

嵌入式 HMI 产品规格书

Embedded HMI Module Specification

☒初定规格 Preliminary specification

☐正式规格 Official specifications

项目编号 Project No.	HTM-H050A29-ESP-StdRGB
产品描述 Product Description	5.0英寸ESP32-S3嵌入式HMI模块 支持Wi-Fi + BLE5 800×480 分辨率
客 户 确 认 签 章: Signature by customer:	
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HotDisplay Technology Co., Ltd

鑫洪泰科技（广东）有限公司

深圳市鑫洪泰电子科技有限公司

广东省东莞市凤岗镇东深公路凤岗段 208 号天安数码城 N3 栋 3 楼

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一、产品概述 Product Overview

1.1 简介 Introduction

HTM-H050A29-ESP-StdRGB 是一款基于 ESP32-S3-WROOM-1 (N8R8) 的嵌入式 HMI 模块, 集成 2.4 GHz Wi-Fi 与 BLE 5.0 无线通信, 板载 8 MB Flash 与 8 MB Octal PSRAM, 搭配 5.0 英寸 RGB 接口 TFT LCD 显示屏 (800×480 分辨率) 与电容触摸面板, 支持基于 LVGL GUI 框架开发图形界面。

本模块提供 1 路 UART 外部通信接口与 2 路 USB Type-C 接口 (USB-UART 调试+ESP32 原生 USB), 支持固件烧录、串口调试与 USB CDC 通信。基于 ESP-IDF 开发框架, 采用 BSP / Display / Panel 三层组件化架构, 通过 menuconfig 即可切换板卡、显示接口与屏幕型号, 适用于工业 HMI、智能家居控制面板、物联网终端显示、消费电子等人机交互场景。

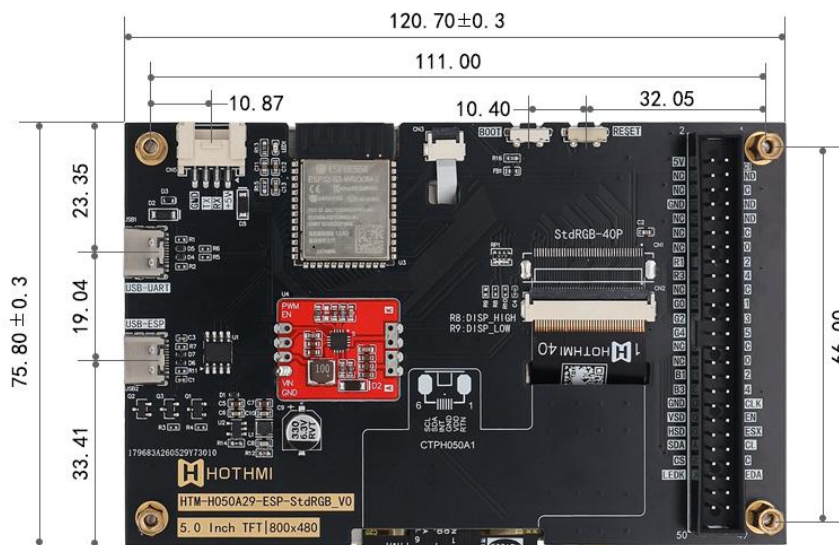
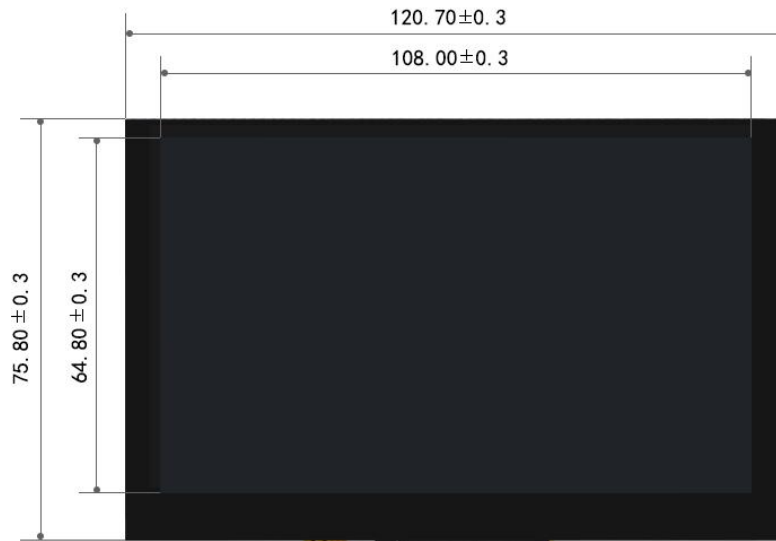
HTM-H050A29-ESP-StdRGB is an embedded HMI module based on the ESP32-S3-WROOM-1 (N8R8V) module, integrating 2.4 GHz Wi-Fi and BLE 5.0 wireless communication. It features 8 MB Flash and 8 MB Octal PSRAM, paired with a 5.0-inch RGB-interface TFT LCD display (800×480 resolution) and capacitive touch panel, supporting GUI development with LVGL.

