DAC

An **R-2R ladder** is a simple circuit made with just two resistor values—R and 2R—arranged in a ladder-like structure. Its main job is to convert a **digital signal** (a set of binary values like 1101) into a **smooth analog voltage**. This is important because while microcontrollers and computers use digital signals, many real-world devices (like speakers, motors, and lights) need analog input to work properly.

The way it works is quite clever. Each bit from the digital input (usually coming from a microcontroller) connects to a point on the resistor ladder. Each bit acts like a switch: when it’s a 1, it connects to a high voltage (like 5V); when it’s a 0, it connects to ground (0V). The ladder uses the resistors to combine these voltages in a special way, depending on the position of each bit. The higher-position bits (like the leftmost in the binary number) have more influence on the output voltage, while the lower bits have less.

By combining the voltage contributions from each bit, the R-2R ladder produces a final analog voltage that corresponds to the binary input. This allows digital systems to smoothly control things like brightness, sound, or motor speed—bridging the gap between digital electronics and the analog world.