

Title	Demonstrate and apply fundamental knowledge of analogue electronics for electronics technicians		
Level	3	Credits	7

Purpose	<p>This unit standard covers an introduction to analogue electronic devices and circuits for electronics technicians.</p> <p>People credited with this unit standard are able to demonstrate fundamental knowledge of:</p> <ul style="list-style-type: none"> – semiconductor diodes and their applications; – bipolar and enhancement mode field effect transistors, and their use in d.c. switching circuits; – operational amplifiers and their applications; and – d.c. power supplies and electronic regulators.
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Classification	Electronic Engineering > Core Electronics
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Available grade	Achieved
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Guidance Information

- 1 This unit standard has been developed for learning and assessment off-job.
- 2 References
Health and Safety in Employment Act 1992 and associated regulations; and all subsequent amendments and replacements.
- 3 Definitions
Fundamental knowledge – for the purposes of this unit standard means having some relevant theoretical knowledge of the subject matter with the ability to use that knowledge to interpret available information.
BJT – bipolar junction transistor.
d.c. – direct current.
dB – decibels.
Enterprise practice – those practices and procedures that have been promulgated by the company or enterprise for use by their employees.
 g_{FS} – forward transconductance.
 $h_{FE(SAT)}$ – d.c. forward current gain at saturation.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
 I_{Cmax} – maximum collector current.
 I_{Dmax} – maximum drain current.
LED – light emitting diode.
MOSFET – metal oxide field effect transistor.
 P_{Cmax} – maximum collector power dissipation.

R – resistance.

$R_{DS(ON)}$ – static drain to source on-state resistance.

V_{CEO} – collector-emitter voltage with base open.

V_{CEsat} – collector emitter voltage at saturation.

V_{DSS} – drain-source saturation voltage.

4 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 Use of non-programmable calculators is permitted during assessments.
- d All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with legislation, policies, procedures, ethical codes, Standards, applicable site and enterprise practice, and industry practice; and, where appropriate, manufacturers' instructions, specifications, and data sheets.

Outcomes and performance criteria

Outcome 1

Demonstrate fundamental knowledge of semiconductor diodes and their applications.

Performance criteria

- 1.1 Three types of two terminal semiconductor devices are described in terms of their basic operation, characteristics, and application.

Range may include but is not limited to – rectifier diodes, Schottky diodes, Zener diodes, LEDs.

- 1.2 The use of diodes in signal clipping circuits is explained with the aid of circuit sketches.

- 1.3 Typical configurations, operating parameters, and applications of optocouplers and opto-isolators are described.

Range may include but is not limited to – photo diode, phototransistor, photo-Darlington, triac optocouplers; evidence of two devices and two applications for each device is required.

Outcome 2

Demonstrate fundamental knowledge of bipolar and enhancement mode field effect transistors, and their use in d.c. switching circuits.

Performance criteria

2.1 The construction of the devices is outlined with reference to the materials they are made of, and their operation explained in terms of current carriers and/or the application of electric fields.

Range devices – pnp and npn transistors, n-channel and p-channel MOSFETs.

2.2 Important device parameters are identified from given data sheets, and their meanings stated.

Range evidence of three parameters for one BJT and one MOSFET. Typical parameters may include but are not limited to –
BJT – $h_{FE(SAT)}$, V_{CEO} , I_{Cmax} , P_{Cmax} , V_{CEsat} ;
MOSFET – g_{FS} , I_{Dmax} , V_{DSS} , $R_{DS(ON)}$.

2.3 Advantages and disadvantages of solid state switches are stated.

2.4 Typical applications of BJTs and MOSFETs in switching configurations are sketched, explained, and demonstrated, with flywheel diodes where appropriate.

Range evidence of two designs each for both BJTs and MOSFETs is required.

Outcome 3

Demonstrate fundamental knowledge of operational amplifiers and their applications.

Performance criteria

3.1 Function is described as electronic building blocks with examples of typical applications.

Range typical applications – audio pre-amplifier, transducer signal amplifier, buffer.

3.2 Parameters for an idealised and a typical practical operational amplifier are identified and compared.

Range parameters – differential gain, input impedance, output impedance, maximum output amplitude in relation to supply voltage, slew rate, bandwidth (3dB and unity gain), offset, common mode rejection.

3.3 Typical operational amplifier configurations are sketched and their practical operation and features explained.

Range configurations may include but are not limited to – voltage follower (unity gain buffer), inverting, non-inverting, inverting summing, differential, differentiator, integrator, comparator, voltage to current converter, current to voltage converter.
Evidence of four configurations is required.

3.4 The operation and application of an instrumentation amplifier as a transducer signal amplifier is explained.

Outcome 4

Demonstrate fundamental knowledge of d.c. power supplies and electronic regulators.

Performance criteria

4.1 The operation of half-wave and full-wave rectification for d.c. power supplies is explained.

Range single and bridge, simple capacitor filter.

4.2 The use of a Zener diode as a shunt regulator is described and evaluated.

Range calculation of series resistor for varying loads only.

4.3 Three-terminal series regulators are explained, and typical circuits based on manufacturers' data sheets are analysed and experimentally evaluated.

4.4 The operation of one three-terminal series regulator circuit configuration based on manufacturers' data sheets is demonstrated.

Range drop-out voltage, line regulation, load regulation, maximum output current, maximum power dissipation.

4.5 The concepts, operation, and application of switching regulators are explained and one step-up or one step-down switching regulator configuration is demonstrated.

This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	24 November 2003	31 December 2011
Rollover and Revision	2	22 August 2008	31 December 2012
Review	3	21 July 2011	31 December 2024
Review	4	25 May 2023	31 December 2024

Consent and Moderation Requirements (CMR) reference	0003
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.