e-Quals Unit Syllabus

Level 3 Test and Measurement (7267-524)

www.cityandguilds.com/ivqit
January 2010
Version 1.0

About City & Guilds

City & Guilds is the UK's leading provider of vocational qualifications, offering over 500 awards across a wide range of industries, and progressing from entry level to the highest levels of professional achievement. With over 8500 centres in 100 countries, City & Guilds is recognised by employers worldwide for providing qualifications that offer proof of the skills they need to get the job done.

City & Guilds Group

The City & Guilds Group includes City & Guilds, ILM (the Institute of Leadership & Management) which provides management qualifications, learning materials and membership services, NPTC which offers land-based qualifications and membership services, and HAB (the Hospitality Awarding Body). City & Guilds also manages the Engineering Council Examinations on behalf of the Engineering Council.

Equal opportunities

City & Guilds fully supports the principle of equal opportunities and we are committed to satisfying this principle in all our activities and published material. A copy of our equal opportunities policy statement *Access to assessment and qualifications* is available on the City & Guilds website.

Copyright

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute 2007 and may not be copied, reproduced or distributed without prior written consent.

However, approved City & Guilds centres and learners studying for City & Guilds qualifications may photocopy this document free of charge and/or include a locked PDF version of it on centre intranets on the following conditions:

- centre staff may copy the material only for the purpose of teaching learners working towards a City & Guilds qualification, or for internal administration purposes
- learners may copy the material only for their own use when working towards a City & Guilds qualification
- the *Standard Copying Conditions* on the City & Guilds website.

Please note: National Occupational Standards are not © The City and Guilds of London Institute. Please check the conditions upon which they may be copied with the relevant Sector Skills Council.

Publications

City & Guilds publications are available on the City & Guilds website or from our Publications Sales department at the address below or by telephoning +44 (0)20 7294 2850 or faxing +44 (0)20 7294 3387.

Every effort has been made to ensure that the information contained in this publication is true and correct at the time of going to press. However, City & Guilds' products and services are subject to continuous development and improvement and the right is reserved to change products and services from time to time. City & Guilds cannot accept liability for loss or damage arising from the use of information in this publication.

City & Guilds
1 Giltspur Street
London EC1A 9DD
T +44 (0)20 7294 2885
F +44 (0)20 7294 2405
www.cityandguilds.com
centresupport@cityandguilds.com

Contents

Unit 524	**Test and Measurement**	**2**
Outcome 1	Demonstrate an understanding of analogue and digital meters	3
Outcome 2	Demonstrate an understanding of oscilloscopes and their uses	5
Outcome 3	Demonstrate an understanding of test and measurement instruments for components and signals	6
Outcome 4	Demonstrate an understanding of the role of the PC in test and measurement	7
Outcome 5	Demonstrate an understanding of equipment reliability and surface mount repair	8
Outcome 6	Demonstrate an understanding of safety testing and electromagnetic compatibility	10
Unit record sheet		**11**

Unit 524 Test and Measurement

Rationale

This unit concerns the operating principles of electronic instruments, techniques of measurement, aspects of reliability and SMT.

Learning outcomes

There are **six** performance outcomes for this unit. The candidate will be able to demonstrate an understanding of:

- analogue and digital meters
- oscilloscopes and their uses
- test and measurement instruments for components and signals
- the role of the PC in test and measurement
- equipment reliability and surface mount repair
- safety testing and electromagnetic compatibility.

Assessment and grading

Assessment will be by means of a **set assignment** covering both practical activities and underpinning knowledge.

Unit 524 Test and Measurement

Outcome 1 Demonstrate an understanding of analogue and digital meters

Practical activities

The candidate will be able to:

1 select suitable shunts and multipliers to extend the range of analogue and digital panel meters

2 use a digital multimeter for measurement of current, voltage and resistance

Underpinning knowledge

The candidate will be able to:

1 a define accuracy, resolution and linearity

b state calibration requirements

c describe analogue and digital panel meters

d explain shunts and multipliers for analogue and digital instruments

e specify adaptation of panel meters for a.c., including the use of a current transformer

2 a explain analogue and digital multimeters

i. circuit features for switched ranges.

ii. block diagrams

iii. frequency limitations

b define multimeter facilities

i. auto range

ii. capture of readings

iii. peak readings

iv. clamp current adaptor for a.c.

v. overload protection

vi. RS232 data transfer

c describe

i. the concept of true rms

ii. how rms value varies with waveshape

iii. input impedance

iv. instrument loading

3 explain:

i. the advantages of logarithmic units when dealing with large ranges of numbers

ii. logarithmic frequency scales

iii. the definition of Bel, decibel and dBm

4 describe the need for and the function of instrument buses

i. I EEE488

ii. RS 232

Unit 524 Test and Measurement

Outcome 2 Demonstrate an understanding of oscilloscopes and their uses

Practical activities

The candidate will be able to use:

1 an analogue oscilloscope in different modes

2 a digital real time oscilloscope

3 a digital storage oscilloscope

Underpinning knowledge

The candidate will be able to:

1 a describe the use and function of an analogue oscilloscope

i. its circuit features

ii. distinguish between dual trace and dual beam operation

b describe the use of oscilloscope features

i. a.c./d.c. coupling

ii. triggering employed by a general purpose oscilloscope

iii. input impedance

iv. high impedance probes

v. frequency response

vi. phase measurement

vii. internal calibration facilities

2 describe the use and function of a digital oscilloscope with respect to

i. real time

ii. digital storage

3 state the benefits and limitations of analogue and digital oscilloscopes.

