



Australian Government

UEENEEH185A Design signal-conditioning subsystems

Release: 2

UEENEEH185A Design signal-conditioning subsystems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This unit covers designing signal-conditioning subsystems incorporating sensors and transducers and digital and analogue elements. It encompasses working safely, following design brief, apply knowledge of digital and analogue devices, interpreting device specifications, constructing prototypes, testing developed system prototype operation and documenting design and development work

Application of the Unit

Application of the Unit 2)

This unit is intended for competency development entry-level employment based programs incorporated in approved contracts of training or approved training programs. It is intended to apply to any formal recognition for this standard at the aligned AQF 6 level.

Licensing/Regulatory Information

License to practice 3)

The skills and knowledge described in this unit do not require a license to practice in the workplace. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Pre-Requisites

Prerequisite Unit(s) 4)

Competencies 4.1)

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

UEENEEE101 A Apply Occupational Health and Safety regulations, codes and practices in the workplace

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 5 Writing 5 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 design signal-conditioning subsystems	<p>1.1 OHS processes and procedures for a given work area are obtained and understood.</p> <p>1.2 Established OHS risk control measures and procedures are followed in preparation for the work.</p> <p>1.3 The extent of the proposed signal-conditioning subsystem is determined from the design brief or in consultations with appropriate person(s)</p> <p>1.4 Design development work is planned to meet scheduled timelines in consultation with others involved on the work site</p> <p>1.5 Materials and devices/components required for the work are determined on compatibility of their specifications with data acquisition system requirements and project budget constraints.</p>
2 Design signal-conditioning subsystems	<p>2.1 OHS risk control work measures and procedures are followed.</p> <p>2.2 Knowledge of digital and analogue elements used in signal-conditioning subsystems and compliance standards are applied to the design</p> <p>2.3 Alternative arrangements for the design are considered based on the requirements outlined in the design brief.</p> <p>2.4 Safety, functional and budget considerations are incorporated in the design.</p>

ELEMENT**PERFORMANCE CRITERIA**

- | | | |
|---|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| | 2.5 | Prototype devices and circuits are constructed, programmed and tested for compliance with the design brief and regulatory requirements. |
| | 2.6 | Prototype malfunctions are rectified and retested to ensure effective operation of design. |
| | 2.7 | The design is documented for submission to appropriate person(s) for approval |
| | 2.8 | Solutions to unplanned situation are provided consistent with organisation policy. |
| 3 | Obtain approval for signal-conditioning subsystems design | |
| | 3.1 | The design is presented and explained to client representative and/or other relevant person(s). |
| | 3.2 | Requests for modifications to the design are negotiated with relevant person(s) within the constraints of organisation policy. |
| | 3.3 | Final design is documented and approval obtained from appropriate person(s). |
| | 3.4 | Quality of work is monitored against personal performance agreement and/or established organizational or professional standards |

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

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

Evidence shall show that knowledge has been acquired of safe working practices and designing a signal-conditioning subsystem.

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

KS01-EH185A

Principles of Signal Conditioning

Evidence shall show an understanding of principles of signal conditioning, applying safe working practices and relevant Standards, Codes and Regulations to an extent indicated by the following aspects:

T1. Differential amplifiers of suitable characteristics to meet system objective

- differential gain, common mode rejection ratio and the required CMRR
- variable gain input stage
- connections for an instrumentation amplifier to meet given objectives.

T2. Audio frequency integrator working to given specifications

- ideal integrator
- practical difficulty with the ideal circuit
- common applications of the integrator.

T3. Operational amplifier circuits

- use of d.c. offset and capacitive blocking and Norton amplifiers powered by a single supply
- operation of single-supply inverting and noninverting amplifiers employing DC offset bias at the input and blocking capacitors
- operation of a high input resistance unity gain
- circuit symbol of the Norton (input current difference) amplifier
- areas of use for single-supply amplifiers.

T4. Comparator circuits (open loop, limited swing and hysteresis) using operational amplifiers:

- ideal op-amp comparator
- typical uses of the comparator.
- comparators with limited (i) negative swing and (ii) both positive negative swing
- hysteresis comparator with positive resistor divider feedback and calculate the input switching voltages.
- desirable properties of an operational amplifier for use as comparator and the characteristics of comparator op amps.
- op amp oscillators

REQUIRED SKILLS AND KNOWLEDGE

T5. Amplifiers with given piecewise linear transfer characteristics

T6. Operation and building precision of half-wave and fullwave rectifiers

- precision two-diode half-wave rectifier
- typical applications of precision rectifiers.

T7. Operation of and build a sine - triangle – square function generator:

- block diagram of a sine-triangle-square signal generator using an integrator, comparator and sine-wave shaper.
- waveforms at various points in the circuit.
- frequency range and setting of frequency changes.
- Timer circuits
- function generators and oscillators.

T8. Sensors and transducers

- static and dynamic characteristics Sensor types encompassing:
 - strain and force
 - thermocouples
 - displacement, location, proximity
 - motion
 - light and radiation
 - pressure

T9. Feedback Control Systems basics

- closed loop systems
- open loop systems

T10. Actuators and Drive Systems

- types and characteristics
- Power Ics
- PLL circuits

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/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 essential knowledge and associated skills 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:
 - Design signal-conditioning subsystems as described in 8) and including:
 - a. Developing outlines of alternative designs.
 - b. Developing the design within the safety and functional requirements and budget limitations.
 - c. Documenting and presenting design effectively.
 - d. Successfully negotiating design alteration requests.
 - e. Obtaining approval for final design.

- f. Dealing with unplanned events by drawing on essential knowledge and skills 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 designing signal-conditioning subsystems.

**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 essential knowledge and associated skills 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 essential knowledge and skills described in this unit.

**Concurrent
assessment and
relationship with
other units**

9.5)
There are no concurrent assessment recommendations for 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 using a representative range of signal-conditioning subsystems in designing signal-conditioning subsystems incorporating sensors and transducers and digital and analogue elements.

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)

Electronics