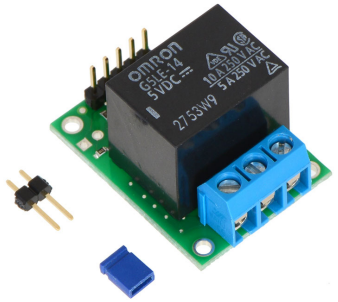
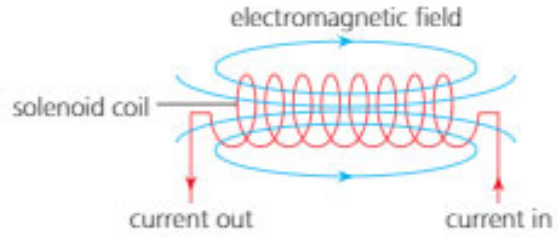
OUTPUT DEVICES

- Actuators
  - It is a mechanical device such as a relay, solenoid or motor
  - Actuators are used a switch, value or motor to turn on/off or operate a device

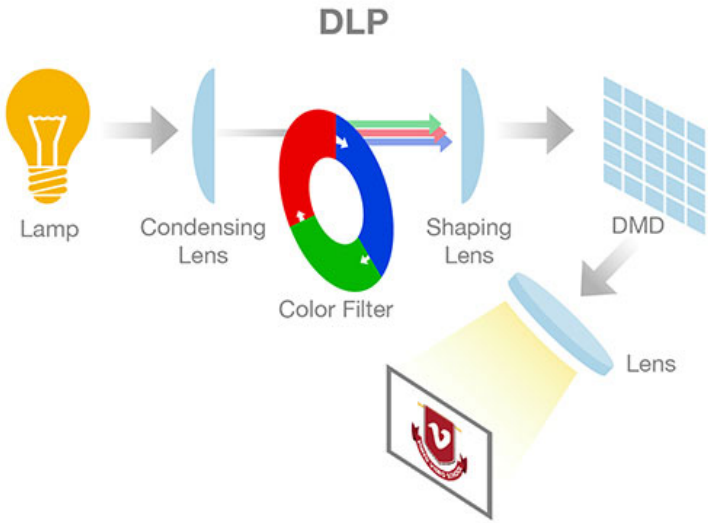




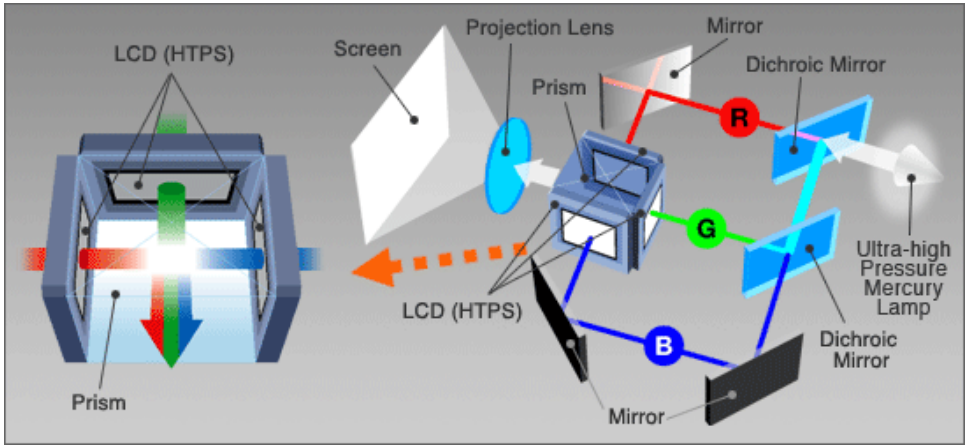
▲ **Figure 3.36** A solenoid

OUTPUT DEVICES

- Digital Light Projector (DLP)
  - The light passes through colour wheel filter which create different colors
  - Then the light is shone to a large number of micro mirrors
  - Each mirror represents each pixel in an image
  - The mirrors reflect light toward lens and display on the screen
  - Micro mirrors https://youtu.be/8I8p62JhH6o?t=148
  - Micro mirrors work https://youtu.be/9nb8mM3uElc?t=239



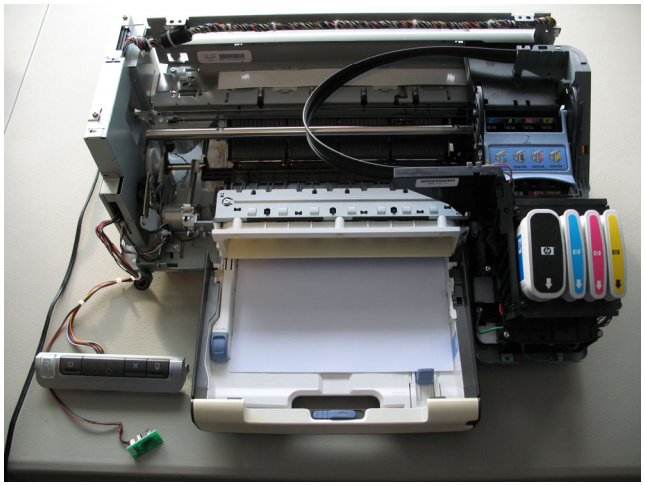
OUTPUT DEVICES



- Liquid crystal display (LCD) projector
  - Older projector technology
- How does it work?
  - a powerful beam of white light is generated from a bulb or LED inside the projector body
  - this beam of light is then sent to a group of chromatic-coated mirrors (known as dichromic mirrors); these reflect the light back at different wavelengths
  - when the white light hits these mirrors, the reflected light has wavelengths corresponding to red, green and blue light components
  - these three different coloured light components pass through three LCD screens that allow part of the light pass through
  - these images are then re-combined using a special prism to produce a full colour image
  - finally, the image passes through the projector lens onto a screen
  - https://youtu.be/kbKj-1ZIt_M?t=190