The board provides 1× UART external communication interface and 2× USB Type-C ports (USB-UART for debugging + ESP for native USB), supporting firmware flashing, serial debugging, and USB CDC communication. Built on the ESP-IDF framework with a three-layer component architecture (BSP / Display / Panel), it allows switching between boards, display interfaces, and panel models via menuconfig. It is suitable for industrial HMI, smart home control panels, IoT terminal displays, and consumer electronics applications.

1.2 核心特性 Key Features

- ◆ 无线 HMI 一体化, 集显示、触摸、Wi-Fi、BLE 于一板, 提供配套驱动与示例, 便于客户二次开发
- ◆ ESP32-S3 双核 + 8MB PSRAM, 支持 LVGL 图形界面及无线通信应用开发
- ◆ 配套 5 英寸 TFT RGB 显示屏, 800×480 分辨率, 采用 16 位 RGB565 显示输出
- ◆ 支持 I2C 接口电容触摸, 5 点触控, 支持中断
- ◆ ESP-IDF + BSP/Display/Panel 三层组件化架构, menuconfig 一键切换板卡/接口/屏幕
- ◆ 提供 USB-UART、ESP32 原生 USB 及 UART 接口, 应用通信协议由客户按项目需求开发
- ◆ 面向设备控制面板、仪器仪表及物联网终端的人机交互应用
- ◆ Wireless HMI integration, all-in-one board for display, touch, Wi-Fi, and BLE, with supporting drivers and examples for customer application development
- ◆ ESP32-S3 dual-core + 8MB PSRAM, supports LVGL GUI and wireless application development
- ◆ 5-inch TFT RGB display with 800×480 resolution and 16-bit RGB565 output
- ◆ Supports I2C interface capacitive touch, 5-point touch, and interrupt support
- ◆ ESP-IDF + BSP/Display/Panel three-layer component architecture, menuconfig enables one-click switching between board/card/interface/screen

- ◆ Provides USB-UART, native USB and UART interfaces for firmware development and application communication
- ◆ Designed for user interfaces in equipment control panels, instruments and IoT terminals



二、主要参数 Main Parameters

项目 Item	标准值 Standard Value	单位 Unit
主控芯片 MCU	ESP32-S3	-
主频 CPU Frequency	240	MHz
内存 Memory	8MB PSRAM	-
存储 Storage	8MB Flash	-
无线 Wireless	WiFi 2.4GHz + Bluetooth 5	-
编程平台 Programming Platform	ESP-IDF v6.0.0	-
固件下载方式 Firmware Download	USB TYPE-C	-
供电方式 Power Supply	USB-5V	-
默认配套显示屏 Bundled Display	TFT-H050A29	-
显示接口 Display Interface	RGB 16Bit	-
板载通信接口 On-board Comms	UART	-
外形尺寸 Dimensions	120.7x75.8x8.15	mm
工作温度 Operating Temperature	-20~+70	°C

三、配套显示屏 Bundled Display

项目 Item	参数 Specification	单位 Unit
屏幕 Display	TFT-H050A29	—
显示尺寸 Size	5.0	inch
分辨率 Resolution	800 × 480	pixels
显示接口 Interface	16-bit RGB parallel	—
模块输出格式 Output format	RGB565	—
触摸方式 Touch type	电容触摸 Capacitive touch	—
触摸接口 Touch interface	I2C	—
触摸点数 Touch points	5（按配套触摸屏配置）	points

本型号的默认配套分辨率为 800×480。显示效果、亮度和触摸功能与配套屏幕及应用程序有关；屏幕光学参数以对应显示屏规格书为准。

The standard panel resolution is 800×480. Optical specifications are defined in the specification of the bundled display.

