

PaperMono

SKU:C153

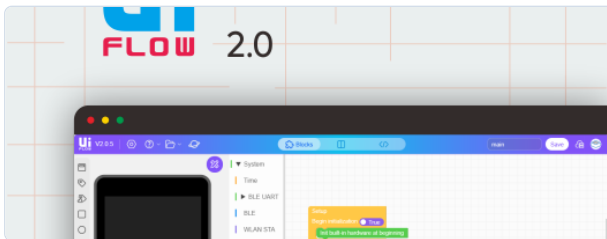




Description

PaperMono is an e-paper development board built around low-power display, near-field identification, and long-range communication capabilities. It features a touch-enabled 3.97-inch 4-level grayscale monochrome e-paper display, driven by SSD1677 with a resolution of 480 x 800, and integrates an FT6336G touch controller and a frontlight system for a more comfortable reading and interaction experience in low-light environments. The core adopts an ESP32-S3R8, paired with 16MB Flash, 8MB PSRAM, and 2.4 GHz Wi-Fi, along with an onboard buzzer, PDM microphone (LMD4737T261-AC02), RGB LED, BMI270 6-axis IMU, M5IOE1 IO expander, microSD card slot, and RX8130CE real-time clock. The NFC section is based on the ST25R3916, supporting ISO14443A, ISO14443B, FeliCa™, and ISO15693; LoRa communication adopts the SX1262 (Stamp LoRa-1262) solution with a built-in FPC antenna, supporting the 868MHz ~ 923MHz band. Combined with the M5PM1 multi-level power management system and a 1150mAh battery, it meets the requirements of low-power IoT and embedded applications such as e-readers, e-paper signage, access control terminals, identity authentication, and intelligent transportation.

Tutorial



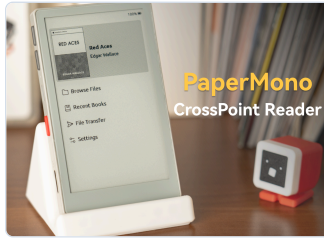
UiFlow2

This tutorial will introduce you to controlling the PaperMono device through the UiFlow2 graphical programming platform.



Arduino IDE

This tutorial introduces how to program and control the PaperMono device using Arduino IDE.



CrossPoint E-Reader

[Click here to download the PaperMono CrossPoint E-Reader firmware.](#)

Note

E-Paper Usage Precautions

1. Avoid direct sunlight/prolonged sun exposure during use; high temperatures or strong UV can damage the panel.
2. After approximately 10 partial fast refreshes in software, it is recommended to perform one full-screen refresh to clear the screen and avoid severe accumulated ghosting.
3. The screen has built-in OTP waveforms that can be called directly. When using custom external waveforms, pay attention to DC balance; otherwise, irreversible damage may be caused to the panel.
4. Avoid uninterrupted continuous partial fast refreshes, to prevent long-term DC imbalance from causing irreversible damage to the panel.

Touch Active Area

PaperMono Touch Active Area

The touch IC firmware internally shrinks the touch boundary. The effective touch coordinate range is limited to: **X-axis: 5 ~ 475** (total width 480px), **Y-axis: 5 ~ 795** (total height 800px).

Features

- ESP32-S3R8 Core Controller
 - 16MB Flash
 - 8MB PSRAM
 - 2.4 GHz Wi-Fi
- 3.97-inch 4-level grayscale monochrome e-paper display with touch
 - SSD1677
 - 480x800 resolution
 - 4-level grayscale display
 - FT6336G touch
- Integrated frontlight system
- Audio interaction
 - PDM microphone (LMD4737T261-AC02)
 - Built-in buzzer
- Onboard peripherals
 - BMI270 6-axis IMU
 - M5IOE1 IO expander
 - microSD card slot
 - RX8130CE RTC
 - RGB LED

- NFC function
 - ST25R3916
 - Supports ISO14443A / ISO14443B / FeliCa™ / ISO15693
- LoRa communication
 - SX1262 (Stamp LoRa-1262)
 - 868MHz ~ 923MHz
 - Built-in FPC antenna
- Built-in 1150mAh battery

| Includes

- 1 x PaperMono

| Applications

- E-Reader
- E-Paper Signage
- Access Control Terminal
- Identity Authentication Device
- Intelligent Transportation Terminal

