旋钮屏二次开发指导手册

Knob Display Secondary Development Guide Manual

深圳怀智科技有限公司

Shenzhen Huai Zhi Technology Co., Ltd.

前言 Preface

本文档共包含三个部分，分别是 PC 端图片格式转换操作说明、 从 PC 端将转换后的图片下载到旋钮屏的操作说明以及主设备端和从设备端之间的通信交互协议。

This document consists of three parts, which are the operation instructions for converting the image format on the PC, the operation instructions for downloading the converted image to the knob display from the PC, and the communication protocol between the master and slave devices.

本文档定义了主控端与从设备端之间的通信协议，该协议描述了两者收发命令、以及进行数据同步。主控端及从设备端的软件开发人员在进行通信联调时可能需要参考本文档。

This document defines the communication protocol between the main control terminal(Host) and slave terminal(Slave), which describes both receiving and sending commands and performs data synchronization. Developers of software on Host and Slave may need to refer to this document when they link the communication.

但开发人员不可随意更改、增加或删减协议的功能，否则有可能会导致不兼容异常。如有需求需要修改或删减协议功能，请联系我司相关负责人进行评估。

However, developers can’t modify, add, or delete the functionality of the protocol casually, otherwise it may cause incompatible and unusual phenomenon. If you need to modify or delete the protocol function, please contact our relevant responsible person for evaluation.

纲要信息 Protocol Outline Information

修订版本 Revision version	V1.0.3
修订时间 Revision time	2023 年 5 月 13 日 On May 12,2023
修订人员 Revisionists	FA,ZEMY, Rebecca,Paul

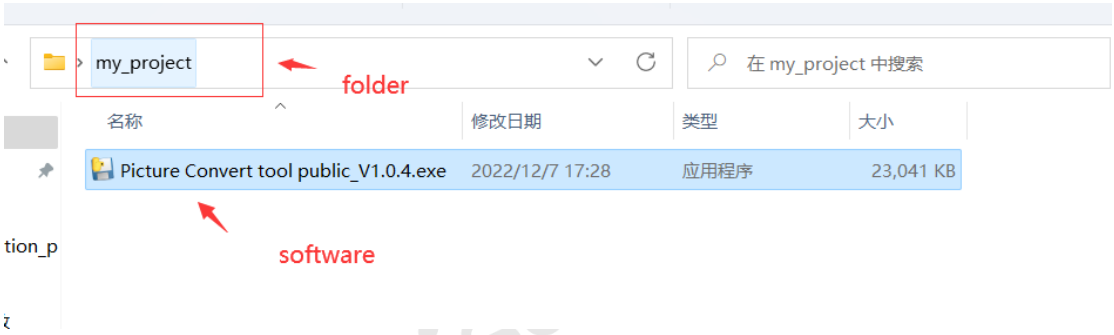
PART1:PC 端图片格式转换 Picture format converting on PC

1、主要概念定义 Main Concept Definition

1.1 应用 Application

软件本体所在的文件夹，即类似认为根目录，软体适用于当前文件夹

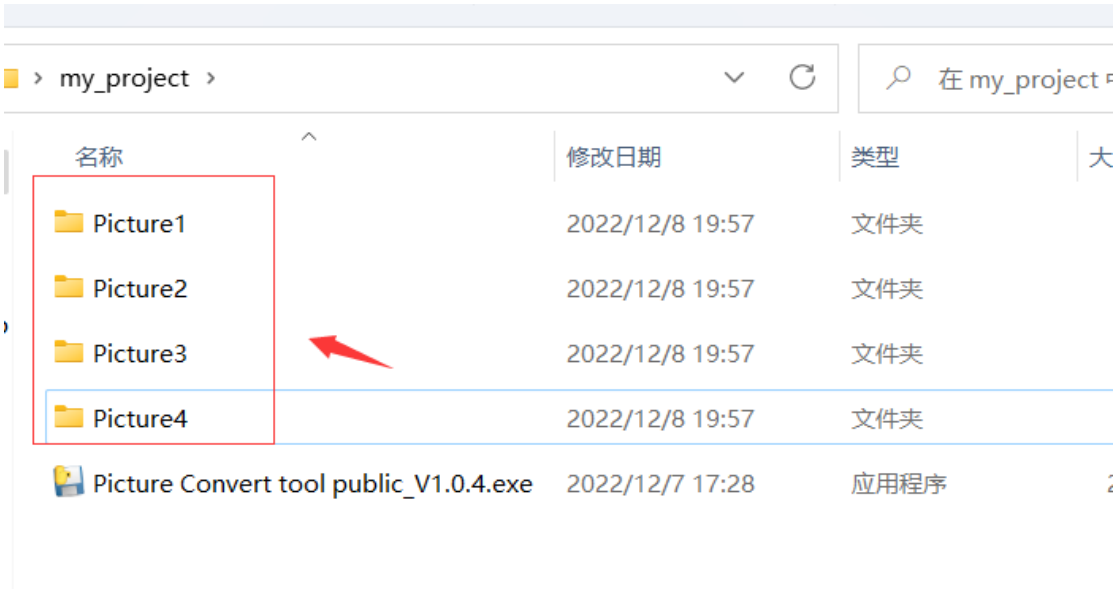
The folder where the software placed in and suits for, be taken as root directory.