Unit 524 Test and Measurement

Outcome 3 Demonstrate an understanding of test and measurement instruments for components and signals

Practical activities

The candidate will be able to:

1 use electronic instruments for component testing

2 use electronic instruments to make measurements on a prepared circuit

3 use electronic instruments as signal sources for prepared circuits

4 make dB measurements using an intelligent digital multimeter

Underpinning knowledge

The candidate will be able to:

1 describe

- i. BJT and FET testing using analogue and digital multimeters
- ii. transistor testing
- iii. component testing for L, C and R
- iv. the bridge concept

2 interpret block diagrams and recognise circuit features of a

- i. digital counter/timer
- ii. frequency counter
- iii. l.f. signal generator
- iv. function generator with sweep facility
- v. pulse generator

3 explain measurement of

- i. power gain or loss in db
- ii. voltage and current gain or loss in dB
- iii. the signal to noise ration in dB

Unit 524 Test and Measurement

Outcome 4 Demonstrate an understanding of the role of the PC in test and measurement

Practical activities

The candidate will be able to use:

1 a PC to access technical information from several sources

2 PC-based virtual instruments to make measurements on a prepared circuit

Underpinning knowledge

The candidate will be able to:

1 explain the use of a PC in a servicing environment to provide

- i. diagnostic information
- ii. technical information from CD ROMS
- iii. data from websites

2 describe the use and function of a PC to provide virtual instrumentation as a

- i. digital multimeter
- ii. oscilloscope
- iii. spectrum analyser

Unit 524 Test and Measurement

Outcome 5 Demonstrate an understanding of equipment reliability and surface mount repair

Practical activities

The candidate will be able to:

1 specify a soak test rack for electronic instruments

2 use anti-static measures when dismantling equipment

3 undertake the construction and repair of a simple surface mount assembly.

Underpinning knowledge

The candidate will be able to:

1
- a define reliability
- b state the importance of high reliability in systems
- c describe the reliability bathtub diagram
- d explain methods for soak testing electronic equipment after assembly and repair
- e describe the effect on reliability of
  - i. de-rating components
  - ii. ambient temperature and humidity
- f state the importance of reporting failures

2 describe anti-static handling and precautions

3
- a explain how surface mount technology is used to construct electronic circuits on printed circuit boards
  - i. use of adhesives for placement
  - ii. use of solder creams
  - iii. advantages of SMT
- b describe surface mount passive component packages
  - i. resistors (tolerance and power rating)
  - ii. capacitors (values tolerances and working voltages)
  - iii. inductors (values and tolerances)
  - iv. transformers (frequency range)
- c describe surface mount active device packages
  - i. discrete semiconductor SOT packages
  - ii. SO packages (also used for passive networks)

iii. SOL packages

iv. plastic quad flat packages

d describe repair techniques for SMT using

i. discrete semiconductor SOT packages

ii. SO packages (also used for passive networks)

Unit 524 Test and Measurement

Outcome 6 Demonstrate an understanding of safety testing and electromagnetic compatibility

Practical activities

The candidate will be able to use instruments to measure:

1 earth loop impedance and mains polarity

2 protective conductor resistance (earth bond test)

3 insulation resistance.

Underpinning knowledge

The candidate will be able to:

1 a explain the following in the context of PAT testing

- i. the difference between insulation Classes 1 and 2
- ii. Class 1 and 2 insulation resistance testing
- iii. protective conductor resistance (earth bond test)
- iv. earth loop impedance and mains polarity
- v. legal requirements
- vi. CE marking

b explain in an emc context the importance of

- i. lead dressing
- ii. mains plug filters
- iii. shielding equipment
- iv. mains connectors

c describe the low voltage directive LVD EN 600065 EN 60950

2 state the importance of COSHH information for

- i. contact cleaners
- ii. solvent cleaners
- iii. adhesives
- iv. sealants

Unit record sheet

Use this form to track your progress through this unit.

Tick the boxes when you have covered each outcome. When they are all ticked, you are ready to be assessed.

Outcome	✓	Date
1 Demonstrate an understanding of analogue and digital meters	☐	
2 Demonstrate an understanding of oscilloscopes and their uses	☐	
3 Demonstrate an understanding of test and measurement instruments for components and signals	☐	
4 Demonstrate an understanding of the role of the PC in test and measurement	☐	
5 Demonstrate an understanding of equipment reliability and surface mount repair	☐	
6 Demonstrate an understanding of safety testing and electromagnetic compatibility	☐	

Candidate Signature ..... **Date** .....

City & Guilds Registration Number .....

Quality nominee (if sampled) ..... **Date** .....

Assessor Signature ..... **Date** .....

External Verifier Signature (if sampled) ..... **Date** .....

Centre Name ..... **Centre Number** .....

Published by City & Guilds
1 Giltspur Street
London
EC1A 9DD
T +44 (0)20 7294 2468
F +44 (0)20 7294 2400
www.cityandguilds.com
www.cityandguilds.com/ivqit

City & Guilds is a registered charity established to promote education and training