Specifications

Specification	Parameter
SoC	ESP32-S3R8 @ Xtensa® 32-bit LX7 dual-core processor, 240MHz
Flash	16MB
PSRAM	8MB Octal
Wi-Fi	2.4 GHz Wi-Fi
Screen	3.97" E-Paper (Mono) SSD1677 @ 480x800, Touch FT6336G
Screen Grayscale	4-level grayscale display
Frontlight	Integrated e-paper frontlight
Input Power	USB Type-C DC 5V
Battery Capacity	1150mAh
Microphone	PDM microphone LMD4737T261-AC02
Buzzer	Built-in buzzer
IMU	BMI270
Power Management	M5PM1
IO Expander	M5IOE1
Expansion Storage	microSD
RTC	RX8130CE
RGB LED	Built-in RGB LED
NFC	ST25R3916 (ISO14443A/B, FeliCa™, ISO15693)
LoRa	SX1262 (Stamp LoRa-1262), 868MHz ~ 923MHz, built-in FPC antenna
User Buttons	2x user buttons + 1x power button (ON / OFF / RESET / BOOT)
Product Size	62.0 x 101.0 x 8.0mm
Product Weight	74.7g
Package Size	113.2 x 69.6 x 21.0mm
Gross Weight	91.3g

Learn

Power On/Off

- Power on / Reset: press the power button once briefly
- Power off: press the power button twice in succession

[C153_PaperMono_poweron_EN.mp4](#)

Download Mode

Press and hold the power button (about 2 seconds) until the red LED blinks, then release. The device enters download mode and is ready for flashing.



M5GFX LUT Refresh Speed

The following data is the laboratory test result of PaperMono under different M5GFX refresh modes. The actual refresh time may vary depending on the display content and operating environment, and is provided for reference only.

