



**Australian Government**

# **UEENEEI124A Fault find and repair analogue circuits and components in electronic control systems**

**Release: 2**

## UEENEEI124A Fault find and repair analogue circuits and components in electronic control systems

### Modification History

| Release | Action | Core/Elective | Details   | Points |
|---------|--------|---------------|---|--------|
| 2       | Edit   | N/A           | Show full pre-req chain in the unit   |        |
| 2       | Edit   | N/A           | Inserted topic numbering in Required Skills and Knowledge                                 |        |
| 2       | Edit   | N/A           | Replaced "essential knowledge and associated skills" with "required skills and knowledge" |        |

### Unit Descriptor

#### Unit Descriptor

#### 1) Scope:

#### 1.1) Descriptor

This unit covers fault finding and repairing analogue applications in electronic control systems. The unit encompasses safe working practices, interpreting diagrams and technical data, applying knowledge of analogue circuits and components to logical fault finding processes, implementing fault rectification, safety and functional testing and reporting work activities and outcomes.

Note.

Examples of analogue applications are power and differential amplifiers, integrators, comparators function generators precision rectifiers, active filters and the like.

### Application of the Unit

#### Application of the Unit 2)

This unit is intended as an additional competency to relevant competencies previously acquired. It is suitable

for employment-based programs under an approved contract of training at the aligned AQF 4 level or higher.

## Licensing/Regulatory Information

### License to practice 3)

The skills and knowledge described in this unit require a license to practice in the workplace where plant and equipment operate at voltage above 50 V a.c. or 120 V d.c. However other conditions may apply in some jurisdictions subject to regulations related to electrical work. Practice in the workplace and during training is also subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Note:

1. Compliance with permits may be required in various jurisdictions and typically relates to the operation of plant, machinery and equipment such as elevating work platforms, powder operated fixing tools, power operated tools, vehicles, road signage and traffic control, lifting equipment and the like. Permits may also be required for some work environments such as confined spaces, working aloft, near live electrical apparatus and site rehabilitation.
2. Compliance may be required in various jurisdictions relating to currency in First Aid, confined space, lifting and risk safety measures

## Pre-Requisites

### Prerequisite Unit(s) 4)

### Competencies 4.1)

Granting of competency in this unit shall be made only after competency in the following unit(s) has/have been confirmed.

Where pre-requisite pathways have been identified. All competencies in the Common Unit Group must be have

**Prerequisite Unit(s) 4)**

been completed plus all the competencies in one (1) of the identified Pathway Unit Group(s):

Instrumentation and Control

Electrical

Common Unit Group

| Unit Code   | Unit Title   |
|-------------|--|
| UEENEEE101A | Apply Occupational Health and Safety regulations, codes and practices in the workplace |
| UEENEEE104A | Solve problems in d.c. Circuits  |
| UEENEEE107A | Use drawings, diagrams, schedules, standards, codes and specifications                 |

Instrumentation and Control Pathway Group

| Unit Code   | Unit Title   |
|-------------|--|
| UEENEEE119A | Solve problems in multiple path extra low voltage (ELV) a.c. circuits        |
| UEENEEI101A | Use instrumentation drawings, specification, standards and equipment manuals |
| UEENEEI102A | Solve problems in pressure measurement components and systems                |
| UEENEEI103A | Solve problems in density/level measurement components and systems           |
| UEENEEI104A | Solve problems in flow measurement components and systems                    |
| UEENEEI105A | Solve problems in temperature measurement components and systems             |
| UEENEEI106A | Set up and adjust PID control loops  |
| UEENEEI110A | Set up and adjust advanced PID process control loops                         |
| UEENEEI112A | Verify compliance and functionality of instrumentation and control           |

**Prerequisite Unit(s) 4)**

installations

UEENEEI113A Setup and configure Human-Machine Interface (HMI) and industrial networks

Electrical Pathway Group

Unit Code Unit Title

UEENEEE105A Fix and secure electrotechnology equipment

UEENEEG006A Solve problems in single and three phase low voltage machines

UEENEEG033A Solve problems in single and three phase electrical apparatus and circuits

UEENEEG063A Arrange circuits, control and protection for general electrical installations

UEENEEG101A Solve problems in electromagnetic devices and related circuits

UEENEEG101A Solve problems in electromagnetic devices and related circuits

UEENEEG102A Solve problems in low voltage a.c. circuits

UEENEEG102A Solve problems in low voltage a.c. circuits

UEENEEG106A Terminate cables, cords and accessories for low voltage circuits

UEENEEG108A Trouble-shoot and repair faults in low voltage electrical apparatus and circuits

**Literacy and numeracy skills 4.2)**

Participants are best equipped to achieve competency in this unit if they have reading, writing and numeracy skills indicated by the following scales. Description of each scale is given in Volume 2, Part 3 'Literacy and

Numeracy<sup>7</sup>

Reading 4 Writing 4 Numeracy 5

## Employability Skills Information

### Employability Skills 5)

This unit contains Employability Skills

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements.

