



ARRANGEMENTS

SQA Advanced Certificate in Electronics

Group Award Code: GM8C 47

and

SQA Advanced Diploma in Electronics

Group Award Code: GM8T 48

Arrangements Document: Date of publication: (August 2017)

Version: 02

SQA Advanced Qualifications

© Copyright SQA 2003, 2017

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.

SQA Advanced Qualifications

CONTENTS

1	INTRODUCTION	2
2	RATIONALE FOR THE GROUP AWARDS	3
3	AIMS	4
3.1	General Aims of the SQA Advanced Certificate in Electronics	4
3.2	Specific Aims of the SQA Advanced Certificate in Electronics	4
3.3	General Aims of the SQA Advanced Diploma in Electronics	5
3.4	Specific Aims of the SQA Advanced Diploma in Electronics	5
3.5	How the General Aims are met in the SQA Advanced Certificate and SQA Advanced Diploma Award Structures and Content	7
3.6	How the Specific Aims are met in the SQA Advanced Certificate and SQA Advanced Diploma Structures and Content	9
4	RECOMMENDED ACCESS	14
5	STRUCTURE OF THE QUALIFICATIONS	16
5.1	SQA Advanced Certificate in Electronics Structure	16
5.2	SQA Advanced Diploma in Electronics Structure	17
5.3	SCQF Levels	19
5.4	Conditions of Awards	20
6	APPROACHES TO DELIVERY AND ASSESSMENT	24
6.1	Content and Context	24
6.2	Delivery	25
6.3	Assessment	26
6.4	Re-assessment	29
7	GUIDANCE FOR CENTRES	30
7.1	Equality and inclusion	30
7.2	Internal and external verification	30
7.3	Open and Distance Learning	30
7.4	General Information for Candidates	31
7.5	Articulation Arrangements	32
8	CORE SKILLS AUDIT OF SQA ADVANCED CERTIFICATE AND SQA ADVANCED DIPLOMA IN ELECTRONICS UNITS	33
9	EXAMPLES OF SQA ADVANCED CERTIFICATE AND SQA ADVANCED DIPLOMA IN ELECTRONICS TIMETABLES	48

SQA Advanced Qualifications

1 INTRODUCTION

This is the Arrangements Document for the SQA Advanced Certificate in Electronics and SQA Advanced Diploma in Electronics. This document includes background information on the Group Award, its aims, details of the Group Award structure, and guidance on delivery.

SQA Advanced Qualifications

2 RATIONALE FOR THE GROUP AWARDS

The SQA Advanced Certificate and SQA Advanced Diploma in Electronics are designed to equip candidates with the knowledge, understanding and skills required for success in current and future employment or for progression to further academic and/or professional qualifications.

SQA Advanced Qualifications

3 AIMS

The General and Specific Aims of the SQA Advanced Certificate in Electronics are provided below:

3.1 General Aims of the SQA Advanced Certificate in Electronics

The general aims of this award are to:

- 3.1.1 Enhance candidates' employment prospects.
- 3.1.2 Support candidates' Continuing Professional Development and career development.
- 3.1.3 Enable progression within the SCQF (Scottish Credit and Qualifications Framework).
- 3.1.4 Develop candidates' ability to apply analysis and synthesis skills to the solution of electronic problems.
- 3.1.5 Develop learning and transferable skills (including Core Skills).

3.2 Specific Aims of the SQA Advanced Certificate in Electronics

The specific aims of this award are to:

- 3.2.1 Provide an award that will allow candidates to work now, or in the future, as electronic technicians or incorporated electronic engineers.
- 3.2.2 Provide an award that creates a route towards meeting the academic requirements for Incorporated Engineer status.
- 3.2.3 Develop an award that on successful completion will allow candidates' to progress to a SQA Advanced Diploma in Electronics and/or a degree in Electronics or related subject discipline area.
- 3.2.4 Develop a range of Communication and Information Technology knowledge and skills relevant to the needs of electronic incorporated engineers.
- 3.2.5 Develop knowledge, understanding and skills in a range of core electrical, analogue electronics and digital electronics principles and technologies at SQA Advanced level (all underpinned by a mandatory Unit in Mathematics).
- 3.2.6 Develop knowledge, understanding and skills to apply a structured approach to high level language or assembly language programming with reference to applications within a microprocessor/embedded system.

SQA Advanced Qualifications

- 3.2.7 Allow a degree of specialisation within the following areas: electronic and electrical principles, electronic construction and testing skills, printed circuit board design, manufacture and test, Programmable Logic Controllers, implementation of local area networks, further mathematical studies, information technology applications or employment experience.
- 3.2.8 On successful completion of the award, achieve the Core Skill in Communication at SCQF level 6, the Using Number component at SCQF level 6 and be provided with opportunities to develop the remaining Core Skills. Within the Mandatory Section of the award, there are opportunities to develop Information and Communication Technology Core Skill components at SCQF level 6. Opportunities also exist to acquire the Information and Communication Technology Core Skill at SCQF level 6 and the Core Skill Working With Others at SCQF level 6 if the following optional Units are taken: HP6L 47 Information Technology: Applications Software 1 and HR1D 47 Employment Experience 2.

3.3 General Aims of the SQA Advanced Diploma in Electronics

The same as for the SQA Advanced Certificate in Electronics but with the addition of the following:

- 3.3.1 Develop candidates' knowledge and skills in planning and project management.
- 3.3.2 Develop investigation skills.

3.4 Specific Aims of the SQA Advanced Diploma in Electronics

The same as for the SQA Advanced Certificate in Electronics but with the addition of the following:

- 3.4.1 Develop an award that on successful completion will allow candidates' to progress to a degree in Electronics or related subject discipline area.
- 3.4.2 Develop knowledge and understanding of the external and internal factors that influence the performance of modern companies.
- 3.4.3 Recognise the important role Continuing Professional Development plays in career development.
- 3.4.4 Expand on the range of knowledge, understanding and skills of core electrical, analogue electronics and digital electronics principles and technologies included within the SQA Advanced Certificate in Electronics (all underpinned by mandatory Units in Mathematics).
- 3.4.5 Develop a range of practical electronic construction and testing skills.

SQA Advanced Qualifications

- 3.4.6 Develop knowledge, understanding and skills to apply a structured approach to high level language and assembly language programming. Use the programming skills developed to control the flow of and process data in an appropriate target system such as a Microprocessor or Microcontroller.
- 3.4.7 Allow for further specialisation within the following subject areas; printed circuit board design, manufacture and test, electronic fault finding, Programmable Logic Controllers, transmission lines and complex waves, implementing small local area networks, microprocessor technology, signal processing and conditioning, systems integration, power electronics and fundamentals of control systems and transducers advanced mathematical studies and employment experience.
- 3.4.8 On successful completion of the award, achieve the Core Skills in Communication, Information and Communication Technology, the Using Number component at SCQF level 6 and be provided with opportunities to develop the Core Skill of Problem Solving at SCQF level 6. Opportunities also exist to acquire the Working with others Core Skill at SCQF level 6 if the optional Unit HR1D 47 Employment Experience 2 is taken.

SQA Advanced Qualifications

3.5 How the General Aims are met in the SQA Advanced Certificate and SQA Advanced Diploma Award Structures and Content

Aim No.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.1.1	The SQA Advanced Certificate and SQA Advanced Diploma in Electronics equip candidates to seek employment in a wide range of manufacturing, service and public sector organisations. Market research indicates that SQA Advanced Certificate and SQA Advanced Diploma in Electronics are regarded as the minimum qualifications required by many organisations to work at electronic technician or incorporated engineer level.
3.1.2	Candidates in employment can take the SQA Advanced Certificate Electronic and Electrical awards on a part-time basis to increase their knowledge of Electronic and Electrical Engineering and enhance their career development. Commonality between the SQA Advanced Certificate and SQA Advanced Diploma in Electronics provides flexibility in the way these awards can be delivered. Candidates in employment can take the SQA Advanced Diplomas on a part-time basis. The two awards contain a balance of core principles and up to date knowledge and skills in Electronic Engineering, which lend themselves to the Continuous Professional Development of candidates working at electronic technician and incorporated engineer levels. Furthermore, the award structures have been designed to allow for easy progression between SQA Advanced Certificate and SQA Advanced Diploma awards.
3.1.3	All Units within the SQA Advanced Certificate and SQA Advanced Diploma in Electronics have been levelled at SCQF levels 6, 7 or 8. The two awards also conform to the SQA levelling requirements for SQA Advanced Certificate and SQA Advanced Diploma awards. Thus, successful completion of one or both awards will allow progression within the SCQF.
3.1.4	The nature of Electronics as a discipline lends itself to both the analysis and synthesis of problems. For example, when a complex electronic system is analysed (using say, a block diagram approach) by breaking it down into separate functional parts or alternatively the synthesis of a complex system from simpler electronic systems. The two awards allow these important skills to be developed further both in the technical subjects and in the core Communication, Information Technology and Business Awareness and Continuing Professional Development Units.