1.2 图片存放形式 Picture Storage Format

多文件夹归类存放，图片 1 文件夹，图片 2 文件夹... 图片 N 文件夹等

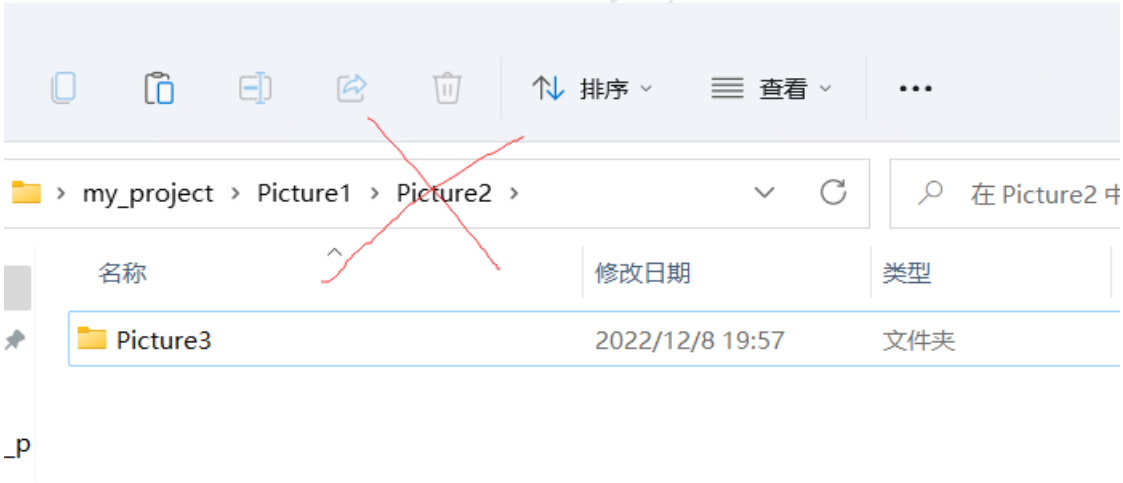
Multi folder storage, picture 1 , picture 2 ... picture N ,etc



1.3 图片存放形式-禁止情形 Picture Storage Format- Forbid Condition

根目录下，不支持多层子目录的形式

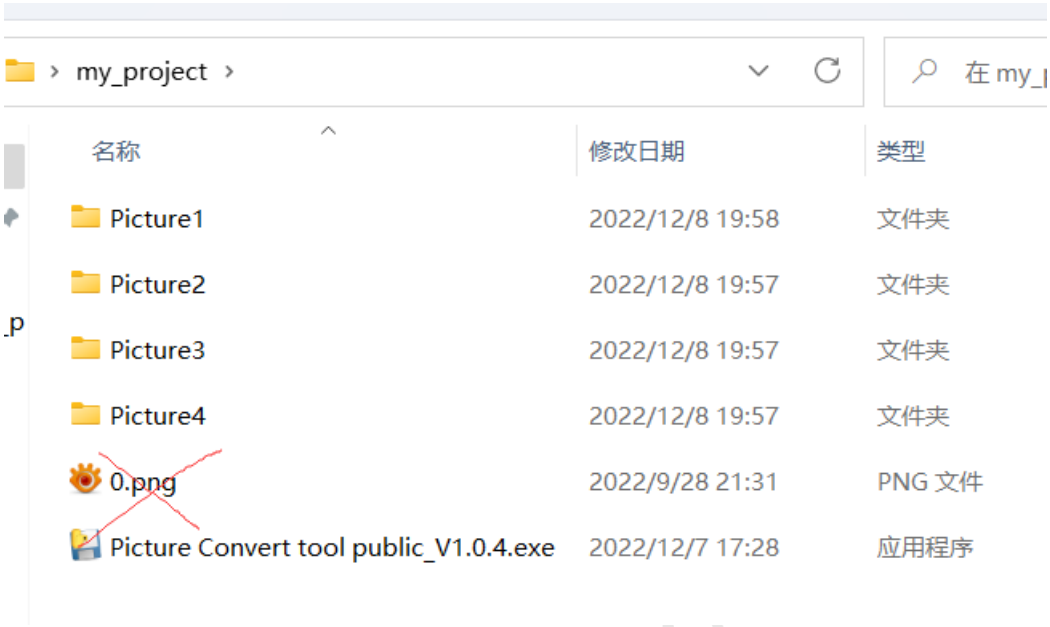
The multi-layer subdirectory is not supported under root directory.



