



Australian Government

Department of Education, Employment and Workplace Relations

ICTRFN4095A Conduct radio frequency measurements

Release: 1

ICTRFN4095A Conduct radio frequency measurements

Modification History

Not Applicable

Unit Descriptor

Unit descriptor	This unit describes the performance outcomes, skills and knowledge required to conduct and analyse radio frequency (RF) measurements. No licensing, legislative, regulatory or certification requirements apply to this unit at the time of endorsement but users should confirm requirements with the relevant federal, state or territory authority.
------------------------	--

Application of the Unit

Application of the unit	Field staff who install, maintain, upgrade and commission telecommunications RF systems apply the skills and knowledge in this unit. Systems that use RF include satellite and microwave, radio or TV broadcasting, pay TV, free to air TV, radio frequency identification (RFID), mobile radio, cellular and worldwide interoperability for microwave access (WiMAX) networks.
--------------------------------	---

Licensing/Regulatory Information

Refer to Unit Descriptor

Pre-Requisites

Prerequisite units		

Employability Skills Information

Employability skills	This unit contains employability skills.
-----------------------------	--

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.
---	--

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Plan to conduct RF measurements	1.1. Arrange access to the site according to required procedure 1.2. Determine type of measurements required based on the industry environment 1.3. Assess the impact of conducting measurements on the network and advise customers and appropriate person accordingly 1.4. Assess previous measurement data if available
2. Conduct RF measurements	2.1. Check that prescribed safety arrangements associated with RF radiation are in place otherwise take corrective action 2.2. Monitor work activity to ensure it meets site specifications, and relevant legislation, codes, regulations and standards 2.3. Configure test equipment according to manufacturer's specifications 2.4. Conduct measurements according to planned requirements 2.5. Assess RF levels at occupational and non occupational distances 2.6. Record all measurements and test configurations
3. Analyse measurement outcomes	3.1. Verify measurements against relevant standards and vendor specifications 3.2. Assess problems and variance for corrective action and notify appropriate person according to enterprise procedures 3.3. Record processes and recommendations
4. Document measurement results	4.1. Complete customer documentations 4.2. Notify customer to obtain sign off

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

REQUIRED SKILLS AND KNOWLEDGE

- analytical skills to review and evaluate measurements
- communication skills to provide advice and guidance to others or to seek assistance
- literacy skills to interpret technical documentation
- numeracy skills to check that equipment is calibrated, to take RF measurements, interpret results and evaluate different types of technical data
- planning and organisational skills to organise and prepare for measurements
- problem solving skills to minimise measurement errors
- task management skills to work logically and systematically with required attention to detail when following complex test procedures
- technical skills to:
 - operate a range of specialised radio frequency test equipment and
 - perform diagnostic procedures
 - use hand and power tools

Required knowledge

- detailed knowledge of:
 - analog and digital modulation methods
 - logarithmic units
 - standard test procedures and test setups
 - transmitter and receiver architectures
- RF:
 - instrument and features and types
 - radiation hazards
 - safety practices

Evidence Guide

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

Overview of assessment

Critical aspects for assessment and evidence required to demonstrate competency in this unit

Evidence of the ability to:

- plan and conduct RF test using RF test equipment and instruments
- measure, record and interpret test results
- monitor work to meet related OHS requirements and work practices.

Context of and specific resources for assessment

Assessment must ensure:

- site for RF measurements
- a range of test equipment and items to test
- relevant regulatory and equipment documentation that impact on work activities.

Method of assessment

A range of assessment methods should be used to assess practical skills and knowledge. the following examples are appropriate for this unit:

- direct observation of the candidate setting up equipment and performing RF measurements
- review report of RF measurements prepared by candidate
- oral or written questioning of the candidate to support the above measurement results
- candidate report on findings and making recommendations.

Guidance information for assessment

Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended, for example:

- ICTRFN4158A Select an antenna system for radio communications
- ICTRFN4159A Identify and test cellular network equipment
- ICTRFN4174A Undertake radio communications signals monitoring
- ICTRFN4177A Install radio communications base station equipment

EVIDENCE GUIDE

- ICTRFN4178A Maintain hybrid fibre coaxial broadband cable network
- ICTTEN4202A Install and test an radio frequency identification system
- ICTRFN3175A Operate and maintain radio communications technical instruments and field equipment
- ICTCMP5176A Undertake radio communications site audit.

Aboriginal people and other people from a non-English speaking background may have second language issues.