SQA Advanced Qualifications

Aim No.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.1.5	<p>The SQA Advanced Certificate and SQA Advanced Diploma in Electronics provide centres with an opportunity to enhance learning skills not least by creating opportunities for candidates to combine theory and practice to achieve a real understanding of a subject. For example, some Units recommend significant use of practical work and/or computer simulation to reinforce learning. It is also anticipated that centres will use innovative delivery approaches that may make use of sophisticated electronic laboratory equipment and/or on-line delivery and/or Virtual Learning Environments to enhance candidate learning.</p> <p>By their very nature, Engineering courses require the transfer of technical knowledge and skills from one area to another. For example, a significant level of Electrical Principles and Mathematics has been included in both SQA Advanced Certificate and SQA Advanced Diploma in Electronics awards because these subjects provide underpinning knowledge, understanding and skills which are used elsewhere in both awards. Candidates will also have an opportunity to use the Communication and Information Technology knowledge and skills developed in the mandatory core Units in other parts of the awards to support such activities as report writing, presentation and the application of specialist software packages. Core Skills in general and problem solving in particular, have been regarded as very important since it is recognised that a good level of competence in these skills is essential in the work of an incorporated electronic technician.</p>
3.3.1	<p>The double credit (16 SCQF points) Electronics: Graded Unit 2 in the SQA Advanced Diploma in Electronics award provides opportunities for candidates to develop both their planning and project management knowledge and skills.</p>
3.3.2	<p>The Business Awareness and Continuing Professional Development Unit provides candidates with the opportunity to develop their investigative skills by exploring the external and internal factors that affect the performance of a modern company and the different ways that people learn. Electronics: Graded Unit 2 also requires candidates to undertake some investigations into the background to and a range of solutions for their engineering project.</p>

SQA Advanced Qualifications

3.6 How the Specific Aims are met in the SQA Advanced Certificate and SQA Advanced Diploma Structures and Content

Aim No.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.2.1	<p>The SQA Advanced Certificate and SQA Advanced Diploma in Electronics are recognised by employers and other stakeholders as appropriate qualifications for persons wishing to work at electronic technician or senior technician levels. Market research indicates that there is a growing demand for people with technician level skills in electronics especially as companies automate more of their processes. Thus, it is confidently anticipated that those achieving the SQA Advanced Certificate and SQA Advanced Diploma in Electronics will find employment as electronic technicians and senior electronic technicians in a wide range of small, medium and large companies.</p>
3.2.2 & 3.2.3	<p>An SQA Advanced Certificate or SQA Advanced Diploma in Electronics does not fully meet the academic requirements for Incorporated Engineer status, although these qualifications completely satisfy Engineering Technician requirements. The minimum qualification for Incorporated Engineer is an ordinary degree. The SQA Advanced Diploma course framework and content is satisfactory in terms of contributing to the education of an Incorporated Engineer. Formal accreditation would require the delivering centre to be audited.</p> <p>SQA Advanced Certificate and SQA Advanced Diploma in Electronics will form very important ‘stepping stones’ towards candidates achieving degrees (and thus satisfy fully the academic requirements for Incorporated Engineer status).</p>
3.2.4	<p>There is solid support for the inclusion of a distinct Communication Unit in the mandatory core of the SQA Advanced Certificate and a Communication and Information Technology Unit within the mandatory core of the SQA Advanced Diploma in Engineering. The benefit of having separate Units is that it significantly improves the prospect of sufficient attention being given to the teaching of these two key subjects and they include the Communication, and Information and Communication Technology Core Skills at SCQF level 6. This was considered to be more appropriate than trying to embed such Core Skills across, say, a range of engineering Units, except at SQA Advanced Certificate level where there are considerable opportunities to develop Information and Communication Technology Core Skills within electronics Units.</p> <p>Assessment exemplar materials specifically contextualised to engineering have been developed for each of these Units to address concerns raised by centres about their delivery and assessment in the context of Electronics.</p>

SQA Advanced Qualifications

Aim No.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.2.5	<p>Market research shows that employers place a high priority on employees having the correct technical and practical skills to function effectively in their job. Whilst there continues to be a debate about the precise nature of these skills, it is clearly important that electronic technicians and incorporated engineers have a sound knowledge and understanding of core electronic principles. This will serve candidates well in employment and provide the platform for learning more advanced technical skills. The Principles/Technology section of the SQA Advanced Certificate in Electronics reflects this by providing studies in the key areas of Electronics namely, analogue electronics, digital electronics, electrical and electronic principles, and engineering programming. A knowledge and understanding of Mathematics is fundamental to the work of electronic technicians and a Mathematics Unit (containing the Using Number Core Skill component at SCQF level 6) was therefore included within the Principles/Technology section of the SQA Advanced Certificate in Electronics. For discussions on practical electronics, skills see 3.2.7.</p>
3.2.6	<p>The two awards do not seek to create software systems or support specialists. Candidates who wish to pursue such a career route would be better to study an SQA Advanced Certificate or SQA Advanced Diploma in Computing. The two programming Units, one in a High Level Language and the other in Assembly Language, were included simply to allow candidates to develop knowledge and skills in the fundamentals of structured programming. This is with a view to providing candidates with a better knowledge and understanding of the role that software plays in the operation of various target devices/systems including Microprocessor and Microcontroller based systems. A knowledge and understanding of Assembly Language programming is so critical to understanding how a target device/system, such as Microprocessor or Microcontroller, operates that a Unit on this was included.</p>
3.2.7	<p>In the 2-SQA-Credit optional section, candidates will be able to specialise further in the following areas: electronic and electrical principles, electronic construction and testing skills, printed circuit board design, manufacture and test, Programmable Logic Controllers, implementation of small local area networks, further mathematical studies and employment experience. Note: It is strongly recommended that candidates with little or no practical electronics experience (eg those on a full-time SQA Advanced Certificate) take the Electronic Construction Skills Unit as part of their optional studies.</p>

SQA Advanced Qualifications

Aim No.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.2.8	<p>The Communication Core Skill at SCQF level 6 has been incorporated into the SQA Advanced Certificate in Electronics through the mandatory core Communication: Practical Skills Unit. The Core Skill component Using Number at SCQF level 6 is embedded in the Unit Engineering Mathematics 1.</p> <p>Opportunities to develop the Core Skills in Information and Communication Technology are signposted within individual Unit specifications. Candidates may achieve the Information and Communication Technology and Working with Others Core Skills at SCQF level 6 if they take the optional Units in Information Technology: Applications Software 1 and Employment Experience 2 respectively.</p>
3.4.1	See comments under 3.2.2 and 3.2.3.
3.4.2 & 3.4.3	<p>Some form of Business Studies Unit can be delivered in SQA Advanced Diploma in Engineering, which looks at issues such as costing/pricing of products and services. However, the focus of the Business Awareness and Continuing Professional Development Unit is quite different, as it looks at the changing industrial environment in which incorporated engineers have to work nowadays. This environment is characterised by globalisation of the market place leading to world-wide marketing opportunities and competitive pressures; greater use of advanced technologies and the predominance of Small and Medium Sized Enterprises in the British economy. It is important that in SQA Advanced Diploma in Engineering awards, candidates are suitably prepared to work in this ever-changing employment environment. The Business Awareness and Continuing Professional Development Unit seeks to do this by allowing candidates to explore the external factors that affect the performance of modern companies and the ways in which companies are responding to these external pressures internally. This Unit also has an Outcome on the important role that continuous learning and Continuing Professional Development will increasingly play in helping candidates to obtain sustainable and rewarding employment.</p>