1.4 图片存放形式-禁止情形 1 Picture Storage Format- Forbid Condition 1

根目录下，不支持零散图片存放。请将图片文件归类，可用 OTHER,OTHER1 等文件夹存放

The root directory do not support scattered pictures storing. Please classify the picture files and store them in OTHER, OTHER1 and other folders



1.5 TXT 文档说明 TXT File Explanation

文档已经附加说明

The files related explanation attached

1、可以查有多少张图，通过看图片序号

1.Check picture quantity via check the picture series number

2、文档是用于检查：因图片命名或其他原因，导致产品实际显示图效果与开发不一致的情形

2. The file examine: The discrepancy between actual display effect and development caused by picture name or other reason

2、图片说明即要求 Picture description is required

2.1 图片支持 24 位或 32 位 PNG 24 bit or 32 bit PNG pictures are supported

1、图片宽度一定为偶数 Picture width must be even

2、是否需要透明度，看实际开发情形 Whether the transparency is required depended by the actual development situation

2.2 图片命名建议 Picture Naming Suggestions

同一类型的图片，例如某个动图有 14 张， 那么相应的文件夹内文件命名 01 02 -- 14 即可，或者例如 星期_01 星期_02 等

For the same type of pictures,for example, if there are 14 moving pictures, the files in the corresponding folder can be named 01 02 -- 14, or for example, week_ 01 week_ 02 etc

若是命名方式为 旋转 1.bmp，旋转 2.bmp.....旋转 15.bmp...旋转 101.bmp

If the naming method is rotation1.bmp, rotation2.bmp..... rotation15.bmp... rotation101.bmp

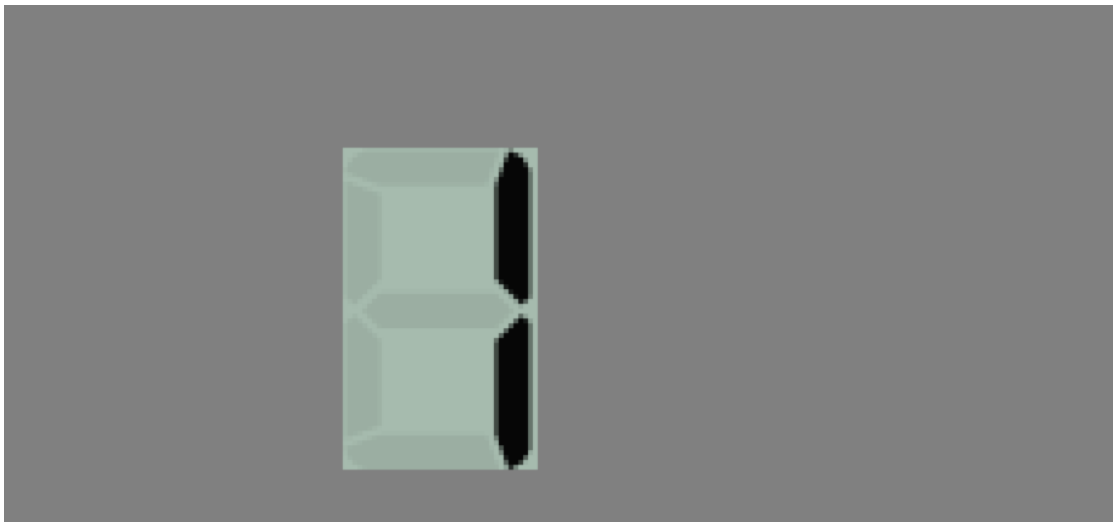
(后续处理的软件会排序为 旋转 1.bmp 旋转 15.bmp... 旋转 101.bmp... 旋转 2.bmp.... 引发异常，但无法改动软件处理的排序问题)

(The software for subsequent processing will be sorted as rotating 1. bmp rotating 15. bmp... rotating 101. bmp... rotating 2. bmp.... And an exception will be raised, but the sorting problem handled by the software cannot be changed.)

