



**Australian Government**

# **UEEIC0042 Solve problems in single phase electronic power control circuits**

**Release: 1**

# UEEIC0042 Solve problems in single phase electronic power control circuits

## Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

## Application

This unit involves the skills and knowledge required to solve problems in single phase electronic power control circuits.

This unit includes preparing and solving problems in single phase electronic power control systems. It also includes testing and documenting solutions to single phase electronic power control.

Typical single phase electronic power control problems are those encountered in meeting performance requirements and compliance standards, revising control operating parameters and dealing with control malfunctions.

The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.).

Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, is required.

Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.

## Pre-requisite Unit

Where prerequisite pathways have been identified, all competencies in the Common Unit Group must be have been completed plus all the competencies in one (1) of the identified Pathway Unit Group(s)

Common Unit Group

UEECD0007 Apply work health and safety regulations, codes and practices in the workplace and

UEECD0043 Solve problems in direct current circuits

or

UEECD0044 Solve problems in multiple path circuits

UEECD0046 Solve problems in single path circuits

Electrotechnology Pathway Group

UEEEEC0060 Repairs basic electronic apparatus faults by replacement of components

UEEEEC0067 Troubleshoot basic amplifier circuits

UEEEEC0065 Solve problems in basic electronic circuits

Electronics and Communications Pathway Group

UEEEEC0060 Repairs basic electronic apparatus faults by replacement of components

UEEEEC0074 Troubleshoot resonance circuits in an electronic apparatus

UEEEEC0067 Troubleshoot basic amplifier circuits

Electrical Pathway Group

UEECD0020 Fix and secure electrotechnology equipment

UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications

UEEEL0003 Arrange circuits, control and protection for electrical installations

UEEEL0020 Solve problems in low voltage a.c. circuits

UEEEL0023 Terminate cables, cords and accessories for low voltage circuits

UEEEL0019 Solve problems in direct current (d.c.) machines

UEEEL0021 Solve problems in magnetic and electromagnetic devices

UEEEL0008 Evaluate and modify low voltage heating equipment and controls

UEEEL0009 Evaluate and modify low voltage lighting circuits, equipment and controls

UEEEL0010 Evaluate and modify low voltage socket outlets circuits

UEEEL0024 Test and connect alternating current (a.c.) rotating machines

UEEEL0025 Test and connect transformers

Instrumentation and Control Pathway Group

UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications

UEECD0045 Solve problems in multiple path extra-low voltage (ELV) a.c. circuits

UEEIC0047 Use instrumentation drawings, specifications, standards and equipment manuals

UEEIC0041 Solve problems in pressure measurement components and systems

UEEIC0038 Solve problems in density/level measurement components and systems

UEEIC0039 Solve problems in flow measurement components and systems

UEEIC0043 Solve problems in temperature measurement components and systems

UEEIC0029 Set up and adjust PID control loops

UEEIC0030 Set up and adjust advanced PID process control loops

UEEIC0048 Verify compliance and functionality of instrumentation and control installations

UEEIC0031 Set up and configure human-machine interface (HMI) and industrial networks

## Competency Field

Instrumentation & Control

## Unit Sector

Electrotechnology

## Elements and Performance Criteria

### ELEMENTS

### PERFORMANCE CRITERIA

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

#### 1 Identify problems in single phase electronic power control system

- 1.1 WHS/OHS requirements and workplace procedures are identified and applied
- 1.2 Hazards are identified, risks are assessed and control measures implemented
- 1.3 Extent of single phase electronic power control problems are determined from performance specifications, situation reports and consultations with relevant person/s
- 1.4 Activities are planned to meet scheduled timelines in consultation with relevant person/s
- 1.5 Tools, equipment and testing devices needed for the work are obtained in accordance with workplace procedures and checked for correct operation and safety

#### 2 Solve problems in single phase electronic power control system

- 2.1 WHS/OHS risk control measures and workplace procedures for carrying out the work are followed
- 2.2 Single phase electronic power control devices, circuit operation characteristics and applications are used to develop solutions for control problems
- 2.3 Parameters, specifications and performance requirements in relation to each single phase electronic power control problem are obtained in accordance with

|                                                                               |                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                               | workplace procedures                                                                                                                                                                                   |
|                                                                               | 2.4 Approaches to resolving single phase electronic power control problems are evaluated to provide most effective solutions                                                                           |
|                                                                               | 2.5 Unplanned situations are responded to in accordance with workplace procedures in a manner that minimises risk to personnel and equipment                                                           |
|                                                                               | 2.6 Problems are solved efficiently using sustainable energy practices without waste of materials, damaging apparatus, the surrounding environment or services in accordance with workplace procedures |
| <b>3 Test and document solutions to single phase electronic power control</b> | 3.1 WHS/OHS risk control measures and workplace procedures for carrying out the work are followed                                                                                                      |
|                                                                               | 3.2 Solutions to single phase electronic power control problems are tested to determine effectiveness and modified as necessary                                                                        |
|                                                                               | 3.3 Adopted solutions are documented, including instructions for implementation, incorporating risk control measures                                                                                   |
|                                                                               | 3.4 Justification for solutions used to solve single phase electronic power control problems are documented in accordance with workplace procedures                                                    |

## Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

## Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the UEE Electrotechnology Training Package Companion Volume Implementation Guide.