## Elements and Performance Criteria Pre-Content

6) Elements describe the essential outcomes of a competency standard unit Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.

## Elements and Performance Criteria

### ELEMENT

### PERFORMANCE CRITERIA

|                                    |   |
|------------------------------------|---|
| 1 Prepare to fault find and repair | 1.1 OHS procedures for a given work area are identified, obtained and understood.   |
|                                    | 1.2 Established OHS risk control measures and procedures are followed in preparation for the work.  |
|                                    | 1.3 Safety hazards which have not previously been identified are documented and risk control measures devised and implemented in consultation with appropriate personnel. |
|                                    | 1.4 The extent of faults is determined from reports and other documentation and fro discussion with   |

**ELEMENT**

**PERFORMANCE CRITERIA**

- appropriate personnel
- 1.5 Appropriate personnel are consulted to ensure the work is co-ordinated effectively with others involved on the work site
- 1.6 Tools, equipment and testing devices needed to diagnose faults are obtained in accordance with established procedures and checked for correct operation and safety.
- 2 Fault find and repair
- 2.1 OHS risk control measures and procedures for carrying out the work are followed.
- 2.2 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures
- 2.3 Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures
- 2.4 Logical diagnostic methods are applied to diagnose electronic control system apparatus faults employing measurements and estimations of system operating parameters referenced to system operational requirements.
- 2.5 Suspected fault scenarios are tested as being the cause(s) of system fault.
- 2.6 Cause of the fault is identified and appropriately competent persons are engaged to rectify the fault where it is outside the scope of the analogue circuits and components.
- 2.7 Faults in the electronic components of the system are rectified to raise apparatus and system to its operational standard.
- 2.8 System is tested to verify that the system operates as intended and to specified requirements
- 2.9 Decisions for dealing with unexpected situations are made from discussions with appropriate

## ELEMENT

## PERFORMANCE CRITERIA

|   |  |  |
|---|--|--|
|   |  | persons and job specifications and requirements.   |
|   | 2.10   | Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.  |
|   | 2.11   | Diagnosis and rectification activities are carried out efficiently without waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices. |
| 3 | Complete and report fault find and repair activities | 3.1 OHS work completion risk control measures and procedures are followed.   |
|   |  | 3.2 Work site is made safe in accordance with established safety procedures.   |
|   |  | 3.3 Rectification of faults is documented in accordance with established procedures.   |
|   |  | 3.4 Appropriate person or persons notified, in accordance with established procedures, that the system faults have been rectified  |

## Required Skills and Knowledge

### REQUIRED SKILLS AND KNOWLEDGE

8) This describes the required skills and knowledge and their level, required for this unit.

Evidence shall show that knowledge has been acquired of safe working practices and fault finding and repairing analogue circuits and components in electronic control systems.

All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies.

### KS01-EI124 Analogue electronic control systems

A

Evidence shall show an understanding of analogue electronic control systems indicated by the following aspects:



## REQUIRED SKILLS AND KNOWLEDGE

- T1 Amplifier fundamentals
- The purpose and application of amplifiers
  - The basic characteristics of small signal amplifiers.
  - The ideal op amp
- T2 Basic op-amp configurations
- Various operational amplifier circuit configurations and where they are used.
  - Measured and calculated values of gain and output voltage for various operational amplifier configurations
  - Circuit configurations:
    - inverting,
    - non-inverting,
    - voltage follower,
    - summing
    - comparators
    - Schmitt trigger
    - differential configurations
- T3 Op amp limitations
- Use of frequency compensation,
  - Offset null,
  - Bias compensation
  - Slew rate
  - Frequency response
  - Bandwidth
  - Noise figures.
- T4 Single stage amplifiers
- Determination of d.c. bias conditions for a single-stage amplifier
  - Small signal terminal characteristics of single-stage amplifiers
  - Effects of coupling and by-pass capacitors in single-stage amplifiers
- T5 Amplifier applications
- Operation of multistage amplifiers
  - Effects of component values and frequency response
  - Negative feedback loop in multistage amplifiers
  - Negative feedback and amplifier parameters

## REQUIRED SKILLS AND KNOWLEDGE

- Effects on the output voltage when amplifiers are subjected to control signal overdrive, bias faults and amplifying device faults
- T6 Op amp/diode circuits
- Clippers
  - Clamp circuits
  - Precision rectifiers
- T7 Oscillators
- Oscillator circuits using op amps
  - sine wave
  - square wave
  - triangular wave
  - sawtooth
- T8 Op amp/RC circuits
- Integrator
  - Differentiator
  - Function generators
- T9 Filters
- Active filter circuits
  - First and second order
  - Low, high and band pass circuits
- T10 Timers
- Operation of typical timer ICs
- T11 Power amplifiers
- Power output ICs
  - Power amplifiers using op amps
  - Power supplies
- T12 Multi-stage circuits
- Circuits using several different op amp configurations.
  - Fault-finding procedures

## Evidence Guide

### EVIDENCE GUIDE

9) The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package. .