SQA Advanced Qualifications

Aim No.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.4.4	<p>The Principles/Technology (P/T) section of the SQA Advanced Diploma in Electronics award contains all the Units in the P/T section of the SQA Advanced Certificate Electronics award. In addition, within the P/T section of the SQA Advanced Diploma in Electronics awards there are Units which allow candidates to expand their knowledge, understanding and skills in the four key areas of analogue electronics, digital electronics, electrical and electronic principles and engineering computing. For example, in the area of digital electronics candidates will be able to build on their knowledge and understanding of Combinational and Sequential Logic by studying Units in MSI Devices and Programmable Logic Devices.</p> <p>It was considered important to build on the mathematical skills developed in the Engineering Mathematics 1 Unit by including another core Mathematics Unit (entitled Engineering Mathematics 2) within the P/T section of the SQA Advanced Diploma award. The subject area of this Unit is Calculus.</p>
3.4.5	<p>It is anticipated that the majority of candidates taking the SQA Advanced Diploma in Electronics award will do so on a full-time basis with many of these candidates coming directly from school. Such candidates do not normally possess a wide range of practical electronics skills. The Electronic Construction Skills Unit has been included in the P/T section of the SQA Advanced Diploma in Electronics award as a mandatory Unit to allow candidates to develop an appropriate range of practical electronic construction skills. Candidates will also have an opportunity to develop other practical skills via the laboratory work, which they will undertake as a part of their course of study.</p>
3.4.6	See 3.2.6

SQA Advanced Qualifications

Aim No.	How it is met in SQA Advanced Certificate and SQA Advanced Diploma
3.4.7	<p>As in the case of the SQA Advanced Certificate in Electronics award, candidates will be able to specialise further into certain areas of Electronics and/or Mathematics in the optional section of the SQA Advanced Diploma in Electronics. All the optional SQA Advanced Certificate Units that have not been transferred to the SQA Advanced Diploma P/T section are in the optional section of the SQA Advanced Diploma. However, there is a greater choice of Units. For example, there is a Unit in Transmission Lines and Complex Waves. There are also Units in Microprocessor and Microcontroller Technology, Applications of Signal Processing and Conditioning, Power Electronics and Fundamentals of Control Systems and Transducers and Electronic Fault Finding. The inclusion of all these Units will allow candidates to pursue a degree of specialisation in areas such as data communication, integrated circuit technology and/or electronic fault finding at circuit and system levels.</p> <p>The Engineering Mathematics 3 Unit has been included in the optional section to allow candidates who wish to progress to honours degree level in an engineering discipline to develop the necessary mathematical knowledge and understanding to support such progression.</p> <p>The Systems Integration Unit reflects the ever-increasing trend to integrate electronic hardware and embedded software systems within products. Candidates doing this Unit will have an opportunity to consider the various issues involved in integrating such systems.</p>
3.4.8	<p>Communication, and Information and Communication Technology Core Skills at SCQF level 6 have been incorporated into the SQA Advanced Diploma in Electronics through the mandatory core Communication: Practical Skills and Information Technology: Application Software 1 Units respectively. As already noted for the SQA Advanced Certificate in Electronics, the Core Skill component Using Number at SCQF level 6 is embedded in the Engineering Mathematics 1 Unit. Problem Solving at SCQF level 6 is embedded within Electronics Graded Unit 2. Candidates may achieve the Core Skill Working with Others at SCQF level 6 if they take the optional Unit Employment Experience 2.</p>

4 RECOMMENDED ACCESS

In defining the access requirements for both SQA Advanced Certificate and SQA Advanced Diploma in Electronics, care was taken to ensure that no artificial barriers were created to prospective candidates. Of equal importance was ensuring that candidates entering for an SQA Advanced Certificate or SQA Advanced Diploma in Electronics would have a realistic chance of successfully achieving them. It is assumed that most centres will deliver the SQA Advanced Certificate in Electronics as the first year of the SQA Advanced Diploma in Electronics and therefore the entry qualifications for the two awards will be the same.

A candidate is regarded as being competent to study for an SQA Advanced Certificate or SQA Advanced Diploma in Electronics if she/he possesses knowledge, understanding and skills in electronic and electrical engineering that is broadly equivalent to level 6 in the Scottish Credit and Qualifications Framework (SCQF). This does not mean that all areas of a potential entry qualification should be at level 6, but it does assume that the majority of the qualification should be at this level.

A qualification which satisfies fully the electronic and electrical knowledge and skills criteria at level 6 is:

- ◆ National Certificate Group Award in Electronic Engineering

Qualifications that contribute significantly towards meeting the electronic and electrical knowledge and skills criteria required include the following:

- ◆ Higher Electronics
- ◆ Higher Electrical Engineering
- ◆ Higher Technological Studies
- ◆ National Certificate Group Award in Electrical Engineering (depending on whether electronic Units are included in this group award)
- ◆ National Certificate Group Award in Electronic Engineering Practice*

* It should be noted that this award contains insufficient Electrical Principles and Mathematics to allow it to be used as an entry qualification for the SQA Advanced Certificate or SQA Advanced Diploma in Electronics awards alone.

In setting out suitable entry qualifications for the SQA Advanced Certificate and SQA Advanced Diploma in Electronics awards, it is important to clarify the situation regarding Mathematics. The Mathematics for Engineering 1: Electronics and Electrical Unit is mandatory in both the P/T sections of the SQA Advanced Certificate and SQA Advanced Diploma in Electronics awards. This Unit is at level 6 in the SCQF. Thus, the recommended entry requirement for this Unit would be Mathematics at National 4 or National 5.

SQA Advanced Qualifications

With the information detailed above it is possible to provide the following as a list of qualifications that would be suitable for entry into and SQA Advanced Certificate or SQA Advanced Diploma in Electronics:

- ◆ National Certificate Group Award in Electronic Engineering
- ◆ National Certificate Group Award in Electrical Engineering preferably supplemented by additional electronic optional Units
- ◆ A choice of any two Highers from Electronics, Electrical Engineering and Technological Studies plus Mathematics at National 4 or National 5 and English at National 5 (to support entry into the core Communication Unit in the SQA Advanced Certificate or SQA Advanced Diploma in Electronics)

Highers in Physics and/or Mechatronics may also be regarded as appropriate entry qualifications although it must be borne in mind that neither of these Highers give the same depth of treatment to electronic and electrical engineering as the Highers in Electronics, Electrical Engineering or Technological Studies.

Mature candidates with good industrial experience in electronic and electrical industries may also be eligible for admission to the SQA Advanced Certificate or SQA Advanced Diploma in Electronics.

A selection process is recommended where a centre is uncertain if a candidate's qualifications and/or experience is suitable for entry to the SQA Advanced Certificate or SQA Advanced Diploma in Electronics. This may consist of an interview and/or some form of test to assess the candidate's knowledge and understanding of electronic and electrical engineering, and/or mathematics. In broad terms the questions in any test paper on electronic and electrical engineering should be at SCQF Level 6 (Higher) level and any questions on mathematics should be at SCQF Level 5 (National 5) level.

SQA Advanced Qualifications

5 STRUCTURE OF THE QUALIFICATIONS

5.1 SQA Advanced Certificate in Electronics Structure

Mandatory Section (9.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
HP4A 47	Communication: Practical Skills	1	7
Principles/Technology Units (8 credits)			
HP48 46	Engineering Mathematics 1	1	6
HP46 47	DC and AC Principles	1	7
HP47 47	Analogue Electronic Principles	2	7
HP3G 47	Combinational Logic	1	7
HP3Y 47	Sequential Logic	1	7
HP41 47	High Level Engineering Software	1	7
OR	OR		
HP42 47	MCU/MPU Assembly Language Programming	1	7
HP3M 47	Electronic Testing Skills	1	7

Optional Section (2.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
HP6L 47	Information Technology: Applications Software 1	1	7
HP3J 47	Electrical Networks and Resonance	1	7
HP3K 47	Electronic Construction Skills	1	7
HP3V 47	Printed Circuit Board Design, Manufacture and Test	1	7
HT1K 47	Applications of Programmable Logic Controllers	1	7
HP49 47	Engineering Mathematics 2	1	7
HP3P 47	Implementing Small Local Area Networks	1	7
HP42 47	MCU/MPU Assembly Language Programming	1	7
OR	OR		
HP41 47	High Level Engineering Software	1	7
HR1D 47	Employment Experience 2	1	7
HT1W 47	Power Electronics	1	7

SQA Advanced Qualifications

Unit No.	Unit Title	Credit Value	SCQF Level
HT1R 47	Fundamentals of Control Systems and Transducers	1	7
HP6M 47	Personal Development Planning	1	7
HR1C 46	Workplace Communication in English	1	6
HT1Y 47	Energy Overview	1	7
J1CH 47*	Computer Programming	1	7
J1S1 47 *	Data Security	1	7

