



**Australian Government**

**MEM23116A Evaluate programmable logic  
controller and related control system  
component applications**

**Release: 1**

# **MEM23116A Evaluate programmable logic controller and related control system component applications**

## **Modification History**

Release 1 - New unit. Replaces MEM23082A, but not equivalent.

## **Unit Descriptor**

This unit of competency covers the evaluation of automated devices, machines and processes controlled by programmable logic controllers (PLCs). It includes basic PLC architecture, associated control system components and programming techniques, work health and safety (WHS) compliance requirements, risk management, automation safety, networking for data sharing and remote control, and broad implications of wiring rules.

## **Application of the Unit**

This unit applies to evaluations of PLCs and their use in engineering applications. The evaluation may be undertaken as part of a PLC selection process or to assess PLC and control system condition or efficiency. It is suitable for people working as automation, mechatronics or maintenance technicians or for those pursuing qualifications or careers in those disciplines.

## **Licensing/Regulatory Information**

Not applicable.

## **Pre-Requisites**

MEM23004A Apply technical mathematics

MEM23111A Select electrical equipment and components for engineering applications

MEM23112A Investigate electrical and electronic controllers in engineering applications

## Employability Skills Information

This unit contains employability skills.

## Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.

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

## Elements and Performance Criteria

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|---|---|-----|--|
| 1 | Determine scope of evaluation                   | 1.1 | Confirm and apply safe electrical working practice   |
|   |   | 1.2 | Review the currents and voltages present in the PLC applications and check for regulatory requirements and dangerous high currents and voltages, including effects on humans and on application equipment and components |
|   |   | 1.3 | Identify WHS and regulatory requirements with particular emphasis on automation safety, codes of practice, standards, risk management and organisational procedures  |
|   |   | 1.4 | Determine requirement for PLC and related control system components  |
|   |   | 1.5 | Ensure appropriate support, including licensed electrical, technical and professional assistance, is available.  |
|   |   | 1.6 | Determine software and software techniques for analysis and graphics required by the evaluation task   |
|   |   | 1.7 | Identify stakeholders to be consulted on evaluation  |
|   |   | 1.8 | Investigate sustainability implications of PLC applications  |
| 2 | Establish existing features of PLC applications | 2.1 | Review the functions and features of devices, machines and processes controlled by PLCs  |
|   |   | 2.2 | Identify features and functions of PLC systems and components  |

- 2.3 Review PLC programming and functions
  - 2.4 Identify system integrating principles and techniques, signal conditioning and power interfacing
  - 2.5 Identify networking and system supervision, data acquisition and systems control options
- 3 Evaluate PLC applications
- 3.1 Determine suitability of components of application including sensor/transducers, PLC and output devices, signal conditioning and interfacing
  - 3.2 Establish suitability of controller functions, PLC software and programming
  - 3.3 Determine suitability of network, system control and data acquisition (SCADA) communications protocols, standards and network topologies, human-machine interfaces (HMIs) and graphical user interfaces (GUIs) used by applications
  - 3.4 Evaluate compliance of application with WHS and regulatory requirements, codes of practice, standards and risk management procedures
- 4 Report results
- 4.1 Record results of evaluation
  - 4.2 Provide documentation, such as layouts, programs, flow charts, state diagrams and files

## Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

### Required skills

Required skills include:

- identifying features and functions of PLCs and control systems, including:
  - components
  - signal conditioning and power interfacing
  - networking and system supervision, data acquisition and systems control options
- ensuring safe electrical working practice, including use of licensed personnel, where required
- investigating sustainability implications of PLC applications
- evaluating safety, condition, efficiency and functionality of PLCs and associated applications, including:
  - controller functions and programming
  - network and interfacing, including SCADA, communications protocols, standards and network topologies
  - suitability of HMIs and GUIs
  - compliance with WHS and regulatory requirements
- applying WHS, regulatory and automation safety requirements, risk management and organisational procedures
- reporting and documenting results of evaluation, including layouts, programs, flow charts or state diagrams and files

### Required knowledge

Required knowledge includes:

- features of a range of PLC and related control system component applications used in engineering environments
- effects of electricity on humans, dangerous high currents and voltages and automated systems, regulatory requirements related to extra low, low and high voltage applications
- relevant compliance requirements of WHS, regulations, codes of practice, standards, and risk assessment requirements for integrated manufacturing systems with particular emphasis on automation safety
- hardware functions, options and integration into PLC and related control systems
- input devices/sensors
- output devices/actuators
- PLCs
- interfacing and signal conditioning

- communications and networking options for devices
- HMIs and GUIs
- PLC architecture
- Input/Output (I/O) functions and arrangements
- typical input signals and sensor/transducers
- shielding and twisted pairing for noise mitigation
- calibration techniques
- reading of discrete levels from analog input data (other analog I/O functions not required by this unit)
- input signal conditioning
- digitally driven output devices and interface requirements power supply
- programming techniques and options

## Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

<p><b>Overview of assessment</b></p>	<p>A person who demonstrates competency in this unit must be able to evaluate PLCs and related control system component applications for safety, efficiency and function.</p>
<p><b>Critical aspects for assessment and evidence required to demonstrate competency in this unit</b></p>	<p>Assessors must be satisfied that the candidate can competently and consistently:</p> <ul style="list-style-type: none"> <li>• identify and assess compliance with WHS and regulatory requirements, and risk management procedures</li> <li>• review dangers and effects of electricity on humans</li> <li>• identify PLC related systems and components, integrating principles and techniques</li> <li>• assess suitability of programming</li> <li>• investigate sustainability implications of PLC applications</li> <li>• assess and apply basic electrical and electronic, control principles, controller programming principles and techniques, software basic analysis and graphics skills and techniques</li> <li>• evaluate components of applications against application specifications for safety, economy and fitness for purpose</li> <li>• report and document results.</li> </ul>
<p><b>Context of and specific resources for assessment</b></p>	<ul style="list-style-type: none"> <li>• This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then a simulated working environment must be used where the range of conditions reflects realistic workplace situations. The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team.</li> <li>• Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability.</li> <li>• Access must be provided to appropriate learning and/or assessment support when required. Where applicable, physical resources should include equipment modified for people with disabilities.</li> </ul>