2.3 图片-有效部分不能用纯黑 Picture - the effective part cannot be pure black

例如下图，本图目的是显示数字 1，1 的有效显示内容，不能为纯黑#000000，可以用接近纯黑的颜色即可

For example, in the figure below, the purpose of this figure is to display the effective display content of the number 1, 1, which cannot be pure black # 000000, but can be used in a color close to pure black

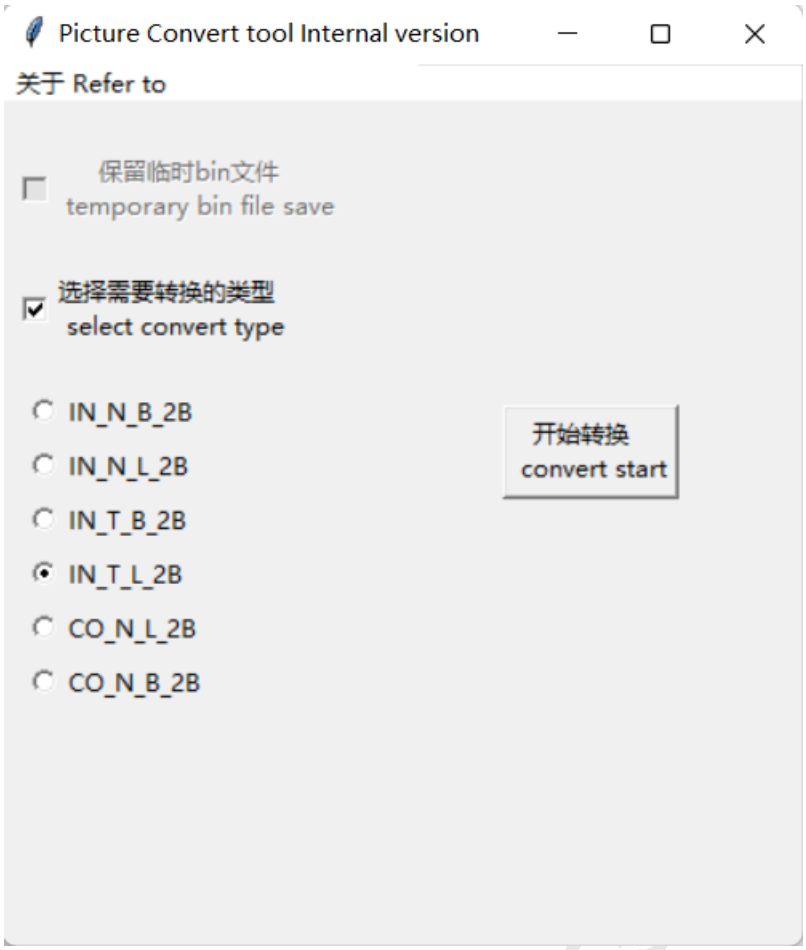


3、Picture Convert tool public manual 使用说明

3.1 运行软件 Run software

运行软件 xxx_Picture Convert tool public_V1.0.x.exe
sun software xxx_Picture Convert tool public_V1.0.x.exe

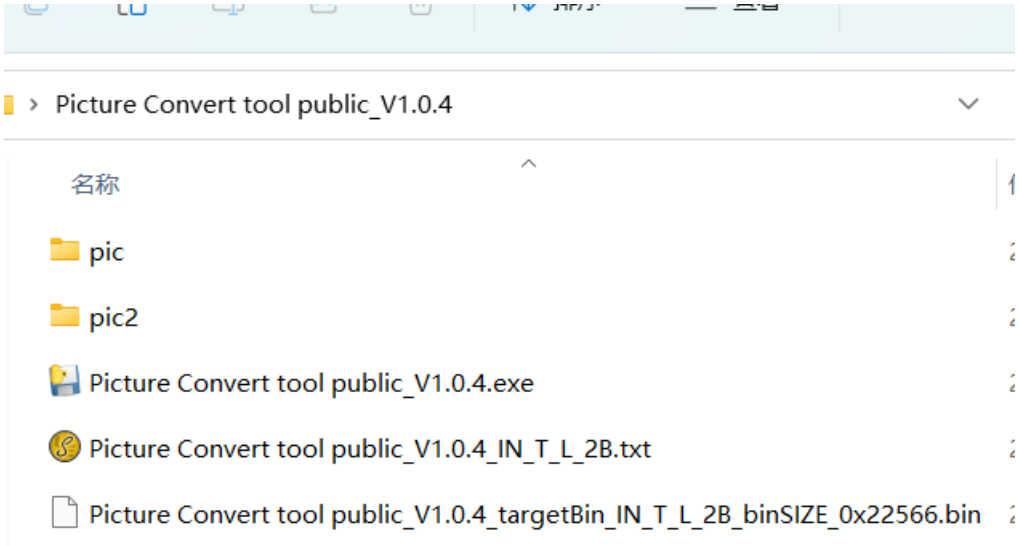
3.2 配置对应的选择 Related setting select



1、因产品存在差异性，使用之前，请联系商家，商家将告知你，需要选择的配置 As product difference, please apply from seller to select related setting before use

