

Title	Demonstrate and apply knowledge of radio communications for electronics technicians		
Level	4	Credits	15

Purpose	<p>This unit standard covers radio communications theory for electronics technicians.</p> <p>People credited with this unit standard are able to:</p> <ul style="list-style-type: none"> - demonstrate knowledge of frequency and the electromagnetic spectrum; - demonstrate knowledge of electromagnetic propagation, RF transmission lines, and aerials; - demonstrate knowledge of modulation and noise; - demonstrate knowledge of AM and SSB receiver principles; - demonstrate knowledge of FM receiver principles; - demonstrate knowledge of transmitter principles; - demonstrate knowledge of frequency synthesis; - demonstrate knowledge of basic concepts of communication systems; and - apply radio communications principles.
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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 at Work Act 2015 and associated regulations; and all subsequent amendments and replacements.

Kennedy, G.S. Davis, B. & Prasanna, S.R.M. (2011). *Kennedy's Electronic Communication Systems*. 5th edition. New Delhi, India: McGraw Hill.
- 3 Definitions

AGC – automatic gain control.

AM – amplitude modulation.

DSB – double sideband.

Electromagnetic spectrum – the range of frequencies of electromagnetic radiation from zero Hertz to infinity.

Enterprise practice – those practices and procedures that have been promulgated by the company or enterprise for use by their employees.

FM – frequency modulation.

IF – intermediate frequency.

Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.

ISB – independent sideband.

RF – radio frequency.

SSB – single sideband.

- 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 Mathematical proof of the subject matter covered by this unit standard is not required.
 - d All activities and evidence presented for all outcomes and evidence requirements 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 knowledge of frequency and the electromagnetic spectrum.

Performance criteria

- 1.1 The concepts of frequency, wave length, velocity, and amplitude of sine waves are explained, and wavelength is calculated from frequency and velocity.
- 1.2 The electromagnetic spectrum is described in terms of frequency bands, band characteristics, and typical usage.

Outcome 2

Demonstrate knowledge of electromagnetic propagation, RF transmission lines, and aerials.

Performance criteria

- 2.1 The properties and behaviour of electromagnetic waves are described.

Range wavelength and frequency ($\lambda = \frac{c}{f}$); propagation in terms of electrostatic and electromagnetic fields; inverse square law ($\rho = \frac{P}{4\pi r^2}$); reflection, refraction, and diffraction; ground, sky, and space wave propagation.

2.2 The properties and behaviour of transmission lines at RF are described.

Range transmission loss; velocity factor; characteristic impedance; standing waves; properties of open circuit, short circuit, and properly terminated lines; Balun circuit; directional coupler.

2.3 The construction and properties of commonly used aerials are described.

Range properties – voltage and current distribution, beam width, polarisation, gain; aerials may include – long wire; dipole; grounded quarter wave Marconi; directional, including folded dipole and Yagi; wideband including rhombic; high gain including hyperboloid and paraboloid; evidence of three aerials is required.

2.4 Methods of coupling the aerial impedance to a radio transmitter are described.

Range coupling methods may include – voltage and current fed, π -coupling and transmission line coupling, gamma matching; evidence of two methods is required.

Outcome 3

Demonstrate knowledge of modulation and noise.

Performance criteria

3.1 Double sideband amplitude modulation is described and frequency spectrum and waveforms are drawn from memory.

Range sidebands, percentage modulation, methods of achieving high and low level modulation.

3.2 DSB with suppressed carrier, SSB, and ISB are explained with the aid of frequency spectrum sketches, and their advantages over DSB with carrier are stated.

3.3 Frequency modulation is described with the aid of sketches showing frequency spectrum and waveforms.

Range frequency deviation, bandwidth.

3.4 The difference between phase and frequency modulation is explained.

3.5 The nature of noise and its measurement are described.

Range internal and external noise sources, signal to noise ratio, noise figure.

Outcome 4

Demonstrate knowledge of AM and SSB receiver principles.

Performance criteria

- 4.1 The operation of a super-heterodyne radio receiver is explained with the aid of a block diagram, drawn from memory, which depicts the major stages and functions.
- Range RF amplifier; tuning; IF stages; demodulation; audio stages with tone controls and speaker; simple and delayed AGC; automatic frequency control; reference to selectivity, tracking, stability.
- 4.2 The characteristics of inductance-capacitance filters, ceramic filters, and mechanical filters are compared.
- 4.3 The operation of a balanced demodulator circuit and the principle of carrier re-insertion are explained.
- 4.4 The operation of an SSB receiver is explained with the aid of a given block schematic.

Outcome 5

Demonstrate knowledge of FM receiver principles.

Performance criteria

- 5.1 The operation of an FM radio receiver is explained with the aid of a block diagram drawn from memory.
- 5.2 The operation of two types of FM demodulators is explained with reference to given circuit diagrams.
- 5.3 The purpose of pre-emphasis and de-emphasis is explained with reference to noise.

Outcome 6

Demonstrate knowledge of transmitter principles.

Performance criteria

- 6.1 The operation of balanced modulator circuits is described.
- 6.2 Two methods of suppressing the unwanted sideband are explained with the aid of given circuit diagrams.
- 6.3 The operation of an ISB transmitter is explained with the aid of a given block schematic.
- 6.4 The characteristics of RF power amplifiers are outlined, with reference to the causes of harmonic and inter-modulation distortion.

Outcome 7

Demonstrate knowledge of frequency synthesis.

Performance criteria

- 7.1 The use of a phase-locked loop to generate a range of frequencies with the same stability as a reference oscillator is described with the aid of a block diagram drawn from memory.
- 7.2 The use of multipliers, dividers, mixers, and filters to generate a range of frequencies with the same stability as a reference oscillator is described with the aid of a block diagram drawn from memory.

Outcome 8

Demonstrate knowledge of basic concepts of communication systems.

Performance criteria

- 8.1 Concepts underlying modern communication systems are described.
- Range redundancy; error detection and correction; sampling theorem; frequency and phase shift keying; pulse width and pulse position modulation; simplex, duplex, and full duplex operation; modem; pulse code modulation.
- 8.2 The basic principles of a frequency division multiplex system are described with the aid of a block diagram drawn from memory.
- 8.3 The basic principles of a time division multiplex system are described with the aid of a block diagram drawn from memory.

Outcome 9

Apply radio communications principles.

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

Performance criteria

- 9.1 The use of instruments, tests, and experimental procedure is demonstrated.
- 9.2 The analysis of measurements and observations is demonstrated.
- 9.3 Purpose, method, observations, measurements, and conclusions are recorded in accordance with a given format.

Planned review date	31 December 2028
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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 2027
Review	3	24 August 2023	N/A

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>.

Comments on this unit standard

Please contact Waihanga Ara Rau Construction and Infrastructure Workforce Development Council qualifications@waihangaararau.nz if you wish to suggest changes to the content of this unit standard.