waveshare WS-12915

Waveshare 2.13inch E-Ink Display HAT V4 Instruction Manual

Model: WS-12915 | Brand: Waveshare

1. PRODUCT OVERVIEW

The Waveshare 2.13inch E-Ink Display HAT V4 is a low-power, two-color (black and white) e-paper screen module designed for various embedded applications. It features a 250x122 resolution and communicates via an SPI interface. This HAT (Hardware Attached on Top) is compatible with Raspberry Pi series boards (including Zero/Zero W/Zero WH/2B/3B/3B+/4B) and Jetson Nano. Its key advantages include ultra-low power consumption, wide viewing angles, and the ability to retain displayed content without continuous power, making it suitable for applications like electronic shelf labels and industrial instrumentation.
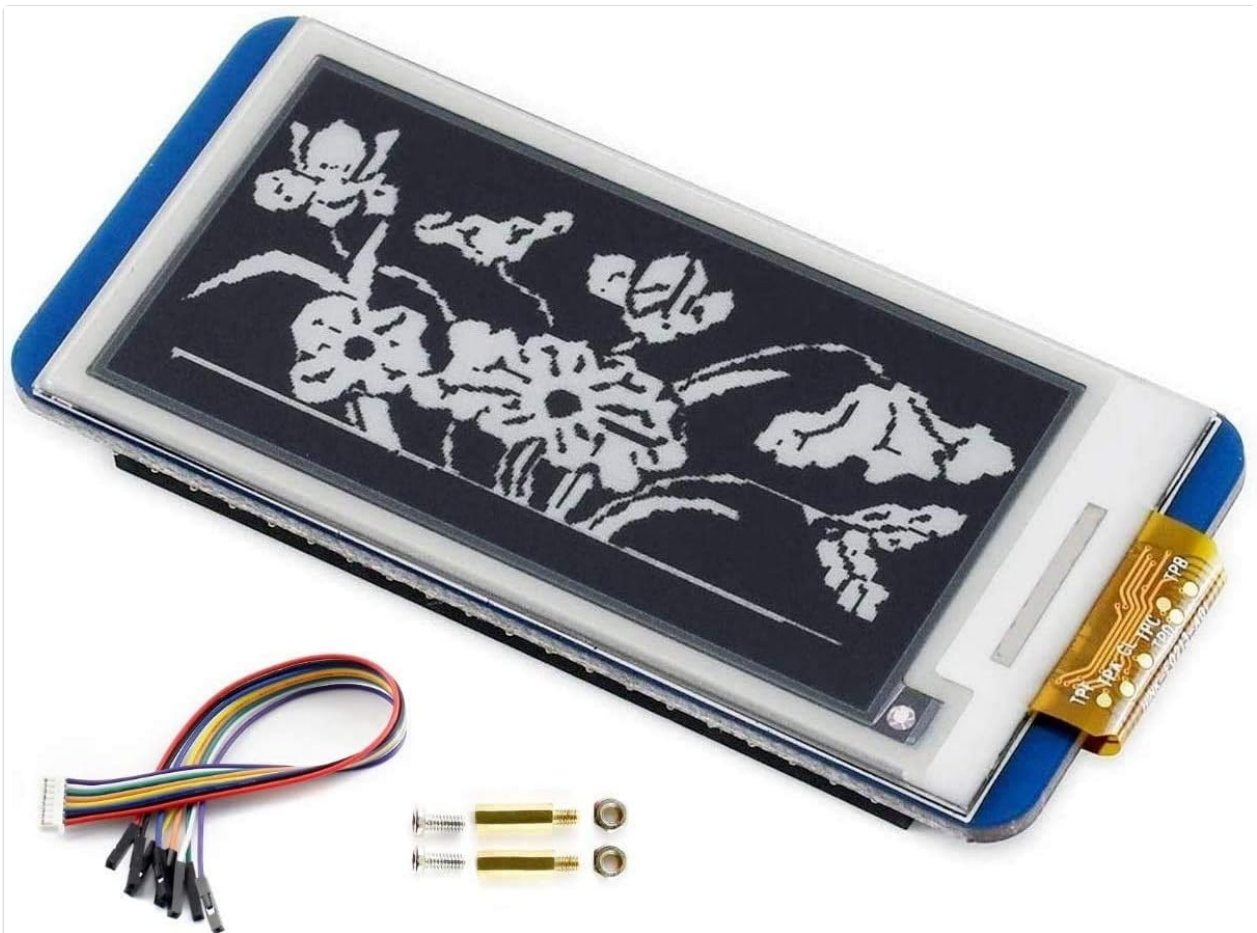
Image 1.1: The 2.13inch E-Ink Display HAT V4 module with included accessories.

