



National Unit Specification: general information

UNIT Semiconductor Applications (SCQF level 5)

CODE F5JN 11

SUMMARY

This Unit introduces candidates to applications of semiconductor devices. The use of diodes and transistors within electronic circuit applications will be investigated. This Unit is suitable for candidates wishing to embark upon a career in electrical and/or electronic engineering. It is also relevant to candidates studying other branches of engineering, science or technology, requiring knowledge of the application of these devices.

Candidates will be able to apply the skills in relation to understanding the function of each device within electronic circuits and the operation of the circuit in terms of input and output signals. This Unit may form part of a National Qualification Group Award or may be offered on a free standing basis.

OUTCOMES

- 1 Investigate rectifier and zener diode applications in terms of input and output signals.
- 2 Investigate the operation of the Bipolar transistor as an amplifier.
- 3 Investigate the operation of the Junction Field Effect transistor as an amplifier.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- ◆ Standard Grade in a Science or Technology subject — General Level

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Administrative Information

Superclass: XL

Publication date: May 2009

Source: Scottish Qualifications Authority

Version: 01

© Scottish Qualifications Authority 2009

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

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

National Unit Specification: general information (cont)

UNIT Semiconductor Applications (SCQF level 5)

CREDIT VALUE

1 credit at SCQF level 5 (6 SCQF credit points at SCQF level 5*).

CORE SKILLS

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

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

- ◆ *Communication* (SCQF level 5)
- ◆ *Numeracy* (SCQF level 5)
- ◆ *Problem Solving* (SCQF level 5)

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

National Unit Specification: statement of standards

UNIT Semiconductor Applications (SCQF level 5)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

Investigate rectifier and zener diode applications in terms of input and output signals.

Performance Criteria

- (a) Investigate the use of diodes in half wave and full wave rectifier circuits.
- (b) Investigate the function of smoothing.
- (c) Investigate the operation of smoothed rectifier circuits using a pre-built circuit.
- (d) Investigate the use of a zener diode as a stabilizer.
- (e) Investigate the use of a zener diode as a simple stabilizer using a pre-built circuit.

OUTCOME 2

Investigate the operation of the Bipolar transistor as an amplifier.

Performance Criteria

- (a) Investigate bias conditions and the effect on signal output.
- (b) Investigate the voltage gain of pre-built amplifier circuits.
- (c) Investigate the frequency response of pre-built transistor amplifiers.
- (d) Investigate the effect of the bypass capacitor on voltage gain and frequency response using a pre-built common emitter amplifier circuit.

OUTCOME 3

Investigate the operation of the Junction Field Effect transistor as an amplifier.

Performance Criteria

- (a) Investigate bias conditions and the effect on signal output.
- (b) Investigate the voltage gain of pre-built amplifier circuits.
- (c) Investigate the frequency response of pre-built transistor amplifiers.
- (d) Investigate the effect of the bypass capacitor on voltage gain and frequency response using a pre-built common source amplifier circuit.

National Unit Specification: statement of standards (cont)

UNIT Semiconductor Applications (SCQF level 5)

EVIDENCE REQUIREMENTS FOR THIS UNIT

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

Written and/or recorded oral evidence is required which demonstrates that the candidate has achieved all Outcomes to the standards specified in the Outcome and Performance Criteria.

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

The required written and/or recorded oral evidence is as follows:

For Outcome 1:

- ◆ state the purpose of diodes in half and full-wave bridge rectifier circuits
- ◆ sketch input and output waveforms for half and full-wave bridge rectifier circuits, clearly indicating phase relationships
- ◆ state the purpose of smoothing
- ◆ sketch input and output waveforms for half and full-wave bridge smoothed rectifier circuits, clearly indicating magnitude and phase relationships
- ◆ state why the operational characteristics of a zener diode enables it to be used in stabilization circuits
- ◆ sketch output voltage of a zener diode stabilizer circuit for input voltages from zero to maximum specified value

For Outcome 2:

