

Title	Demonstrate knowledge of radar principles for electronics technicians		
Level	4	Credits	15

Purpose	<p>This unit standard covers radar theory for electronics technicians.</p> <p>People credited with this unit standard are able to demonstrate knowledge of:</p> <ul style="list-style-type: none"> – electromagnetic propagation relevant to radar systems; – radar fundamentals; – radar antennae and waveguides; – microwave technology relevant to radar systems; – radar systems technology; and – radar performance.
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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 Reference
Health and Safety in Employment Act 1992 and associated regulations;
Kennedy, George S. and Davis, Bernard. (1992). *Electronic Communication Systems*. 4th edition. Lake Forest, Illinois: Glencoe. ISBN: 0028005929; and all subsequent amendments and replacements.
- 3 Definitions
AFC – automatic frequency control.
BARITT – barrier injection transit time diode.
GaAsFET – gallium arsenide field effect transistor.
Enterprise practice – those practices and procedures that have been promulgated by the company or enterprise for use by their employees.
IF – intermediate frequency.
IMPATT – impact plasma avalanche transit time diode.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
LASER – light amplification by stimulated emission of radiation.
MASER – microwave amplification by stimulated emission of radiation.
PIN – positive intrinsic negative diode.
TRAPATT – trapped plasma avalanche transit time diode.

- 4 Range
- All measurements are to be expressed in Système Internationale (SI) units and multipliers.
 - 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 knowledge of electromagnetic propagation relevant to radar systems.

Performance criteria

- 1.1 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 ($\rho = \frac{P_t}{4\pi r^2}$); reflection, refraction, and diffraction; ground, sky, and space wave propagation; effect of the Earth's curvature on optical and radar horizons; detection range.

- 1.2 Environmental factors impacting on radio wave propagation are identified and their influence on optical horizon, radar horizon, and detection range are stated.

Range environmental factors – reflection, refraction, diffraction, Earth's curvature.

Outcome 2

Demonstrate knowledge of radar fundamentals.

Performance criteria

- 2.1 The operation of a basic radar system is explained with reference to its basic functional sub-systems.

Range sub-systems – power supply, aerial, receiver, transmit-receive switch, transmitter.

- 2.2 The differences between continuous wave, Doppler, and pulse Doppler transmissions are explained and the concept of pulse compression is outlined.

- 2.3 The hazards associated with work on radar equipment are identified and their management is described.

Outcome 3

Demonstrate knowledge of radar antennae and waveguides.

Performance criteria

- 3.1 The characteristics of cosecant squared and parabolic reflector antennae are described.
- Range beam width, gain, coupling, frequency of operation, bandwidth.
- 3.2 Hydraulic and electrical systems for antenna rotation and stabilisation, and the generation of bearing information are outlined.
- 3.3 Propagation of an electromagnetic wave in a waveguide is explained with reference to waveguide dimensions and cut-off frequency.
- 3.4 Practical methods of waveguide configuration, impedance matching, tuning, and attenuating are described.
- 3.5 Wave guide handling requirements are identified.
- Range mechanical distortion, exclusion of dirt, pressurisation.

Outcome 4

Demonstrate knowledge of microwave technology relevant to radar systems.

Performance criteria

- 4.1 Characteristics, handling requirements, and typical applications of microwave semiconductor devices are described.
- Range GaAsFET, step recovery diode, negative resistance diodes (for example Gunn, IMPATT, TRAPATT, BARITT, tunnel diodes), PIN diode, Schottky diode, backward diode, MASER, LASER; evidence of five devices is required.
- 4.2 Purpose and operation of klystrons, magnetrons, and travelling wave tubes are explained.
- 4.3 Concepts of microwave transmission and reception relevant to radar systems are explained from an operational viewpoint.
- Range generation of transmitter frequencies; pulse-forming networks; modulators and sub-modulators; pulse compression; anti-clutter; isolators; circulators; Faraday rotation; transmit/receive switches; magic tee; hybrid ring; use of diodes for detection and mixing.

Outcome 5

Demonstrate knowledge of radar systems technology.

Performance criteria

5.1 Purpose and operation of radar system components are explained.

Range may include – AFC, duplexers and receiver protectors, IF stages, linear amplification, logarithmic amplification, low noise amplifiers, mixers, automatic detection and tracking system, video generation; evidence of four is required.

5.2 Concepts of radar systems technology are explained from an operational point of view.

Range may include – moving target indication, clutter maps, blind speeds, constant false alarm rate, velocity and range ambiguities, use of correlation and signal processing; evidence of three is required.

Outcome 6

Demonstrate knowledge of radar performance.

Performance criteria

6.1 The relationship between peak and average power output of a radar transmitter is explained.

6.2 The nature of index error and its measurement are explained.

6.3 The nature of radar receiver noise and the noise figure are explained.

6.4 The effects of radar system parameters on radar performance are identified.

Range minimum detectable signal on radar range; pulse repetition frequency on range and range ambiguity; pulse length on range discrimination.

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	26 July 2004	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>.