2、选择完成后，点击开始转换 Click” Convert start” after select convert type

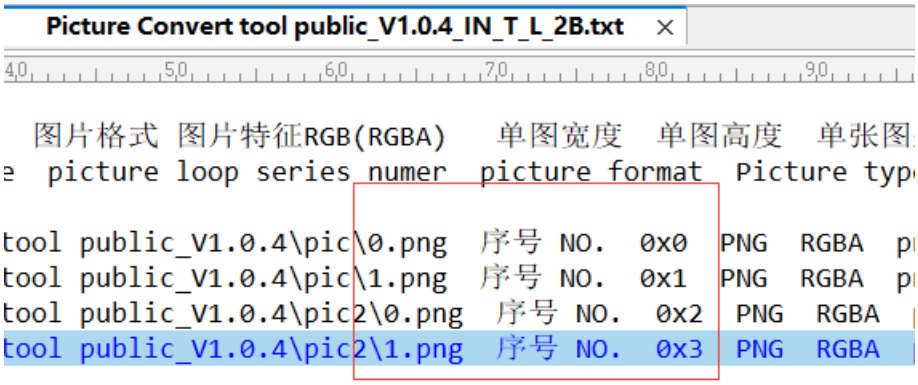
3.3 转换后的范例文件示意 The interface as below after convert



其中

1、用户转换后的需要用到文件 The required file after convert: Picture Convert tool public_V1.0.4_targetBin_IN_T_L_2B_binSIZE_0x22566.bin

2、用于刷新图片并显示的指引文件 The files for picture refresh and display the indicated file:Picture Convert tool public_V1.0.4_IN_T_L_2B.txt



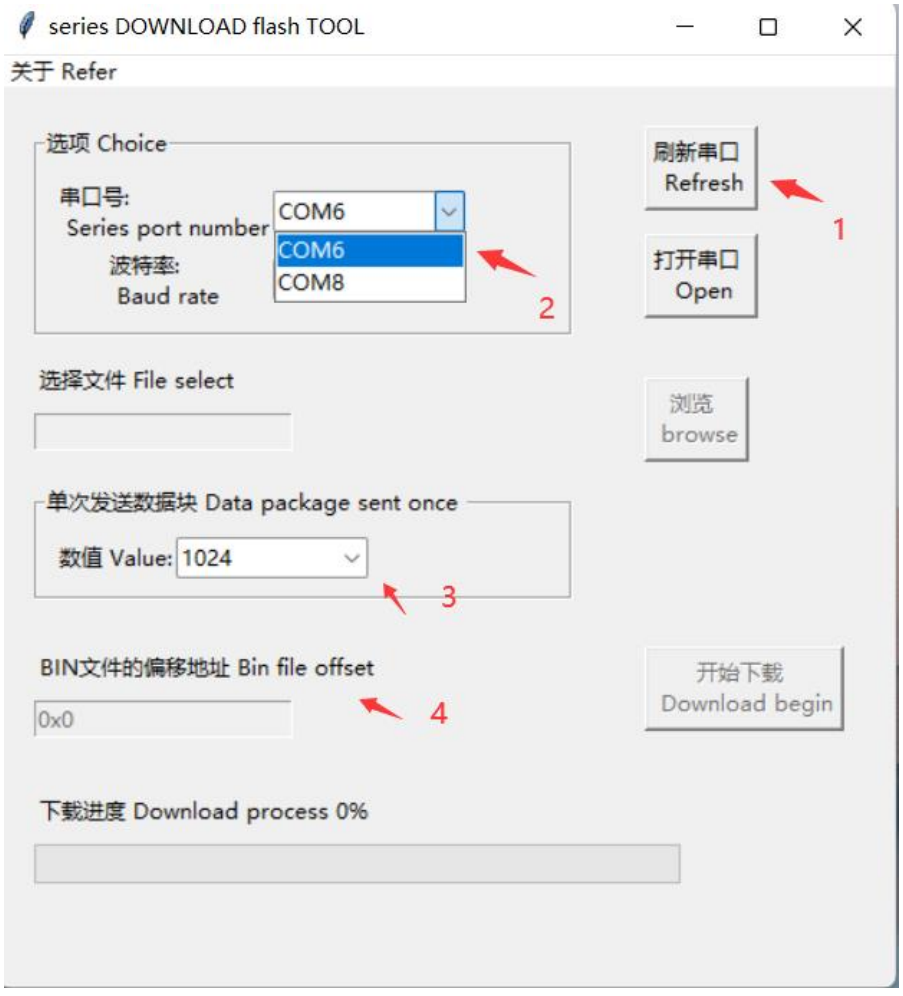
PART2:通过 PC 端软体下载资源到设备 Download converted picture from PC to display by DOWNLOAD flash TOOL

