

# DIGITAL SIGNAL GENERATOR & DECODER – REPORT

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## Overview

This program demonstrates different line encoding and decoding techniques. It supports both analog and digital input signals and visualizes the encoded waveforms using a Swing-based GUI.

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## Tech Stack

- **Language :** Java
  - **Environment :** IntelliJ IDEA
  - **Libraries Used :** Swing , java.util.Scanner , java.awt , javax.swing , javax.imageio
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## How To Run The Code

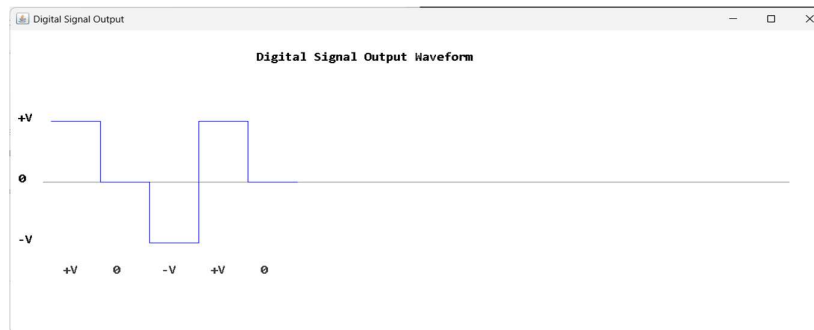
1. Install JDK 17 or above from Oracle or OpenJDK and verify using `java -version`.
  2. Install VS Code with the “Extension Pack for Java”.
  3. Create the correct folder structure with main, encoders, and decoders packages.
  4. Open the project in IntelliJ IDEA or VS Code.
  5. Compile and run Main.java from the main package.
  6. OR, open the terminal in the project directory and run:
    - `javac main/Main.java`
    - `java main.Main`
  7. Choose Analog or Digital Input and enter the bit stream when prompted.
  8. Select the desired Line Encoding Scheme (NRZ-L, NRZ-I, Manchester, etc.).
  9. The encoded output will appear in the console.
  10. A Swing window will automatically open displaying the waveform visualization.
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## Result & Learning

The program correctly encodes and decodes signals for all listed line encoding techniques.

Through this project, we gained a strong conceptual understanding of :

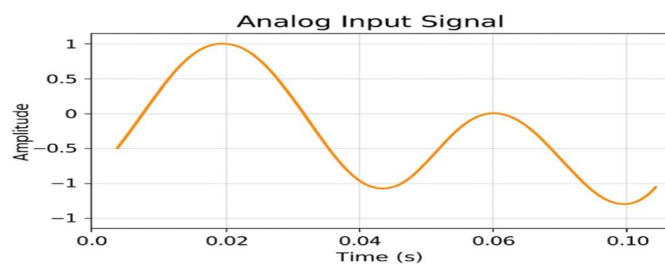
- Digital data representation
- Encoding and decoding logic
- Data recovery at the receiver end



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### Assumptions

- For analog signals, only one input PNG file , i.e. , input\_signal.png is used for PCM and DM conversion.



- In Differential Manchester decoding, the first bit is assumed to be 1 (positive logic).
- During Manchester, AML, and Differential Manchester encoding,
  - each bit is represented by two voltage levels to visualize transitions.
  - (+V, -V) represents 1
  - (-V, +V) represents 0
- The sampling gap in PCM is fixed but can be adjusted to modify the distance between samples.

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### References

1. ChatGPT (OpenAI, 2025). Used as a coding reference and guide for implementing PCM DM encoder logic and project documentation.
2. Java AWT Documentation :- <https://docs.oracle.com/javase/7/docs/api/java/awt/package-summary.html> for graph generations