四、开发资源 Development Resources

4.1 配套软件 Software Resources

本产品按“显示屏+控制板+SDK 及示例工程”的方式交付，面向具备嵌入式开发能力的客户。客户可在配套示例基础上开发界面、设备通信及业务功能。

The product combines a display, controller board and SDK/examples. Customers develop their own user interface, device communication and application logic.

资源 Resource	用途 Purpose
ESP-IDF 6.0.0	示例工程所采用的开发框架。 Development framework used by the example project.
LVGL 示例工程 LVGL example project	用于显示驱动、触摸交互及图形界面开发参考。 Examples for display, touch interaction and GUI development.
板级与显示适配 Board and display support	提供ESP32-S3及ESP32-P4相关板卡、显示接口和屏幕配置。 Board, interface and panel configurations for ESP32-S3 and ESP32-P4.
README 使用文档 Repository README	提供当前版本的环境安装、配置、编译、下载及常见问题说明。 Current setup, configuration, build, flashing and troubleshooting instructions.

4.2 示例仓库 Repository

<https://github.com/HotDisplay/esp32-hmi-demo>

仓库包含 ESP32-S3 和 ESP32-P4 驱动显示屏的 LVGL 示例。本型号使用 ESP32-S3 与 RGB 显示接口，请按本型号选择配套资料。ESP32-P4 及其他板卡的接口和外设功能以相应硬件为准。

软件使用方法、支持范围及更新说明以仓库 README 为准。开始项目开发时，建议保存所采用的软件版本和配置，以便后续维护。

The repository contains LVGL display examples for ESP32-S3 and ESP32-P4. This model uses ESP32-S3 with an RGB display interface. Features available on other boards depend on their hardware.

Refer to the repository README for current usage, supported features and updates. Retain the software revision and configuration used for each project.

五、接口与连接说明 Interfaces and Connections

5.1 外部连接 External Connections

接口或标识 Interface	用途 Function	使用说明 Notes
USB-UART USB Type-C	USB转串口, 用于下载及串口调试。 USB-to-UART flashing and debug.	首次开发建议使用此接口; 通过数据线连接电脑。 Recommended PC connection for initial development.
USB-ESP USB Type-C	ESP32-S3原生USB接口。 ESP32-S3 native USB.	功能由固件配置决定, 具体使用方式见README。 Operation depends on firmware configuration.
UART	外部串口通信。 External serial communication.	按原理图核对TX、RX、GND及电平。 Check signals and voltage levels before connection.
RGB显示连接 RGB display connection	连接配套TFT显示屏。 Connection to the TFT panel.	本型号采用16位RGB输出; 引脚定义见原理图。 16-bit RGB output; refer to the schematic.
CTP触摸连接 CTP connection	连接配套电容触摸屏。 Connection to the capacitive touch panel.	采用I ² C通信; 连接及配置应与屏幕匹配。 I ² C interface; use the matching touch configuration.
BOOT / RESET	下载模式与复位控制。 Download mode and reset.	操作方法见第九章使用说明。 See Chapter 9 for operation.

