



## Higher National Unit specification

### General information

**Unit title:** Audio System Design (SCQF level 8)

**Unit code:** DR0N 35

**Superclass:** KG

**Publication date:** August 2014

**Source:** Scottish Qualifications Authority

**Version:** 03

### Unit purpose

This Unit is designed to give candidates a clear knowledge and advanced understanding of the design of audio equipment. This Unit is intended primarily for candidates who are interested in pursuing a career in sound production.

### Outcomes

On successful completion of the Unit the learner will be able to:

- 1 Describe the specification and operation of the hardware and software involved from capture to reproduction of audio in professional studio systems.

### Credit points and level

1 Higher National Unit credit at SCQF level 8: (8 SCQF credit points at SCQF level 8)

### Recommended entry to the Unit

Access to this Unit will be at the discretion of the centre. However, it would be beneficial if candidates had some experience (practical or theoretical) and knowledge of sound recording. It is recommended that this Unit be delivered after completion of the Units *Sound Production Theory 1* (H1M1 34) and *Sound Production Practice 1* (DJ36 34).

## **Higher National Unit Specification: General information (cont)**

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### **Core Skills**

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

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

### **Context for delivery**

This is a mandatory Unit in the framework for HNC/HND Sound Production. It is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

### **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](http://www.sqa.org.uk/assessmentarrangements).

## Higher 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.

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. Learners 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

Describe the specification and operation of the hardware and software involved from capture to reproduction of audio in professional studio systems.

#### Knowledge and/or Skills

- ◆ Common audio transducers
- ◆ Mixing consoles
- ◆ Signal processors
- ◆ Amplifiers
- ◆ Audio software
- ◆ Signal flow from first input to final outputs

#### Evidence Requirements for this Unit

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills across all Outcomes by showing that they can specify and justify selection of hardware and software for a recording studio installation.

Learners will submit a significant portfolio, which details the justified selection of equipment and explains the basic principles of their operation and illustrates the signal flow through the various devices. Justification should be based on critical comparisons with other models and types stating their relevant specifications clearly. For each type of hardware/software the portfolio should describe the following:

- ◆ Signal flow — gain structure
- ◆ Transducers; microphones — design, frequency response, polar response, sensitivity, impedance
- ◆ Transducers; loudspeaker — design, frequency response, sensitivity, impedance, dispersion angle
- ◆ Mixing consoles — design, signal flow, routing, inputs, outputs, automation
- ◆ Signal processors — types (compressors, noise gates, equalisers), design, signal-flow
- ◆ Amplifiers — design, signal flow, safety features, frequency response, signal to noise ratio
- ◆ Software — design, types, plug-ins, automation, compatibility, latency

Learners should liaise with their tutor to identify the area of study to ensure that there are materials available to enable adequate research.



## Higher National Unit Support Notes

**Unit title:** Audio System Design (SCQF level 8)

Unit Support Notes are offered as guidance and 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 purpose of this Unit is to enable candidates to design an audio system found in a typical professional recording studio. Learners will critically analyse the system components and then choose a combination of components in response to a brief. Evidence should be delivered in the form of a portfolio.

This Unit will help establish confidence and deeper understanding of how to interpret audio system component specifications. The specifications do not give an indication of how a component or collection of components will sound but they can provide candidates with an opportunity to objectively compare two or more components and make professional judgements as to their suitability.

This Unit is designed to give a deeper understanding and practical skills in selecting and using appropriate hardware and software components which are essential for producing high-quality recordings and mixes. The Unit draws on Knowledge and Skills from mandatory and optional Units within the Sound Production framework such as *Sound Production Theory 1 and 2*, *Digital Audio Theory* and *Digital Audio Workstations*.

Ideally elements of the recording and mixing/listening path would be linear devices and have no discernable impact on the recording and reproduction process. Through comparison of system components and the critical analysis of their specifications, audio characteristics and typical behaviours, candidates should be able to recommend appropriate elements of an audio recording/reproduction system that meets the technical and creative professional sound production requirements.

This Unit should be regarded as a progression to understanding the terminology familiar to audio electronics engineers. It should be primarily concerned with the most important characteristics that affect the quality of the audio signal path recognised by professional audio engineers rather than the depth of skills and knowledge of the electronics engineer. For example when discussing power amplifiers, it is sufficient to discuss the effect of Inter-modulation Distortion (IMD) but it is not necessary to explain or calculate an amplifiers' Slew Rate.

