



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution



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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

23ECB202 – LINEAR INTEGRATED CIRCUITS

II YEAR/ III SEMESTER
1

UNIT 4 – ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTER

TOPIC 4.8 – Weighted resistor type, R-2R Ladder type





Weighted resistor type

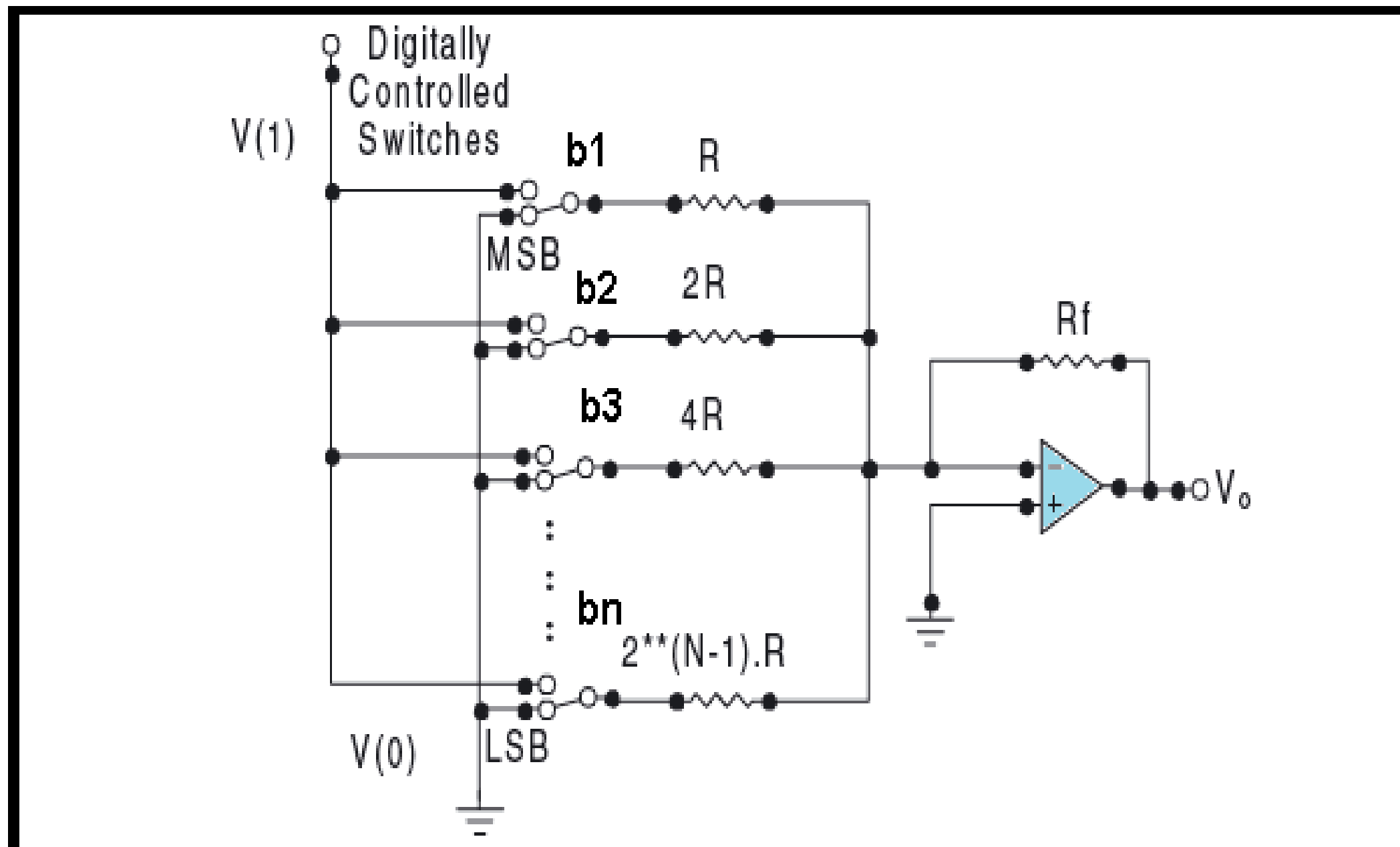


- Weighted resistor digital to analog Converter is a very basic D/A converter.
- By using simple resistor network we can easily build that. .
- Let us consider a N-bit straight binary resistor network, which produces a current I corresponding to logic 1 at the most significant bit, $I/2$ corresponding to logic 1 at the next lower bit, $I/2^2$ for the next lower bit and so on, and $I/2^{N-1}$ for logic 1 at the least significant bit position.
- Now the total current thus produced by that resistive network will be proportional to the digital inputs, which we want to convert in equivalent analog signal.
- Farther this current can be converted to voltage with the help of a converter circuit by an using operational amplifier (OP AMP).
- Finally then we get the produced voltage is analog in nature and will be proportional to the digital inputs