5.2 连接注意事项 Connection Notes

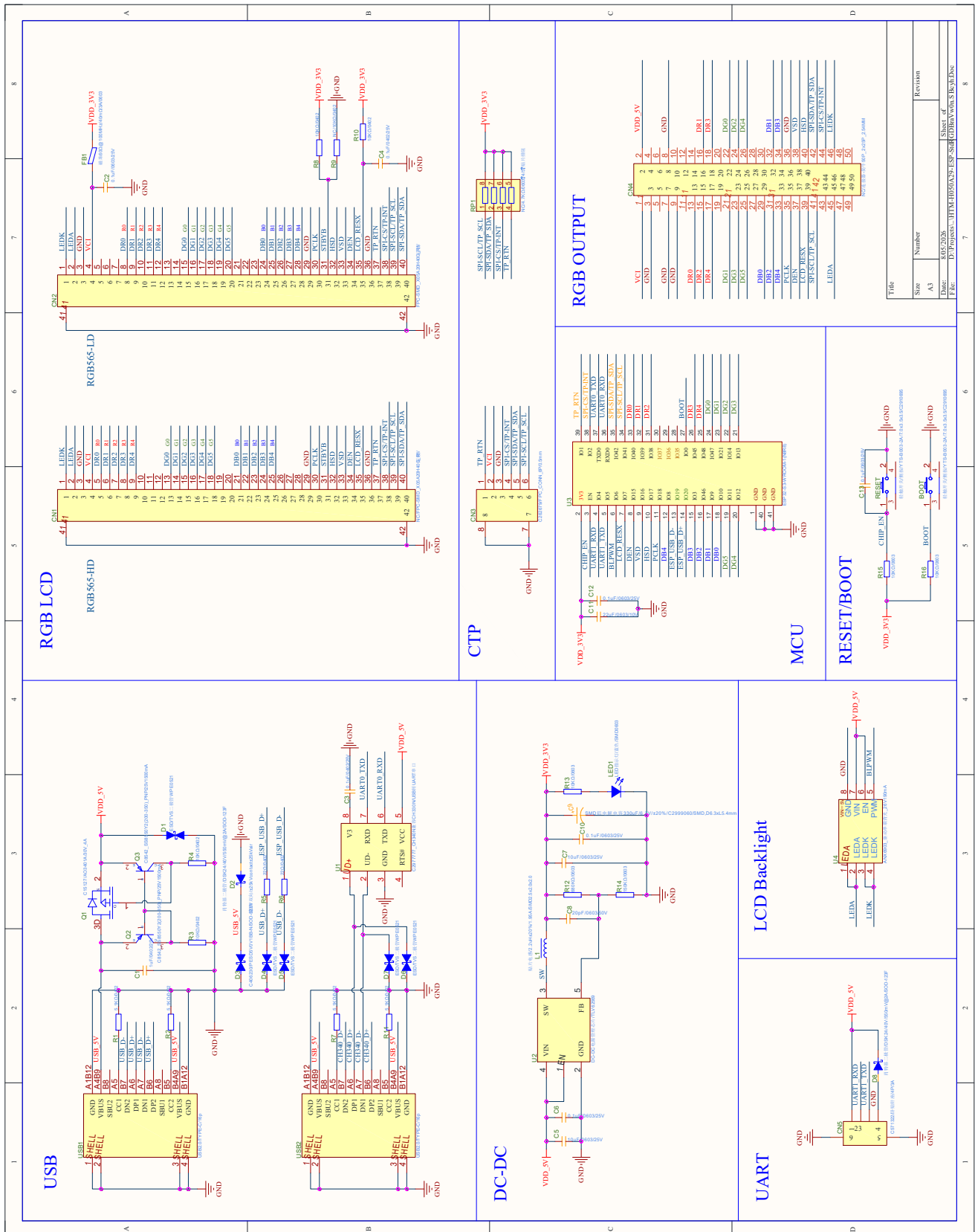
连接器位置可参见产品实物图, 连接器引脚、电气连接及器件配置以本型号原理图为准。更换显示屏、插拔排线或连接外部电路前, 请先断开电源。

