

Title	Demonstrate knowledge of data communications in power engineering		
Level	5	Credits	15

Purpose	<p>People credited with this unit standard are able to, in the electricity supply industry, demonstrate knowledge of:</p> <ul style="list-style-type: none"> • the concepts and applications of common wired and wireless telecommunication systems, • the concepts, characteristics, and applications of transmissions lines, • digital and analogue modulation and multiplexing methods and compression processes used in telecommunication systems, • the source, effect, and reduction of noise in wired and wireless telecommunication systems, • radio data communication systems, and • safety relating to high frequency radio systems, testing and operation of radio systems. <p>This standard provides electricity supply industry power technicians with the fundamental knowledge of power protection and control network theory, and hardware.</p>
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Classification	Electricity Supply > Electricity Supply - Power System Maintenance
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Available grade	Achieved
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Guidance Information

1 Definitions

Asset owner refers to the owner of an electricity supply network that takes its point of supply from Transpower NZ or other local reticulation systems, and delivers electricity to industrial, commercial and residential customers.

LAN – local area network.

WAN – wide area network.

TDR – time-domain reflectometer.

SINAD – signal-to-noise and distortion.

DSP – digital signal processing.

SAW – surface acoustic wave.

VSB – vestigial sideband.

AM – amplitude modulation.

FM – frequency modulation.

PM – phase modulation.

PAM – pulse amplitude modulation.

QPSK – quadrature phase shift keying.
QAM – quadrature amplitude modulation.
OFDM – orthogonal frequency division multiplexing.
DVB-T – Digital Video Broadcasting – Second Generation Terrestrial.
CDMA – code division multiple access.
RFI – radio frequency interference.
EMI – electromagnetic interference.
PCB – printed circuit board.
UTP – unshielded twisted pair.
TDR – time domain reflectometer.

- 2 It is recommended that 29743, *Demonstrate knowledge of electronics in power engineering* is assessed prior to assessment with this standard or equivalent knowledge and skills demonstrated.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of the concepts and applications of common wired and wireless telecommunication systems.

Performance criteria

- 1.1 The common topologies used for modern data industrial communication are explained.
- Range may include – LAN, WAN, cellular networks (2G/3G/4G), radio and satellite communication.
- 1.2 The structure of cellular networks is described and their services explained.
- 1.3 The structure of a wireless LAN is described and their services explained.

Outcome 2

Demonstrate knowledge of the concepts, characteristics, and applications of transmission lines.

Performance criteria

- 2.1 Types of transmission media are described.
- Range includes but is not limited to – UTP cable, fibre optic cable, coaxial cable, wireless.
- 2.2 Fundamental properties of transmission media are explained.
- Range includes but is not limited to – primary coefficients, impedance, attenuation, bandwidth, standing waves, power transfer, line matching, line termination.

- 2.3 The primary constants of a transmission line are defined, calculated and measured.
- Range R, L, G and C per unit length quantities are measured for various cable types.
- 2.4 The lumped component representation of a transmission line is drawn and explained for a T section representing a short line terminated in Z_0 .
- 2.5 The secondary constants of a transmission line are defined, calculated and measured.
- 2.6 Reflection of a pulse at a short- and open-circuit is explained in terms of polarity.
- Range application of TDR equipment to determine cable faults.
- 2.7 The formation of standing waves on a short- and open-circuited line is illustrated and explained.
- 2.8 The importance of impedance matching and mismatching is explained to reduce standing waves.
- 2.9 Factors affecting the performance of coaxial cable as a transmission line at radio frequencies are described.
- Range electrical length and physical length, dielectric and skin-effect losses.
- 2.10 The effect active and passive components and printed circuit board tracks have on transmission lines at RF frequencies is described.

Outcome 3

Demonstrate knowledge of digital and analogue modulation, multiplexing methods, and compression processes used in telecommunication systems.

Range may include – VSB, AM, FM, PM, PAM, QPSK, QAM, OFDM, DVB-T, CDMA.
Evidence of four methods is required.

Performance criteria

- 3.1 Principles of modulation, multiplexing and compression are described with the aid of circuit or block diagrams.
- 3.2 Digital modulation methods are compared with reference to differing applications and media.
- Range control and data information, error correction.

- 3.3 Digital and analogue modulation types are compared in terms of application in accordance with industry practice.
- 3.4 The reasons for digital modulation types used by data modems and digital radio systems are identified and explained.

Outcome 4

Demonstrate knowledge of the source, effect, and reduction of noise in wired and wireless telecommunication systems.

Performance criteria

- 4.1 The sources of noise and their effects on telecommunications data networks are explained.
- Range includes but is not limited to – thermal, nature, intermodulation, cross talk, switching transients, RFI/EMI radiation.
- 4.2 Noise reduction methods that are used in wired and wireless networks are described with the aid of diagrams.
- Range may include – suppressing noise at source, filtering of leads leaving noise source, twisting or shielding noisy conductors, surge damping of relay coils, limiting pulse rise times; eliminating coupling, separate grounds for signal and power, low impedance power distribution lines; reducing noise at receiver, selective filtering, power supply decoupling.
evidence of four is required.
- 4.3 Intermodulation noise as the result of system non-linearity is explained for an analogue system.

Outcome 5

Demonstrate knowledge of radio data communication systems.

Performance criteria

- 5.1 The engineering and design requirements of radio frequency subsystems are explained.
- Range transmitter, receiver, antenna.
- 5.2 Design considerations for radio systems are explained.
- Range includes but is not limited to – equipment, site, access, security, costs, antenna, distance.

- 5.3 The propagation of radio waves is explained.
- Range electromagnetic radiation, polarisation, the three modes (ground, surface, sky).
- 5.4 Measurements specific to radio system design are performed.
- Range may include – transmitter power, SINAD, field strength, antenna patterns.
evidence of two measurements required.
- 5.5 The principles of frequency synthesis are explained and demonstrated.
- Range phase-locked loop frequency synthesisers using one loop configuration.
- 5.6 The characteristics, design, and application of radio frequency amplifiers are explained.
- Range small signal wide bandwidth.
- 5.7 The characteristics of digital radio filters are explained and demonstrated with reference to single chip transceivers.
- Range includes but is not limited to – DSP, SAW.
- 5.8 The concepts of software radios are explained.
- 5.9 Single chip transceivers for wireless communication are investigated and explained.
- 5.10 Antennas used with single chip transceivers are investigated and polar plots produced.
- Range includes but is not limited to – whip, PCB stub, helical, chip.

Outcome 6

Demonstrate knowledge of safety relating to high frequency radio systems, testing and operation of radio systems.

Performance criteria

- 6.1 The dangers and safety requirements relating to high frequency radio systems are explained.
- 6.2 Common tests on transceivers used on telecommunication data network systems are described in terms of purpose and application.
- Range test instruments, manufacturers or asset owners test procedures.

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	20 July 2017	31 December 2024
Review	2	2 March 2023	31 December 2024

Consent and Moderation Requirements (CMR) reference

0120

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