## Higher National Unit Support Notes (cont)

**Unit title:** Audio System Design (SCQF level 8)

As well as using Knowledge and Skills from mandatory Units, the ability to interpret specifications and identify working characteristics allows development of vocational and professional standards. There isn't a specific National Occupational Standard (NOS) for this Unit content but the Creative Skillset and Creative and Cultural Skills suites have many relevant NOS and the candidate is encouraged to reference them, eg:

- ◆ NATIONAL OCCUPATIONAL STANDARDS Broadcast Technology level 4
- ◆ PP28 UPGRADE POST PRODUCTION SYSTEMS AND EQUIPMENT
- ◆ CCSMT6 Identify test and use basic professional audio equipment
- ◆ CCSMT8 Use essential analogue and digital sound recording skills
- ◆ CCSMT18 Operate analogue and digital dynamics and effects
- ◆ CCSMT29 Evaluate acoustics and sound reinforcement systems
- ◆ CCSSL22 Source Sound Equipment
- ◆ CCSSL23 Set up and check sound equipment
- ◆ SKSS5 Rig sound equipment

### Guidance on approaches to delivery of this Unit

To cover the Knowledge and Skills and Evidence Requirements for Outcome 1 the candidate will carry out a combination of research and practical analysis of the typical components in the signal path found in professional recording studios.

It is recommended that this Unit starts with an overview of the context, ie the definition of a professional audio system that is free from unintended distortion or artefacts which is able to capture and deliver the highest possible signal quality. A recap of the key knowledge skills from previous relevant mandatory Units as well as linking Knowledge and Skills developed in other practical Units will be beneficial.

Case studies combined with site visits would prove beneficial for candidates in conjunction with learner centred classroom activities based on the analysis of the signal path from the input transducer to the output transducer. To enable candidates to visualise the complex signal path in audio systems the use of block diagrams, wiring schematics, etc will be essential as it is unlikely that studios can be taken apart to show the hidden wiring and inter-connections.

It is essential for the candidate to have formative teaching and assessment opportunities incorporating the terminology in order to secure understanding and its effective application. Candidates should compare and contrast at least two product examples of each of the components listed in the Evidence Requirements. Successful objective analysis of audio system components will require valid interpretations of manufacturers' specifications where the candidate uses appropriate terminology.

Breaking down each subsection of the audio system design into manageable chunks would enable knowledge and skills to be established and tested in a formative setting. For example microphones and pre-amplifiers, mixing desks and outboard processors, loudspeakers with amplifiers would make logical blocks, etc. At each stage the typical and ideal performance characteristics of each of the contributing components should set the foundation for individual study and evaluation.

## Higher National Unit Support Notes (cont)

**Unit title:** Audio System Design (SCQF level 8)

There are many text-books and websites that support the development of Knowledge and Skills for this Unit:

Pro Audio Reference from RANE <http://www.rane.com/digi-dic.html>

THAT corporation Design Notes [http://www.thatcorp.com/Design\\_Notes.shtml](http://www.thatcorp.com/Design_Notes.shtml)

**Stanley R. Alten — *Recording and Producing Audio for Media*, 1st Edition 2012  
Syracuse University** (Course Technology ISBN-10: 1435460650 ISBN-13: 9781435460652)

**Borwick, John**, *Loudspeaker and Headphone Handbook*, 2nd ed. (Focal Press ISBN 0-240-51371-1, Oxford, UK, 1994)

**Davis, Don & Eugene Patronis, Jr.** *Sound System Engineering*, 3rd ed. (Focal Press ISBN 978-0-240-80830-7, Oxford, England, 2006).

**Davis, Gary & Ralph Jones**, *Yamaha Sound Reinforcement*, 2nd ed. (Hal Leonard ISBN 0-88188-900-8, Milwaukee, 1989).

**Eargle, John** *The Microphone Book*, 2nd Ed. (Focal Press ISBN 0-240-51961-2, Oxford, England, 2004)

**Giddings, Philip** *Audio Systems Design and Installation* (Focal Press ISBN 0-240-80286-1)  
**Rumsey, Francis and John Watkinson** *The Digital Interface Handbook*, 3rd edition (Focal Press ISBN 0240519094, Oxford, England, 2003).