SQA Advanced Certificate in Electronics Structure Graded Unit (1.0 credit)

Unit No.	Unit Title	Credit Value	SCQF Level
HT15 47	Electronics: Graded Unit 1 (Examination)	1	7

5.2 SQA Advanced Diploma in Electronics Structure

Mandatory Section (23.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
HP4A 47	Communication: Practical Skills	1	7
HP6L 47	Information Technology: Applications Software 1	1	7
HP3H 48	Business Awareness and Continuing Professional Development	1	8
Principles/Technology Units	17 credits (including 8 from SQA Advanced Certificate P/T section)		
HP48 46	Engineering Mathematics 1	1	6
HP46 47	DC and AC Principles	1	7
HP47 47	Analogue Electronic Principles	2	7
HP3G 47	Combinational Logic	1	7
HP3Y 47	Sequential Logic	1	7
HP41 47 OR HP42 47	High Level Engineering Software OR MCU/MPU Assembly Language Programming	1	7
HP3M 47	Electronic Testing Skills	1	7
HP3K 47	Electronic Construction Skills	1	7
HP3J 47	Electrical Networks and Resonance	1	7
HP40 48	Telecommunications Fundamentals	1	8
HP49 47	Engineering Mathematics 2	1	7
HP3D 48	Active Electronics Circuit	1	8

SQA Advanced Qualifications

Unit No.	Unit Title	Credit Value	SCQF Level
HP3T 48	Power Supply Circuits	1	8
HP3R 48	MSI Devices	1	8
HP3W 48	Programmable Logic Devices	1	8
HP43 48	High Level Language: External I/O Transfer	1	8
OR	OR		
HT1J 48	MCU/MPU I/O Hardware Control	1	8

SQA Advanced Diploma in Electronics Structure Optional Section (7.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
HP3N 48	Field Programmable Gate Arrays	1	8
HT1F 48	Microprocessor and Microcontroller Technology	1	8
HP3V 47	Printed Circuit Board Design, Manufacture and Test	1	7
HP42 47	MCU/MPU Assembly Language Programming	1	7
OR	OR		
HP41 47	High Level Engineering Software	1	7
HT1J 48	MCU/MPU I/O Hardware Control	1	8
OR	OR		
HP43 48	High Level Language: External I/O Transfer	1	8
HP3F 48	Applications of Signal Processing and Conditioning	1	8
HP3L 48	Electronic Fault Finding	1	8
HT1E 48	Mathematics for Engineering 3	2	8
HP3P 47	Implementing Small Local Area Networks	1	7
HT1K 47	Applications of Programmable Logic Controllers	1	7
HT1G 48	Systems Integration	1	8
HT1H 48	Transmission Lines and Complex Waves	1	8
HR1D 47	Employment Experience 2	1	7
HT1W 47	Power Electronics	1	7
HT1R 47	Fundamentals of Control Systems and Transducers	1	7
HP6M 47	Personal Development Planning	1	7
HR1C 46	Workplace Communication in English	1	6
HR0M 47	Work Role Effectiveness	3	7
OR	OR		
HR0P 48	Work Role Effectiveness	3	8
HT1Y 47	Energy Overview	1	7
HT1L 48	Energy Technologies	1	8

SQA Advanced Qualifications

Unit No.	Unit Title	Credit Value	SCQF Level
HT1M 47	Engineering Mathematics 3	1	7
HT03 48	Engineering Mathematics 4	1	8
HT1N 48	Engineering Mathematics 5	1	8
J1CH 47*	Computer Programming	1	7
J1S1 47*	Data Security	1	7

SQA Advanced Diploma in Electronics Structure Graded Unit (3.0 credits)

Unit No.	Unit Title	Credit Value	SCQF Level
HT15 47	Electronics: Graded Unit 1 (Examination)	1	7
HT1A 48	Electronics: Graded Unit 2 (Practical Project)	2	8

5.3 SCQF Levels

c.p. = credit points

Tables 4.1 and 4.2 show the distribution of SCQF levels in the SQA Advanced Certificate and SQA Advanced Diploma in Electronics respectively. It can be seen from Table 4.1 that all Units in the SQA Advanced Certificate in Electronics are at level 7 except for one, the Engineering Mathematics 1 Unit, which is at Level 6. The Table shows that the number of SCQF Level 7 Units substantially exceeds the minimum of 48 SCQF credit points required to be in an SQA Advanced Certificate to satisfy SQA Design Principles.

It can be seen from Table 4.2 that the minimum number of SCQF Level 8 Units a candidate can choose in the SQA Advanced Diploma in Electronics is 88 SCQF credit points which comfortably exceeds the minimum requirement of 64 SCQF credit points as stated in the SQA Design Principles. A number of the SCQF Level 8 Units in the SQA Advanced Diploma follow on from corresponding Level 7 Units and are, therefore, appropriately levelled at SCQF Level 8.

Table 4.1 Distribution of SCQF Levels in the SQA Advanced Certificate in Electronics

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirement for Level 7 Units
8 SCQF c.p.	88 SCQF c.p.	0 SCQF c.p.	96	48 SCQF c.p.

Table 4.2 Distribution of SCQF Levels in the SQA Advanced Diploma in Electronics

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirement for Level 8 Units
8 SCQF c.p.	Minimum of 104 SCQF c.p.	Maximum of 128 SCQF c.p.	240	64 SCQF c.p.
	Maximum of 144 SCQF c.p.	Minimum of 88 SCQF c.p.	240	

SQA Advanced Qualifications

5.4 Conditions of Awards

The conditions of award for SQA Advanced Certificate and SQA Advanced Diploma in Electronic qualifications are as follows:

5.4.1 SQA Advanced Certificate in Electronics

A candidate will be awarded an SQA Advanced Certificate in Electronics on successful completion of 11 Unit credits plus 1 Graded Unit based on the SQA Advanced Certificate in Electronics award structure shown in section 5. More specifically this award structure requires that candidates achieve the following:

- ◆ the 1-SQA-Credit Unit Communication: Practical Skills
- ◆ 8-SQA-Credits from the Principles/Technology section
- ◆ 2-SQA-Credits from the optional section
- ◆ Electronics: Graded Unit 1

Core Skills in the SQA Advanced Certificate in Electronics

Exit Profile

A candidate who successfully achieves an SQA Advanced Certificate in Electronics will automatically obtain the following Core Skills Exit Profile:

- ◆ Communication SCQF level 6 (fully embedded in the Communication: Practical Skills)
- ◆ Numeracy The Using Number component at SCQF level 6

Core Skills Entry Profile

Given the information on Core Skills provided in the previous section, the following candidate Core Skills Entry Profile is recommended:

- ◆ Communication SCQF level 5
- ◆ Information and Communication Technology SCQF level 5
- ◆ Numeracy SCQF level 5
- ◆ Problem Solving SCQF level 5

The level of the Communication and Numeracy Core Skills have been selected on the basis that the level of the entry Core Skill would normally be one level below that of the exit Core Skill. The level of the Information and Communication Technology Core Skill has been chosen to reflect the fact that the Information Technology: Applications Software 1 optional Unit has the Information and Communication Technology Core Skill at SCQF level 6 embedded in it and it is anticipated that this Unit will be a popular option. The level of the Problem Solving Core Skill has been set at SCQF level 5 because it is regarded as the minimum acceptable level for this Core Skill to enter an SQA Advanced Certificate in Electronics award. No level has been set for the Working with Others Core Skill because there are so few opportunities to develop this Core Skill in the SQA Advanced Certificate that there seems no point in creating any artificial barriers to entry to the award.

SQA Advanced Qualifications

Development Opportunities

A Core Skills audit of all the Units in the SQA Advanced Certificate was undertaken to identify opportunities for candidates to develop or be assessed on the component parts of the Information and Communication Technology, Problem Solving and Working with Others Core Skills. The results of this audit are shown in Section 8. The audit revealed that there were clear opportunities for candidates to develop components of the Information and Communication Technology Core Skill in the two Engineering Programming Units and the Applications of Programmable Logic Controllers Unit. This is not to say that there are not opportunities to develop the Information and Communication Technology Core Skill in other Units (eg, where candidates use software simulation) only that it was more difficult to quantify these opportunities in terms of the Information and Communication Technology Core Skill Unit specification.