<p><b>Method of assessment</b></p>	<ul style="list-style-type: none"> <li>• Assessment must satisfy the endorsed Assessment Guidelines of the MEM05 Metal and Engineering Training Package.</li> <li>• Assessment methods must confirm consistency and accuracy of performance (over time and in a range of workplace relevant contexts) together with application of underpinning knowledge.</li> <li>• Assessment methods must be by direct observation of tasks and include questioning on underpinning knowledge to ensure correct interpretation and application.</li> <li>• Assessment may be applied under project-related conditions (real or simulated) and require evidence of process.</li> <li>• Assessment must confirm a reasonable inference that competency is not only able to be satisfied under the particular circumstance, but is able to be transferred to other circumstances.</li> <li>• Assessment may be in conjunction with assessment of other units of competency where required.</li> </ul>
<p><b>Guidance information for assessment</b></p>	<p>Assessment processes and techniques must be culturally appropriate and appropriate to the language and literacy capacity of the candidate and the work being performed.</p>

## Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

<p><b>PLC applications</b></p>	<p>PLC applications may include:</p> <ul style="list-style-type: none"> <li>• industrial (e.g. motor controllers, fault detectors and power controllers)</li> <li>• multi-axis machine control</li> <li>• process automation</li> <li>• packaging, shrink-wrapping, labelling and palletising</li> <li>• utilities, water treatment and effluent treatment</li> <li>• industrial distributed control system</li> <li>• amusement rides</li> <li>• agricultural machine and irrigation controllers</li> </ul>
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	<ul style="list-style-type: none"> <li>• military and aerospace automation (except aircraft systems)</li> <li>• mineral and chemical, and petroleum processing</li> </ul>
<b>PLC software</b>	<p>PLC software and programming language may cover:</p> <ul style="list-style-type: none"> <li>• ladder diagram (LD) – graphical</li> <li>• function block diagram (FBD) – graphical</li> <li>• structured text (ST) – textual</li> <li>• instruction list (IL) – textual</li> <li>• sequential function chart (SFC) – elements to organise programs for sequential and parallel control processing</li> </ul> <p>PLC programming language standards may comply with IEC 61131-3 or other standards</p>
<b>Appropriate technical and professional assistance</b>	<p>Appropriate technical and professional assistance may include:</p> <ul style="list-style-type: none"> <li>• technical support and advice relating to elements which have intrinsic dangers, such as: <ul style="list-style-type: none"> <li>• high pressure</li> <li>• energised fluid vessels</li> <li>• high temperatures and heat energy capacity</li> <li>• wiring with high current control voltages above extra low voltage</li> </ul> </li> <li>• professional support for technologies may include: <ul style="list-style-type: none"> <li>• specialist electric motor drives and controllers</li> <li>• specialist materials, plastics, metal alloys and nano materials</li> <li>• special processes, foundry, alloy welding, heat treatment, sealing and fastening</li> </ul> </li> </ul>
<b>WHS, regulatory requirements and enterprise procedures</b>	<p>WHS, regulatory requirements and enterprise procedures may include:</p> <ul style="list-style-type: none"> <li>• WHS Acts and regulations</li> <li>• relevant standards</li> <li>• codes of practice from Australian and overseas engineering and technical associations and societies</li> <li>• risk assessments</li> <li>• registration requirements</li> <li>• safe work practices</li> <li>• state and territory regulatory requirements</li> </ul>
<b>Standards and codes</b>	<p>Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular PLC related task</p>
<b>Automation safety</b>	<p>Automation safety refers to the reliance on emergency stop,</p>

	failsafe design, redundancy, system interlocks and data integrity. Standards apply to general plant design and use as well as the 'functional safety of safety-related electrical, electronic and programmable electronic control systems'
<b>Data and communications protocols and standards</b>	Data and communications protocols and current standards may include: <ul style="list-style-type: none"> <li>layered communications and networking protocols, such as Open Systems Interconnection Model (OSI Model) – 7 layers</li> <li>TCP/IP Internet Protocol Suite {Transmission Control Protocol (TCP) and the Internet Protocol (IP)} – 4 or 5 layers</li> <li>IEEE 802 Wireless PAN, LAN, MAN and WPAN standards</li> <li>interface standards, such as RS232 and RS485, Fieldbus, Modbus and DNP3.0</li> </ul>
<b>Network topologies</b>	Network topologies may include: <ul style="list-style-type: none"> <li>daisy-chain, star, ring, branch, linear and tree</li> <li>wired and wireless options</li> </ul>
<b>Sustainability</b>	Sustainability is used to mean the entire sustainable performance of the organisation/plant, including: <ul style="list-style-type: none"> <li>meeting all regulatory requirements</li> <li>conforming to all industry covenants, protocols and best practice guides</li> <li>minimising ecological and environmental footprint of process, plant and product</li> <li>maximising economic benefit of process plant and product to the organisation and the community</li> <li>minimising the negative WHS impact on employees, community and customer</li> </ul>

## Unit Sector(s)

### Competency field

**Unit sector**      Engineering science

## Custom Content Section

Not applicable.