**Watkinson, John** *The Art of Digital Audio*, 3rd ed. (Focal Press ISBN 0-240-51587-0, Oxford, England, 2001). *The Art of Sound Reproduction* (Focal Press ISBN 0-240-51512-9, Oxford, England, 1998)

### Guidance on approaches to assessment of this Unit

Success in this Unit will be realised when there is sufficient evidence in the candidate's portfolio to cover the minimum Evidence Requirements. (Guidance on the suggested quantity of evidence follows at the end of this section.) Care must be taken with regard to avoid over-working and over-assessing this project. Each of the audio system elements that are in the Evidence Requirements have a considerable number of design and operational principles that contribute towards their characteristics and subsequent classification as a 'professional' product. Candidates attempting to cover all of the major operational principles would produce an exhaustive portfolio and adopting this approach would be an artificial barrier to success.

The candidate's portfolio should be delivered in response to a brief given by the assessor. The brief requires the candidate to carry out research and critical evaluation during the process of compiling an end-to-end audio system design. The candidate will identify specific audio system components and provide valid justifications for choosing them.

## Higher National Unit Support Notes (cont)

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The portfolio can be electronic or paper or a combination of both. Portfolios could also be augmented by the inclusion of audio examples that illustrate key performance aspects of hardware and software components in the signal path, eg a 'poorer' quality microphone compared to a 'better' one. To create a streamlined portfolio, when critically evaluating system components, candidates should refer to published specifications in the body of their work.

It is recommended that supplementary information such as manufacturers' full specifications should be kept to a minimum in the portfolio and, if unavoidably included, they should be used as appendices. The use of graphical and pictorial evidence by the candidate to illustrate key points is encouraged.

The assessment should be in the form of a brief that the candidate responds to within a set timeframe. The timeframe should allow a sufficient period of time to produce a valid portfolio. Time should also be allowed for remediation.

The assessment is open-book and can be carried out without restriction of location, ie in class, study centre, in the candidate's own time. Centres should authenticate that the portfolio submission is the work of one learner by standard quality assurance measures, eg using visual checks of submitted text, and questioning the candidate, etc.

There is no formula for establishing a professional recording studio audio system set-up, but for the avoidance of doubt, the following two examples that would be inappropriate for the candidate to base their audio system design on:

- 1 A portfolio that contains a system design based on two mics, an audio I/O, a laptop with a DAW, desktop loudspeakers.
- 2 A portfolio that contains a system design for the re-fit of Real World or Abbey Road studios

Assessors will need to ensure that the candidate's audio system design fits at an appropriate point between these two extremes.

When setting the assessment it is therefore recommended that:

- ◆ the context for the audio system design is clearly established and
- ◆ the performance elements and/or specifications for critical evaluation are agreed in advance between assessor/lecturer and the candidate.

To enable sufficient time to complete the portfolio it is recommended that two products are compared for each type of audio system component in the Evidence Requirements, ie two dynamic microphones, two condensers, two pre-amps, two desks, etc. Setting a maximum number of components, eg between three and four is recommended otherwise the task may prove unmanageable for candidates and assessors.

The justification for choosing product A over product B should relate to the following typical performance characteristics.

## Higher National Unit Support Notes (cont)

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Microphone characteristics comparison to include:

- ◆ On-axis frequency response with tolerance in dB
- ◆ Off-axis frequency response
- ◆ Sensitivity mV per Pa relative to 1V/ Pa
- ◆ SPL handling capability including Clip level
- ◆ Total Harmonic Distortion (THD) for a given SPL where THD <1% is regarded as good
- ◆ Equivalent Noise level A-weighted where <15dB SPL(A) is regarded as good

Loudspeaker characteristics comparison to include:

- ◆ Frequency response with tolerance in dB
- ◆ Half-power/pressure frequency response, or 'frequency range'
- ◆ Sensitivity in dB/W/m for passive designs and implication for Amplifier power
- ◆ Peak Power handling
- ◆ Max Power output in dB SPL relating sensitivity and Amplifier power
- ◆ Advantages of self-powered over passive plus amplifier

