The Inkjet Printing Process

The inkjet printing process is how a digital document or image gets printed on a physical media, typically paper, by the use of a driver, printer, liquid ink, and paper. This process goes through the steps of how the information is sent to the printer after clicking “Print,” how the stepper motors is activated, how ink is deposited from the print head, how duplex printing works, and ends with ejecting the paper from the printer. Figure 1 shows the inkjet printing process for a typical top loading printer.

![Image of inkjet printing process](image)

Figure 1. Piece of paper going through the feed tray and being printed on.

Sending the Information to the Printer

After the print button is clicked on the computer, a printer driver translates the data to be printed. Manual driver installation (via a CD or through the manufacturer’s website) used to be required, but technology has allowed printer drivers to be integrated with OS, such as Windows 8. This means that many new printers can work immediately out-of-the-box.

Since the speed of the printer is often slower than the speed of data transmission, spooling is used to temporarily save translated data for the printer that will be needed for the print job. Spooling saves the data translated by the driver on a buffer. This stored data can then be taken from the printer when needed during the printing process. Spooling allows multiple print jobs to be placed on a queue and longer print jobs to be done without constant aid of the computer.
Activating the Stepper Motors

When the computer sends the signal to print to a printer, a cue to take paper from the feed tray starts. Stepper motors engage small rollers, shown in Figure 2, that pick up a sheet of paper for use. When the paper is picked up, the stepper motors continue to feed the paper through during the inking process. The stepper motors move the piece of paper forward in precise increments to allow the ink to be deposited at the right place on the page.

![Figure 2. Rollers on a paper feed tray.](image)

Depositng Ink with the Print Head

Once the paper is positioned to print, the print head deposits ink over the page. This movement occurs horizontally in increments, milliseconds in length, as the print head starts and stops to reach new sections of the page. Each time the print head stops, carefully calculated droplets of ink deposit onto the paper with both the correct mix of colors and locations on the page to make words and images according to the data it received. Once the print head reaches the edge of the page, the rollers move the page down enough to reach the next line without any gaps. The print head moves in the reverse direction within the printer, but the same process occurs repeats until the end of the page is reached.

There are two methods of ink deposition that are widely used in household inkjet printers: thermal bubble and piezoelectric.

- **Thermal Bubble.** Small resistors create heat around 500°F that causes ink to form a bubble. The bubble expands, causing ink to be pushed out of the nozzle. The bubble pops, therefore creating a vacuum that pulls in more ink from the cartridge. This is shown in Figure 3.
• **Piezoelectric.** Small electrical charges causes piezo crystals to vibrate. The inward vibrational movement pushes ink out of the nozzle, while the outward movement pulls ink from the cartridge. This is shown in Figure 4.

![Figure 4. Piezoelectric method of ink deposition.](image)

The ink for the print head comes from *ink cartridges* located in another place on the printer, as shown in color in Figure 5. Ink is drawn from the cartridges into the print head to deposit ink onto the paper. The cartridge allows for many print jobs to be done since the print head needs to be light and agile for precise movements.

![Figure 5. Ink cartridges (shown in color) located near the printing process.](image)
Printing on the Other Side

Many printers also have the capability to automatically print on other side of the sheet, called **duplex printing**. This is done by feeding the paper through a single engine duplexer after printing on the first side and a brief waiting period for the ink to dry. The duplexer uses stepper motors and rollers to take the paper through a path that flips the paper by the time it gets to the print head again, to which the second side is printed and then ejected from the printer.

Ejecting the Paper

After the entire page, whether one-sided or two-sided, is printed as indicated by the data, the paper is ejected onto a, usually expandable, **paper output tray**, as shown in blue in Figure 6. If the user indicated that the paper print on one side only, then the paper is then ejected from the printer without going through the duplexer. If pages are printed on both sides, then the paper will need to go through the duplexer before being ejected.

Summary

The complex process of inkjet printing a document happens relatively fast, allowing users to turn digital media into a physical copy. Using a computer, data is translated into printer-readable data using a driver. That data is sent to the printer at a rate that the printer needs to carry out the printing process. Paper loads into the printer from the feed tray using stepper motors to both move the paper through the printer in precise increments, ensuring the accuracy of ink deposition. The final step before the paper ejects from the printer is ink deposition, which occurs in one of two ways: thermal bubble or piezoelectric. Both ways cause ink droplets to spray onto the page as indicated by the data received from the computer. If a paper is printed on the other side, duplex printing will occur before being ejected onto the output tray.
Glossary

- **Printer Driver** – software that translates data from the application used for the document or image to data that the printer can read.
- **Spooling** – a process that temporarily saves data for later use.
- **Buffer** – temporary space created on the hard drive to store data.
- **Feed tray** – the compartment where paper is loaded into the printer.
- **Stepper motor** – a motor rotates rollers in the printer that feed paper through in precise increments.
- **Print head** – the component of the printer that sprays ink onto the paper.
- **Ink cartridge** – a reservoir of ink for the print head to use.
- **Duplex Printing** – a feature of many printers that allows automatic double sided printing.
- **Paper Output Tray** – A tray that is used to catch papers that have completed printing.

References


