

# YuHongZhu-ENA13 Barcode Generation detail

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## 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 4x2 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\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)