1、下载流程 Download Flow

1.1 运行软件　Software Run

运行软件 series DOWNLOAD flash TOOL_V1.0.x.exe

Sun software　series DOWNLOAD flash TOOL_V1.0.x.exe



1.2 参数说明 Parameter instruction

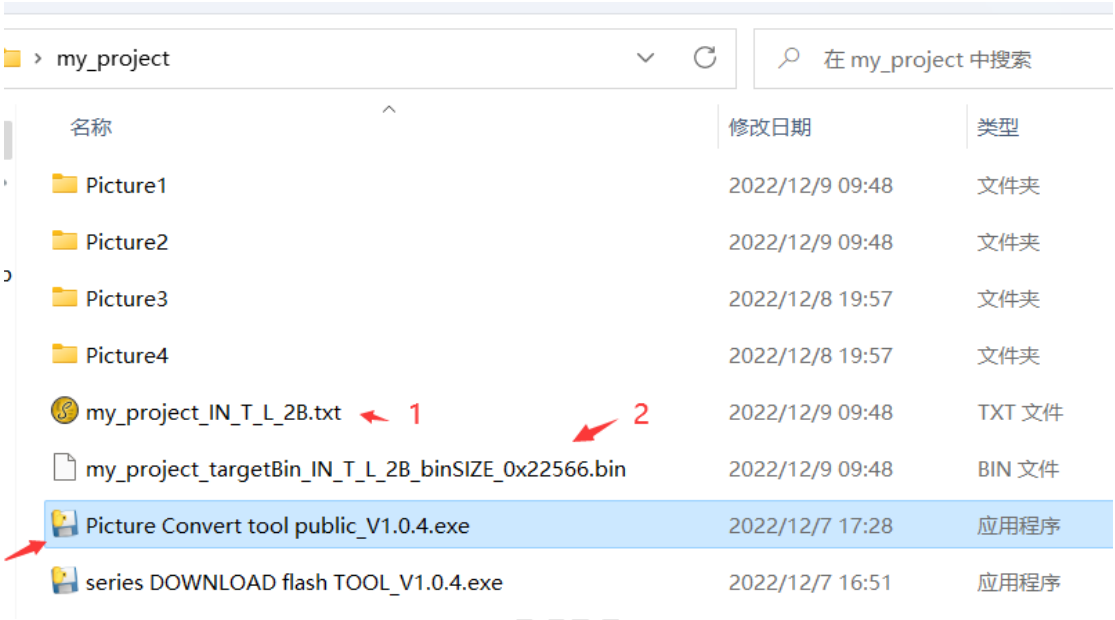
1、根据连接的实际情形，选择对应的串口，例如 COM6　Select corresponded UART per connection actual status,eg COM6

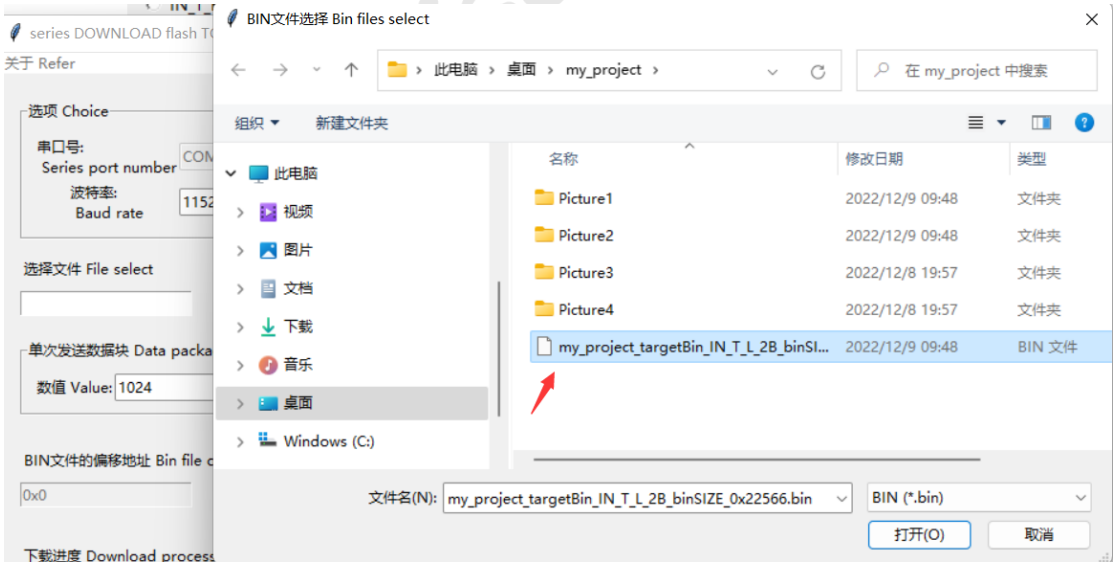
2、波特率，单次发送数据块，BIN 文件的偏移地址，因产品存在差异性，使用之前，请联系商家，商家将告知你，需要选择的配置 For the device discrepancy　problem,please