2. PACKAGE CONTENTS

- 2.13inch e-Paper HAT x1
- RPi screws pack (2pcs) x1
- PH2.0 20cm 8Pin cable x1

3. SPECIFICATIONS

Feature	Description
Operating Voltage	3.3V / 5V
Interface	SPI
Outline Dimension	65mm × 30.2mm
Display Size	23.71mm × 48.55mm
Dot Pitch	0.194 × 0.194
Resolution	250 × 122 pixels
Display Color	Black, White
Grey Level	2

Partial Refresh Time	0.3s
Full Refresh Time	2s
Refresh Power	26.4mW (typical)
Standby Power	<0.017mW
Viewing Angle	>170°

Parameters

Operating Voltage	3.3V/5V	grayscale	2
Communication Interface	3-wire SPI、4-wire SPI	partial refresh	0.3s
Dimensions	65 × 30.2mm	global refresh	2s
Display size	48.55 x 23.71mm	Refresh power consumption	26.4mW (typ.)
dot pitch	0.194 × 0.194mm	sleep current	<0.01uA (close to 0)
Resolution	250 × 122pixels	Viewing angle	>170°
display color	black and white		

Image 3.1: Detailed specifications of the 2.13inch E-Ink Display HAT V4.

4. SETUP & HARDWARE CONNECTION

4.1 Connecting to Raspberry Pi

The 2.13inch E-Ink Display HAT V4 is designed to directly connect to the 40-pin GPIO header of Raspberry Pi boards. Ensure proper alignment of the pins before pressing the HAT onto the Raspberry Pi. The module includes an onboard voltage translator, making it compatible with both 3.3V and 5V MCUs.

Based on Raspberry Pi 40PIN interface

For Raspberry Pi series boards, Jetson Nano

Note: This product does not include the Raspberry Pi in the schematic diagram, if necessary, please purchase it separately.

Image 4.1: The 2.13inch E-Ink Display HAT V4 connected to a Raspberry Pi Zero.

Image 4.2: Hardware connection tables for various platforms including Raspberry Pi, Arduino, Jetson Nano, and STM32.

4.2 SPI Interface Pinout

The module communicates via the Serial Peripheral Interface (SPI). Below is the pinout for the SPI interface:

Pin	Function
VCC	3.3V / 5V Power Supply
GND	Ground
DIN	SPI MOSI (Master Out Slave In)
CLK	SPI SCK (Serial Clock)
CS	SPI Chip Select (Low active)
DC	Data/Command Control Pin (High for data, Low for command)
RST	External Reset Pin (Low for reset)
BUSY	Busy State Output Pin (Low for busy)
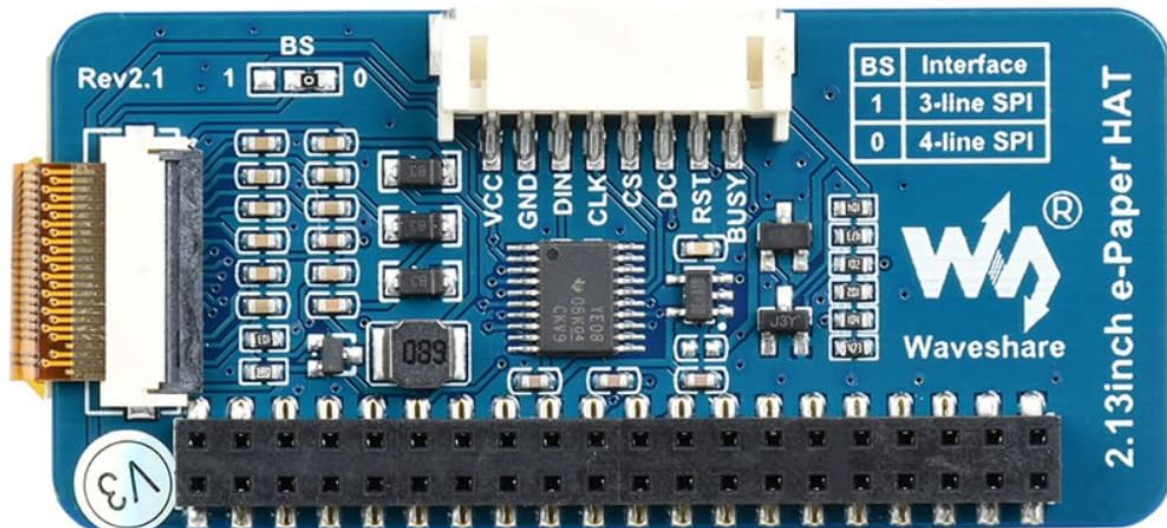
VCC	3.3V/5V
GND	GND
FROM	SPI communication MOSI pin
CLK	SPI communication SCK pin
CS	SPI chip select pin (active low)
DC	Data/command control pin (high for data, low for command)
RST	External reset pin (low reset)
BUSY	Busy status output pin (high level means busy)

Image 4.3: Pinout and interface details for the 2.13inch E-Ink Display HAT V4.

5. OPERATING PRINCIPLES: ADVANTAGES OF E-INK DISPLAYS

E-Ink displays, also known as e-paper, utilize microcapsule electrophoresis technology. This technology involves charged nanoparticles suspended in a liquid that migrate under the action of an electric field, forming a display that closely resembles traditional printed paper. The primary advantages of e-ink screens include:

- **Ultra-Low Power Consumption:** Power is primarily consumed only during display refreshes, not for maintaining a static image.
- **No Backlight:** E-Ink displays are reflective, relying on ambient light, which makes them easy on the eyes and visible in bright conditions.
- **Persistent Display:** Content remains visible for extended periods even when power is removed.
- **Wide Viewing Angle:** Offers a viewing angle greater than 170 degrees, similar to paper.

Advantages of e-ink Displays

The electronic ink screen uses the "microcapsule electrophoresis display" technology to display images. Its working principle is that the charged nanoparticles suspended in the liquid migrate under the action of the electric field, and form a display close to traditional printing paper through reflection under ambient light. Effect. The e-ink screen can clearly display the picture under ambient light such as light and natural light without backlight, and the viewing angle can reach almost 180°. Because of its display effect comparable to traditional paper, it is often used in applications such as readers.

Electronic Paper Display　　Printing on A4 paper　　LCD Display

Image 5.1: Visual comparison highlighting the paper-like effect of E-Ink displays.

6. SOFTWARE & DEVELOPMENT RESOURCES

Waveshare provides comprehensive online development resources and user manuals to assist with quick setup and programming. These resources typically include:

- Driver board schematics
- User manuals with detailed instructions
- Demo code and examples for Raspberry Pi, Arduino, and STM32
- Libraries and API documentation

For access to these resources, please refer to the official Waveshare product page or contact their support.

6.1 Introduction Video

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Video 6.1: An introductory video showcasing the features and basic operation of the 2.13inch E-Paper HAT+ for Raspberry Pi, highlighting its low power consumption and compatibility.

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Video 6.2: A video demonstrating the 2.13inch E-Ink display HAT, its partial refresh capabilities, and its use with Raspberry Pi and Jetson Nano.

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Video 6.3: A general overview video of the 2.13 inch e-Paper HAT, illustrating its features such as low power consumption and the ability to display static content without power.