The same was also found to be the case with the Problem Solving and Working with Others Core Skills. By its very nature an electronics award provides numerous opportunities to develop problem solving skills, however it was very difficult to match these opportunities with the Problem Solving Core Skills Framework. Likewise, it is difficult to identify opportunities to develop the Core Skill Working with Others. This is perhaps not surprising given the strong technical rather than interpersonal focus of electronics Units. Candidates in employment who particularly wish to access the Working with Others Core Skill can do so by taking the Employment Experience 2 optional Unit, which has the Working with Others Core Skill at SCQF level 6 embedded in it.

5.4.2 SQA Advanced Diploma in Electronics

A candidate will be awarded an SQA Advanced Diploma in Electronics on successful completion of 27 Unit credits plus 3 Graded Unit Assessment credits based on the SQA Advanced Diploma in Electronics award structure shown in section 5.2. More specifically this award structure requires that candidates achieve the following:

- ◆ the 3-SQA-Credit units Communication: Practical Skills, Information Technology: Applications Software 1 and Business Awareness and Continuing Professional Development
- ◆ 17-SQA-Credits from the Principles/Technology section
- ◆ 7-SQA-Credits from the optional section
- ◆ Electronics: Graded Unit 1 and Electronics: Graded Unit 2

Core Skills in the SQA Advanced Diploma in Electronics

Exit Profile

A candidate who successfully achieves an SQA Advanced Diploma in Electronics will automatically obtain the following Core Skills Exit Profile

- ◆ Communication SCQF level 6
- ◆ Information and Communication Technology SCQF level 6
(fully embedded in the Information Technology: Applications Software 1 Unit)

SQA Advanced Qualifications

- ◆ Problem Solving SCQF level 6 (fully embedded in Electronics Graded Unit 2)
- ◆ Numeracy Using Number Core Skills component at SCQF level 6

Core Skills Entry Profile

The recommended Core Skills Entry Profile is as follows (it should be noted that it is the same as for the SQA Advanced Certificate in Electronics)

- ◆ Communication SCQF level 5
- ◆ Information Technology SCQF level 5
- ◆ Numeracy SCQF level 5
- ◆ Problem Solving SCQF level 5

As in the case of SQA Advanced Certificate in Electronics, the level of the Communication, Information and Communication Technology and Numeracy Core Skills have been selected on the basis that the level of the entry Core Skill would normally be one level below that of the exit Core Skill. The level of the Problem Solving Core Skill has once again been set at SCQF level 5 because this is regarded as the minimum acceptable level for this Core Skill to enter the SQA Advanced Diploma. As was the case with the SQA Advanced Certificate, no level has been set for the Working with Others Core Skill simply because there are so few opportunities to develop this Core Skill in the SQA Advanced Diploma and there seems no point in creating any artificial barriers to entry to the award.

Development Opportunities

A Core Skills audit was also carried out on all the SQA Advanced Diploma in Electronics Units for the Problem Solving and Working with Others Core Skills. The results of this audit are shown in Section 8. As was the case with the SQA Advanced Certificate in Electronics, it proved very difficult to align Core Skill opportunities identified in individual Units with the outcomes and performance criteria in the Problem Solving and Working with Others Core Skills Unit specifications. The notable exception to this was in the Electronics: Graded Unit 2 unit specification where strong development opportunities were identified for the Problem Solving Core Skill at SCQF level 6. Problem Solving has been formally validated as a Core Skill at SCQF level 6 within the Electronics: Graded Unit 2.

5.5 Graded Unit Assessments

The purpose of the Graded Units in SQA Advanced awards is to assess candidates' ability to apply and integrate knowledge and/or skills developed in individual Units in order to demonstrate that they have achieved the principal aims of the award. Graded Units allow for the grading of candidate achievement.

The SQA Advanced Certificate Graded Unit, entitled Electronics: Graded Unit 1, is a 1-SQA-Credit Unit levelled at SCQF Level 7. It consists of a three hour examination which must be conducted under controlled, supervised conditions. The examination paper comprises six, 25 mark questions of which the candidate should answer any four. Each question should include a measure of integration from two of the following three Electronic subject areas: Analogue Electronics, Digital Electronics and Electronics and

SQA Advanced Qualifications

Electrical Principles. The examination paper should also include opportunities to assess core Communication and Mathematics knowledge and skills.

Electronics: Graded Unit 2, is a 2-SQA-Credit Unit levelled at SCQF Level 8. The Graded Unit consists of a Project (Practical Assignment) which must involve the construction of some form of product (either hardware, hardware and software or software). Where the product is only software, the candidate must demonstrate that the software can drive a piece of hardware. While the Graded Unit involves a practical electronics project, drawing from one or more technical areas, it also provides opportunities to apply and integrate non-technical knowledge and skills. Thus, the Graded Unit provides candidates with opportunities to develop and integrate skills in such areas as project planning and management, investigation, practical electronic skills, developing and testing systems, oral and written communication and evaluation. Candidates must prepare a written report and undertake an oral presentation as part of the Graded Unit.

6 APPROACHES TO DELIVERY AND ASSESSMENT

6.1 Content and Context

Throughout the design and development of the SQA Advanced Certificate and SQA Advanced Diploma in Electronics, a high priority was placed on producing awards that allow candidates to develop appropriate technical and practical skills. As noted earlier, it is not possible to quantify such technical and practice skills in exact detail. However, the best way to prepare candidates to meet the changing technical and practical requirements of the modern Electronics industry is to ensure candidates have a solid foundation of theory and practical upon which they can build new knowledge, understanding and skills. Thus, the Principles/Technology section of the SQA Advanced Certificate in Electronics contains fundamental studies in Analogue Electronics, Digital Electronics, Electrical Principles and Engineering Programming. The SQA Advanced Diploma in Electronics Principles/Technology section builds on and extends these studies. A good grasp of mathematics is essential to the understanding of Electronics. The Electronics Units are therefore underpinned by the inclusion of a core Mathematics Unit in the SQA Advanced Certificate and two core Mathematics Units in the SQA Advanced Diploma.

The optional sections of both the SQA Advanced Certificate and SQA Advanced Diploma in Electronics provide candidates with the opportunity to specialise in technical and/or non-technical subjects. In line with normal good practice, centres are encouraged to advise candidates to choose those options that best meet their future career and educational aspirations.

The two awards also contain opportunities for candidates to develop a range of related skills, which would make the holder of the award better prepared for employment and/or degree studies. For example, the Communication: Practical Skills Unit has been included within the mandatory cores of both SQA Advanced Certificate and SQA Advanced Diploma awards to provide candidates with the opportunity to develop their written and group discussion skills about complex vocational issues.

Whilst a discrete Information Technology Unit is not included within the SQA Advanced Certificate mandatory section, centres will still have the opportunity to access such a Unit via the optional section of the SQA Advanced Certificate (Information Technology: Applications Software 1). Even where centres choose not to select this Unit from the optional section there are a number of opportunities to develop Information and Communication Technology knowledge and skills within individual Electronics Unit (see Section 8). The Information Technology: Applications Software 1 Unit has been included within the core of the SQA Advanced Diploma to allow centres to concentrate on business applications, such as word processing, spreadsheets, databases, or engineering specific applications or a combination of the two.

The Business Awareness and Continuing Professional Development Unit, in the core of the SQA Advanced Diploma in Electronics, focuses on two areas considered important to working in the modern electronics industry. These areas are: the external and internal factors that affect business performance, and the need for continuing learning and development if candidates are to have sustainable and rewarding employment in the future.

SQA Advanced Qualifications

6.2 Delivery

The SQA Advanced Certificate and SQA Advanced Diploma in Electronics can be delivered by the following modes of delivery

- ◆ full-time
- ◆ block-release
- ◆ part-time day
- ◆ part-time evening basis

In timetabling the two awards, centre staff should take account of information contained in the Recommended Prior Knowledge and Skills statement in Unit specifications in sequencing the delivery of Units. For example, the DC and AC Principles Unit would normally be delivered before the Electrical Networks and Resonance Unit. Examples of full-time SQA Advanced Certificate in Electronics, part-time SQA Advanced Certificate in Electronics and 2nd Year SQA Advanced Diploma in Electronics timetables are shown in Section 9. Each of these timetables assumes a semester length of 20 weeks with each period of study lasting two hours.