Mixing Consoles characteristics to include:

- ◆ Pre-amp performance, eg Frequency Response, Noise, THD, Gain range. Common Mode Rejection Ratio (CMRR)
- ◆ Equalisation (EQ) Parametric bands, Q, pre-post routing features
- ◆ Busses and routing, eg AUX, Matrix, VCA, Groups, Monitoring, Returns, etc
- ◆ Gain structure characteristics including THD from Channel to Master Bus out
- ◆ Signal to Noise Ratio (S/N)
- ◆ Automation, eg Mutes, Snapshots/Scenes, Dynamic Automation, Recall
- ◆ Analogue and Digital integration with DAW
- ◆ Connectivity including A/D D/A I/O, MIDI, RS422, MADI, Ethernet, etc

Signal Processor characteristics to include:

- ◆ Frequency Response
- ◆ THD
- ◆ CMRR
- ◆ Gain structure and S/N ratio
- ◆ Latency if digital



## Higher National Unit Support Notes (cont)

**Unit title:** Audio System Design (SCQF level 8)

Amplifiers characteristics to include:

- ◆ Input sensitivity
- ◆ Frequency response with tolerance
- ◆ CMRR
- ◆ Channel Separation in dB
- ◆ S/N ratio
- ◆ Damping Factor and its implications
- ◆ Peak Power available
- ◆ Long term RMS power available
- ◆ THD

Software characteristics to include:

- ◆ Audio performance characteristics, eg Fs, Bit Depth, Audio/MIDI/Instrument Tracks, Busses, Video integration
- ◆ Plug-in Formats and features, real-time, non-real-time, automation, latency compensation
- ◆ Native or DSP processing
- ◆ Synchronisation to external devices
- ◆ Audio File delivery including formats, dithering
- ◆ Metering, compatibility with other delivery media, established standards R128, etc

It is envisaged that this Outcome will be assessed individually. However, if the candidate is studying the HN Unit *Acoustics 2* (DR2V 36) it may be possible to integrate Outcome 3 with the assessment of this Unit.

### Opportunities for 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 Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at [www.sqa.org.uk/e-assessment](http://www.sqa.org.uk/e-assessment).

## Higher National Unit Support Notes (cont)

**Unit title:** Audio System Design (SCQF level 8)

### **Opportunities for developing Core and other essential skills**

Candidates will be producing written and oral communication evidence as part of the assessment for this Unit. This offers ideal opportunities to develop aspects of the Core Skill of *Communication*.

In addition, candidates may work in groups throughout the delivery of this Unit. This would allow the opportunities to further develop the Core Skills of *Working with Others*.

This Unit also provides opportunities for candidates to develop *Problem Solving* skills when designing an audio system.

## History of changes to Unit

Version	Description of change	Date
03	Further information has been included in the 'Guidance on the content and context for this Unit' and 'Guidance on the delivery and assessment of this Unit' sections of this Unit specification.	25/08/14
02	Removal of Word Count.	02/06/11

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## General information for learners

### Unit title: Audio System Design (SCQF level 8)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This Unit is designed to enable you to identify and describe, in detail, the many different pieces of equipment used in the capture, recording, storage and monitoring of audio, from microphones to mixing desks to software and hardware processors to amplification and then final monitoring. It is intended to enable you to further develop and use the Knowledge and Skills of the HN Units: *Sound Production Theory 1* (H1M1 34) and *Sound Production Theory 2* (H1M2 35) with any number of practical sound Units.

On completion of the Unit you will be able to:

- 1 Describe the specification and operation of the hardware and software involved from capture to reproduction of audio in professional studio systems.

In order to complete this Unit successfully, you will be required to achieve a satisfactory level of performance in the assessment. Assessment will take the form of a research project which will require you to submit a written portfolio assignment which details and justifies the selection of equipment and explains the basic principles of their operation. Justification should be based on critical comparisons with other models and types stating their relevant specifications clearly. The written evidence may be supported by diagrammatical/pictorial evidence.

Much of the basic knowledge can be found in *Modern Recording Techniques*, written by Huber and Runstein, or the *Music Technology* series published by Focal Press.

The internet can be a good source of information but you should check with your tutor as to the validity and authenticity of any site and/or information.