**STM32F401RE: Nokia 5110 (PCD8544) Display via SPI1**

**Overview**

This project drives a **Nokia 5110** (PCD8544) LCD display via **SPI1** on an **STM32F401RE** (for example, Nucleo-F401RE). It writes the letters **A**, **B**, **C** on the top-left corner using a minimal font table.

**Features**

1. **SPI1** in Master Mode (Mode 0, ~1 MHz)
2. **Manual Chip Select** (CE) on **PA8**
3. **Pins** used for **DC** (PB6) and **RESET** (PB10)
4. **PCD8544** commands to set contrast, bias, normal mode

**Hardware Setup**

**Pin Connections (PCD8544 LCD)**

| **Signal** | **Nokia 5110** | **STM32F401RE Pin** | **Notes** |
| --- | --- | --- | --- |
| RST | Pin 1 | PB10 | Display Reset |
| CE | Pin 2 | PA8 (SW-based) | Software Chip Select |
| DC | Pin 3 | PB6 | Data/Command Select |
| DIN | Pin 4 | PA7 (SPI1 MOSI) | SPI MOSI |
| CLK | Pin 5 | PA5 (SPI1 SCK) | SPI SCK |
| VCC | Pin 6 | **3.3 V** | Power |
| LIGHT | Pin 7 | (Optional) | Backlight Control |
| GND | Pin 8 | **GND** | Common Ground |

**Connection Notes**

* **CE** is driven in software (PA8), pulled low before sending data, then released.
* **DC** toggles between Command/Data for the PCD8544.
* **RESET** is toggled briefly at startup.

**Software Explanation**

**SPI1 Configuration**

* **PA5** = SCK, **PA7** = MOSI, both in **AF5**.
* **Prescaler** = /16 -> ~1 MHz if system clock = 16 MHz.
* **Mode 0**: CPOL=0, CPHA=0.

**Display Initialization**

1. **RESET** the PCD8544 by pulling **PB10** low, then high.
2. **Extended Mode** -> configure contrast (0xB8), temperature (0x04), bias (0x14).
3. **Basic Mode** -> normal display (0x0C).
4. **Clear** the screen by writing 0x00 to all 504 bytes (84x48/8).

**Displaying Letters**

* A small font table for **A, B, C** is in font\_table.
* Each character is 5 columns + 1 blank => 6 bytes.
* This code writes them at top-left (x=0, y=0 by default) => letters appear left to right.

**Project Structure**

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├── Inc/

│ └── stm32f4xx.h

├── Src/

│ └── main.c // Nokia 5110 code

└── README.md

**Building & Uploading**

**Using Keil uVision / STM32CubeIDE**

1. **Open** your IDE.
2. **Create** a new project for **STM32F401RE**.
3. **Copy** main.c into Src/.
4. **Compile** & **flash** the board.

**Usage**

**1️⃣ Wire the LCD**

* Follow the table above for RST, CE, DC, DIN, CLK, VCC, GND.

**2️⃣ Power On**

* The display should initialize to **blank**.

**3️⃣ Observe Letters**

* The code writes **A, B, C** at the top-left by default.
* Extend the code for more text or custom fonts.

**Troubleshooting**

* **No text**? Ensure correct wiring & check for short circuits.
* **Contrast** too dark/light? Adjust 0xB8 in GLCD\_init().
* **SPI** not sending? Check prescaler, CPOL/CPHA.

**License**

This project is under the **MIT License**.

**References**

* [STM32F401RE Datasheet](https://www.st.com/en/microcontrollers-microprocessors/stm32f401re.html)
* [PCD8544 Nokia 5110 Docs](https://cdn.sparkfun.com/datasheets/LCD/Monochrome/Nokia5110.pdf)
* [SPI & GPIO Info in RM0368](https://www.st.com/resource/en/reference_manual/dm00096844.pdf)

**🚀 Summary**

* **SPI1** to PCD8544, ~1 MHz.
* **Letters** A, B, C displayed.
* **Software** chip select on PA8.

**Enjoy your Nokia 5110 display on STM32F401RE!**