One of the key features of the awards is the reduction in the time candidates have to spend on summative Unit assessment. This should provide lecturers with more time to deliver Units. Lecturers are encouraged, in particular, to use this additional time to reinforce learning in core electronic principles and technologies and enhance the development of candidates' practical electronics skills.

Lecturers may use a variety of teaching and learning approaches in delivering the Units. These may include lecturing, group work, laboratory and practical work, computer simulation (using appropriate electronic packages), project work and case studies. The use of open, distance learning, and on-line materials may help to supplement and support the learning that takes place in the classroom, laboratory or workshop.

Industrial visits are encouraged wherever possible to provide 'real life' industrial examples of the application of the theory and practice learnt in the classroom, laboratory or workshop.

Computer simulation, such as electronic design and implementation software, plays a very important role in the modern electronics industry. The use of computer simulation wherever appropriate is recommended but not at the expense of candidates doing practical work. It is very important that candidates get as much exposure as possible to practical electronic hand skills, the use of electronic test equipment and other practical electronic activities if they are to be suitably prepared to work in industry.

SQA Advanced Qualifications

Lecturers should also seek opportunities to integrate Core Skills within their teaching and learning programmes. Such opportunities may include the following:

- ◆ giving candidates opportunities to give full answers to questions asked by the lecturer
- ◆ correcting poor English in written responses
- ◆ allowing candidates to develop their communication skills in group work activities
- ◆ reinforcing numeracy and mathematical skills when teaching electronic and electrical principles topics
- ◆ reinforcing information technology skills when delivering high level language or assembly language Units and when using computer simulation
- ◆ developing problem solving skills by providing candidates with ranges of increasingly difficult problems to solve
- ◆ developing team working and team leadership skills through group and project work

6.3 Assessment

The assessment strategy for the SQA Advanced Certificate and SQA Advanced Diploma is shown below:

Aims

To ensure that:

- (1) consistent, rigorous and efficient approaches are adopted for the development and administration of SQA Advanced Engineering assessment instruments at both Unit and Graded Unit levels, which satisfy nationally agreed standards.
- (2) the assessment load on students and staff is sensible and assessment does not unduly detract from teaching and learning.
- (3) as far as possible reliable and rigorous verification processes are put in place in order to ensure that consistent national standards are achieved for SQA Advanced Engineering assessments

SQA Advanced Qualifications

Objectives

Listed below are the measures that have been put in place to meet the aims:

- 1 Develop nationally at least one assessment exemplar pack for each mandatory Unit, which clearly sets out the standards of assessment expected in the Unit.
- 2 Adopt a holistic approach to Unit assessment. The implications of this are as follows:
 - (i) Assessment instruments will normally be designed only to sample knowledge and skills in a Unit (this is consistent with the SQA Advanced Unit format)
 - (ii) A Unit assessment strategy will be adopted, where possible, to produce a single assessment instrument for the whole Unit. Where this is not possible, the assessment strategy will seek to ensure that the minimum number of assessment instruments required is consistent with maintaining agreed national standards.
- 3 Whilst not seeking to be entirely prescriptive with regard to the time spent on assessment in each SQA Advanced Unit, over assessment should be avoided if the following guidelines are adopted for the maximum time spent on an SQA Advanced Unit assessment:
 - (i) One and a half hours per SQA Credit for SQA Advanced Units at SCQF levels 6 and 7
 - (ii) Two hours per SQA Credit for SQA Advanced Units at SCQF level 8
- 4 Produce assessment exemplar packs for the two Graded Units. For the Graded Unit examination produce an exemplar exam paper to show the standards expected in such a paper. Likewise, for the 2-SQA-Credit Graded Unit Electronics Project produce a set of materials which clearly set out the standards of candidate response required to achieve a Grade A and a Grade C.
- 5 Actively encourage colleges to work in partnership in producing Graded Unit assessment materials, which meet nationally agreed standards reducing, in turn, the workload on staff in individual colleges.
- 6 Ensure that consistent and rigorous internal and external verification procedures operate through both SQA Advanced Unit level and Graded Unit processes. This places a clear responsibility both on centres and the SQA.

As far as has been practical the above objectives have been adhered to when developing assessment exemplar and Graded Unit materials.

SQA Advanced Qualifications

Assessment Exemplar Materials

Assessment exemplar packs have been produced for the following Units and Graded Units as shown in the list below:

- ◆ Active Electronic Circuits
- ◆ Analogue Electronic Principles
- ◆ Applications of Programmable Logic Controllers
- ◆ Business Awareness and Continuing Professional Development
- ◆ Combinational Logic
- ◆ Communication: Practical Skills (two available — generic and contextualised)
- ◆ Transmission Lines and Complex Waves
- ◆ DC and AC Principles
- ◆ Electrical Networks and Resonance
- ◆ Electronic Construction Skills
- ◆ Electronic Testing Skills
- ◆ High Level Engineering Software
- ◆ High Level Language: External I/O Transfer
- ◆ Information Technology: Applications Software 1 (two available — generic and contextualised)
- ◆ Mathematics for Engineering 1: Electronics and Electrical
- ◆ Mathematics for Engineering 2
- ◆ MCU/MPU Assembly Language Programming
- ◆ MCU/MPU I/O Hardware Control
- ◆ MSI Devices
- ◆ Power Supply Circuits
- ◆ Programmable Logic Devices
- ◆ Sequential Logic
- ◆ Telecommunications Fundamentals
- ◆ Electronics: Graded Unit 1
- ◆ Electronics: Graded Unit 2

Graded Unit Assessment Exemplars

It is recommended that candidates do not sit the Graded Unit examination until the end of the SQA Advanced Certificate (1st Year of the SQA Advanced Diploma) given the range of Units that it draws from. It is recommended that given the size and complexity of the project, the Graded Unit project is started at the beginning of the second year of the SQA Advanced Diploma.

Formative Assessment

Formative assessment should be used throughout the delivery of Units to reinforce learning, build candidates' confidence and prepare candidates' for summative assessment.

SQA Advanced Qualifications

6.4 Re-assessment

The way in which centres re-assess candidates is integral to the way they manage the award assessment process as a whole. Re-assessment should be subject to rigorous internal verification in exactly the same way as assessment is.

Candidates may require to be re-assessed on only a part of an assessment where their evidence has been generated over a period of time and/or a discrete part of the Unit, such as an Outcome, has been assessed previously. On other occasions it may not be possible to re-assess candidates on parts of their performance which are unsatisfactory. Situations where candidates may have to re-do a whole assessment include:

- ◆ assessments which test knowledge and understanding and where it may not be possible to extract some of the items for re-assessment purposes
- ◆ where parts of several outcomes are involved
- ◆ where a project has been designed as an integral assessment and where there is a requirement to complete the project as a single complex task

Re-assessment Opportunities

Re-assessment should operate in accordance with a centre's assessment policy and the professional judgement of the assessor. SQA advises that there should normally be one, or in exceptional circumstances two, re-assessment opportunities. Please refer to the SQA publication *Guide to Assessment and Quality Assurance for Colleges of Further Education*.

Developing Alternative Assessments

The design of original assessments should inform the re-assessment process to a large extent, as the original determines the type of assessment instruments used and the purpose of the assessment. It is normal practice for centres to build up a bank of assessments, which can be used in whole, or in part for re-assessment purposes.

Assessment writers should always refer to the Unit specification when developing an alternative assessment to ensure that it is of equal demand to the original assessment and that it covers all the necessary criteria. Where candidates have not provided satisfactory evidence for knowledge and/or skills items which have been sampled, they should be re-assessed on a different sample.

Re-assessing SQA Advanced Graded Units

Re-assessment of the Electronics: group award Graded Unit 1 should be based on an alternative examination paper. Re-assessment of Electronics: Graded Unit 2 should normally entail a candidate undertaking a completely new project. Where a candidate marginally fails the Electronics: Graded Unit 2 the centre may wish to re-assess her/him on that part(s) of the performance, which was unsatisfactory. Such re-assessment would be at the discretion of the centre and should be subject to rigorous internal verification.

7 GUIDANCE FOR CENTRES

7.1 Equality and inclusion

This qualification 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.

7.2 Internal and external verification

All instruments of assessment used within this/these Group Award(s) should be internally verified, using the appropriate policy within the centre and the guidelines set by SQA.

External verification will be carried out by SQA to ensure that internal assessment is within the national guidelines for these qualifications.

