

YuHongZhu-ENA13 Barcode Generation detail

1. Project Overview	1
1.1 Project Name	1
1.2 Background & Pain Points	1
1.3 Target	1
2. Operating Instructions	2
2.1 Preparation	2
2.2 Execution	2
2.3 Output & Validation	3
3. Technical Appendix	3
3.1 Tools & Technology	3
3.2 Coordinate Mapping & Precision Alignment	3
3.3 Label Specifications	3
3.4 Industrial Features	4
4. EAN-13 Structure	4

1. Project Overview

1.1 Project Name

Automated EAN-13 Barcode Generation & Industrial Imposition System

1.2 Background & Pain Points

- **Low Efficiency:** Manually imposing 8 different SKU labels into a 4 × 2 grid typically takes 10–15 minutes. In a fast-paced supply chain, manual typesetting has become a bottleneck.
- **Human Error:** Manual data entry is prone to digit omissions, and manual alignment cannot guarantee the millimeter-level precision required for industrial printing.

1.3 Target

Development of a Python-based high-precision automation system to realize:

- **Zero-Error Alignment:** Utilizing mathematical formulas to lock industrial registration marks, ensuring constant positioning between content and die-cut lines.
- **Throughput Optimization:** Compressing typesetting time from minutes to milliseconds through batch processing.

2. Operating Instructions

2.1 Preparation

1. **Access Permissions:** Operators must be added to the Google Drive Shared Drive. Contact the administrator to manage membership.
2. **File Integrity:** Ensure [Registration_Template.pdf](#) and [Barcode_Input_Sheet](#) (Google Sheets) remain in the shared folder.
3. **Data Entry:** Fill in the [P_Number](#), [SKU](#), [Description](#), and [Barcode_Number](#) in the Google Sheet before running.

2.2 Execution

1. **Launch:** Open the Colab link and click the **Run** button to generate the UI form.
2. **Data Entry:** Input the **P_Number**. The system will automatically traverse the Google Sheet to fetch corresponding metadata.
3. **Path Configuration:** Ensure the template path is correctly displayed (it should auto-populate if permissions are correct).



2.3 Output & Validation

- **Generation:** Click the **Generate PDF** button. Upon success, a download link for the generated PDF will appear.
- **Self-Check:** Verify the times 4 layout (8 labels total) and scan the barcode to confirm the readout matches the work order.

3. Technical Appendix

3.1 Tools & Technology

- **Python (ReportLab):** Used for high-precision vector PDF generation, ensuring zero loss of resolution during printing.
- **PDF Processing (PyPDF):** Used to parse the industrial template, extract the **MediaBox** coordinate system, and merge the transparent **Overlay** layer with the template.
- **Vector Barcode Engine:** Based on the [Ean13BarcodeWidget](#) algorithm, strictly adhering to the 95-module standard width for scanner compatibility.

3.2 Coordinate Mapping & Precision Alignment

The system maps coordinates from the PDF's default bottom-left origin to the industrial top-left origin by locking the "cross-hair" registration centers:

- **Horizontal Start:** $\text{Base_X} = (\text{Canvas_Width} - 292.1\text{mm}) / 2 + 1.5125\text{mm}$
- **Vertical Start:** $\text{Base_Y_Top} = (\text{Canvas_Height} + 106\text{mm}) / 2 - 0.1\text{mm}$

3.3 Label Specifications

Element	Font	Size	Constraints
P Number	SimHei*	11 pt	Top: 2.7mm, Left: 2.2mm
SKU Number	SimHei*	11 pt	Top: 2.7mm, Right: 2.2mm
Description	SimHei*	6 pt	Left: 10.6mm, Below P-Num: 9.7mm
Barcode	Vector	N/A	Left: 13.8mm, Below Desc: 4mm

Red Box Size: 70mm \times 50mm

3.4 Industrial Features

- **Black Block Sensor:** A 5 \times 3mm (K100) black block is inserted for photoelectric cutting sensors.
- **Header Metadata:** Rotated 180° production strings generated via `Canvas.saveState()` and `Canvas.translate()` for precise edge alignment.
- **Interaction Logic:** Utilizes Colab Forms to decouple algorithmic logic from user operation, protecting core code via `{ display-mode: "form" }`.

4. EAN-13 Structure

The system generates standard EAN-13 barcodes comprising:

- 1. Quiet Zones (Left & Right)
- 2. Guard Bars (Start, Center, End)
- 3. Data Characters (L-Code, G-Code, R-Code)
- 4. Check Digit
- 5. Human Readable Text (HRI)

