

## Unit 6: Circuit simulation and manufacture

### LO5: Understand commercial circuit manufacture

#### Commercial component and PCB types

#### *Instructions and answers for teachers*

*These instructions should accompany the OCR resource 'Commercial component and PCB types' activity which supports OCR Level 3 Cambridge Technicals in Engineering.*



The thumbnail shows the following content:

- Unit 6: Circuit simulation and manufacture
- LO5: Understand commercial circuit manufacture
- Commercial component and PCB types
- Activity 1
- The use of through-hole and surface mount devices (SMDs) is commonplace in the manufacture of electronic circuits using printed circuit boards (PCBs). The photographs below show both types of device.
- Two photographs: 'Through-hole' (components with leads inserted into holes) and 'Surface mount' (components soldered directly onto the board).
- Investigate commercial PCB production, giving advantages and disadvantages of using SMDs compared to through-hole components.
- The following video demonstrates commercial circuit board manufacture using different component types and may prove a useful starting point.
- <http://www.youtube.com/watch?v=2a85v0Y46A>
- January 2013
- OCR logo

#### **The Activity:**

Learners have been tasked to investigate commercial printed circuit board (PCB) manufacture including advantages and disadvantages of using surface mount devices (SMDs) compared to conventional through-hole components.



*This activity offers an opportunity for English skills development.*



*This activity offers an opportunity for maths skills development.*

#### **Suggested timings:**

2 hours

### Activity 1

Learners have been tasked to investigate commercial printed circuit board (PCB) manufacture including advantages and disadvantages of using surface mount devices (SMDs) compared to conventional through-hole components.

Learners have been referred to the following video, which may prove a useful starting point:

<http://www.youtube.com/watch?v=2qk5vxWY46A>

If possible, the teacher might be able to arrange a visit to see commercial PCB production taking place to help bring the learning to life.

<b>Advantages</b>	<b>Disadvantages</b>
Smaller components. Allows for circuit miniaturisation.	Manual prototype assembly or component-level repair is more difficult. Difficult to solder or de-solder manually.
Much higher component density (components per unit area) and many more connections per component.	SMDs cannot be used directly with breadboards (e.g. when building a prototype).
Lower initial cost and time of setting up for production. Fewer holes need to be drilled.	Devices are temperature sensitive. SMDs' solder connections may be damaged by environmental sealing (potting compounds) going through thermal cycling.
Simpler and faster automated assembly (e.g. using pick and place robot).	SMT is unsuitable for large, high-power, or high-voltage parts, for example in power circuitry. This includes transformers, some large inductors, large power transistors etc.
Small errors in component placement are corrected automatically as the surface tension of molten solder pulls components into alignment with solder pads.	SMT is unsuitable as the sole attachment method for components that are subject to frequent mechanical stress – such as edge connector or some switches.
Components can be placed on both sides of the circuit board.	
Lower resistance and inductance at the connection; consequently, fewer unwanted RF signal effects and better and more predictable high-frequency performance.	
Better mechanical performance under shake and vibration conditions.	
Many SMD parts cost less than equivalent through-hole parts.	

### Activity 2

For Activity 2 learners have been tasked to investigate multiple layer PCBs. Typical responses might include:

#### Construction:

Multiple layer PCBs are PCBs manufactured with more than two layers of copper tracks by using a sandwich construction. This is achieved by gluing (laminating) several double-sided boards together with insulating layers in between.

The number of layers is referred to as the number of separate conductor patterns. It is usually even and includes the two outer layers. Most main boards have between 4 and 8 layers, but PCBs with almost 100 layers can be made.

Advantages and disadvantages of multiple layer PCBs might include:

Advantages	Disadvantages
The extra layers may be used to route more complicated circuitry.	Board is less flexible.
Power supplies can be distributed more effectively.	Higher initial design cost – design has to take into account additional layers.
Smaller board size for given circuit (allows for miniaturisation).	Not easy to prototype.
Better resistance to interference (EMC)	Difficult to fault find and repair
Better use in high speed circuitry where signals need to be separated.	Higher cost to produce – cost is reflected in number of layers.
	Higher cost for manufacture.

Teachers might show learners examples of different multiple layer PCB component types (through-hole and surface mount) and multiple layer PCB construction.

Learners might also be able to dismantle electronic equipment containing circuit boards in order to investigate the production methods used.



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