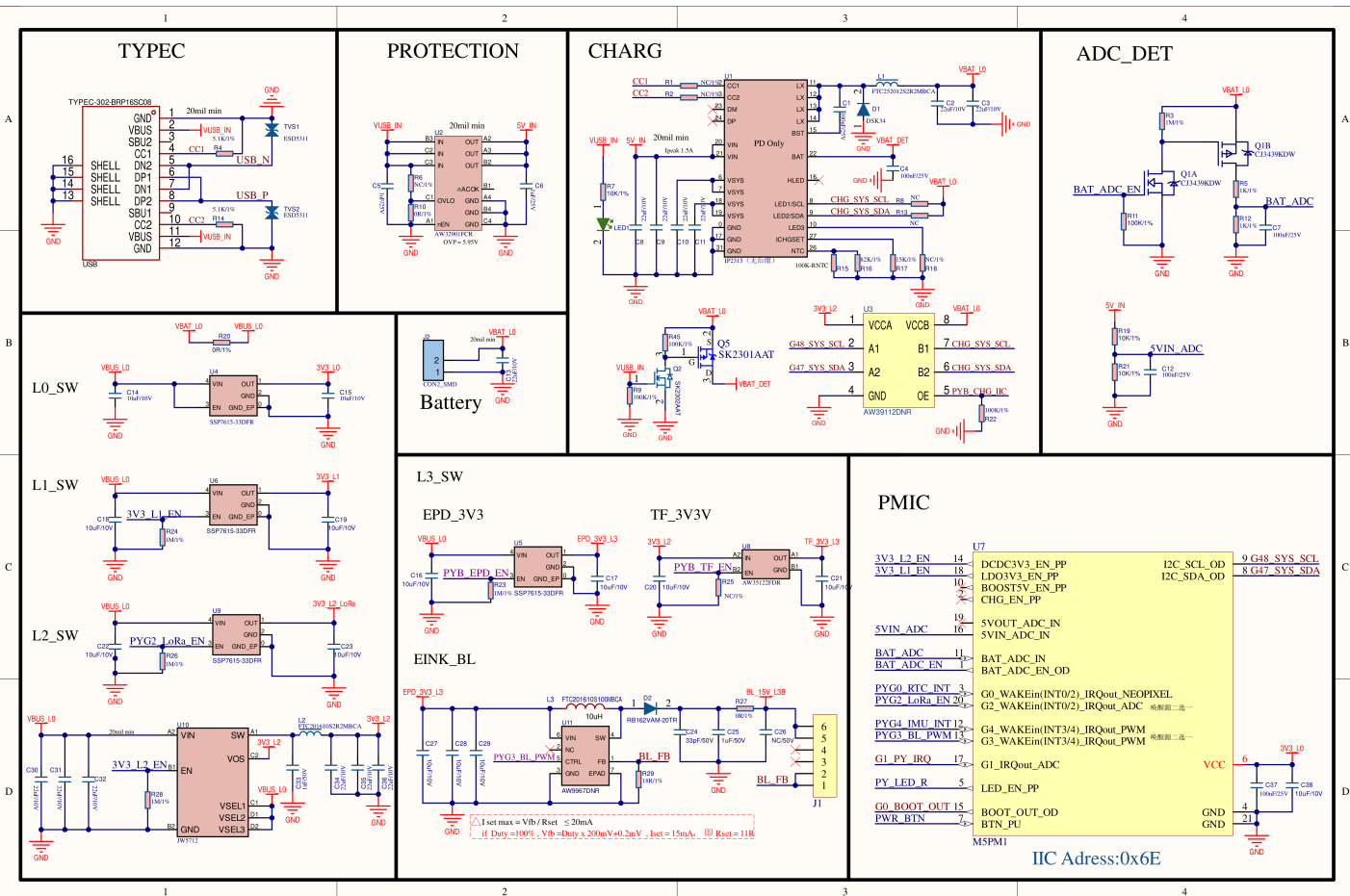
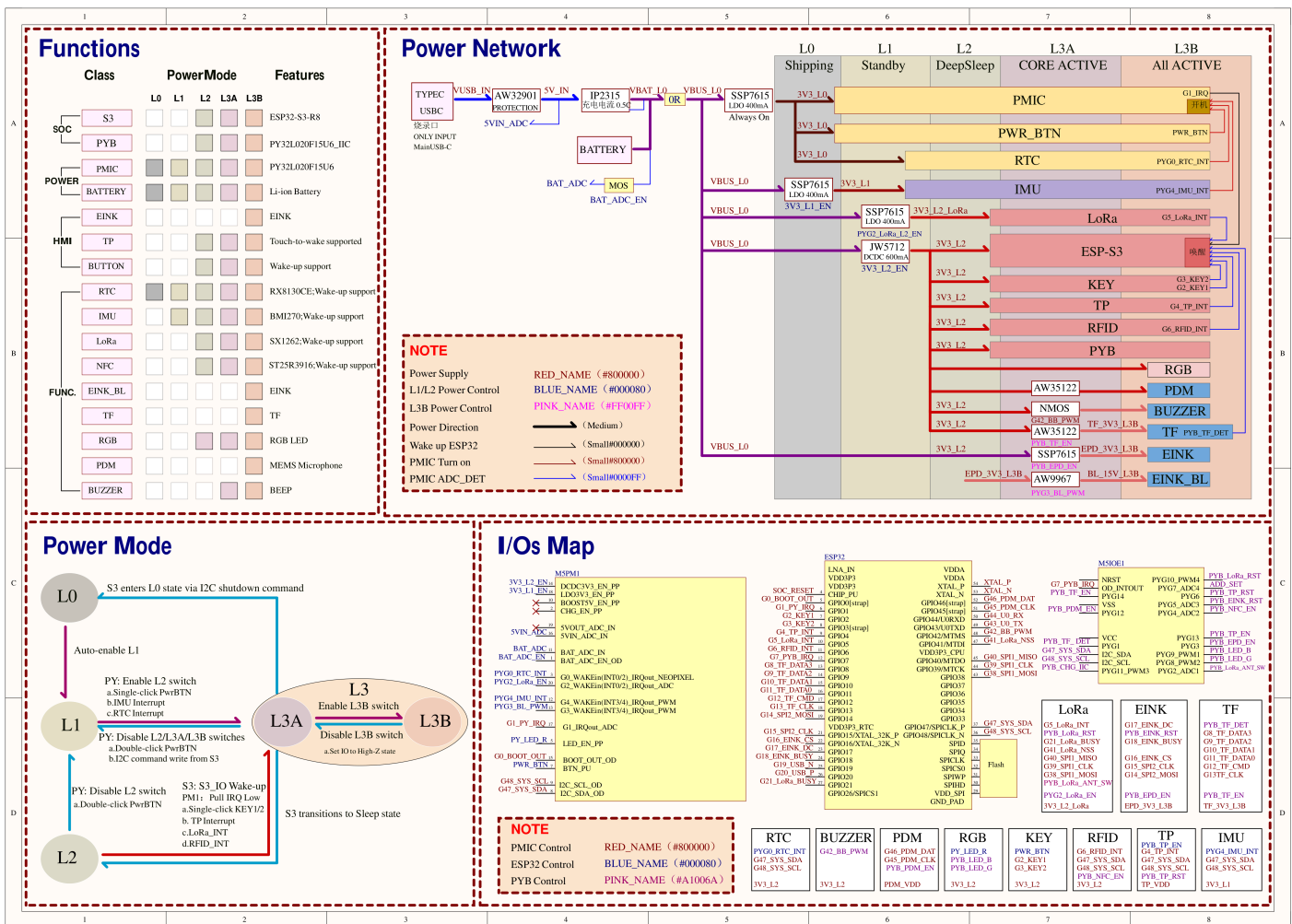
Refresh Mode	Time per Refresh
<code>epd_quality</code>	4.71 s
<code>epd_text</code>	0.45 s
<code>epd_fast</code>	0.34 s
<code>epd_fastest</code>	0.07 s