7. APPLICATION EXAMPLES

The unique characteristics of E-Ink displays make them ideal for a variety of applications where low power, readability, and persistent display are crucial:

- Electronic Shelf Labels in retail environments
- Industrial Instrumentation displays
- Price Tags and Asset/Equipment Tags
- Conference Name Tags and information displays
- Low-power data logging displays

2.13 inch e-ink Display HAT

Support partial refresh, low power consumption, wide viewing angle, and clear display after power failure

For display applications such as shelf labels, industrial instrumentation, etc.
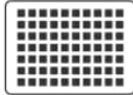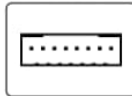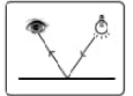
size	Resolution	Viewing angle	display color	gray level	partial refresh
2.13 inches	250 × 122	>170°	black and white	2	Support partial refresh

Communication Interface	display panel	Display experience	display environment	Display method
SPI	E-ink screen	close to paper	Visible in ambient light	Reflective, not actively emitting light

Image 7.1: Overview of the 2.13inch E-Ink Display HAT's features and potential applications.

Image 7.2: Detailed view of the onboard level conversion chip and physical dimensions of the module.

8. TROUBLESHOOTING

If you encounter issues with your 2.13inch E-Ink Display HAT V4, consider the following:

- **Connection Check:** Ensure all pins are correctly aligned and securely connected to the Raspberry Pi or other controller board. Verify the PH2.0 cable is properly seated.
- **Power Supply:** Confirm that your Raspberry Pi or controller board is receiving adequate power.
- **Software Setup:** Double-check your code and ensure all necessary libraries and drivers are installed and configured correctly as per the Waveshare online resources.

- **SPI Interface:** Verify that the SPI interface is enabled on your host device (e.g., Raspberry Pi).
- **Partial vs. Full Refresh:** If the display shows ghosting or artifacts, perform a full refresh. E-Ink displays that support partial refresh may require occasional full refreshes to clear residual images.
- **Voltage Compatibility:** The onboard voltage translator supports 3.3V/5V. Ensure your MCU's voltage is within this range.

For persistent issues, consult the Waveshare online development resources or contact their technical support.

9. WARRANTY & SUPPORT

This Waveshare product is covered by the standard manufacturer's warranty. For detailed warranty information, technical support, or to access additional resources, please visit the official Waveshare website or contact their customer service department. Online development resources and user manuals are available to assist with product integration and troubleshooting.
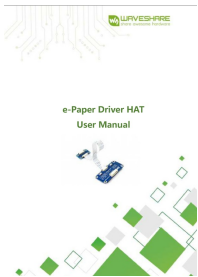
Related Documents - WS-12915
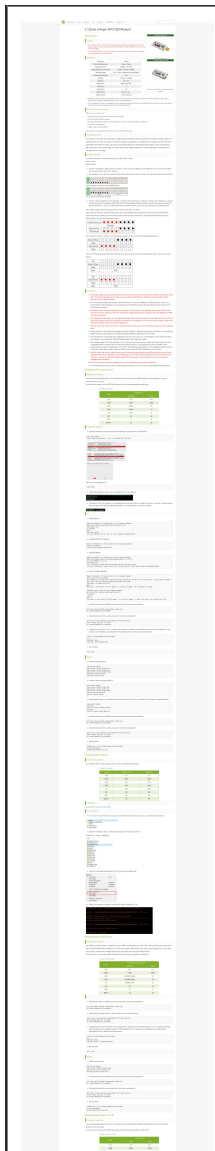
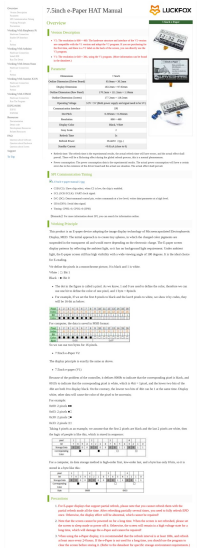[Waveshare 2.13inch e-Paper HAT (B) User Manual and Technical Guide](#)
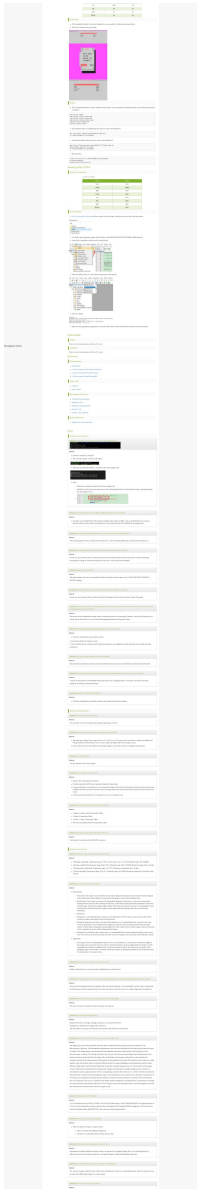
Comprehensive guide for the Waveshare 2.13inch e-Paper HAT (B), covering hardware connections, software setup, programming principles, and troubleshooting for Raspberry Pi, Arduino, Jetson Nano, and STM32.