Access must be provided to appropriate learning and assessment support when required.

Assessment processes and techniques must be culturally appropriate, and appropriate to the oral communication skill level, and language and literacy capacity of the candidate and the work being performed.

In all cases where practical assessment is used it will be combined with targeted questioning to assess required knowledge. Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

Where applicable, physical resources should include equipment modified for people with special needs.

Range Statement**RANGE STATEMENT**

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating

RANGE STATEMENT

conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Measurements may relate to:

- antenna
 - bandwidth
 - beamwidth
 - impedance
 - radiation pattern
 - return loss
- bit error rate (BER) as a function of received signal level (RSL)
- carrier to noise ratio
- electric field strength
- electromagnetic interference (EMI) and electromagnetic compatibility (EMC) measurements:
 - conducted
 - radiated
- impedance
- modulation error rate (MER)
- receiver:
 - 20 dB quieting
 - blocking
 - cross modulation
 - image frequency
 - intermodulation
 - sensitivity
 - SINAD
 - total harmonic distortion
- RF amplifier:
 - gain
 - stability of RF amplifier when
 - operating at 10% higher or lower supply voltage
 - operating at extreme humidity
 - operating at extreme temperatures
 - operating into a complex load impedance
 - noise figure
- RF hazard measurements:

RANGE STATEMENT

	• non-occupational worker • occupational worker • RF measurements on passive devices: • return loss • S parameters • transmission loss • spectrum surveillance • sweep measurements • transmission line measurements • transmitter: • adjacent channel power • carrier frequency • carrier frequency stability • carrier power level • deviation limiting • frequency deviation • harmonic power level • modulation depth • modulation response • occupied bandwidth • out of band spurious emissions • phase deviation • phase noise • spectrum mask • transient frequency behaviour • two-tone intermodulation distortion • unwanted spurious emissions.
Industry environment may include:	• aeronautical • aerospace • broadcasting: • AM in MW band • analog • cable • digital DAB+ • digital DRM • digital DVB • FM stereo in VHF band • global positioning system (GPS)

RANGE STATEMENT	
	• short wave (HF) • low power open narrowcasting (LPON) • radio • satellite • television • Bluetooth • cellular mobile telephony • fixed service • industrial and scientific • land mobile • licence-free ISM • marine • medical • microwave point to point • radio paging systems • RFID • WiMAX IEEE 802.16 • WiFi IEEE 802.11 • ZigBee IEEE 802.15.4-2003.
<i>Appropriate person</i> may include:	• ACMA representative • consultant • engineer • supervisor.
<i>Measurement data</i> may include:	• date • time • location • test configuration • measurement results • test equipment: • manufacturer • model • serial number.
<i>Relevant legislation, codes, regulations and standards</i> may include:	• Australian Communications Industry Forum (ACIF) standards and codes • Australian Communications and Media Authority (ACMA) technical standards • Australian Radiation Protection and Nuclear Safety Agency (ARPANSA (EMR) standard • AS/NZS 4268:2008 • AS/NZS 4295:2004

RANGE STATEMENT

	• AS/NZS 4415.1:2003 • AS/NZS 4582:1999 • AS/NZS 4583:1999 • AS/NZS 4769.1:2000 • AS/NZS 4770:2000 • Australian building codes and regulations • Australian standards • enterprise standards • environmental protection • equipment standards • European Telecommunications Standards Institute (ETSI) EN 300 220-1 Year? • ETSI EN 301 406 Year? • fire regulations • heritage legislation • international standards • intrinsically safe lightning protection • local government • OHS • Radcoms Act • RSS-119 • site engineering standards • spectrum planning reports • Telecommunications Act • Telecommunications Industry Alliance and Electronic Industries Alliance (TIA/EIA) standards.
Test equipment may include:	• antenna analyser • BER tester • cellular radio test set • constellation analysers • digital signal level meter • digital transmission analyser • directional RF power meter • dummy load • termination • EMI test receiver • frequency counter • multimeter • noise and distortion meter

RANGE STATEMENT

	• oscilloscope • RF connectors and adaptors • RF test cables • return loss measuring equipment • RF power meter • RF radiation meter • RF scalar network analyser • RF termination • RF vector network analyser • spectrum analyser • switched or variable attenuator.
--	--

Unit Sector(s)

Unit sector	Telecommunications
--------------------	--------------------

Co-requisite units

Co-requisite units	

Competency field

Competency field	Radio frequency networks
-------------------------	--------------------------