OUTPUT DEVICES

- Inkjet printers
  - a print head, which consists of nozzles that spray droplets of ink onto the paper to form characters
  - an ink cartridge or cartridges
  - a stepper motor and belt, which moves the print head assembly across the page from side to side
  - a paper feed, which automatically feeds the printer with pages as they are required



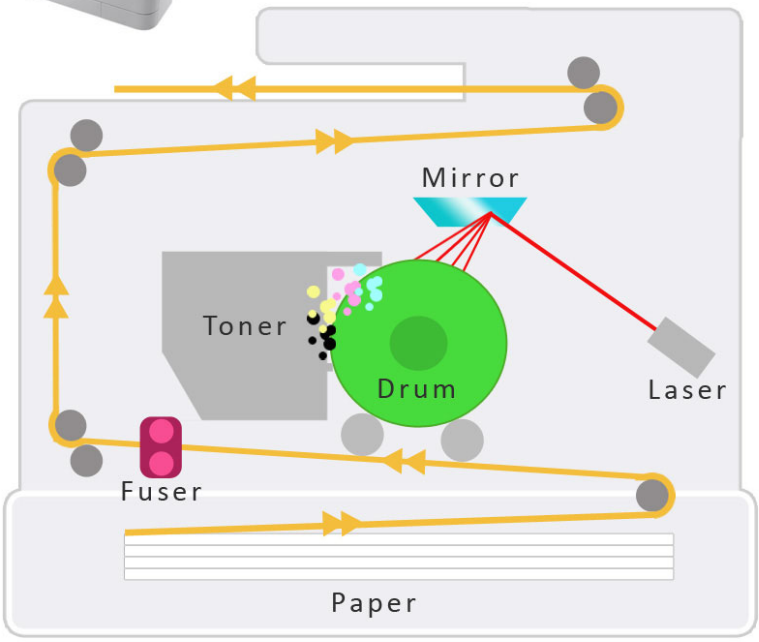
- There are two technologies in inkjet printer
  - Thermal bubble
    - tiny resistors create localised heat which makes the ink vaporise
    - This causes the ink to form a tiny bubble; as the bubble expands, some of the ink is ejected from the print head onto the paper
  - Piezoelectric
    - a crystal is located at the back of the ink reservoir for each nozzle. The crystal is given a tiny electric charge which makes it vibrate. This vibration forces ink to be ejected onto the paper
    - https://youtu.be/DI1zP4-0zYY?t=21

OUTPUT DEVICES

Stage	Description of what happens
1	the data from the document is sent to a printer driver
2	the printer driver ensures that the data is in a format that the chosen printer can understand
3	a check is made by the printer driver to ensure that the chosen printer is available to print
4	the data is then sent to the printer and it is stored in a temporary memory known as a printer buffer
5	a sheet of paper is then fed into the main body of the printer
6	as the sheet of paper is fed through theprinter, the print head moves from side to side across the paper printing the text of image
7	at the end of each full pass of the print head, the paper is advanced very slightly to allow the next line to be printed; this continues until the whole page has benn printed
8	if there is more data in the printer buffer, then the whole process from stage 5 is preated until the vuffer is finally empty

OUTPUT DEVICES

How a laser printer works:



www.tonergiant.co.uk

- Laser printers
  - It uses dry powder ink
  - Use of static electricity to produce the text and images
  - Main components of laser printers
    - Drum
    - Toner
    - Fuser
    - laser
  - https://youtu.be/WB0HnXcW8qQ?t=30

OUTPUT DEVICES

Stage in process	Description of what happens
1	the data from the document is sent to a printer driver
2	the printer driver ensures that the data is in a format that the chosen printer can understand
3	a check is made by the printer driver to ensure that the chosen printer is available to print (e.g. is it busy, is it off-line, is it out of ink, and so on)
4	the data is then sent to the printer and it is stored in a temporary memory known as a printer buffer
5	the start of the printing process involves a printing drum being given a positive charge; as this drum rotates, a laser beam is scanned across it removing the positive charge in certain areas; this leaves negatively charged areas that exactly match the text/images of the page to be printed
6	the drum is then coated with positively charged toner (powdered ink); since the toner is positively charged, it only sticks to the negatively charged parts of the drum
7	a negatively charged sheet of paper is then rolled over the drum
8	the toner on the drum now sticks to the paper to produce an exact copy of the page sent to the printer
9	to prevent the paper sticking to the drum, the electric charge on the paper is removed after one rotation of the drum
10	the paper finally goes through a fuser which is a set of heated rollers; the heat melts the ink so that it fixes permanently to the paper
11	at the very end, a discharge lamp removes all the electric charge from the drum making it ready to print the next page

OUTPUT DEVICES

- Applications of inkjet and laser printers
- Inkjet printer
  - inkjet printers are often used for printing one-off photos or where only a few pages of good quality, colour printing is needed;
- Laser printer
  - these devices produce high quality printouts and are very fast when making multiple copies of a document; any application that needs high volume printing (in colour or monochrome) would choose the laser printer (for example, producing a large number of high-quality flyers or posters for advertising).
  - Laser printers have two advantages: they have large toner cartridges and large paper trays (often holding more than a ream of paper)

OUTPUT DEVICES

- 3D printer
  - It uses plastic ink or resin
  - use with CAD/CAM (Computer Aided Design) applications
  - print a solid object e.g., prosthetic limbs, tools, old parts, architect and fashion
- How does it work?
  - The printer received data from program e.g. CAD program
  - The printer prints layer by layer
  - It will create a solid object