Title	**Demonstrate and apply knowledge of digital principles for electronics technicians**		
Level	**4**	**Credits**	**7**

Purpose	People credited with this unit standard are able to: – demonstrate knowledge of microprocessor or microcontroller systems; – programme and test a microprocessor or microcontroller application; – demonstrate knowledge of external serial bus systems to enable expansion; – demonstrate knowledge of analogue-to-digital and digital-to-analogue conversion; and – test analogue-to-digital and digital-to-analogue converters.

Classification	Electronic Engineering > Core Electronics

Available grade	Achieved

Guidance Information

1 References
Electricity Act 1992;
Electricity (Safety) Regulations 2010;
Electrical Workers Registration Board (*EWRB) Rules of the Board* and *Teaching Guidelines* available at www.ewrb.govt.nz;
Health and Safety at work Act 2015;
and all subsequent amendments and replacements.

2 Definitions
ADC – analogue-to-digital converter.
DAC – digital-to-analogue converter.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
I/O – input/output port.
I^2C – inter integrated circuit bus.
I^2S – inter-IC sound bus.
LED – light emitting diode.
R/2R ladder networks – used in one type of DAC.
RS-232 – asynchronous serial line standard point-to-point interface bus.
RS-485 – 2 wire, half duplex differential line multi-point communications standard differential bus transceiver.
SPI – serial peripheral interface.

3 Range
- a Electrical, radiation, and workshop or laboratory safety practices are to be observed at all times.
- b All measurements are to be expressed in Système Internationale (SI) units and multipliers.
- c All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with:
  - i legislation;
  - ii policies and procedures;
  - iii ethical codes;
  - iv Standards – may include but are not limited to those listed in Schedule 2 of the Electricity (Safety) Regulations 2010;
  - v EWRB Rules of the Board;
  - vi safe and sound practice;
  - vii applicable site, company, and industry practice, and industry conventions.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of microprocessor or microcontroller systems.

Performance criteria

1.1 Describe the architecture of a typical microprocessor or microcontroller with a given functional block diagram.

Range description must include the purpose of each functional block and the flow of information and data.

1.2 Sketch the programming of a microprocessor or microcontroller.

1.3 Explain the operation of a microprocessor or microcontroller with a given functional block diagram.

Range clock, reset, fetch, execute cycle, read or write cycle to peripheral devices.

Outcome 2

Programme and test a microprocessor or microcontroller application.

Performance criteria

2.1 Write, debug, and test a simple assembler or high-level language programme to enable a microprocessor or microcontroller to interface with peripheral devices.

Range programme is required to read simple digital input devices such as switches or opto-couplers, and process these to produce some output algorithm to a digital output such as LEDs, relays, solenoids.

2.2 Write, debug, and test a simple assembler or high-level language software test routine, to test the operation of two programmable peripheral interface devices.

Range may include – programmable I/O parallel port, programmable serial port, programmable timer.

2.3 Write, debug, and test a simple programme exploiting the interrupt feature of a programmable peripheral device, and explain the operation of the interrupt structure.

Outcome 3

Demonstrate knowledge of external serial bus systems to enable expansion.

Range may include but is not limited to – RS-232, RS-485, I2C, I2S, SPI, J-Tag. evidence of two is required.

Performance criteria

3.1 Describe the use of bus systems, and explain their operation using sample frames.

3.2 Explain the use of bus systems to provide I/O expansion, control, or transfer of data in commercial electronics products or systems.

Outcome 4

Demonstrate knowledge of analogue-to-digital and digital-to-analogue conversion.

Performance criteria

4.1 Explain terms associated with analogue-to-digital and digital-to-analogue conversion.

Range terms – servo or counter, successive approximation, dual slope, flash, delta-sigma, weighted networks, one bit DAC, DAC using R/2R ladder networks, resolution, quantisation, conversion time, linearity, offset, gain errors.

4.2 Explain the operation of ADCs and DACs.

Range two ADCs and one DAC.

4.3 Identify ADCs and DACs in the circuits of commercial electronic products and describe the functions of the ADCs and DACs.

Outcome 5

Test analogue-to-digital and digital-to-analogue converters.

Performance criteria

5.1 Test an ADC and a DAC and measure parameters.

Range parameters – conversion rate, resolution, offset, gain, linearity errors, microcontroller-based converters may be tested.

Planned review date	31 December 2025

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	26 July 2004	31 December 2012
Review	2	21 July 2011	31 December 2022
Review	3	24 June 2021	N/A

Consent and Moderation Requirements (CMR) reference	0003

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

Comments on this unit standard

Please contact The Skills Organisation reviewcomments@skills.org.nz if you wish to suggest changes to the content of this unit standard.