UART 接入外部设备时需匹配信号电平; 接入 RS-232 或 RS-485 设备应配置相应电平转换或收发电路。首次使用建议仅连接一个 USB 接口供电。

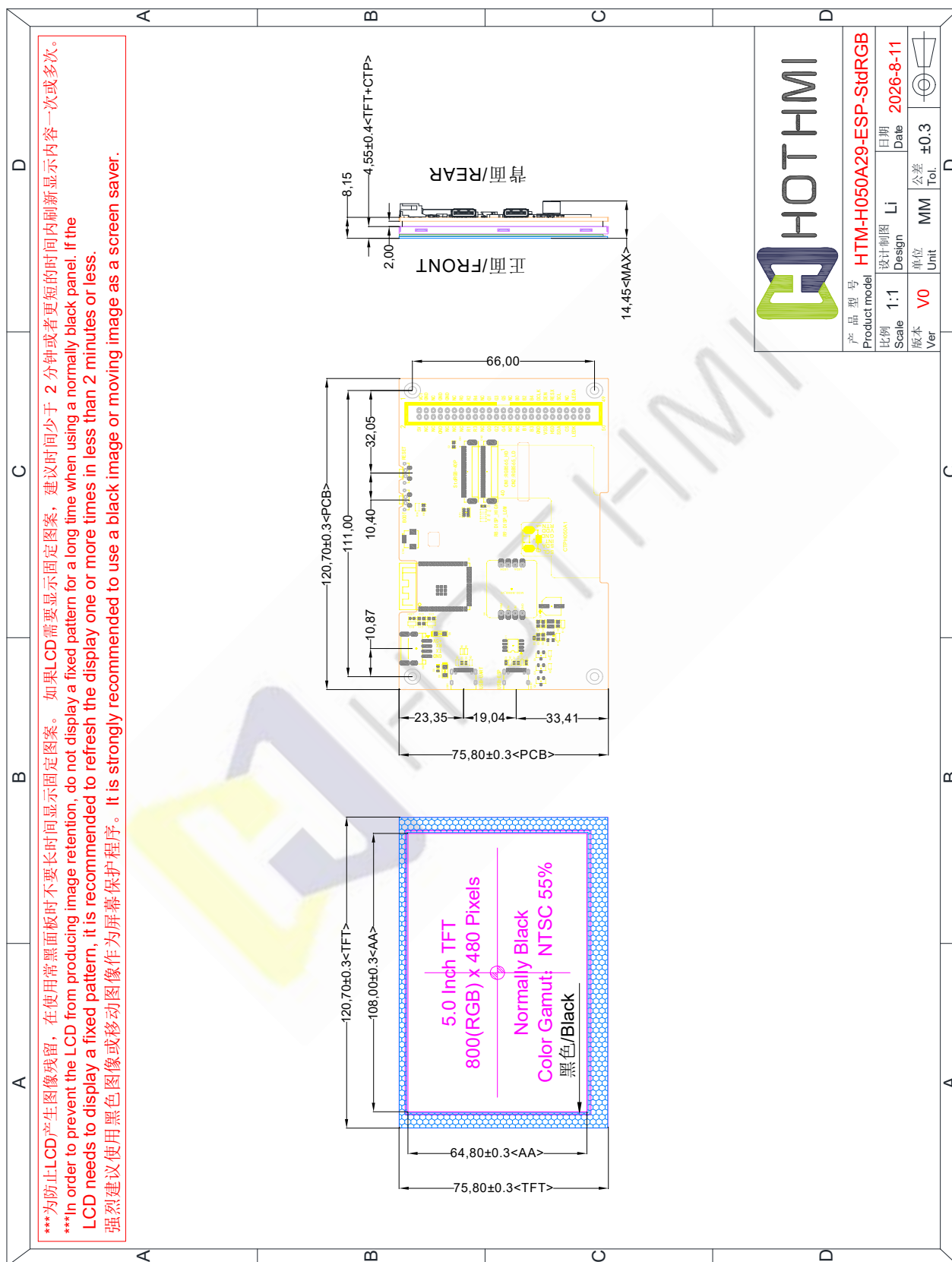
Use the product images to locate connectors and the schematic to confirm pin definitions. Disconnect power before changing panels, reconnecting FPC cables or wiring external circuits.

Match UART signal levels to the external device. RS-232 or RS-485 connections require the appropriate interface circuitry. Use one USB power connection during initial setup.

六、原理图 Schematic



七、尺寸图 Outline Dimensions



八、使用说明 Getting Started

8.1 使用准备 Before You Start

准备本 HMI 模块、一台电脑和一根支持数据传输的 USB Type-C 线。通过 USB-UART 接口连接电脑，可使用同一根数据线完成模块供电、程序下载和串口调试，无需另配 USB 转串口工具。

用于下载和调试的 USB 线必须支持数据传输。仅支持充电的线缆可以供电，但不能用于程序下载或串口通信。

Prepare the HMI module, a computer and a USB Type-C data cable. The USB-UART port provides power, firmware flashing and serial debugging through one cable.

Use a data-capable cable for flashing and debugging. A charge-only cable cannot transfer firmware or serial data.

8.2 首次连接与上电 First Connection

1. 确认配套显示屏及触摸排线连接到位，模块放置平稳，背面电路避免接触导电物体。
2. 将 USB 数据线连接至板上标有 USB-UART 的接口，另一端连接电脑 USB 接口。
3. 电脑识别串口后，即可按仓库 README 进行程序下载或串口调试；如未识别串口，检查线缆并安装匹配的 USB 转串口驱动。
4. 上电后模块运行内部已烧录的程序。若已预装演示程序，可观察画面并操作触摸界面；需要更新或开发功能时，再下载配套示例或客户应用程序。
5. 使用外接 5 V 电源运行已烧录程序时，无需始终连接电脑。电源连接方式及供电要求应符合本规格书和原理图。

1. Ensure that the accompanying display screen and touch cable connections are properly made, the module is placed stably, and the back circuitry is kept away from conductive objects.