Further information on internal and external verification can be found in *SQA's Guide to Assessment* (www.sqa.org.uk)

7.3 Open and Distance Learning

There are a number of different open and distance learning packages available in the Electronic and Electrical Engineering area.

Advice on the use of open and distance learning is given in individual Unit specifications. However, where it is used with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would require to be put in place to ensure that the assessment or assessments were conducted under the conditions specified in the Unit specification. For example, in the case of a Unit which involved a Unit end test a centre would have to make arrangements for the test to be conducted under controlled, supervised conditions. Likewise, where a Unit involved a practical based assessment, a centre would have to make arrangements for candidates to come into the centre to undertake the assessment under the conditions specified in the Unit specification.

It should be noted that the same requirements as specified in the previous paragraph apply where part or all of a Unit is delivered on-line.

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

7.4 General Information for Candidates

The following note may be used to provide candidates with general information about the SQA Advanced Certificate and SQA Advanced Diploma in Electronics:

The awards have been designed by an expert team of educators and an industrialist with a view to allowing you to meet the educational requirements to work as an electronics technician. They contain up to date and relevant electronics subject content and skills and satisfy the SQA Advanced Design Principles.

The awards have been designed to give you opportunities to learn and understand the core principles and technologies that underpin Electronics. Learning these will be essential in providing you with a platform for tackling many electronics tasks and in allowing you to develop a more in-depth knowledge of Electronics. At the same time, you will have opportunities to develop sound practical electronics construction, testing and project skills, which are critical to being a good electronics technician.

As well as studying Electronics subjects, you will also gain Communication skills and have the option to take Information Technology as part of the SQA Advanced Certificate. Good Communication skills are essential to understanding technical material, and in communicating with others whether on an individual basis or when working as part of a team. Information Technology underpins much of the work in Electronics whether this is through computer simulation of electronic circuits or systems or in preparing a written report on the work you have been involved in. Opportunities to develop Information Technology knowledge and skills are also available in a number of Units in the SQA Advanced Certificate.

The Communication and Information Technology Units are mandatory within the SQA Advanced Diploma in Electronics although you will not need to study these Units if you have already done so as part of the SQA Advanced Certificate. There is an additional mandatory core Unit in the SQA Advanced Diploma in Electronics entitled Business Awareness and Continuing Professional Development. This Unit will provide you with an awareness of the business pressures on modern electronics companies and what strategies they are adopting to meet these pressures. This Unit will also provide you with the opportunity to develop your own career and education action plan for the next five years or so.

As already mentioned Electronics is very much about learning and understanding core principles and technologies whilst also doing practical work such as constructing and testing circuits and project work. Thus, whilst taking the SQA Advanced Certificate and SQA Advanced Diploma in Electronics you can anticipate that the teaching and learning approaches adopted by your lecturers will include the following: lecturing, group work, practical electronics work involving basic electronics skills such as soldering, constructing and testing circuits, computer simulation of circuits and systems and project work.

The two awards have been designed to reduce the assessment load so that more time is available for you to learn the electronic principles and technologies and the practical skills that are essential to being a good electronics technician.

SQA Advanced Qualifications

You can expect to be assessed at individual Unit level and at qualification level. At Unit level, assessment will consist of some form of written end test, or a combination of a short written test and practical exercise or a purely practical exercise. Your lecturer should tell you at the start of the Unit what form the Unit assessment will take. In addition to Unit tests, there will also be a three hour examination at SQA Advanced Certificate level and a 2-SQA-Credit project at SQA Advanced Diploma level. Both these assessments have been designed to allow you to demonstrate your ability to integrate knowledge, understanding and skills gained in the two awards as a whole. Your performance in these Units will also be graded at A, B or C.

It is recommended that a candidate have one of the following qualifications before entering the SQA Advanced Certificate or SQA Advanced Diploma in Electronics:

- 1 Two Highers from the following list: Electronics, Electrical Engineering, Technological Studies, Physics or Mathematics
- 2 A National Certificate in Electronic Engineering or Electrical Engineering
- 3 Equivalent qualifications or experience to those shown in (1) and (2)

An SQA Advanced Certificate or SQA Advanced Diploma in Electronics does not satisfy the full academic requirements to become an incorporated engineer, as a degree is required. However, the SQA Advanced Certificate and SQA Advanced Diploma in Electronics provides a very solid platform for candidates to proceed to the advanced stages of a degree programme in electronics. Ask your lecturer about progression arrangements your college has with any university (ies).

7.5 Articulation Arrangements

Articulation arrangements exist between a number of Scottish, UK and international universities where SQA Advanced Certificates and Diplomas will be accepted as advanced entry to either the second or the third year of a related degree programme. Depending on the specific degree programme, certain units may be required as part of the SQA Advanced Certificate/Diploma. The optional section of the framework is sufficiently broad to ensure that centres are able to comply with reasonable articulation requests. A high proportion of our candidates have articulated to degree programmes and successfully completed them.

8 CORE SKILLS AUDIT OF SQA ADVANCED CERTIFICATE AND SQA ADVANCED DIPLOMA IN ELECTRONICS UNITS

Core Skills Signposting

There may be opportunities to gather evidence towards Core Skills or Core Skills components, however there is only automatic certification as detailed below:

Core Skill	Component	SQA Advanced Unit	Level	Mandatory/Optional
Communication	Oral Communication	Embedded in HP4A 47 Communication: Practical Skills	SCQF level 6	Mandatory SQA Advanced Certificate and SQA Advanced Diploma
	Written Communication	Embedded in HP4A 47 Communication: Practical Skills	SCQF level 6	Mandatory SQA Advanced Certificate and SQA Advanced Diploma
Numeracy	Using Graphical Information	Engineering Mathematics 1 Electronics Units within mandatory section of the awards	development opportunities	
	Using Number	Engineering Mathematics 1	SCQF level 6	Mandatory SQA Advanced Certificate and SQA Advanced Diploma
Information Technology	Using Information Technology	Embedded in HP6L 47 Information Technology: Applications Software 1	SCQF level 6	Optional in SQA Advanced Certificate Mandatory in SQA Advanced Diploma
		High level Engineering Software, MCU/MPU Assembly Language Programming, High Level Language: External I/O Transfer, MCU/MPU I/O Hardware Control, Applications of Programmable Logic Controllers	development opportunities	
Working with Others		Embedded in HR1D 47 Experience 2	SCQF level 6	Optional in SQA Advanced Certificate and SQA Advanced Diploma

Core Skills Audit of SQA Advanced Certificate and SQA Advanced Diploma Electronics Units

Using Information Technology (SCQF level 6) — Applicable to the SQA Advanced Certificate Electronics

Outcome — Use an IT system effectively

Performance Criteria

- a — Operation of hardware devices is efficient.
- b — Operation of the system is responsible and considerate of other users.
- c — Problems are identified and corrected effectively.
- d — Security and management of data is effective and efficient.
- e — Use of operating systems is effective.

SQA Advanced Qualifications

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
High Level Engineering Software	<p>p.c. a – Candidates will have opportunities to evidence the efficient use of the following hardware devices: keyboard, mouse, VDU, disk drive and printer.</p> <p>p.c. b – Candidates would normally be taught and evidence responsible and considerate operation of a system as part of the delivery of this unit.</p> <p>p.c. c – Candidates will have opportunities to engage in problem identification and correction during the development of different pieces of software but particularly at the compiling and debugging and program verification stages.</p> <p>p.c. d – Candidates would normally be taught and evidence the secure and manageable use of data (eg backing-up files, passwords, virus checks etc) in effective and efficient ways as part of the delivery of this unit.</p> <p>p.c. e – Candidates will have opportunities to demonstrate effective use of OS as part of a pc, development system or microcontroller.</p>	Developed	√	√	√	√	√

Using Information Technology (SCQF level 6) — Applicable to the SQA Advanced Certificate in Electronics

Outcome — Use software in an unfamiliar context to produce complex information

Performance Criteria

- a — The analysis of the information requirements is correct.
- b — The design of the solution is effective.
- c — The selection of the application packages is appropriate.
- d — The data components are assembled and integrated.
- e — The output format is appropriate to the purpose and audience.