Solving electrical problems must include at least four of the following:

- single phase electronic power control systems

## Unit Mapping Information

This unit replaces and is equivalent to UEENEEI148A Solve problems in single phase electronic power control circuits.

## Links

Companion Volume implementation guides are found in VETNet - -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6>

# Assessment Requirements for UEEIC0042 Solve problems in single phase electronic power control circuits

## Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

## Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least two separate occasions and include:

- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements, including implementing risk control measures
- applying sustainable energy principles and practices
- evaluating problem resolutions, testing for effectiveness and modifying as required
- meeting scheduled timelines
- preparing and solving problems in single phase electronic power control systems
- using tools, equipment and testing devices
- obtaining and checking tools and equipment
- dealing with unplanned events/situations in accordance with workplace procedures in a manner that minimises risk to personnel and equipment.

## Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- introduction to power control, including:
  - advantages and benefits of power control
  - need for power control and typical applications
  - power control methods
  - types of solid-state switches
  - block diagram of a power converter
  - power control terminology
  - modes of operation
- single phase power rectifiers, including:
  - single phase rectifier circuit configurations
  - resistive/inductive loads

- output voltages/waveforms
- ripple voltage frequency
- peak reverse voltages
- freewheeling diodes
- silicon controlled rectifiers (SCRs), including:
  - construction and symbol
  - basic operating principles
  - characteristics
  - gate requirements
  - commutation
  - electrical ratings
  - testing SCRs
  - applications
- triacs and gate turn off (GTO) thyristors, including:
  - triac construction and symbol
  - triac basic operating principles
  - triac characteristics
  - triac triggering modes
  - triac electrical ratings
  - triac testing
  - GTO construction and symbol
  - GTO basic operating principles
  - GTO characteristics
  - GTO electrical ratings
  - applications for triac and GTOs
- power transistors bipolar junction transistor (BJT), including:
  - BJT construction and symbol
  - BJT basic operating principles
  - BJT characteristics
  - BJT electrical ratings
  - BJT testing
  - applications for BJTs
- power field effect transistors (FET), including:
  - types of FETs used for power control
  - power FETs construction and symbol
  - FET basic operating principles and characteristics
  - insulated gate bipolar transistor (IGBT) basic operating principles and characteristics
  - power FET electrical ratings
  - power FET Testing

- applications for power FETs
- triggering devices diac, including:
  - construction and symbol
  - operating principles
  - breakover voltage
  - unijunction transistors (UJT)
  - construction and symbol
  - operating principles
  - intrinsic stand-off ratio and peak point voltage
- programmable unijunction transistors (PUTs) including:
  - construction and symbol
  - operating principles
  - programmable standoff ratio
  - peak point voltage
- triggering circuits, including:
  - R-C time constant circuits
  - diac trigger circuit operation
  - UJT relaxation oscillator circuit operation
  - PUT relaxation oscillator circuit
- half wave-controlled rectification, including:
  - phase shift control
  - controlled rectifiers
  - controlled rectifier power output control
  - single phase half wave-controlled rectifier
  - circuit configuration
  - circuit operation
  - waveforms
  - load voltage
  - applications and limitations
  - problems associated with phase shift control
- full wave-controlled bridge rectification including:
  - single phase full wave-controlled bridge rectifier circuit
  - output voltage
  - output waveforms
  - applications and limitations
  - advantages and disadvantages
- fully controlled bridge rectification, including:
  - single phase fully controlled rectifier bridge circuit
  - output voltage

- output waveforms
- applications and limitations
- advantages and disadvantages
- single phase alternating current (a.c.) voltage control, including:
  - phase control of a.c. power
  - circuit configurations - half and full control circuits
  - triggering circuits
  - circuit performance and operation on resistive and inductive loads
  - output voltage and waveform, determination of output voltage using circuit characteristics
  - range of control with inductive loads
  - triggering problems associated with inductive loads
  - applications and limitations
- zero voltage switching (ZVS), including:
  - operating principles
  - circuit configuration, including trigger circuits
  - circuit operation and waveforms resistive loads only
  - relationship between load power and conduction time
  - solid state relays: types and ratings
  - applications and limitations
- fault finding of power control circuits, including:
  - fault-finding procedures
  - typical faults power and trigger circuits
  - characteristics displayed by common faults
  - comparison of test data with expected data (voltage/current waveforms)
  - location and replacement of faulty components
- job safety assessments or risk mitigation processes, including risk control measures
- relevant manufacturer specifications
- relevant tools, equipment and testing devices
- relevant WHS/OHS legislated requirements
- relevant workplace documentation
- relevant workplace policies and procedures
- single phase electronic power control circuits
- solutions to single phase electronic power control problems
- sustainable energy principles and practices.

## Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the

time of assessment.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated workplace operational situations that replicate workplace conditions.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or other simulations
- relevant and appropriate materials, tools, equipment and personal protective equipment (PPE) currently used in industry
- applicable documentation, including workplace procedures, equipment specifications, regulations, codes of practice and operation manuals.

## Links

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