**-SQA-SCOTTISH QUALIFICATIONS AUTHORITY**

**HIGHER NATIONAL UNIT SPECIFICATION**

**GENERAL INFORMATION**

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| **-Unit number-** | **D6NK 04** |
| **-Unit title-** | **POWER SOURCES FOR SEMICONDUCTOR FABRICATION** |
| **-Superclass category-** | **XL** |
| **-Date of publication- (month and year)** | **APRIL 2001** |
| **-Originating centre for unit-** | **SQA** |

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**-DESCRIPTION-**

**GENERAL COMPETENCE FOR UNIT**: Analysing power sources used in the semi-conductor industry.

**OUTCOMES:**

1. explain DC power supplies;
2. evaluate three phase systems;
3. analyse the operation of three phase rectifier circuits;
4. explain the operation of voltage multiplier circuits.

**CREDIT VALUE:** 1 HN Credit

**ACCESS STATEMENT:** Access to the unit is at the discretion of the centre. However it would be beneficial if the candidate had basic competence in single and three phase electrical circuits. This may be evidenced by possession of National Certificate Module E9S1 12 Transformation and Rectification, National Certificate Module E9S0 12 Single Phase AC, National Certificate Module E9RY 12 Power Factor Improvement and Three Phase Theory, or similar qualifications or experience.

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Additional copies of this unit can be obtained from:

The Committee and Administration Unit, SQA, Hanover House, 24 Douglas Street, Glasgow G2 7NQ, (Tel: 0141-242 2168).

At the time of publication the cost is £2.50 per unit (minimum order £5.00).

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**STATEMENT OF STANDARDS**

Unit number: D6NK 04

Unit title: POWER SOURCES FOR SEMICONDUCTOR FABRICATION

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

**OUTCOME**

**1.** EXPLAIN DC POWER SUPPLIES

**PERFORMANCE CRITERIA**

(a) Explanation of the operation of a regulated DC power supply is correct.
(b) Identification of faults associated with a regulated DC power supply is correct.
(c) Explanation of the operation of a switched-mode power supply is correct.

**RANGE STATEMENT**

Faults in: transformer; rectifier; smoothing capacitor; regulator.

**EVIDENCE REQUIREMENTS**

Performance evidence that the candidate can identify faults in regulated DC power supplies. Written evidence that the candidate can explain the operation of regulated DC supplies and switched mode power supplies.

**OUTCOME**

**2.** EVALUATE THREE PHASE SYSTEMS

**PERFORMANCE CRITERIA**

(a) Construction of phasor diagrams showing the relationships between phase and line currents, and phase and line voltages for three phase systems is correct.
(b) Derivation of the relationships between phase and line currents, and phase and line voltages for three phase systems is correct.
(c) Calculation of circuit quantities in three phase systems is correct.

(d) Measurement of phase and line, currents and voltages in three phase systems are safely carried out and are correct to within the tolerance of the instruments used.

**RANGE STATEMENT**

Three phase systems: balanced star connected load; balanced delta connected load.

Circuit quantities: phase current; phase voltage; line current; line voltage; total active power; total reactive power; total apparent power.

Safely: safe procedures compliant with the Electricity at Work Regulations are adopted for measurement of voltages up to 415V ac.

**EVIDENCE REQUIREMENTS**

Written and graphical evidence that the candidate can derive and calculate quantities as detailed in Performance Criteria (a), (b) and (c).

Performance evidence that the candidate can make measurements on three phase systems as detailed in Performance Criterion (d).

**OUTCOME**

**3.** ANALYSE THE OPERATION OF THREE PHASE RECTIFIER CIRCUITS

**PERFORMANCE CRITERIA**

(a) Explanation of the operation of circuits with the aid of diagrams is clear and precise.
(b) Graphical representation of output voltage and current waveforms for the circuits is correct.
(c) Calculation of the mean output voltage in terms of given parameters is correct.

**RANGE STATEMENT**

Operation of circuits: half-wave; three-phase rectifiers with resistive inductive load; full-wave three phase rectifiers with resistive inductive load.

Parameters: peak voltage; triggering angle.

**EVIDENCE REQUIREMENTS**

Written and graphical evidence of the candidate's ability to explain the operation, sketch relevant waveforms and perform a calculation on either the half-wave controlled and uncontrolled rectifier circuits or full-wave controlled and uncontrolled rectifier circuits.