[Waveshare e-Paper Driver HAT User Manual: Connect SPI E-Paper Displays to Raspberry Pi, Arduino, STM32](#)
User manual for the Waveshare e-Paper Driver HAT, detailing its features, product parameters, interface specifications, and supported e-Paper models. Includes setup guides for Raspberry Pi, Arduino, and STM32 development boards.
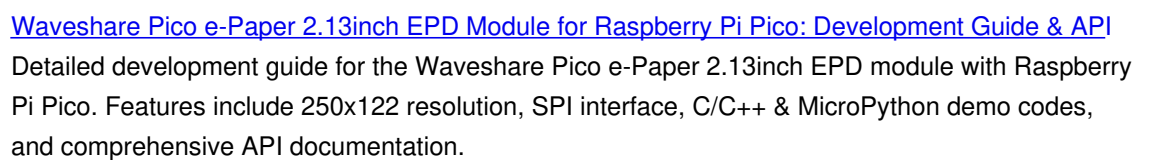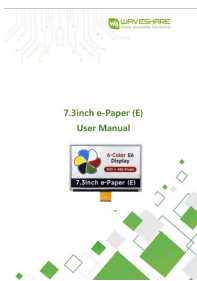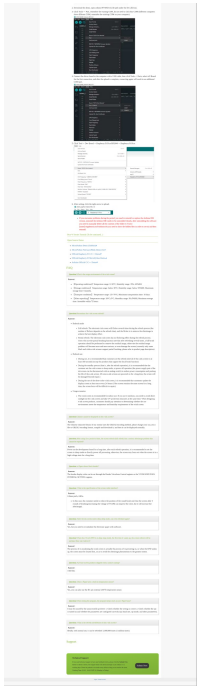
[Waveshare 7.5-inch E-Paper HAT User Manual and Guide](#)

This comprehensive user manual provides detailed information on the Waveshare 7.5-inch E-Paper HAT (V1/V2), an 800x480 resolution display module utilizing Microencapsulated Electrophoretic Display technology. It covers hardware connections, SPI communication, working principles, and integration with Raspberry Pi, Arduino, Jetson Nano, Sunrise X3 Pi, STM32, ESP32, and ESP8266. Essential precautions, resources, and FAQs are included for optimal use.
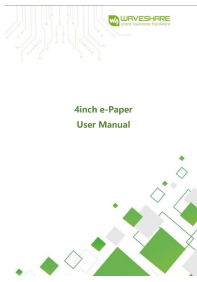
[Waveshare 7.3inch e-Paper (E) User Manual - Specifications and Guide](#)
Comprehensive user manual for the Waveshare 7.3inch e-Paper (E) display module, detailing specifications, features, pin assignments, electrical and optical characteristics, and handling instructions.

[Waveshare 4-inch e-Paper Display User Manual](#)
Comprehensive user manual for the Waveshare 4-inch e-Paper display module (EL040EF1), detailing its features, specifications, electrical characteristics, power sequences, optical properties, handling, safety, and reliability tests.