

SQA Advanced Unit Specification

General information for centres

Unit title: MSI Devices

Unit code: HP3R 48

Unit purpose: The purpose of this Unit is to provide candidates with the necessary skills and knowledge to select and apply specific MSI devices to electronic circuits.

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

1. Explain the operation and use of Analogue to Digital Conversion.
2. Explain the operation and use of Digital to Analogue Conversion.
3. Explain the operation of specific MSI devices.
4. Apply MSI devices.

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

**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 a knowledge of combinational and sequential logic. This may be evidenced by the possession of the SQA Advanced Units in Combinational Logic and Sequential Logic.

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 Diploma in Electronics award. If this Unit is used in another group award(s) it is recommended that it should be taught and assessed within the context of the particular group award(s) to which it contributes.

Assessment: Assessment for Outcomes 1, 2 and 3 may be carried out using a single written assessment paper conducted under controlled, supervised conditions lasting one hour. The assessment should be composed of a suitable balance of written and graphical questions covering the minimum sample requirement for each Outcome being assessed.

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Outcome 4 should be assessed under laboratory conditions with evidence being generated by a short report and an observation check list. The time that should be allocated to this assessment activity is one hour and thirty minutes.

Unit specification: statement of standards

Unit title: MSI Devices

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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

Explain the operation and use of Analogue to Digital Conversion

Knowledge and/or skills

- ◆ Analogue signals
- ◆ Sampling criteria
- ◆ Analogue to Digital convertor types and applications
- ◆ Specify main characteristics of ADC

Evidence requirements

Evidence for knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome two out of the four knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a random selection from the knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all items assessed.

Where sampling takes place, a candidate's response can be judged satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to :-

- ◆ explain an analogue signal
- ◆ describe key sampling issues
 - aliasing
 - sample and hold
- ◆ explain the operation of one of the following ADC:
 - dual slope
 - flash
 - tracking
 - successive approximation

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- ◆ explain the main characteristics of ADC
 - linearity
 - speed
 - resolution
 - settling time
 - relative cost

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment of this Outcome should be combined with Outcome 2 and 3 to form a single assessment paper, details of which are given under Outcome 3.

Outcome 2

Explain the operation and use of Digital to Analogue Conversion

Knowledge and/or skills

- ◆ Digital Signals
- ◆ Digital to Analogue Convertor types and applications
- ◆ Specify main characteristics of DAC

Evidence requirements

Evidence for knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome two out of the three knowledge and/or skills elements should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a random selection from the knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all items assessed.

Where sampling takes place, a candidate's response can be judged satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ explain a digital signal
- ◆ explain the operation of one of the following DAC
 - weighted resistor
 - R/2R Ladder
- ◆ explain the main characteristics of a DAC
 - speed

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- resolution
- accuracy
- linearity
- settling time
- relative cost

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment of this Outcome should be combined with Outcomes 1 and 3 to form a single assessment paper, details of which are given under Outcome 3. The verification of characteristics of DAC is undertaken in Outcome 4.

Outcome 3

Explain the operation of specific MSI devices

Knowledge and/or skills

- ◆ Driver MSI's
 - display
 - motor
- ◆ Shift Registers
 - series
 - parallel
- ◆ Counters
 - asynchronous
 - synchronous
 - decade
 - BCD
- ◆ Multiplexers & De-multiplexers
- ◆ Generator MSI's
 - clock
 - waveform
- ◆ Signal Convertor MSI's
 - voltage – frequency
 - frequency – voltage
 - current – voltage

Evidence requirements

Evidence for knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome two out of the six knowledge and/or skills elements

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should be sampled with emphasis on selecting a combination of digital and analogue technologies.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a random selection from the knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all items assessed.