The Evidence Guide forms an integral part of this unit. It must be used in conjunction with all parts of the unit and performed in accordance with the Assessment Guidelines of this Training Package.

### Overview of Assessment 9.1)

Longitudinal competency development approaches to assessment, such as Profiling, require data to be reliably gathered in a form that can be consistently interpreted over time. This approach is best utilised in Apprenticeship programs and reduces assessment intervention. It is the Industry-preferred model for apprenticeships. However, where summative (or final) assessment is used it must include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment. It is recognised that, in some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accord with industry and regulatory policy.

Methods chosen for a particular assessment will be influenced by various factors. These include the extent of the assessment, the most effective locations for the assessment activities to take place, access to physical resources, additional safety measures that may be required and the critical nature of the competencies being assessed.

The critical safety nature of working with electricity, electrical equipment, gas or any other hazardous substance/material carries risk in deeming a person competent. Sources of evidence need to be 'rich' in nature to minimise error in judgment.

Activities associated with normal everyday work influence decisions about how/how much the data gathered will contribute to its 'richness'. Some skills are more critical to safety and operational requirements while the same skills may be more or less frequently practised. These points are raised for the assessors to consider when choosing an assessment method and developing assessment instruments. Sample assessment instruments are included for Assessors in the Assessment Guidelines of this Training Package.

**Critical aspects of evidence required to demonstrate competency in this unit 9.2)**

Before the critical aspects of evidence are considered all prerequisites shall be met.

Evidence for competence in this unit shall be considered holistically. Each Element and associated performance criteria shall be demonstrated on at least two occasions in accordance with the 'Assessment Guidelines – UEE11'. Evidence shall also comprise:

- A representative body of work performance demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:
  - Implement Occupational Health and Safety workplace procedures and practices, including the use of risk control measures as specified in the performance criteria and range statement
  - Apply sustainable energy principles and practices as specified in the performance criteria and range statement
  - Demonstrate an understanding of the required skills and knowledge as described in this unit. It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or licensing requirements.
  - Demonstrate an appropriate level of skills enabling employment
  - Conduct work observing the relevant Anti Discrimination legislation, regulations, policies and workplace procedures
- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
  - Fault finding and repairing analogue circuits and components in electronic control systems as described in 8) and including:
    - A Applying logical diagnostic methods.
    - B Using fault scenarios to test the cause(s) of system faults.
    - C Identifying faults and their cause and competency

- needed to rectify them.
- D Rectifying faults in system analogue circuits and components.
- E Verifying that the system operates correctly.
- F Documenting fault rectification.
- G Dealing with unplanned events by drawing on required skills and knowledge to provide appropriate solutions incorporated in a holistic assessment with the above listed items.

Note:

Successful completion of relevant vendor training may be used to contribute to evidence on which competency is deemed. In these cases the alignment of outcomes of vendor training with performance criteria and critical aspects of evidence shall be clearly identified.

**Context of and specific resources for assessment 9.3)**

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OHS policy and work procedures and instructions.
- Suitable work environment, facilities, equipment and materials to undertake actual work as prescribed by this unit.

These should be part of the formal learning/assessment environment.

Note:

Where simulation is considered a suitable strategy for assessment, conditions must be authentic and as far as possible reproduce and replicate the workplace and be consistent with the approved industry simulation policy.

The resources used for assessment should reflect current industry practices in relation to diagnosing and rectifying faults in analogue circuits and components in electronic control systems.

**Method of  
assessment**

**9.4)**

This unit shall be assessed by methods given in Volume 1, Part 3 'Assessment Guidelines'.

Note:

Competent performance with inherent safe working practices is expected in the industry to which this unit applies. This requires that the specified required skills and knowledge are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the required skills and knowledge described in this unit.

**Concurrent  
assessment and  
relationship with  
other units**

**9.5)**

There are no concurrent assessment recommendations for this unit.

The critical aspects of occupational health and safety covered in unit UEENEEE101A and other discipline specific occupational health and safety units shall be incorporated in relation to this unit.

## Range Statement

### RANGE STATEMENT

**10)** This relates to the unit as a whole providing the range of contexts and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

This unit shall be demonstrated by fault finding and repairing at least four of the following faults in analogue circuits and components:

- Open-circuit
- Short-circuit
- Incorrect or failed connections
- Insulation failure
- Unsafe condition
- Apparatus/component failure
- Related mechanical failure

Generic terms used throughout this Vocational Standard shall be regarded as part of the Range Statement in which competency is demonstrated. The definition of these and other terms that apply are given in Volume 2, Part 2.1.

## Unit Sector(s)

Not applicable.

## Competency Field

**Competency Field**            **11)**

Instrumentation and Control