



**Australian Government**

# **MEM23117 Evaluate microcontroller applications**

**Release: 1**

# MEM23117 Evaluate microcontroller applications

## Modification History

Release 1. Supersedes and is equivalent to MEM23117A Evaluate microcontroller applications.

## Application

This unit of competency defines the skills and knowledge required to evaluate automated devices, machines and processes controlled by microprocessors. It includes integration of input devices/sensors, output devices/actuators, controllers, interfacing and signal conditioning, human-machine interfaces (HMIs), networking options, data and communications protocols software, programming of microcontrollers and automation safety. Analogue interfacing is included but the unit does not cover proportional integral derivative (PID) interfacing.

Microcontrollers are typically an integrated circuit consisting of a central processing unit (CPU) combined with support functions. These functions include a crystal oscillator, timers, watchdog timer, serial and optional analog input/output (I/O). There is a limited amount of read/write memory on the chip along with program memory in the form of reprogrammable flash or 'one-time programmable' ROM.

The unit applies to the evaluation of microcontrollers and their use in automated devices, machines and engineering processes. It is suitable for people working as automation, mechatronics or maintenance technicians or for those pursuing qualifications or careers in those disciplines.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

## Pre-requisite Unit

### MEM23004 Apply technical mathematics

MEM23111 Select electrical equipment and components for engineering applications

MEM23112 Investigate electrical and electronic controllers in engineering applications

## Competency Field

Engineering science

## Elements and Performance Criteria

| Elements                                         | Performance Criteria                                                                                   |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| <i>Elements describe the essential outcomes.</i> | <i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i> |

| <b>Elements</b>                                               | <b>Performance Criteria</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Elements describe the essential outcomes.</i>              | <i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 1. Determine scope of evaluation                              | 1.1 Confirm and apply safe electrical working practice<br>1.2 Review the currents and voltages present in the microcontroller applications and check for regulatory requirements and dangerous high currents and voltages, including effects on humans and on application equipment and components<br>1.3 Identify work health and safety (WHS) and regulatory requirements, codes of practice, standards, risk management and organisational procedures, including those related to automation safety<br>1.4 Identify software techniques and graphics required for evaluation<br>1.5 Identify stakeholders to be consulted on evaluation tasks<br>1.6 Identify sources of technical and professional assistance<br>1.7 Investigate sustainability implications of microcontroller applications |
| 2. Establish existing features of microprocessor applications | 2.1 Review the functions and features of devices, machines and processes controlled by microprocessors<br>2.2 Identify features and functions of microprocessor devices and components<br>2.3 Review microprocessor programming and functions<br>2.4 Identify system integrating principles and techniques, signal conditioning and power interfacing<br>2.5 Identify networking and system supervision, data acquisition and systems control options                                                                                                                                                                                                                                                                                                                                            |
| 3. Evaluate microcontroller applications                      | 3.1 Determine suitability of components of application, including sensor or transducers, microcontroller and output devices, signal conditioning and interfacing used by applications<br>3.2 Assess scope and suitability of microcontroller functions, software and programming to applications<br>3.3 Assess suitability of network, supervisory control and data acquisition (SCADA) options, communications protocols, standards and network topologies, human-machine interfaces (HMIs) and graphical user interfaces (GUIs) used by applications<br>3.4 Review application for compliance with WHS and regulatory requirements, codes of practice, standards and risk management procedures                                                                                                |

| Elements                                         | Performance Criteria                                                                                                                                                                                                  |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Elements describe the essential outcomes.</i> | <i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>                                                                                                                |
| 4. Report results                                | <p>4.1 Record results of scoping, principles and techniques identification, and evaluation of applications</p> <p>4.2 Provide documentation that includes files, layouts, programs, flow charts or state diagrams</p> |

## Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

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

## Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

|                                                                                              |                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Microcontroller applications include:                                                        | <ul style="list-style-type: none"> <li>• motor controllers</li> <li>• fault detectors</li> <li>• power controllers</li> <li>• communications</li> <li>• security systems</li> <li>• machine and process automation</li> <li>• automotive and transport applications</li> <li>• domestic appliances</li> <li>• medical equipment.</li> </ul> |
| Appropriate technical and professional assistance includes:                                  | <ul style="list-style-type: none"> <li>• technical support and advice relating to elements which have intrinsic dangers including</li> <li>• professional support for technologies.</li> </ul>                                                                                                                                              |
| Work health and safety (WHS), regulatory requirements and organisational procedures include: | <ul style="list-style-type: none"> <li>• WHS, acts, regulations and 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> </ul>                                                           |

|                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                       | <ul style="list-style-type: none"> <li>• safe work practices</li> <li>• state and territory regulatory requirements.</li> </ul>                                                                                                                                                                                                                                                                                                                                      |
| Automation safety refers to use of general and specific safety features and includes: | <ul style="list-style-type: none"> <li>• emergency stop</li> <li>• failsafe design</li> <li>• redundancy</li> <li>• interlocks</li> <li>• guarding data integrity</li> <li>• general plant design and use</li> <li>• functional safety of safety-related electrical, electronic and programmable electronic control systems.</li> </ul>                                                                                                                              |
| Network topologies include:                                                           | <ul style="list-style-type: none"> <li>• daisy-chain</li> <li>• star</li> <li>• ring</li> <li>• branch</li> <li>• linear</li> <li>• tree</li> <li>• wired and wireless options.</li> </ul>                                                                                                                                                                                                                                                                           |
| Software for microcontroller applications include:                                    | <ul style="list-style-type: none"> <li>• integrated development environment software which can include: <ul style="list-style-type: none"> <li>• programmer</li> <li>• editor</li> <li>• assembler</li> <li>• compiler</li> <li>• linker</li> <li>• simulator</li> <li>• emulator</li> </ul> </li> <li>• HMI software</li> <li>• network software</li> <li>• modem software.</li> </ul>                                                                              |
| Sustainability includes:                                                              | <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 Mapping Information

Release 1. Supersedes and is equivalent to MEM23117A Evaluate microcontroller applications.

## Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

# Assessment Requirements for MEM23117 Evaluate microcontroller applications

## Modification History

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## Performance Evidence

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

- identifying and assessing compliance with work health and safety (WHS) and regulatory requirements, and risk management procedures
- identifying microprocessor-related systems and components, integrating principles and techniques
- assessing suitability of programming
- investigating sustainability implications of microprocessor-related applications
- assessing and applying basic electrical and electronic control principles, controller programming principles and techniques, software basic analysis, and graphics skills and techniques on at least two occasions
- evaluating components of applications against application specifications for safety, economy and fitness for purpose on at least two occasions
- reporting and documenting processes and results of evaluation, including layouts, programs and flow charts or state diagrams.

*Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.*

## Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- features of microcontrollers and related control system component applications used in engineering environments
- compliance requirements of WHS, regulations, codes of practice, standards and risk assessment
- appropriate technical and professional assistance
- effects of electricity on humans, dangerous high currents and voltages and automated systems, and regulatory requirements related to extra low, low and high voltage applications
- hardware functions, options and integration with microprocessor applications
- software for microcontrollers

- input devices and sensors, output devices and actuators, controller, interfacing and signal conditioning, communications, human-machine interfaces (HMIs), graphical user interfaces (GUIs), and networking options for devices
- appropriate use of microprocessor related terminology
- microcontroller features and function including:
  - volatile and non-volatile memory and data storage
  - one-time programmable and reprogrammable microcontrollers
  - typical microcontroller architecture characteristics
  - central processing unit (CPU) functions
  - interrupt structures
  - input/output (I/O) functions
  - timers and clocks
  - logic
  - programming methods and techniques.
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## Assessment Conditions

- Assessors must:
  - have vocational competency in evaluating microcontroller applications at least to the level being assessed with relevant industry knowledge and experience
  - satisfy the assessor requirements in the Standards for Registered Training Organisations 2015 or its replacement and comply with the National Vocational Education and Training Regulator Act 2011, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires.
- Where possible assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- Conditions for assessment must include access to all tools, equipment, materials and documentation required including relevant workplace procedures, product and manufacturing specifications.
- 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.
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## Links

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