SQA Advanced Qualifications

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
High Level Engineering Software	<p>p.c. a — Candidates have opportunities to evidence good analysis skills as part of the software user requirement and analysis and problem specifications stages.</p> <p>p.c. b — Candidates will have appropriate opportunities to evidence effective software solutions as part of program testing and verification stages</p> <p>p.c. c — Candidates may have opportunities to evidence this in, for example, the choice of high level language and word processing package they use.</p> <p>p.c. d — Candidates will have opportunities to evidence this p.c. as part of their detailed design, particularly with regard to the design and assembly of individual software modules.</p> <p>p.c. e — Candidates will have opportunities to evidence the appropriateness of output formats in their logbooks and /or portfolios and particularly via the documentation requirements in Outcome 4.</p>	Developed	√	√		√	√

Using Information Technology (SCQF level 6) — Applicable to the SQA Advanced Certificate in Electronics

Outcome — Use an IT system effectively

Performance Criteria

- a — Operation of hardware devices is efficient.
- b — Operation of the system is responsible and considerate of other users.
- c — Problems are identified and corrected effectively.
- d — Security and management of data is effective and efficient.
- e — Use of operating systems is effective.

SQA Advanced Qualifications

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
MCU/MPU Assembly Language Programming	<p>p.c. a — Candidates will have opportunities to evidence the efficient use of the following hardware devices: keyboard, mouse, VDU, disk drive and printer.</p> <p>p.c. b — Candidates would normally be taught and evidence responsible and considerate operation of a system as part of the delivery of this unit.</p> <p>p.c. c — Candidates will have opportunities to engage in problem identification and correction during the development of different pieces of software but particularly when debugging software on a target system.</p> <p>p.c. d — Candidates would normally be taught and evidence the secure and manageable use of data (eg backing-up files, passwords etc) in effective and efficient ways as part of the delivery of this unit.</p> <p>p.c. e — Candidates will have opportunities to demonstrate effective use of OS on target pc, microprocessor or microcontroller system.</p>	Developed	√	√	√	√	√

Using Information Technology (SCQF level 6) — Applicable to the SQA Advanced Certificate in Electronics

Outcome — Use software in an unfamiliar context to produce complex information

Performance Criteria

- a — The analysis of the information requirements is correct.
- b — The design of the solution is effective.
- c — The selection of the application packages is appropriate.
- d — The data components are assembled and integrated.
- e — The output format is appropriate to the purpose and audience.

SQA Advanced Qualifications

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
MCU/MPU Assembly Language System	<p>p.c. a — Candidates have some opportunities to evidence analysis skills as part of analysing the data flow and programming requirements associated with the software exercises they undertake in this unit.</p> <p>p.c. b — Candidates will have appropriate opportunities to evidence effective software solutions particularly as part of programme debugging and verification.</p> <p>p.c. c — It is unlikely that candidates will have a sufficiently large range of software to choose from to regard this as a development opportunity.</p> <p>p.c. d — Candidates will have opportunities to evidence this p.c. as part of their detailed software design, particularly with regard to the use of subroutines in Outcome 4.</p> <p>p.c. e — Candidates will have opportunities to evidence the appropriateness of output formats in their logbooks and/or portfolios and reports they have to be generate for Outcomes 2, 3 and 4.</p>	Developed	√	√		√	√

Using Information Technology (SCQF level 6) — Applicable to the SQA Advanced Certificate in Electronics

Outcome — Use an IT system effectively

Performance Criteria

- a — Operation of hardware devices is efficient.
- b — Operation of the system is responsible and considerate of other users.
- c — Problems are identified and corrected effectively.
- d — Security and management of data is effective and efficient.
- e — Use of operating systems is effective.

SQA Advanced Qualifications

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
Applications of Programmable Logic Controllers	<p>p.c. a — Candidates will have opportunities to evidence the efficient use of the following hardware devices: keyboard, mouse, VDU, disk drive and printer particularly if they program a PLC via a p.c.</p> <p>p.c. b — Candidates would normally be taught and evidence responsible and considerate operation of a system as part of the delivery of this unit.</p> <p>p.c. c — Candidates will have opportunities to engage in problem identification and correction during the programming, testing and verification of the PLC software in Outcome 3.</p> <p>p.c. d — Candidates would normally be taught and evidence the secure and manageable use of data in effective and efficient ways as part of the delivery of this unit.</p> <p>p.c. e — Candidates will have opportunities to demonstrate effective use of OS as part of the PLC software assignment in Outcome 3.</p>	Developed	√	√	√	√	√

Using Information Technology (SCQF level 6) — Applicable to the SQA Advanced Certificate in Electronics

Outcome — Use software in an unfamiliar context to produce complex information

Performance Criteria

- a — The analysis of the information requirements is correct.
- b — The design of the solution is effective.
- c — The selection of the application packages is appropriate.
- d — The data components are assembled and integrated.
- e — The output format is appropriate to the purpose and audience.

SQA Advanced Qualifications

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
Applications of Programmable Logic Controllers	<p>p.c. a — Candidates have opportunities to evidence good analysis skills as part of the programming, editing, testing and verification PLC assignment in Outcome 3 .</p> <p>p.c. b — Candidates will have appropriate opportunities to evidence effective software solutions as part of the programming, testing and verification stages of the assignment in Outcome 3.</p> <p>p.c. c — Candidates may have opportunities to evidence this in, for example, the choice of PLC system they use to do the assignment in Outcome 3.</p> <p>p.c. d — Candidates will have opportunities to evidence this p.c. as part of their detailed design, particularly with regard to the design and assembly of individual parts of their PLC programme for the assignment in Outcome 3.</p> <p>p.c. e — Candidates will have opportunities to evidence the appropriateness of output formats in the report required for Outcome 3.</p>	Developed	√	√		√	√

Using Information Technology (SCQF level 6) — Applicable to the SQA Advanced Certificate in Electronics

Outcome — Carry out searches to extract and present relevant information

Performance Criteria

- a — Selection of data sources is effective.
- b — Search strategy selected is efficient and effective.
- c — Data is correctly extracted using several selection criteria.
- d — Information is presented effectively.

SQA Advanced Qualifications

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d
High Level Engineering Software	None					
MCU/MPU Assembly Language System	None					
Applications of Programmable Logic Controllers	None					

SQA Advanced Qualifications

9 EXAMPLES OF SQA ADVANCED CERTIFICATE AND SQA ADVANCED DIPLOMA IN ELECTRONICS TIMETABLES

Examples of SQA Advanced Certificate in Electronics Timetables

It should be noted that in all the following timetables, each semester is 20 weeks long and each period is 2 hours in duration.

Full – Time (1 – Year, 15 credits)

Semester 1

Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Engineering Mathematics 1	DC and AC Principles	Analogue Electronic Principles	Combinational Logic	Information Technology: Applications Software 1	Electronic Testing Skills	Communication: Practical Skills	

Semester 2

Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Engineering Mathematics 2	Electrical Networks and Resonance	Analogue Electronic Principles	Sequential Logic	High Level Engineering Software or MCU/MPU Assembly Language Programming	Electronic Construction Skills	Applications of Programmable Logic Controllers	Electronics: Graded Unit 1

SQA Advanced Qualifications

Possible SQA Advanced Certificate in Electronics Timetables

Day-Release (2 – Year, 12 credits)

Year 1, Semester 1

Period 1	Period 2	Period 3
Engineering Mathematics 1	Electronic Testing Skills	Analogue Electronic Principles

Year 1, Semester 2

Period 1	Period 2	Period 3
DC and AC Principles	Combinational Logic	Analogue Electronic Principles

Year 2, Semester 1

Period 1	Period 2	Period 3
Communication: Practical Skills	Sequential Logic	High Level Engineering Software or MCU/MPU Assembly Language Programming

Year 2, Semester 2

Period 1	Period 2	Period 3
Implementing Small Local Area Networks	Applications of Programmable Logic Controllers	Electronics: Graded Unit 1

SQA Advanced Qualifications

An Example of a 2nd Year SQA Advanced Diploma in Electronics Timetable

(This timetable assumes that the full-time SQA Advanced Certificate timetable shown above is also the first year SQA Advanced Diploma in Electronics timetable)

Semester 1

Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Mathematics for Engineering 3	Active Electronics Circuit	Power Supply Circuits	MSI Devices	High Level Language: External I/O Transfer or MCU/MPU I/O Hardware Control	Printed Circuit Board Design, Manufacture and Test	Business Awareness and Continuing Professional Development	Electronics: Graded Unit 2

Semester 2

Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Mathematics for Engineering 3	Telecommunications Fundamentals		Programmable Logic Devices	Microprocessor and Microcontroller Technology	Electronic Fault Finding	Systems Integration	Electronics: Graded Unit 2