contact the seller before use.The setting selection will be told : BT rate,data module sent once ,bin files offset address.

3、通常产品，波特率：115200，单次发送数据块 1024 ，BIN 文件的偏移地址 0x80000，若不是完成下载，那么请联系商家 General product bit rate:115200, Data module sent once 1024,Bin file offset address 0x8000,please contact the seller the download failure

1.3 选择目标文件 Select the file





1.4 配置好后，点击开始下载 Click Download after finish setting

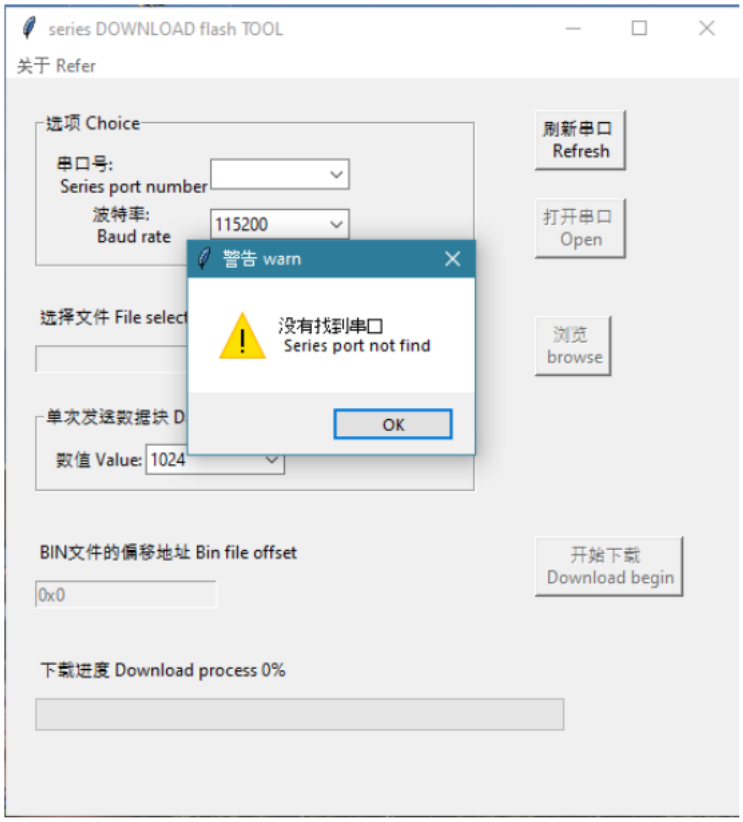
点击开始后，等下下载完成，若是出现异常，将会有报错提示，我们尽可能双语描述错误点，若存在理解差异。请联系商家详细描述你遇到的问题。 Click“begin”

download and wait for download finish, if there is error message,please contact seller to solve

