Unit 036  Assembling and testing electronic circuits

Level: 2  
Credit value: 14  
NDAQ number: 500/9514/6

Unit aim
This unit covers the skills and knowledge needed to prove the competences required to assemble and test electronic circuits. It will prepare the learner for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or it will provide a basis for the development of additional skills and occupational competences in the working environment.

The activities will include the assembly of a range of electronic components such as resistors (fixed and variable), capacitors (fixed and variable), diodes, transistors and other semiconductor devices, integrated circuits (analogue and digital), miniature transformers, switches, indicators, wire links and a range of connectors, spacers and brackets to form various types of circuits. This will involve using a range of tools and equipment along with soldering techniques and anti-static protection techniques.

The assembly activities will include making all necessary checks and adjustments to the circuits, including continuity checks, voltage and resistance values, waveform and ensuring that the circuit functions to the specification.

The learner’s responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the electronic assembly activities undertaken. The learner will need to take account of any potential difficulties or problems that may arise with the assembly and wiring activities, or with the tools and equipment used, and to seek appropriate help and advice in determining and implementing a suitable solution. The learner will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner’s knowledge will provide an understanding of their work, and will enable them to apply appropriate electronic assembly, wiring and testing procedures and techniques safely. The learner will understand the assembly methods and procedures used, and their application, and will know about the various components used to produce the circuits, to the required depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when carrying out the electronic component assembly activities, and with using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.
Learning outcomes
There are two learning outcomes to this unit. The learner will be able to:
1. Assemble and test electronic circuits
2. Know how to assemble and test electronic circuits

Guided learning hours
It is recommended that 64 hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit has been derived from national occupational standard Performing Engineering Operations Unit No. 36: Assembling and testing electronic circuits (Suite 2)

Support of the unit by a sector or other appropriate body
This unit is endorsed by Semta.

Assessment
This unit must be assessed in a work environment and must be assessed in accordance with the ‘Common Requirements for National Vocational Qualifications (NVQ) in the QCF’ which can be downloaded from Semta’s website: http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta’s Performing Engineering Operations Level 2 unit assessment strategy which can be downloaded from Semta’s website: http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx

Unit specific additional assessment requirements:
In order to prove their ability to combine different electronic assembly and testing activities, at least one of the electronic assemblies produced must be of a significant nature, and must contain a minimum of ten of the components listed in assessment criteria 1.10.
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Outcome 1  Assemble and test electronic circuits

Assessment Criteria

Practical skills
The learner will be able to:
1. work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
2. carry out all of the following during the electronic assembly and testing activities:
   - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
   - follow job instructions, assembly drawings and test procedures at all times
   - ensure that the components are free from damage, dirt or other contamination
   - prepare the electronic components for the assembly operations (such as pre-forming pins)
   - use safe and approved techniques to mount the electronic components on the circuit boards
   - check that the tools and test instruments are within calibration date and are in a safe and usable condition
   - where appropriate, apply procedures and precautions to eliminate electrostatic discharge (ESD) hazards (such as the use of grounded wrist straps)
   - follow clean work area protocols, where appropriate
   - return all tools and equipment to the correct location on completion of the assembly activities
3. assemble one of the following circuit types:
   - single-sided circuit
   - flexible circuit
   - thick film circuit
   - double-sided circuit
   - thin film circuit
   - hybrid circuit
4. plan the electronic assembly, wiring and testing activities before they start them
5. use appropriate sources to obtain the required specifications, circuit diagrams, component assembly and test information
6. obtain the correct tools and equipment for the assembly and test operations, and check that they are in a safe and usable condition
7. assemble circuits using four of the following tools:
   - heat shunts/tweezers
   - snipe or long nosed pliers
   - sleeving pliers
   - component forming devices
   - wire strippers
   - side or end cutters
   - bolt fasteners (screwdriver, spanners)
   - anti-static packaging, mats and straps
   - specialised assembly tools/equipment
8. use the appropriate methods and techniques to assemble the components in their correct positions

9. assemble electronic components using two of the following:
   - manual soldering techniques
   - surface mount techniques
   - mechanical fixing methods

10. assemble circuits to the required specification, to include using fifteen of the following types of component:
    - fixed resistors
    - variable resistors
    - potentiometers
    - sensing resistors (such as temperature or light operated)
    - fixed capacitors
    - variable capacitors
    - electrolytic capacitors
    - diodes
    - Zener diodes
    - light emitting diodes (LEDs)
    - transistors
    - thyristors
    - thermistors
    - analogue or digital integrated circuits
    - surface mount packages
    - rectifiers
    - switches
    - mini transformers
    - decoders
    - regulators
    - encoders or resolvers
    - inverters or servo controllers
    - edge connectors
    - wiring pins/tags/wire links
    - fixing spacers
    - insulators
    - small heat sinks
    - cables
    - cable connectors
    - protection devices
    - opto-electronics/optical fibre components

11. assemble electronic components to produce five of the following types of circuit:
    - audio amplifiers
    - signal converters
    - signal generators
    - counter/timers
    - oscillators
    - filters
    - microprocessor based applications
    - comparators
    - power amplifiers
    - motor control
    - regulated power supplies
• logic function controls
• display circuits
• other specific circuit
• sensor/actuator circuit (such as linear, rotational, temperature, photo-optic, flow, level, pressure)
• digital circuit (such as process control, microprocessor, logic devices, display devices)
• signal processing circuit (such as frequency modulating/demodulating, amplifiers, filters)
• alarms and protection circuits
• ADC and DAC hybrid circuits

12. secure the components, using the specified connectors, securing devices and soldering techniques
13. wire and terminate cables to the appropriate connections on the circuit boards
14. use appropriate test methods and equipment to check that the completed assembly is safe and meets all aspects of the specification
15. carry out visual checks on the completed circuits, to include all of the following:
   • soldered joints are clean, shiny, free from solder spikes, bridges, holes, excess solder and flux
   • components are correctly mounted for best physical support, and are correctly orientated
   • excess component leads have been trimmed off to the standard required
   • circuit tracks are free from faults (such as lifting, breaks, bridges, hot spots)
   • there are no obvious signs of damage, to components or to the substrate
   • all required connectors, wire links, spacers and other ancillary items are in place

16. use five of the following types of test equipment:
   • multimeter
   • oscilloscope
   • logic probe/clip
   • logic analyser
   • pulse sequencing analyser
   • counter/timers
   • signature analysers
   • protocol analyser
   • signal generator
   • signal tracer
   • stabilised power supplies
   • measuring bridges
   • software diagnostic programs
   • data communications test set
   • bus exerciser

17. carry out checks and adjustments, appropriate to the circuits being assembled, to include six of the following:
   • logic states
   • dc voltage/current levels
   • ac voltage/current levels
   • clock/timer switching
   • oscillations
   • attenuation
   • pulse width/rise time
   • open/short circuit
   • resistance
   • capacitance
• waveform analysis
• inductance
• frequency modulation/demodulation
• amplification
• signal noise/interference levels

18. produce electronic circuits in accordance with one of the following:
   • BS or ISO standards and procedures
   • customer standards and requirements
   • company standards and procedures
   • other international standard

19. deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

20. leave the work area in a safe and tidy condition on completion of the electronic assembly and testing activities
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Outcome 2  Know how to assemble and test electronic circuits

Assessment Criteria
The learner will be able to:
1. describe the specific safety practices and procedures that they need to observe when assembling and testing electronic circuits (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)
2. describe the hazards associated with assembling and testing electronic circuits (such as heat, toxic fumes, spilled/splashed chemicals/solder, static electricity, using sharp instruments for stripping cable insulation, connecting clips/probes into circuits), and how they can be minimised
3. describe the importance of wearing appropriate protective clothing and equipment, and keeping the work area safe and tidy
4. describe the precautions to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components (such as use of earthed wrist straps, anti-static mats, special packaging and handling areas)
5. explain how to use and extract information from circuit diagrams, block and schematic diagrams, equipment manuals, data sheets, test procedures and instructions (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken
6. describe the various types of circuit boards used (such as printed circuit boards, thin film, thick film and flexible film circuitry)
7. explain how to recognise, read the values and identify polarity and any other orientation requirements for all electronic components being used in the assemblies (such as capacitors, resistors, inductors, diodes, transistors, integrated circuit chips, and other discrete through-hole or surface-mounted components)
8. explain how to check that components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
9. describe the basic principles of operation of the electronic circuits being assembled, and the purpose of the individual modules/components within the circuits
10. describe the application and use of circuit protection equipment (such as fuses and other overload protection devices)
11. describe the preparation requirements for components to be used in the assembly (such as pre-forming component pins/legs)
12. describe the methods of mounting and securing electronic components to various surfaces (such as the use of manual soldering techniques, surface mount technologies and mechanical fixing devices, use of heat sinks/shunts)
13. describe the methods of attaching markers/labels to components or cables to assist with identification (such as colour coding conductors, using coded tabs)
14. describe the use of BS7671/IEE wiring, and other regulations, when selecting wires and cables and when carrying out tests on electronic circuits
15. describe the importance of making visual checks of the completed assembly (such as examination for excessive solder or solder spikes which may allow short circuits to occur, correct orientation of components for pin configuration or polarity, obvious signs of damage (such as heat damage) or strain on terminations)
16. describe the tools and equipment used in the electronic assembly activities (including the use of cable stripping tools, crimping tools, soldering irons, specialist assembly tools)
17. describe the importance of ensuring that all tools are in a safe and serviceable condition, are used correctly and are returned to their correct location on completion of the assembly activities
18. describe the care, handling and application of electronic test and measuring instruments (such as multimeter, oscilloscope, signal generators, stabilised power supplies, logic probes/analyzers, measuring bridges)
19. explain how to check that test equipment is safe to use (such as condition of power cables, using suitably fused test probes, clips and leads); how to check that equipment is within current calibration approval dates; checking that the test equipment is suitable for the tests they are to carry out and can cover the range and values they are to measure
20. explain how to connect to an approved power supply and, where appropriate, signal source; identifying correct test points in the circuit; how to position test instruments into circuits without damaging circuit components (such as using test probes, ensuring correct polarity, taking antistatic precautions); setting instrument zero readings; obtaining instrument readings and comparing them with expected results
21. explain how to make adjustments to circuit components; making decisions on circuit performance and faulty components; removal and replacement of faulty components
22. describe the fault-finding techniques to be used when the equipment fails to operate correctly
23. explain when to act on their own initiative and when to seek help and advice from others
24. describe the importance of leaving the work area in a safe and clean condition on completion of the electronic assembly and testing activities (such as returning hand tools and test equipment to the designated location, cleaning the work area, removing and disposing of waste)