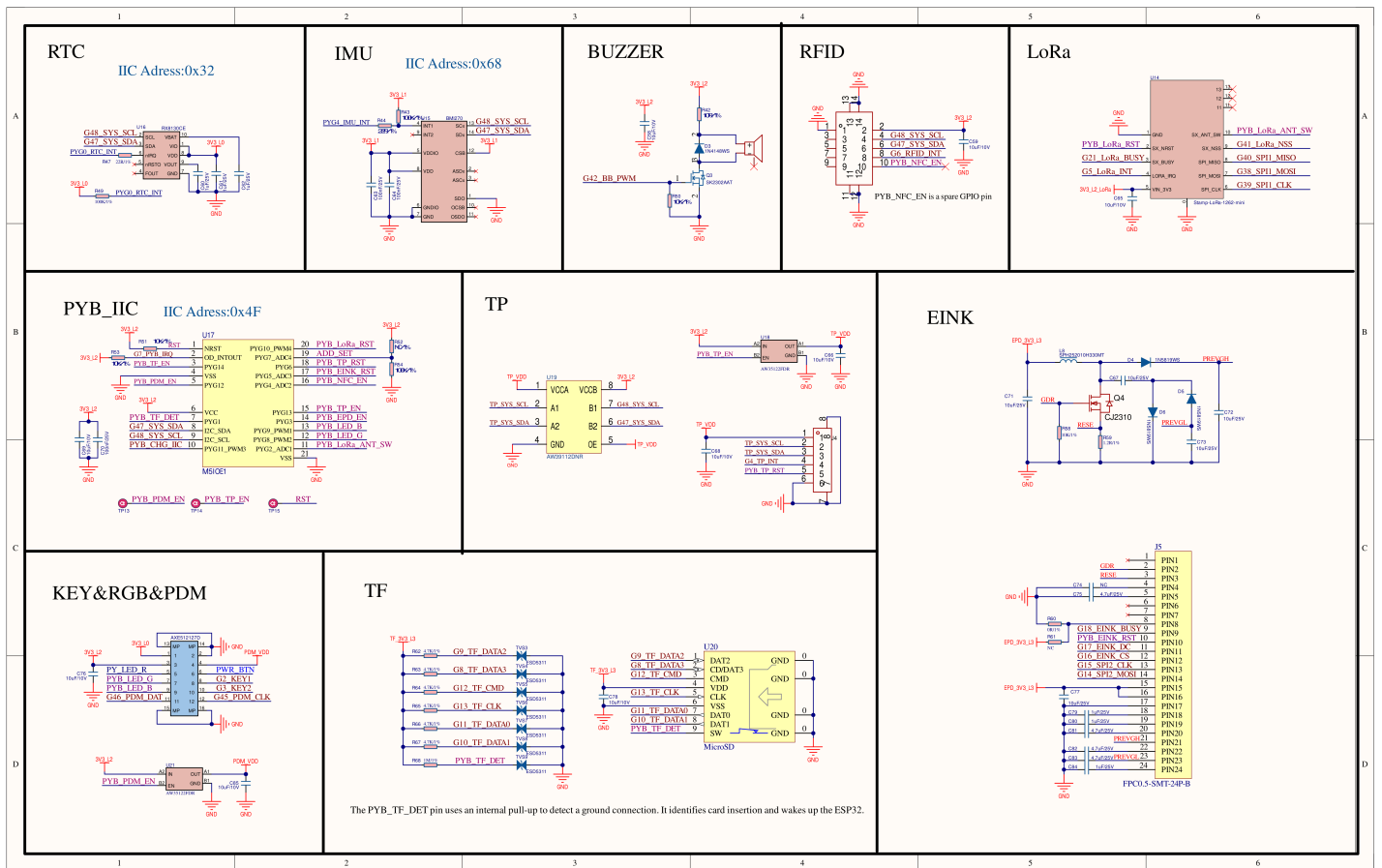
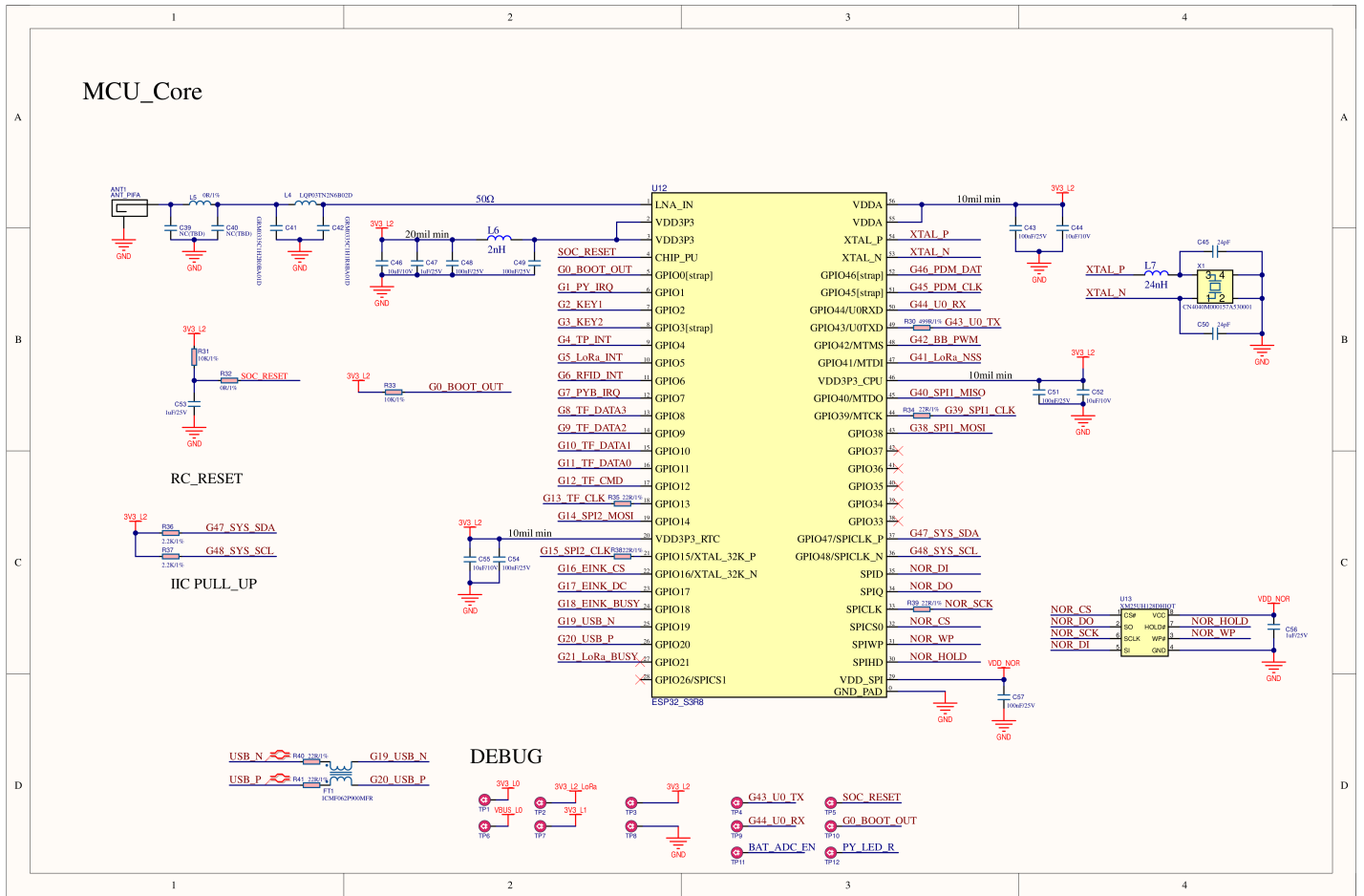
Refresh Mode Demonstration:

[C153_C153-Lite_reflash_mode_demo.mp4](#)

Schematics

- [PaperMono Schematics PDF](#)





The PYB_TP_DET pin uses an internal pull-up to detect a ground connection. It identifies card insertion and wakes up the ESP32.

E-Paper

ESP32-S3R8	G14_SPI2_MOSI	G15_SPI2_CLK	G16_EINK_CS	G17_EINK_DC	G18_EINK_BUSY
SSD1677	MOSI	SCLK	CS	DC	BUSY

M5IOE1	PYG5_ADC3	PYG3
SSD1677	RST	EPD_3V3_EN

M5PM1	G3_WAKEin / IRQout / PWM
Frontlight	BL_FB

The e-paper reset is controlled via `PYG5_ADC3` of the `M5IOE1`, and `PYG3` controls the 3.3V power supply of the e-paper; the frontlight brightness is controlled via `PYG3_BL_PWM` of the `M5PM1`.

Touch

ESP32-S3R8	G47_SYS_SDA	G48_SYS_SCL	G4_TP_INT
FT6336G(0x38)	SDA	SCL	INT

M5IOE1	PYG6	PYG13
FT6336G	TP_RST	TP_VDD_EN

microSD

ESP32-S3R8	G12	G13	G11	G10	G9	G8
microSD	CMD	CLK	DAT0	DAT1	DAT2	DAT3

M5IOE1	PYG14	PYG1
microSD	TF_EN	TF_DET

`TF_DET` is pulled up by the microSD power domain. When the card slot switch is closed, the detection pin is pulled low to identify microSD card insertion.

HMI

ESP32-S3R8	G47_SYS_SDA	G48_SYS_SCL	G2_KEY1	G3_KEY2
RTC - RX8130CE(0x32)	SDA	SCL		
IMU - BMI270(0x68)	SDA	SCL		
KEY			KEY1	KEY2

M5PM1	G0_WAKEin	G4_WAKEin	LED_EN_PP
HMI	RTC_INT	IMU_INT	LED_R

PYG0_RTC_INT and PYG4_IMU_INT are connected to the M5PM1 and can serve as low-power wake-up sources.

M5IOE1	PYG8_PWM2	PYG9_PWM1
HMI	LED_G	LED_B

The RGB LED indicator on the side of the PaperMono body consists of three color LED dies, with the red LED connected to LED_EN_PP of the M5PM1. After the device is powered on, it will light up according to the M5PM1 default behavior. Since LED_EN_PP does not support PWM output mode configuration, the adjustable colors of this indicator will be limited.

KEY

ESP32-S3R8	G2	G3
KEY	USER_KEY1 (Button A)	USER_KEY2 (Button B)

Audio

ESP32-S3R8	G46_PDM_DAT	G45_PDM_CLK	G42_BB_PWM
PDM MIC	DAT	CLK	
BUZZER			BB_PWM

M5IOE1	PYG12
PDM	PDM_VDD_EN

M5PM1

ESP32-S3R8	G47_SYS_SDA	G48_SYS_SCL	G1_PY_IRQ	G0_BOOT_OUT
M5PM1(0x6E)	SDA	SCL	IRQ	BOOT_OUT

M5IOE1

ESP32-S3R8	G47_SYS_SDA	G48_SYS_SCL	G7
M5IOE1(0x4F)	SDA	SCL	PYB_IRQ

M5IOE1	PYG11_PWM3
Charger - IP2315(0x75)	PYB_CHG_IIC

Note

The I2C operating mode of the charging chip IP2315 depends on the I2C pins being pulled up to VBAT voltage. Connecting the device to USB triggers mode detection; if the VBAT voltage is too low, the IP2315 may not initialize into I2C mode properly, which can interfere with other devices on the same I2C bus. M5IOE1 controls the connection between the IP2315 and the system I2C bus via PYG11_PWM3: during device operation, do not keep the IP2315 mounted on the I2C bus for extended periods; disconnect it promptly after communication to avoid reducing bus communication stability. If an I2C bus communication anomaly occurs, you can reset the device by briefly pressing the power button to restore normal bus operation.

RFID

ESP32-S3R8	G47_SYS_SDA	G48_SYS_SCL	G6_RFID_INT
ST25R3916(0x50)	SDA	SCL	IRQ

LoRa

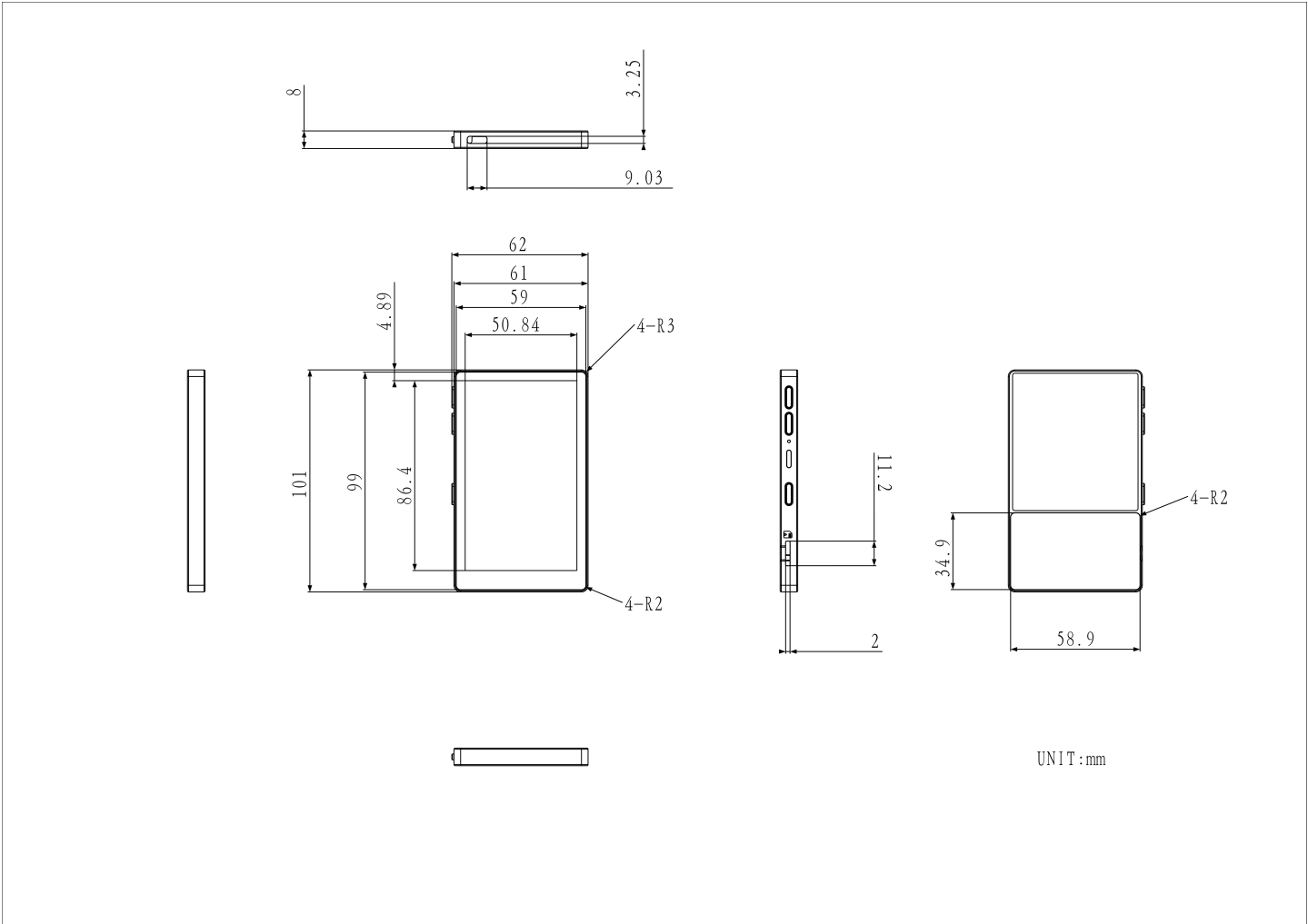
ESP32-S3R8	G38_SPI1_MOSI	G40_SPI1_MISO	G39_SPI1_CLK	G41	G21	G5
Stamp LoRa-1262	SPI_MOSI	SPI_MISO	SPI_CLK	SX_NSS	SX_BUSY	LORA_IRQ