- ◆ state the requirement for correctly biased BJT amplifiers
- ◆ sketch input and output waveforms, for both correctly and incorrectly biased BJT amplifiers clearly indicating correct phase and magnitude relationships
- ◆ determine the voltage gain for the BJT amplifier from measured values
- ◆ measure and record the effect on voltage gain for the BJT amplifier without bypass capacitor, over a range of frequencies
- ◆ use measured values to state the effect on voltage gain over a range of frequencies for the BJT amplifiers without bypass capacitors
- ◆ measure and record the effect on voltage gain and frequency over a range of frequencies for the BJT amplifier incorporating a bypass capacitor
- ◆ use measured values to state the effect on voltage gain and frequency response over a range of frequencies for the BJT amplifier incorporating a bypass capacitor

National Unit Specification: statement of standards (cont)

UNIT Semiconductor Applications (SCQF level 5)

For Outcome 3:

- ◆ state the requirement for correctly biased JFET amplifiers
- ◆ sketch input and output waveforms, for both correctly and incorrectly biased JFET amplifiers clearly indicating correct phase and magnitude relationships
- ◆ determine the voltage gain for the JFET amplifier from measured values
- ◆ measure and record the effect on voltage gain over a range of frequencies for the JFET amplifier without bypass capacitor
- ◆ use measured values to state the effect on voltage gain for the JFET amplifier without bypass capacitors, over a range of frequencies
- ◆ measure and record the effect on voltage gain and frequency over a range of frequencies for the JFET amplifier incorporating a bypass capacitor
- ◆ use measured values to state the effect on voltage gain and frequency response over a range of frequencies for the JFET amplifier incorporating a bypass capacitor

National Unit Specification: support notes

UNIT Semiconductor Applications (SCQF level 5)

This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This Unit sits within the National Certificate in Electrical Engineering and the National Certificate in Electronic Engineering, at SCQF level 5. This Unit can also be delivered on a free-standing basis.

This Unit is intended for candidates with little or no prior knowledge of semiconductor devices and applications. Candidates will develop an understanding of diode applications through investigation of pre-built rectification and stabilization circuits. Knowledge and understanding of transistor applications will be developed through the investigation of pre-built Bipolar and Field Effect transistor amplifier circuits.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The Unit should be delivered in a practical electronics environment with access to a range of test equipment. Testing a range of pre-built circuits with switchable elements could be used enabling quick comparisons to be made for circuit variation in terms of effect on output signal.

Computer simulation software may be used to support teaching and reinforce learning. In particular, simulation software could be used effectively to demonstrate the effect on output signal for changes in circuit component values and the insertion of the bypass capacitor. Access to online resources via the internet could also be used to reinforce learning.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

The Reading component of the Core Skill *Communication* at SCQF level 5 may be developed in all three Outcomes while candidates are reading materials on aspects of suitable applications from paper based and electronic sources.

The Writing component of the Core Skill *Communication* at SCQF level 5 may be developed in all three Outcomes while candidates are preparing written responses to formative and summative assessments,

The Using Graphical Information component of the Core Skill *Numeracy* at SCQF level 5 may be developed in all three Outcomes while candidates represent circuits in suitable diagram format.

The Critical Thinking component of the Core Skill *Problem Solving* at SCQF level 5 may be developed in all three Outcomes while candidates analyse suitable circuits.

National Unit Specification: support notes (cont)

UNIT Semiconductor Applications (SCQF level 5)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Outcome 1 could be assessed using practical exercises. For the half and full-wave rectifier circuits, the smoothing capacitor could be incorporated via a switch. A report could be produced covering all Performance Criteria and used for evidence.

Outcome 2 could be assessed using practical exercises. For the BJT amplifier circuit, the biasing and bypass capacitor could be incorporated via switches. A report could be produced covering all Performance Criteria and used for evidence.

Outcome 3 could be assessed using practical exercises. For the FET amplifier circuit, the biasing and bypass capacitor could be incorporated via switches. A report could be produced covering all Performance Criteria and used for evidence.

DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements