Level 1 - Unit 3 - Smart Electronics (5 credits)

Relevant LINKS

BACK TO Smart Products UNITS **[1]**

Handbook home page **[2]**

Overview

Smart Electronics at Level 1 requires the candidate to understand basic electronics and circuits. They should be comfortable working with circuit diagrams and the various components associated with creating electronics. They should also understand some of the basic differences between analogue and digital technologies. They should be able to apply this knowledge to simple circuits and be able to program some controls and test that they work effectively. They should be capable of combining their knowledge to build a mixed and functional system.

A work activity will typically be 'straightforward or routine' because:

The task or context will be familiar and involve few variable aspects. The techniques used will be familiar or commonly undertaken.

Example of context – Candidates might make a name plate for their bedroom door.

Support for the assessment of this award [3]

Example of typical IT work at this level **[4]**

Assessor's guide to interpreting the criteria

General Information

QCF general description for Level 1 qualifications

- Achievement at QCF level 1 (EQF Level 2) reflects the ability to use relevant knowledge, skills and procedures to complete routine tasks. It includes responsibility for completing tasks and procedures subject to direction or guidance.
- Use knowledge of facts, procedures and ideas to complete well-defined, routine tasks. Be aware of information relevant to the area of study or work
- Complete well-defined routine tasks. Use relevant skills and procedures. Select and use relevant information. Identify whether actions have been effective.
- Take responsibility for completing tasks and procedures subject to direction or guidance as needed

Requirements

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- Standards must be confirmed by a trained Silver Level Assessor or higher

- Assessors must at a minimum record assessment judgements as entries in the on-line mark book on the INGOTs.org certification site.

- Routine evidence of work used for judging assessment outcomes in the candidates' records of their day to day work will be available from their e-portfolios and on-line work. Assessors should ensure that relevant web pages are available to their account manager on request by supply of the URL.

- When the candidate provides evidence of matching all the criteria to the specification subject to the guidance below, the assessor can request the award using the link on the certification site. The Account Manager will request a random sample of evidence from candidates' work that verifies the assessor's judgement.

- When the Account Manager is satisfied that the evidence is sufficient to safely make an award, the candidate's success will be confirmed and the unit certificate will be printable from the web site.

- This unit should take an average level 1 learner 30 hours of work to complete.

Assessment Method

Assessors can score each of the criteria N, L, S or H. N indicates no evidence and it is the default setting. L indicates some capability but some help still required to meet the standard. S indicates that the candidate can match the criterion to its required specification in keeping with the overall level descriptor. H indicates performance that goes beyond the expected in at least some aspects. Candidates are required to achieve at least S on all the criteria to achieve the full unit award. Once the candidate has satisfied all the criteria by demonstrating practical competence in realistic contexts they achieve the unit certificate.

Expansion of the assessment criteria

1. Understand analogue circuits.

1.1 I can identify circuit components and symbols.

The candidate will identify a range of common circuit components either from their circuit symbols or from photographs.

Evidence: From portfolios, internal testing, assessor observations

Additional information and guidance

The components can include power supply (AC and DC), resistor, potentiometer, switch, diode, LED, LDR, variable resistor, bulb/lamp, voltmeter, ammeter, transformer, capacitor, motor, thermistor, loudspeaker, buzzer, motor, transistor, integrated circuit, micro-controller. Make links to work in the core science curriculum and use real and practical applications as illustrations.

1.2 I can identify valid circuits

The candidate will be able to identify simple circuits that will function as intended.

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Evidence: From portfolios, internal testing, assessor observations

Additional information and guidance

Candidates should be able to identify simple circuits that will work and ones that will not. eg identify a short circuit and a broken circuit. In most cases these are the reasons why a circuit will not work. An inappropriately high series resistor will effectively be like a broken circuit.

1.3 I can set up a physical analogue circuit for a purpose

The candidate should be able to set up simple working circuits and test them.

Evidence: From portfolios, internal testing, assessor observations

Additional information and guidance

Candidates will need practice setting up circuits to learn the effects of combining different components and systematically checking connections to find faults and check working. They need to appreciate that short circuits can generate heat very quickly and that mismatching components can damage them. They should be taught to solder and techniques for achieving neat joints.

1.4 I can distinguish between analogue and digital products

The candidate should know the meaning of the terms analogue and digital and they should be able to identify examples.

Evidence: From portfolios, internal testing and/or assessor observations.

Additional information and guidance

Candidates should understand that analogue signals are continuous whereas digital data representing a continuous signal is made of separate or discrete numbers. A variable resistor in a circuit is a good example of an analogue device and a switch is a good example of a digital device. Candidates should be familiar with relays and transistors as switches that can be controlled by a sensor.

2. Understand digital control.

2.1 I can identify digital circuit components.

The candidate will identify switches, and micro-controllers as digital devices.

Evidence: From portfolios, internal testing and/or assessor observations.

Additional information and guidance

At Level 1 it is enough to be able to identify the devices and recognise simple situations where they might be included a circuit. Electromagnetic switches (eg in a relay) are a good introduction and help in understanding basic principles such as in stepper motors which are very common electro-mechanical devices in Smart applications.

2.2 I can identify program elements that control physical components.

The candidate should be able to identify code that has been written to control a physical component.

Evidence: Internal testing, assessor observations.

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Additional information and guidance

In general commented code in any language is reasonable. eg in Arduino LED 1 on for 100 microseconds, off for 50 microseconds. Logo forward 100: Left 90 to drive a floor turtle or write a value of 255 to a byte controlling 8 digital lines to make them all +5 volts.

2.3 I can debug a control program to get it working.

Candidates should be able to find simple faults in code controlling devices.

Evidence: Portfolios, assessor observations.

Additional information and guidance

Any control programming language can be used. At Level 1 Arduino, Logo, Scratch or similar languages can be used. Any questions set in the grading exam will use a generic pseudo-code with sufficiently clear structure to work out what is happening without a knowledge of the specific syntax.

2.4 I can use switches to control actions.

Candidates should use a range of switches for control in circuits

Evidence: Portfolios, assessor observations.

Additional information and guidance

The simplest switch is simply switching a circuit on and off eg a light. Candidates should appreciate that this is a binary operation as there are only 2 possibilities, on or off. They should be familiar with relays as electromagnetic switches where one circuit can switch on another. This principle is a key concept in control in Smart technologies. Two switches in series makes an AND gate because the circuit will only work if switch one AND switch 2 are closed. Using a relay to open a switch is a NOT gate because switching the relay on causes it to open the switch which then breaks the second circuit. The second circuit only works if the relay is not switched on. If there are two wires connecting a device to a power source a switch in both wires means either of them being switched on will switch the device on. This is an OR gate because either switch one OR switch two will switch on the device. Candidates should get practical hands on experience with simple circuits and switches. Switches can be used to represent binary numbers. 7 switches attached to a 7 segment display can make the numbers from 0 to 9. These are typical simple cases appropriate for Level 1.

3. Combine analogue and digital systems.

3.1 I can identify a trigger point in a changing voltage.

Candidates should know that a changing voltage can cause a particular action when the voltage gets to a particular level.

Evidence: Portfolios, assessor observations.

Additional information and guidance

A good example is to use a LDR (Light dependent resistor) as a switch to turn lights on when it gets dark using a transistor switch. The voltage across the LDR will change continuously as the light level falls but at a particular point it will cause the transistor to switch and the light to go on. For Level 1 it is sufficient to have experienced the principle and to know that a particular point can be used to switch things on in a continuously changing property of the environment as this is common to sensors used as switches.

3.2 I can follow instructions to build a Smart system.

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The candidate should be able to follow directions to build a working Smart system that incorporates electronic control.

Evidence: Portfolios, assessor observations.

Additional information and guidance

In general at Level 1 Candidates will be becoming more self-sufficient but they will still need significant guidance and support with all but the simplest systems. If they can self-sufficiently build practical electronic controlling circuits that integrate with wider projects it is a good indication that they are operating at Level 2. Level 1 Candidates should be able to follow clear instructions and work with occasional help to get straightforward systems working.

3.3 I can use a program to control a physical system.

Candidates can use a program to control physical systems relevant to their projects.

Evidence: Portfolios, assessor observations.

Additional information and guidance

At Level 1 they should know how to get a program set up and working even if they did not write the program themselves. They should be given the opportunity to experiment with the source code and explore the effects of changing different parameters. If they can originate programs self-sufficiently and debug them themselves it is an indication of Level 2 work.

3.4 I can combine Smart technology in a design to improve the user experience.

Candidates will use an electronic component or components in their project(s) in order to provide a degree of functionality or user experience that would not otherwise be possible.

Evidence: Portfolios, assessor observations.

Additional information and guidance

An example might be to build an interactive LED display into a model of an eco-house control panel that tells you the amount of energy a house is consuming. Another example might be a window display that contains moving components controlled by simple motors. An example might be to build temperature and light sensing into a model of an eco-house so that temperatures and light levels could be automated to save energy. The exact methods are less important than making the product responsive to the purpose of the project by using a control and/or processing aspect related to digital electronics. It is likely that substantial practice with learning about digital electronics projects will be needed before integrating electronics into wider project briefs that include manufacturing outside the electronics field. At Level 1 Candidates can follow guidance to build a solution using Smart electronics.

Moderation/verification

The assessor should keep a record of assessment judgements made for each candidate and make notes of any significant issues for any candidate. They must be prepared to enter into dialogue with their Account Manager and provide their assessment records to the Account Manager through the online mark book. They should be prepared to provide evidence as a basis for their judgements through reference to candidate e-portfolios and any other sources eg through signed witness statements associated with the criteria matching marks in the online mark book or internal controlled testing. Before authorizing certification, the Account Manager must be satisfied that the assessors judgements are sound.

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