Weighted resistor type

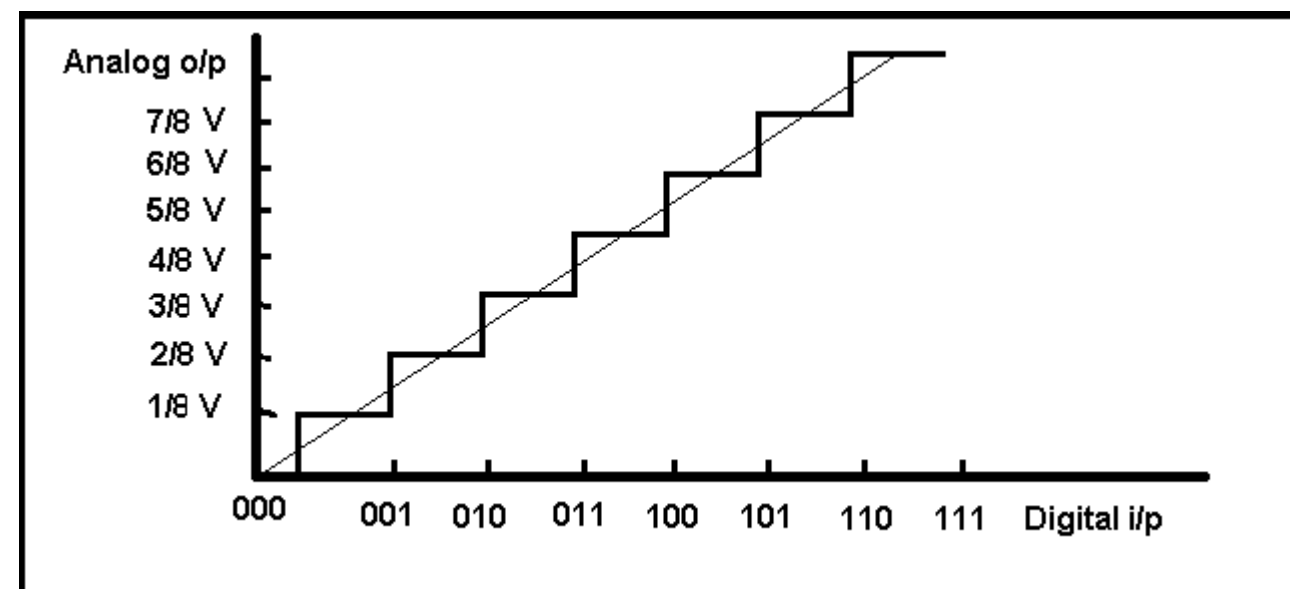




Single Slope Type - ADC



- It may be observed in the circuit diagram that different values of resistances are used at the digital inputs and the resistance values are the multiple of the resistance corresponding to the most significant digital input to produce the currents $I, I/2, I/2^2, \dots, I/2^{N-1}$.
- Since the resistance values are weighted in accordance with the binary weights of the digital inputs, this circuit is referred to as a *weighted-resistor D/A converter*.





R-2R Ladder DAC Circuit



- The R-2R ladder DAC operates by using a network of resistors arranged in a repeating pattern of R and 2R values, forming a binary-weighted voltage divider
- Each bit of the digital input controls a switch that connects either to a reference voltage or to ground
- The most significant bit (MSB) has the largest influence on the output voltage, while the least significant bit (LSB) has the smallest
- When a bit is high (1), its corresponding switch connects to the reference voltage; when low (0), it connects to ground.
- This configuration ensures that each bit contributes a precise fractional voltage based on its position in the binary sequence.
- The summing point of the R-2R network is typically connected to an operational amplifier, which helps in maintaining the output impedance and providing a stable analog output voltage
- The resulting output voltage is a sum of the contributions from each bit, weighted appropriately by the resistor network.
- This analog voltage is proportional to the binary value of the digital input

