Title	**Demonstrate and apply fundamental knowledge of d.c. principles for electronics technicians**		
Level	**3**	**Credits**	**7**

Purpose	This unit standard covers an introduction to direct current principles for electronics technicians. People credited with this unit standard are able to: – demonstrate fundamental knowledge of electrical concepts; – calculate current, voltage, resistance, and power in electric circuits; – demonstrate fundamental knowledge of resistance; – demonstrate fundamental knowledge of practical linear and non-linear resistors; – demonstrate fundamental knowledge of resistive voltage dividers; – demonstrate fundamental knowledge of e.m.f. production; – demonstrate fundamental knowledge of magnetism; and – apply fundamental d.c. principles to a given electronics application.

Classification	Electronic Engineering > Core Electronics

Available grade	Achieved

Guidance Information

1 This unit standard has been developed for learning and assessment off-job.

2 References
Electricity Act 1992;
Electricity (Safety) Regulations 2010;
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.
d.c. – direct current.
e.m.f. – electromotive force.
Simple terms – for the purposes of this unit standard means a non-mathematical treatment generally employing block diagrams identifying key points.
LDR – light dependent resistor.
NTC – negative temperature co-efficient.

PCB – printed circuit board.
PTC – positive temperature co-efficient.
VDR – voltage dependent resistor.

4 Range
a All measurements are to be expressed in Système Internationale (SI) units and multipliers.
b Candidates are expected to have memorised and to be able to use power of ten multipliers and their SI prefixes and abbreviations from pico (10^{-12}) to giga (10^{9}).
c Candidates are expected to have memorised and to be able to use the following laws:
I = q/t;
V = W/q;
V = IR;
$P = I^2R$;
Kirchhoff's first and second laws (sum of currents at a point = 0; sum of voltage changes around a circuit = 0);
Faraday's law; and
Lenz's law.
d Use of non-programmable calculators is permitted during assessments.

Outcomes and performance criteria

Outcome 1

Demonstrate fundamental knowledge of electrical concepts.

Performance criteria

1.1 Electric charge is explained in terms of electrons and examples of charged bodies are given.

1.2 Electric current is defined in terms of electric charge and time, and the units stated.

Range I = Q/t.

1.3 Potential Difference (p.d.) or voltage is defined in terms of energy and charge, and the units stated.

Range V = W/Q.

1.4 Ohm's Law is stated with units, and the effect of a change in any one quantity on the other two is described.

Range V = IR.

1.5 Power is defined in terms of work done in unit time and in terms of heat dissipated in a resistance by a flow of current, and units are stated.

Range $P = W/t = I^2R = IV = V^2/R$.

1.6 The difference between electromotive force and voltage drop is explained.

1.7 Conventional and electronic directions of current flow are explained.

1.8 Kirchhoff's first and second laws are explained.

Outcome 2

Calculate current, voltage, resistance, and power in electric circuits.

Range electric circuits – one battery with internal resistance, and five resistances in any combination.

Performance criteria

2.1 Using Ohm's and Kirchhoff's laws, current at any point and voltage across any two points are calculated.

2.2 Combined resistances of series, parallel, and series-parallel connections are calculated.

2.3 Power dissipation is calculated for individual resistances and for a complete circuit.

Outcome 3

Demonstrate fundamental knowledge of resistance.

Performance criteria

3.1 The electrical behaviour of conducting, semiconducting (both p-type and n-type), and insulating materials is explained in terms of atomic structure, and with reference to the effect of temperature.

3.2 Resistivity is defined and units stated.

Range $\rho = RA/l$;
units – Ωm, μΩm, or nΩm.

3.3 Practical problems involving resistivity, conductor length, diameter or cross section, and voltage drop are solved for cable or PCB track, ignoring temperature effects.

3.4 The operation of a strain gauge is described in simple terms.

Range single gauge only.

3.5 Temperature coefficient of resistance is defined and units stated.

Range $T_t = R_0(1+\alpha_0 t)$.

3.6 Practical problems involving resistance, temperature, and temperature coefficient of resistance are solved.

Range typical examples – PT100 platinum wire temperature sensing device, change of resistance with temperature of motor windings.

Outcome 4

Demonstrate fundamental knowledge of practical linear and non-linear resistors.

Performance criteria

4.1 The meanings of the terms *tolerance, preferred values, stability, power rating, power dissipation, voltage rating,* and *current rating*, as used in connection with resistors, are stated.

4.2 Resistor markings relating to resistance, rating, and tolerance are interpreted.

Range evidence of three different linear resistors is required. Use of resistor colour code chart is permitted.

4.3 Linear and non-linear resistors are briefly described with reference to operating characteristics, symbols, connections, and applications.

Range linear resistors may include – carbon, metal film, thick and thin film, wire-wound, slider potentiometer, rotary carbon potentiometer, rotary rheostat;
non-linear resistors may include – NTC thermistor, PTC thermistor, VDR, LDR;
evidence of two linear resistors and two non-linear resistors is required.

Outcome 5

Demonstrate fundamental knowledge of resistive voltage dividers.

Performance criteria

5.1 Given voltage divider circuits, with and without resistive loads, are analysed to determine open circuit voltage and voltage across load.

5.2 A voltage divider is designed for a specified output voltage using given input voltage and load resistance values. Preferred resistor values are to be used.

Outcome 6

Demonstrate fundamental knowledge of e.m.f. production.

Range chemical, magnetic, friction, piezo-electric, photo-electric, thermocouple.

Performance criteria

6.1 Methods of producing an e.m.f. are described in simple terms with reference to how it is achieved and the relative magnitude of the voltage produced.

6.2 An example of a common device using each method of generation is stated.

Outcome 7

Demonstrate fundamental knowledge of magnetism.

Performance criteria

7.1 Magnetic terms are explained in relation to permanent magnets.

Range permanent magnet, magnetic field, lines of force, magnetic poles, magnetic flux, flux density.

7.2 The direction of the magnetic field surrounding a current carrying wire is determined using any popular rule, such as the right-hand screw rule.

7.3 The construction of an electromagnet is described with the aid of a sketch indicating current direction and magnet polarity.

7.4 The direction of the force exerted on a current carrying conductor in a magnetic field is determined using Fleming's left-hand rule.

7.5 The operation of a simple motor is explained with the aid of a sketch showing direction of current and polarity of the magnet.

Range simple motor – permanent magnet, single loop of wire, two-segment commutator, brush.

7.6 Faraday’s and Lenz’s laws relating to electromagnetic induction are stated.

7.7 The transformer principle is explained in terms of induced e.m.f. resulting from changing flux between two coils.

7.8 The induction of an e.m.f. in a conductor being moved in a magnetic field is demonstrated using Fleming's right-hand rule.

7.9 The operation of a simple d.c. generator is explained with the aid of a sketch.

Range simple d.c. generator – permanent magnet, single loop of wire, two-segment commutator, brush.

7.10 Devices using electromagnetic and magnetic properties are described in simple terms.

Range any two of – loudspeaker, relay, electric bell, moving coil instrument, lifting magnet, electric door lock.

Outcome 8

Apply fundamental d.c. principles to a given electronics application.

Range application must relate to the preceding outcomes, and may include but is not limited to – circuit construction, experiment, fault finding, or project.

Performance criteria

8.1 The application demonstrates use of instruments, tests, and experimental procedure.

8.2 The application demonstrates analysis of measurements and observations.

8.3 Purpose, method, observations, measurements, and conclusions are recorded in accordance with a given format.

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 2012
Review	2	21 July 2011	31 December 2024
Review	3	25 May 2023	31 December 2024

Consent and Moderation Requirements (CMR) reference	0003

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