



## National Unit Specification: general information

**UNIT**        Semiconductor Applications (SCQF level 6)

**CODE**        F5JP 12

### SUMMARY

This Unit introduces candidates to applications of semiconductor devices. Knowledge and understanding will be developed through investigation of device characteristics, parameters and applications and also through carrying out measurements and calculations for a range of circuits. This Unit is suitable for candidates wishing to progress in 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 and operation 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 Certificate Group Award or may be offered on a free standing basis.

### OUTCOMES

- 1 Perform measurements and calculations on circuits demonstrating diode applications.
- 2 Perform measurements and calculations on circuits demonstrating Bipolar Junction Transistors used as amplifiers.
- 3 Perform measurements and calculations on circuits demonstrating Junction Field Effect Transistors used as amplifiers.

### 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 – Credit Level
- ◆ NQ Unit *Semiconductor Applications* (SCQF level 5)

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#### Administrative Information

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## **National Unit Specification: general information (cont)**

**UNIT**        Semiconductor Applications (SCQF level 6)

### **CREDIT VALUE**

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

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

### **CORE SKILLS**

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

This Unit provides opportunities for candidates to develop aspects of the following Core Skill:

- ◆ Numeracy (SCQF level 6)

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

## **National Unit Specification: statement of standards**

### **UNIT        Semiconductor Applications (SCQF level 6)**

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

#### **OUTCOME 1**

Perform measurements and calculations on circuits demonstrating diode applications.

##### **Performance Criteria**

- (a) Carry out measurements on a simple stabilizer circuit comprising a zener diode and ballast resistor.
- (b) Carry out calculations for a simple zener diode circuit to supply a stabilized voltage to a given load.
- (c) Describe the operation of unsmoothed and smoothed half wave and full wave rectified circuits
- (d) Carry out calculations for a full-wave smoothed rectifier circuit for a given load current and maximum ripple voltage.
- (e) Carry out measurements for ripple voltage on a full-wave smoothed rectifier circuit.

#### **OUTCOME 2**

Perform measurements and calculations on circuits demonstrating Bipolar Junction Transistors used as amplifiers.

##### **Performance Criteria**

- (a) Describe the operation of a bipolar junction transistor in terms of device currents and output characteristics.
- (b) Carry out calculations for biasing arrangements for bipolar junction transistor amplifiers.
- (c) Carry out measurements and calculations on a pre-built bipolar transistor amplifier.

#### **OUTCOME 3**

Perform measurements and calculations on circuits demonstrating Junction Field Effect Transistors used as amplifiers.

##### **Performance Criteria**

- (a) Describe the operation of a junction field effect transistor in terms of device voltages, device currents and output characteristics.
- (b) Carry out calculations for biasing arrangements for a junction field effect transistor amplifier.
- (c) Carry out measurements and calculations on a pre-built junction field effect transistor amplifier.

## **National Unit Specification: statement of standards (cont)**

### **UNIT        Semiconductor Applications (SCQF level 6)**

#### **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:**

- ◆ investigate the operation of a simple stabilizer circuit comprising a zener diode and ballast resistor through measurement and recording of results
- ◆ carry out calculations on a simple zener diode circuit for supplying a stabilized voltage to a given load for input voltage variations only
- ◆ describe the operation of unsmoothed and smoothed half wave and full wave rectifier circuits
- ◆ carry out calculations for a full-wave smoothed rectifier circuit for a given load current and maximum ripple voltage
- ◆ carry out measurements of ripple voltage for a full-wave smoother rectifier circuit

#### **For Outcome 2:**

- ◆ describe current gain, output conductance and input resistance
- ◆ carry out calculations for a voltage divider biasing circuit
- ◆ carry out measurements and record base, collector and emitter currents, input and output voltages and compare with predicted values

#### **For Outcome 3:**

- ◆ describe mutual conductance, input resistance for junction and insulated gate types
- ◆ carry out calculations for a biasing circuit
- ◆ carry out measurements and record input and output voltages and compare with predicted values

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard

## National Unit Specification: support notes

### UNIT        Semiconductor Applications (SCQF level 6)

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

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

#### **GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT**

This is a restricted core Unit within the National Certificate in Electronic Engineering at SCQF level 6. It may also be delivered as a free-standing Unit.

This Unit is intended for candidates with little or no prior knowledge of zener diode applications, rectification circuits and Bipolar and Field Effect transistor operation. Candidates will develop an understanding of zener diode applications through investigation of pre-built stabilization circuits. Knowledge and understanding of rectification applications will be developed through the investigation of pre-built circuits. Knowledge and understanding of transistor operation and use as amplifiers will be developed through device parameters and biasing arrangements and the investigation of pre-built Bipolar and Field Effect transistor amplifier circuits.

This level 6 Unit contains more complex device and circuit operation with elements of circuit design in all Outcomes compared to the Unit *Semiconductor Applications* at SCQF level 5.

#### **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. Practical work could be used to reinforce device operation. 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 ability to analyse and interpret complex information in graphic and numerical form underpins competencies developed in the Unit. Candidates investigate device characteristics, parameters and applications and carry out measurements and calculations for a range of circuits. Understanding of the function and operation of each device within electronic circuits and the operation of the circuit in terms of input and output signals is evidenced in an appropriate format. *Numeracy* skills are naturally enhanced, with a focus on their practical application in an electronic engineering context.

## **National Unit Specification: support notes (cont)**

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### **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 communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Each Outcome may be assessed by means of a structured report (consisting of all Outcome Evidence Requirements). The report could have three main sections covering each Outcome. The candidate would then complete each section with required circuit information, test equipment used and all measurements and calculations. The required descriptions of relevant circuits would also be entered by the candidates at appropriate points throughout the Unit. Since the practical work and completion of the structured report is part of the assessment process, it is essential that each candidate works independently and that the evidence is produced under supervised controlled conditions.

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