Where sampling takes place, a candidate's response can be judged satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to :-

- ◆ select an appropriate device to meet the specification
- ◆ explain the operating principles of the chosen device
- ◆ justify the chosen device in relation to alternative devices

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment of this Outcome should be combined with Outcome 1 and 2 to form a single assessment paper. The single assessment paper should be taken at a single assessment event lasting one hour and carried out under supervised, controlled conditions. Such a paper could be composed of an appropriate balance of short answer, restricted response and structured questions.

Outcome 4

Apply MSI devices

Knowledge and/or skills

- ◆ Convert digital to analogue signals
- ◆ Convert analogue to digital signals
- ◆ Build and test a circuit containing an input and output MSI Device
 - driver MSI
 - shift register
 - counter
 - multiplexer or de-multiplexer
 - generators MSI
 - signal convertor MSI

Evidence requirements

Evidence for knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown

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above. In any assessment of this Outcome analogue to digital **or** digital to analogue **must** be sampled with two additional MSI devices from those listed should be sampled

In order to ensure that candidates will not be able to foresee what items they will be assessed on, a random selection from the knowledge and/or skills items is required each time the outcome is assessed. Candidates must provide a satisfactory response to all items assessed.

Where sampling takes place, a candidate's response can be judged satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to :

- ◆ practically demonstrate analogue to digital conversion **or** digital to analogue conversion

And

- ◆ practically demonstrate the use of two further MSI devices

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under laboratory conditions and as such candidates should have access to the required equipment and appropriate data sheets.

Assessment guidelines

The laboratory exercise could be taken at a single event lasting one hour and thirty minutes and carried out under supervised, controlled conditions. Such an exercise could be composed of an appropriate balance of computer simulation, practical build and appropriate test procedures. The numerous MSI devices available allow for various complexities of circuit to be built, this exercise should be restricted to devices which may be categorised as having one main function i.e. voltage to frequency convertor and should not include multifunction devices. Centres should develop appropriate checklists to assess candidates in the various laboratory exercises.

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Administrative information

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Superclass category:	XL
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Unit specification: support notes

Unit title: MSI Devices

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 has been written in order to allow candidates to develop knowledge, understanding and skills in the following areas:-

1. Digital signals and the conversion of these signals into the required format.
2. Analogue signals and the conversion of these signals into the required format.
3. The use of MSI devices and the operating characteristic of these devices when forming a sub element of a circuit.
4. Practical experience of connecting and operating DAC, ADC and common MSI devices.

This Unit has been developed as part of the SQA Advanced Diploma in Electronics award and it is recommended that it follows on from the delivery of Analogue Electronic Principles, Combinational Logic and Sequential Logic Units as the concepts and practical activities will build on the concepts and theory contained within these Units.

In designing this Unit the Unit writers have identified the range of topics they would expect to be covered by lecturers. The writers have also given recommendations as to how much time should be spent on each Outcome. This has been done to help lecturers to decide what depth of treatment should be given to the topics attached to each of the Outcomes. Whilst it is not mandatory for centres to use this list of topics it is strongly recommended that they do so to ensure continuity of teaching and learning and because the assessment exemplar pack for this Unit is based on the knowledge and skills listed in each of the Outcomes.

A list of topics is given below. Lecturers are advised to study this list of topics in conjunction with the assessment exemplar pack for this Unit so that they can get a clear indication of the standards of achievement expected of candidates taking this Unit. The time allocated to delivery and assessment is based upon 12 weeks at three hours per week and is for guidance only.

Outcome 1

Explain the operation and use of Analogue to Digital Conversion (7 hours)

- ◆ Analogue Signals
- ◆ Sampling criteria
- ◆ Analogue to Digital Converter types and applications
- ◆ Specify main characteristics of ADC

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Outcome 2

Explain the operation and use of Digital to Analogue Conversion (7 hours)

- ◆ Digital Signals
- ◆ Digital to Analogue convertor types and applications
- ◆ Specify main characteristics of DAC

Outcome 3

Explain the operation of specific MSI devices (12 hours)

- ◆ Driver MSI
- ◆ Shift register
- ◆ Counter
- ◆ Multiplexer or De-multiplexer
- ◆ Generators MSI
- ◆ Signal convertor MSI

Outcome 4

Apply MSI devices (11.5 hours)

- ◆ Build and test circuits containing:
 - driver MSI
 - shift register
 - counter
 - multiplexer or de-multiplexer
 - generators MSI
 - signal convertor MSI
- ◆ Convert digital to analogue signals
- ◆ Convert analogue to digital signals

Assessment (2.5 hours)

Guidance on the delivery and assessment of this Unit

It should be noted that this Unit can be delivered on a freestanding basis or in combination with the Microprocessor and Microcontroller Technology and Signal Processing and Conditioning Units for teaching and learning and assessment purposes to form an integral part of the Principles and Technology and options available within the SQA Advanced Diploma route.

This Unit has been designed to incorporate sufficient time to allow lecturers to teach the core electronic and electrical principles contained within this Unit. This Unit has also been written such that there is sufficient time built in for candidates to practice what they have learnt through appropriate formative assessment exercises. Additionally this Unit has been designed to incorporate time for practical work and computer simulations so that candidates have an opportunity to confirm theory with practice and evaluate the differences between theory and practical measurement of results. Whilst it is recognised that computer simulation can be a valuable tool in confirming electrical theories, it is nevertheless felt important that candidates do some practical laboratory work so that they can gain experience in reading and wiring up circuit diagrams, using test equipment, analysing test results etc.

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As this Unit expands and builds upon core electronic and electrical principles which are delivered during studies in other areas of the SQA Advanced Certificate in Electronics and SQA Advanced Certificate Electrical awards it is recommended that this Unit be delivered towards the start of the SQA Advanced Diploma award or embedded half way through an SQA Advanced Diploma programme.

Where this Unit is incorporated into other group awards it is recommended that it be delivered in the context of the specific occupational areas(s) that the award is designed to cover i.e. a Mechatronics technician undertaking a SQA Advanced Certificate/Diploma in Mechatronics may focus on equipment level rather than component level where possible.

Details on approaches to assessment are given under Evidence Requirements and Assessment Guidelines under each Outcome in the SQA Advanced Unit specification: statement of standards section. It is recommended that these sections be read carefully before proceeding with assessment of candidates.

The context of this Unit is such that it is recommended that if this Unit is assessed by one holistic assessment instrument then assessment takes place towards the end of the Unit delivery time.

Open learning

This Unit could be delivered by distance learning which may incorporate some degree of on-line support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that assessment whether done at a single or at multiple events was conducted under controlled, supervised conditions.

Arrangements will be required to be arranged for candidates to undertake practical work and assessment in a centre.

To keep administrative arrangements to a minimum, it is recommended that a single assessment paper and single practical laboratory be used for distance learning candidates.

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance 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: MSI Devices

This Unit has been designed to allow you to develop knowledge, understanding and skills in signal conversion techniques, signal conditioning and common MSI devices, which form an integral part of electronic circuits and equipment. If you have studied these subjects before, the early parts of this Unit will provide you with an opportunity to revise the basic concepts and theorems you have learnt in previous courses.

This Unit will be assessed at two assessment events, which will take place at the end of this Unit and will comprise of one assessment paper lasting one hour and a practical laboratory exercise lasting one hour and thirty minutes.. The assessment paper will be conducted under closed book conditions in which you will not be allowed to take notes, textbooks etc into the assessment. However, you will be allowed to use a scientific calculator. The laboratory exercise will also be undertaken in controlled, supervised conditions and you will be provided with the required equipment, data sheets and may also use course notes, textbooks etc.

It is also possible that the centre where you take this Unit will combine it with the Microprocessor and Microcontroller Technology and/or Signal Processing and Conditioning Units for teaching and learning purposes. Under these circumstances the assessment procedure may differ from those outlined above and you should ask your lecturer on the assessment procedures.