M5IOE1	PYG10_PWM4	PYG2_ADC1
Stamp LoRa-1262	SX_NRST	SX_ANT_SW

M5PM1	G2
Stamp LoRa-1262	LoRa_EN

Model Size

◦ [PaperMono Model Size PDF](#)



Structure

- [PaperMono Structure Files](#)

Datasheets

- [ESP32-S3](#)
- [NFC ST25R3916](#)
- [SSD1677 Display Driver](#)
- [3.97-inch Touchscreen](#)
- [RX8130CE Register Datasheet](#)
- [BMI270](#)
- [SX1262](#)

Softwares

E-Paper Driver Notes

1. The e-paper driver waveforms for PaperMono in the M5GFX library are currently unstable. It is recommended to prioritize the e-paper manufacturer's OTP example below for refresh configuration to achieve better panel life and refresh stability.
2. Software recommendation: After approximately 10 partial fast refreshes, perform one full-screen refresh to clear the screen and prevent ghosting from accumulating.
3. After prolonged repeated refreshing, black deposited pixels may appear on the panel due to the physical characteristics of the ink particles. Leave the panel idle for a while, then perform one full-screen refresh to restore it.

Arduino

- [PaperMono Arduino Quick Start](#)
- [PaperMono M5PM1 & M5IOE1 Power Management](#)
- [M5PM1 Arduino Library](#)
- [M5IOE1 Arduino Library](#)
- [M5Unified Arduino Library](#)
- [M5GFX Arduino Library](#)

UiFlow2

- [PaperMono UiFlow2 Quick Start](#)

Protocol

- [M5PM1 Power Management Chip](#)
- [M5IOE1 IO Expander Management Chip](#)

ESP-IDF

- [PaperMono Factory Firmware Source Code](#)
- [PaperMono OTP Example](#)
- [PaperMono Low-Power Test Example](#)

PlatformIO

```
[env:m5stack-papermono]
platform = espressif32@6.12.0
board = esp32-s3-devkitm-1
framework = arduino
board_build.partitions = default_16MB.csv
board_upload.flash_size = 16MB
board_upload.maximum_size = 16777216
board_build.arduino.memory_type = qio_opi
build_flags =
  -DESP32S3
  -DBOARD_HAS_PSRAM
  -mfix-esp32-psram-cache-issue
  -DCORE_DEBUG_LEVEL=0
  -DARDUINO_USB_CDC_ON_BOOT=1
  -DARDUINO_USB_MODE=1
lib_deps =
  M5Unified = https://github.com/m5stack/M5Unified#develop
  M5PM1 = https://github.com/m5stack/M5PM1
  M5IOE1 = https://github.com/m5stack/M5IOE1
  M5Unit-NFC=https://github.com/m5stack/M5Unit-NFC
  RadioLib = https://github.com/jgromes/RadioLib
```

Easyloader

Easyloader	Download	Note
PaperMono User Demo	download	/

Other

- [PaperMono Factory Reset Firmware](#)
- [PaperMono CrossPoint E-Reader](#)

Video

Product Comparison

Product Compare		
		
PaperMono		PaperMono-Lite
Main Controller	ESP32-S3R8	ESP32-S3R8
Screen	3.97" 4-level grayscale monochrome e-paper, 480x800	3.97" 4-level grayscale monochrome e-paper, 480x800
Touch	FT6336G	FT6336G
Frontlight	Integrated	Integrated
Wi-Fi	2.4 GHz	2.4 GHz
NFC	ST25R3916	×
LoRa	Stamp LoRa-1262	×
Expansion Storage	microSD	microSD
IMU	BMI270	BMI270
RTC	RX8130CE	RX8130CE
Battery	1150mAh	1150mAh
Case Color	Gray	White

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