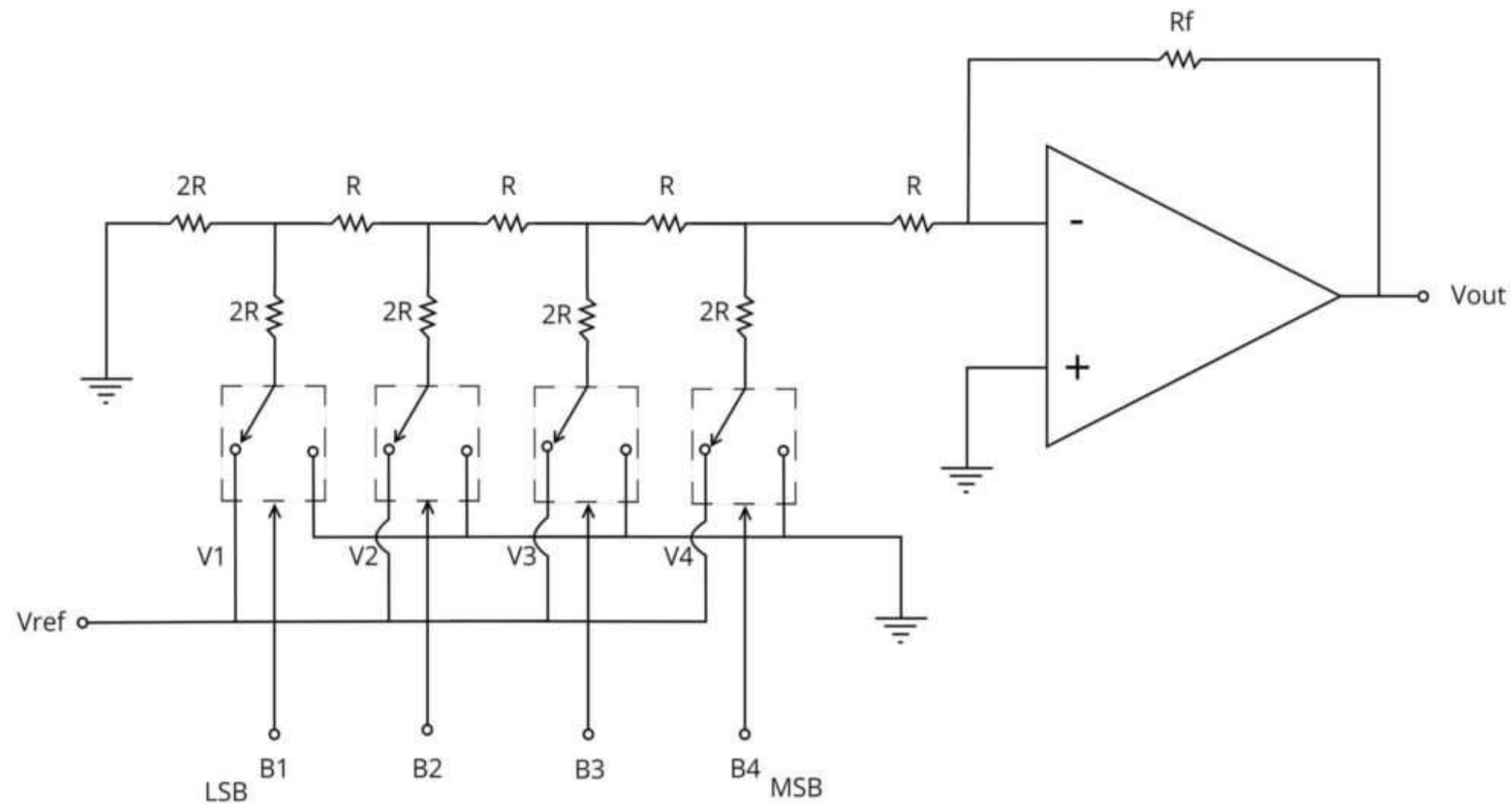




Dual Slope Type - ADC



R-2R LADDER DAC CIRCUIT





Applications of R-2R Ladder DAC



➤ **Audio Equipment:**

R-2R ladder DACs are widely used in audio equipment such as CD players, digital audio players, and sound cards for computers. They convert digital audio signals into precise analog voltages for playback through speakers or headphones, offering high-quality sound reproduction

➤ **Measurement and Instrumentation:**

In test and measurement equipment, R-2R ladder DACs are employed to generate precise analog signals from digital inputs. They are used in oscilloscopes, signal generators, and data acquisition systems for various applications, including sensor calibration, waveform generation, and signal conditioning.





Applications of R-2R Ladder DAC



➤ **Industrial Control Systems:**

R-2R ladder DACs play a crucial role in industrial control systems, where they convert digital control signals into corresponding analog voltages to drive actuators, motors, and other analog-controlled devices. These DACs ensure accurate and reliable control of industrial processes and machinery.

➤ **Telecommunications:**

In telecommunications systems, R-2R ladder DACs are utilized for digital-to-analog conversion in applications such as baseband signal processing, modulation, and demodulation. They enable the conversion of digital signals into analog form for transmission over analog channels, ensuring efficient communication in devices like modems, routers, and telecommunication networks.





THANK YOU