**OUTCOME**

**4.** EXPLAIN THE OPERATION OF VOLTAGE MULTIPLIER CIRCUITS

**PERFORMANCE CRITERIA**

(a) Explanation of the operation of a half-wave voltage doubler circuit with the aid of a circuit diagram is clear and precise.
(b) Derivation of relationship between the output voltage and the peak input voltage for a voltage doubler circuit is correct.
(c) Explanation of the manner in which a voltage doubler circuit can be extended to create a multiplier circuit is clear and precise.

**RANGE STATEMENT**

The range for this outcome is fully expressed within the performance criteria.

**EVIDENCE REQUIREMENTS**

Written and graphical evidence of the candidate's ability to explain the operation, and derive the relationship for the voltage doubler circuit.

Written or oral evidence of the candidate's ability to explain the operation of a voltage tripler or voltage quadrupler circuit.

**MERIT STATEMENT:** To gain a pass in this unit, a candidate must meet the standards set out in the outcomes, performance criteria, range statements and evidence requirements.

To achieve a merit in this unit, a candidate must demonstrate a superior or more sophisticated level of performance. In this unit this might be shown in the following ways:

(a) demonstrating superior awareness of the links between theory and practice;
(b) an ability to perform practical exercises safely with a minimum of supervision.

**ASSESSMENT**

In order to achieve this unit, candidates are required to present sufficient evidence that they have met all the performance criteria for each outcome within the range specified. Details of these requirements are given for each outcome. The assessment instruments used should follow the general guidance offered by the Scottish Qualifications Authority (SQA) assessment model and an integrative approach to assessment is encouraged. (See references at the end of support notes).

Accurate records should be made of the assessment instruments used showing how evidence is generated for each outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

**SPECIAL NEEDS**

Proposals to modify outcomes, range statements or agreed assessment arrangements should be discussed in the first place with the external verifier.

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**SUPPORT NOTES**

Unit number: D6NK 04

Unit title: POWER SOURCES FOR SEMICONDUCTOR FABRICATION

**SUPPORT NOTES**: This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

**NOTIONAL DESIGN LENGTH**: SQA allocates a notional design length to a unit on the basis of time estimated for achievement of the stated standards by a candidate whose starting point is as described in the access statement. The notional design length for this unit is 40hours. The use of notional design length for programme design and timetabling is advisory only.

**CONTENT/CONTEXT** The unit should be delivered in the context of power sources which are currently in use in the semiconductor industry. This unit is designed for training maintenance technicians in the semi-conductor industry.

Wherever possible, a practical approach should be adopted and reference made to circuit diagrams of plant commonly found within the industry.

Safety and safety procedures should be emphasised throughout. The treatment should include safe isolation procedures (lock out – tag out) and the importance of consulting appropriate risk assessments. The requirements of HSE Guidance Note GS38 covering the specifications of equipment used to ensure electrical isolation and for electrical test should be included.

**APPROACHES TO GENERATING EVIDENCE** Wherever possible, assessments should be presented in the context of circuits of power supplies found in equipment used within the semiconductor fabrication industry. A practical approach is envisaged and much of the written evidence could be generated within reports based on such practical exercises.

**ASSESSMENT PROCEDURES** Corresponding to Outcomes:

**Outcome 1**

Performance Criteria (a) and (c) could be assessed as a written report based on appropriate circuit diagrams. Performance criteria (b) could be assessed using an Observation Checklist and/or a short report based on practical exercises.

**Outcome 2**

Performance Criteria (a), (b) and (c) – This outcome could be assessed by means of a report incorporating graphical evidence as necessary based on measurements made on appropriate systems.

Performance Criteria (d) could be based on a short report relating to practical exercises. An observation checklist is considered essential for ensuring compliance with safety requirements.

**Outcomes 3 and 4**

These could be assessed using written assignments.

**REFERENCES**

1. Guide to unit writing, SQA, 1993 (Code: A018).
2. Guide to assessment, SQA, 1993 (Code: B005).
3. Guide to certification, SQA, 1996 (Code: F025).
4. Notes for unit writers, SQA, 1995 (Code: A041).

For details of other SQA publications, please contact staff in the Sales and Despatch section (Tel: 0141-242 2168) who can supply you with a copy of the publication list (Code: X037).