2. Connect the USB data cable to the interface marked as USB-UART on the board, and connect the other end to the USB interface of the computer.

3. After the computer recognizes the serial port, you can download the program or perform serial port debugging according to the README in the warehouse; if the serial port is not recognized, check the cable and install the matching USB-to-serial port driver.

4. After powering on, the module runs the program that has been burned in. If the demonstration program has been pre-installed, you can observe the screen and operate the touch interface; when you need to update or develop functions, download the accompanying examples or customer applications.

5. When running the burned-in program with an external 5V power supply, you do not need to always connect the computer. The power connection method and power supply requirements should comply with this specification and the schematic diagram.

8.3 示例程序与二次开发 Examples and Development

[示例代码与使用方法 Example Code and Instructions](#)

配套示例基于 ESP-IDF 6.0.0，包含 ESP32-S3 及 ESP32-P4 驱动显示屏的 LVGL 演示工程。本型号应选用 ESP32-S3、HTM-H050A29-ESP-StdRGB 及 H050A29 对应的配置。

请在仓库 README 中查看开发环境安装、示例配置、编译、下载及调试方法。客户可在示例基础上修改界面、添加控件并接入设备数据；示例中的功能以对应硬件和当前软件说明为准。

The examples use ESP-IDF 6.0.0 and include LVGL display demos for ESP32-S3 and ESP32-P4. Select the ESP32-S3, HTM-H050A29-ESP-StdRGB and H050A29 configuration for this model.

Follow the README for environment setup, configuration, build, flashing and debugging. Customize the example UI and connect application data as required.

8.4 下载模式与复位 Download Mode and Reset

需要重新启动模块时，短按 RESET。若下载工具无法自动连接，可按住 BOOT，短按并释放 RESET，再松开 BOOT，使模块进入下载模式，然后按 README 进行下载。下载完成后短按 RESET 运行程序。

Press RESET to restart. If flashing does not connect automatically, hold BOOT, press and release RESET, then release BOOT. Flash the firmware as described in the README and press RESET to run it.

8.5 日常使用 Operating Notes

已烧录程序保存在 Flash 中，正常断电后无需重复下载。修改界面或功能后，需要重新编译并下载相应应用程序。

触摸交互、Wi-Fi 及 BLE 等功能由应用程序实现和配置。硬件具备相应接口，不代表所有功能在每个演示版本中均已启用。

Firmware is stored in Flash and does not need to be reflashed after a normal power cycle. Rebuild and reflash the application after changing its interface or functions.

Touch interaction, Wi-Fi and BLE behavior depend on the application. Availability of a hardware interface does not mean every demo enables it.

8.6 常见问题 Troubleshooting

现象 Symptom	检查方法 What to Check
电脑无法识别串口 Serial port is not detected	确认连接USB-UART接口，使用支持数据传输的线缆，并检查USB转串口驱动。 Check the port, data cable and USB-to-UART driver.
程序无法下载 Flashing fails	关闭占用串口的软件，核对所选端口，按下载模式步骤重试；详细方法见README。 Check port selection and enter download mode if needed.
屏幕没有显示 No display	确认供电、排线及已烧录程序；核对应用程序选用的板卡和屏幕配置。 Check power, FPC connections, firmware and board/panel selection.

现象 Symptom	检查方法 What to Check
有显示但触摸无响应 Display works but touch does not	检查触摸排线及触摸功能配置，按README核对配套触摸驱动。 Check the touch cable, configuration and matching driver.
无线功能没有响应 Wireless function is unavailable	确认应用程序已经启用并配置相应功能；Wi-Fi使用2.4 GHz网络。 Check application settings and use a 2.4 GHz Wi-Fi network.

如需技术支持，请提供产品型号、硬件版本、使用的软件版本、连接方式和故障现象，便于定位问题。

For technical support, provide the model, hardware revision, software version, connections and a description of the issue.

文档修订记录 Document revision history

版本 Version	日期 DATE	修改说明 Modify description	编著 Editorial
0-1	2026-09-30	初次编制 First compilation.	Li

— — 结束 — —

— — END — —