



Australian Government

UEENEEI139A Diagnose and rectify faults in digital controls systems

Release: 2

UEENEEI139A Diagnose and rectify faults in digital controls 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	Replaced "essential knowledge and associated skills" with "required skills and knowledge"	
2	Edit	N/A	Inserted topic numbering in Required Skills and Knowledge	

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

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

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

Instrumentation and Control

Electrical

Prerequisite Unit(s) 4)

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

Prerequisite Unit(s) 4)

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
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'

Reading 4 Writing 4 Numeracy 4

Employability Skills Information

Employability Skills 5)

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 diagnose and rectify faults.	1.1 OHS procedures for a given work area are obtained and understood. 1.2 Established OHS risk control measures and procedures are followed in preparation for the work. 1.3 Safety hazards that 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 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

ELEMENT	PERFORMANCE CRITERIA
2 Diagnose and rectify faults.	operation and safety.
	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 digital subsystems.
	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 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

ELEMENT	PERFORMANCE CRITERIA
3 Complete and report fault diagnosis and rectification activities.	energy practices.
	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 diagnosing and rectifying faults in digital control systems.

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

KS01-EI139A Digital electronic control systems

Evidence shall show an understanding of digital electronic control systems to an extent indicated by the following aspects:

T1. Digital control systems

- Comparison between analogue and digital signals
- Advantages of digital control systems
- Digital/analog control system
- Logic gates
- Truth tables
- Digital testing devices

T2. Numbering systems

- The binary number system
- The Octal number system
- The hexadecimal number system
- Binary addition and subtraction
- Conversion between numbering systems
- Binary Coded Decimal (BCD)
- Gray code
- The American Standard Code for Information Interchange (ASCII)

T3. Combinational Logic Networks

- Precautions when handling electronic devices due to electrostatic discharge (ESD)
- Truth tables
- Basic operation and characteristics of logic devices
- Logic probes
- Verification of operation of logic circuits

T4. Logic families and specifications

- Transistor-Transistor Logic (TTL)
- Complementary Metal Oxide Silicone (CMOS) logic families
- the 'unit load' concept
- specifications and features of TTL, TTL low power Schottky (LS) and CMOS

REQUIRED SKILLS AND KNOWLEDGE

logic families.

- three state and open collector logic
- input and output voltage characteristics for CMOS and TTL
- comparison of TTL with CMOS logic families
- Unit load
- noise margin
- interfacing different logic families
- Tri-state logic devices

T5. Encoders and Decoders

- weighted and unweighted codes.
- Gray
- BCD
- ASCII
- Half and full adder
- Encoders, decoders
- error detection.
- decoder and encoder ICs.
- multiplexer and demultiplexer ICs.

T6. Flipflops

- RS flipflops
- D flipflops
- JK flipflops
- truth tables and operation
- debouncing a switch
- timing diagrams
- Sequential logic
- State tables and timing diagrams

T7. Registers

- shift registers
- data latches

T8. Counters

- ripple counters using JK flipflops
- typical IC types
- characteristics and operation.
- Ripple counters
- Use of feedback to modify count
- Circuit verification of a ripple counter
- Synchronous counters

REQUIRED SKILLS AND KNOWLEDGE

- Series and parallel data transfer
- Multivibrators
- Interconnecting digital circuits to perform an application

T9. Digital to analog conversion

- Industrial applications of D/A converters
- Summing D/A converters
- R-2R D/A converters
- Verification of circuit operation of an IC D/A converter

T10. Analog to digital conversion

- Industrial applications of A/D converters
- Digital ramp, dual slope, successive approximation and simultaneous (flash) A/D converters.
- Verification of circuit operation of an IC A/D converters

T11. Display devices

- Liquid Crystal Display (LCD) devices
- Light Emitting Diode (LED) devices.
- Operation and Characteristics.
- Seven segment LED displays
- Drive requirements
- Current limiting
- Multiplexed displays
- Seven segment encoding chips
- Emerging display technologies

T12. Digital fault finding

- General fault finding principles
- Common digital faults
- Digital test equipment
- Locating a fault

T13. Interfacing logic devices to external loads

- Interfacing with a transistor
- Interfacing with a relay
- Solid state switches
- Opto-isolator
- Verification of circuit operation of an opto-coupler.

T14. Programmable logic devices

- Applications of programmable logic devices
- Types of programmable logic devices

REQUIRED SKILLS AND KNOWLEDGE

- Comparison between different programmable logic devices
- Programmable Array Logic (PAL)
- Programmable Logic Devices (PLD)
- Field Programmable Gate Arrays (FPGA)
- Programming and verifying correct operation of a programmable array logic device

Evidence Guide

EVIDENCE GUIDE

9) This provides essential advice for assessment of the unit and must be read in conjunction with the performance criteria and the range statement of the unit and the Training Package Assessment Guidelines.

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**

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:
 - Diagnose and rectify faults in digital subsystems of electronic controls 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 digital subsystems.
 - 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 digital systems of electronic controls.

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)**

For optimisation of training and assessment effort, competency development in this unit may be arranged concurrently with 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 diagnosing and rectifying at least four of the following faults in digital control systems.

- 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