confirming its operation to specification

A full electronic ‘system’ should be constructed from a given circuit diagram or series of diagrams, using a permanent construction technique. At this level, candidates are expected to develop an understanding of the functions of components and should develop their own layout diagrams and component lists from a clear and unambiguous written specification. The operation of the system should be verified using test equipment such as an oscilloscope, a multi-meter, or a logic probe, as appropriate.

Adhering to safe working practices at all times

Electronics and soldering have their own safety practices and procedures, including safety wear, ventilation, equipment checks and work holding. These should be fully covered and firmly enforced.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Outcome 4 provides opportunities to acquire aspects of the Core Skill of *Information Technology* if any of the design, construction or testing of circuits involves the use of software tools such as PCB layout.

Candidates are required to use different formulae, carry out calculations and graph simple circuits, which provides opportunities to develop aspects of the Core Skill of *Numeracy*.

If Outcome 4 involves the use of groups to test assembled leads and circuits, then there will be scope for candidates to develop the Core Skill of *Working with Others*.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

A suitable instrument of assessment for each Outcome is:

Outcome 1: Objective test
Outcomes 2, 3 and 4: Practical exercise with written evidence

If a centre is presenting Outcome 1 online, the following assessment methods may be selected where appropriate:

- ◆ multiple choice
- ◆ drag and drop
- ◆ multiple response
- ◆ mix and match
- ◆ or a combination of the above

Time should be allowed for any necessary re-assessment.

National Unit Specification: support notes (cont)

UNIT Sound: Audio Electronics — An Introduction (SCQF level 6)

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)*.

CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (www.sqa.org.uk).