**Connecting and configuring a 1.28-inch Waveshare Display with Nucleo Board STM32F413ZH**

**1. Introduction**

**Purpose**  
This document provides detailed instructions for connecting and configuring a 1.28-inch Waveshare display with a Nucleo Board STM32F413ZH.

**Scope**  
The scope includes hardware setup, firmware development, and testing procedures.

**2. Hardware Overview**

**2.1 Nucleo Board STM32F413ZH**

**Description**  
The Nucleo Board STM32F413ZH is a development board featuring the STM32F413ZH microcontroller. It offers various interfaces and peripherals for development purposes.

**Specifications**

* **Microcontroller**: STM32F413ZH
* **Core**: ARM Cortex-M4
* **Clock Speed**: Up to 100 MHz
* **Flash Memory**: 1 MB
* **SRAM**: 320 KB
* **Interfaces**: USB, UART, I2C, SPI, etc.

**2.2 1.28-inch Waveshare Display**

**Description**  
The 1.28-inch Waveshare display is a compact, high-resolution screen suitable for various applications.

**Specification**

* **Operating voltage: 3.3V/5V**
* **Interface: SPI**
* **LCD type: IPS**
* **Controller: GC9A01**
* **Resolution: 240 (H)RGB x 240(V)**
* **Display size: Φ32.4mm**
* **Pixel size: 0.135（H）x 0.135（V）mm**
* **Dimension: 40.4 × 37.5(mm) Φ37.5(mm)**

**3. Hardware Connection**

**Pin Connections:**

| **STM32F413ZH Pin** | **Display Pin** | **Function** | **Pins number in STM DEVBOARD** |
| --- | --- | --- | --- |
| 3.3V | VCC | Power Supply | CN8 – 7th pin |
| GND | GND | Ground | CN8 – 11th pin |
| PA5 | CLK | SPI Clock | CN7 – 10th pin |
| PA1 | DIN | SPI Data | CN7 – 14th pin |
| PA6 | CS | Data/Command | CN7 – 17th pin |
| PC7 | DC | Chip Select | CN7 – 11th pin |
| PC9 | RST | Reset | CN8 – 4th pin |
| PE11 | BL | Backlight | CN7 – 17th pin |

**4. Firmware Development**

**4.1 Development Environment**

**Tools Required**

* STM32CubeIDE
* HAL Libraries

**Setup**

* Download and install STM32CubeIDE.
* Create a new project in STM32CubeIDE, selecting the STM32F413ZH as the target microcontroller.

**5. Testing and Debugging**

**5.1 Test Procedures**

* Power on the Nucleo board and ensure the display is connected.
* Load the firmware onto the Nucleo board.
* Verify the display initialization by observing the backlight and any display output.

**5.2 Debugging Tips**

* Ensure all connections are secure.
* Check the SPI configuration and ensure it matches the display requirements.
* Use a logic analyzer to verify SPI communication.

**7. References**

List any references or datasheets used in the creation of this document.

<https://www.waveshare.com/wiki/1.28inch_LCD_Module> - LCD Module

<https://github.com/offpic/GC9A01-STM32/blob/main/GC9A01.rar> (LCD display library)

[https://www.st.com/en/evaluation-tools/nucleo-f413zh.html#documentation](https://www.st.com/en/evaluation-tools/nucleo-f413zh.html%23documentation) – Nucleo board

Source code:

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