附录 1（Appendix 1）、使用过程中可能遇到的问题以及解决方式

Possible issues may encounter and corresponding solutions in the using process

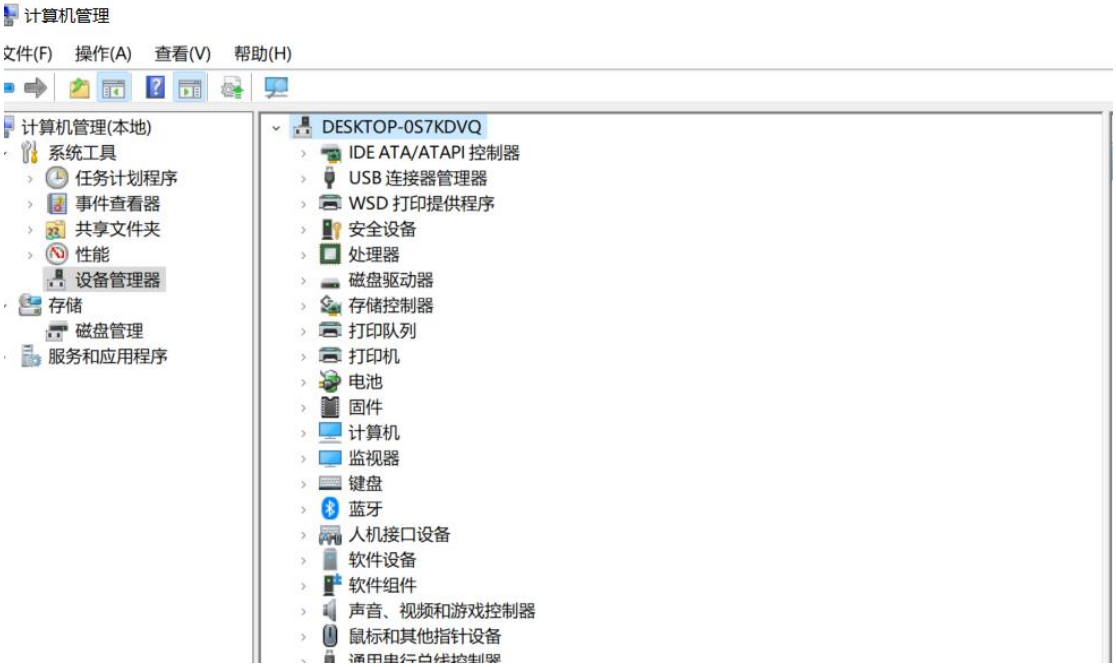
1.1 未发现有效串口 Serial port not found



解决方法 Solution：

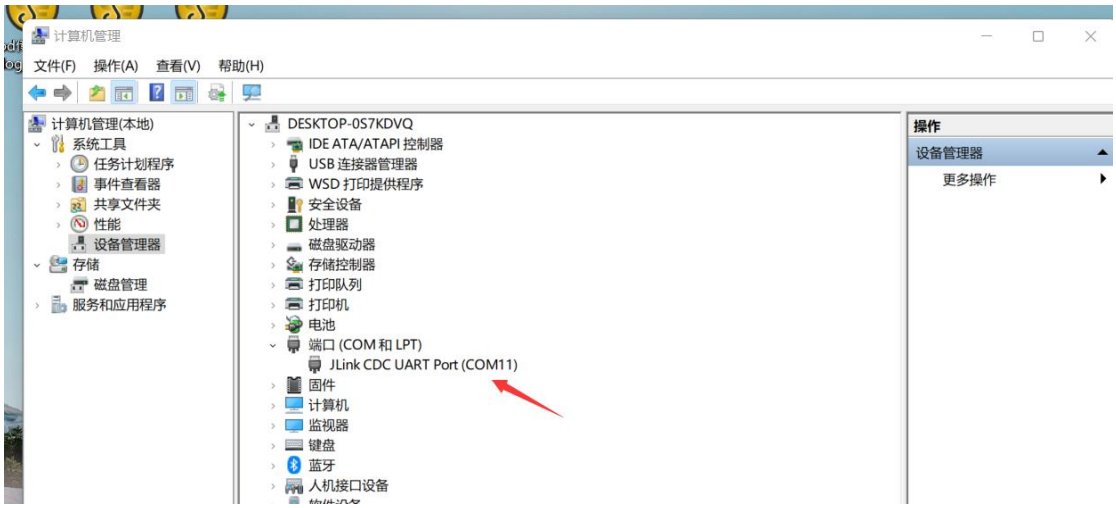
以 windows11 为例子，此电脑（右键选择）---设备管理管理器

Taking Windows 11 as an example, move mouse over “this computer” (right-click and select) - Device Management Manager



当接入 UART 通信串口线，若是识别正常，会有更新弹出端口（COM 和 LPT）。显示端口号，如果有多个端口号（比如 COM11,COM12 或者更多），自行分别插拔判定

When connecting to the serial port, if the connecting is normal, there will pop-up ports (COM and LPT), displaying port number. If there's multiple port number(such as COM11, COM12 or more), please plug and unplug the wire to determine the right one.



如果接入 UART 通信串口线，没弹出端口（COM 和 LPT）。 出现这种现象的可能的原因如下：

When connected to the serial port, but no port (COM and LPT) pop up, it may be due to the following reasons:

1、串口线异常，导致不识别

Serial port cable issue, which leads to not able to connect properly;

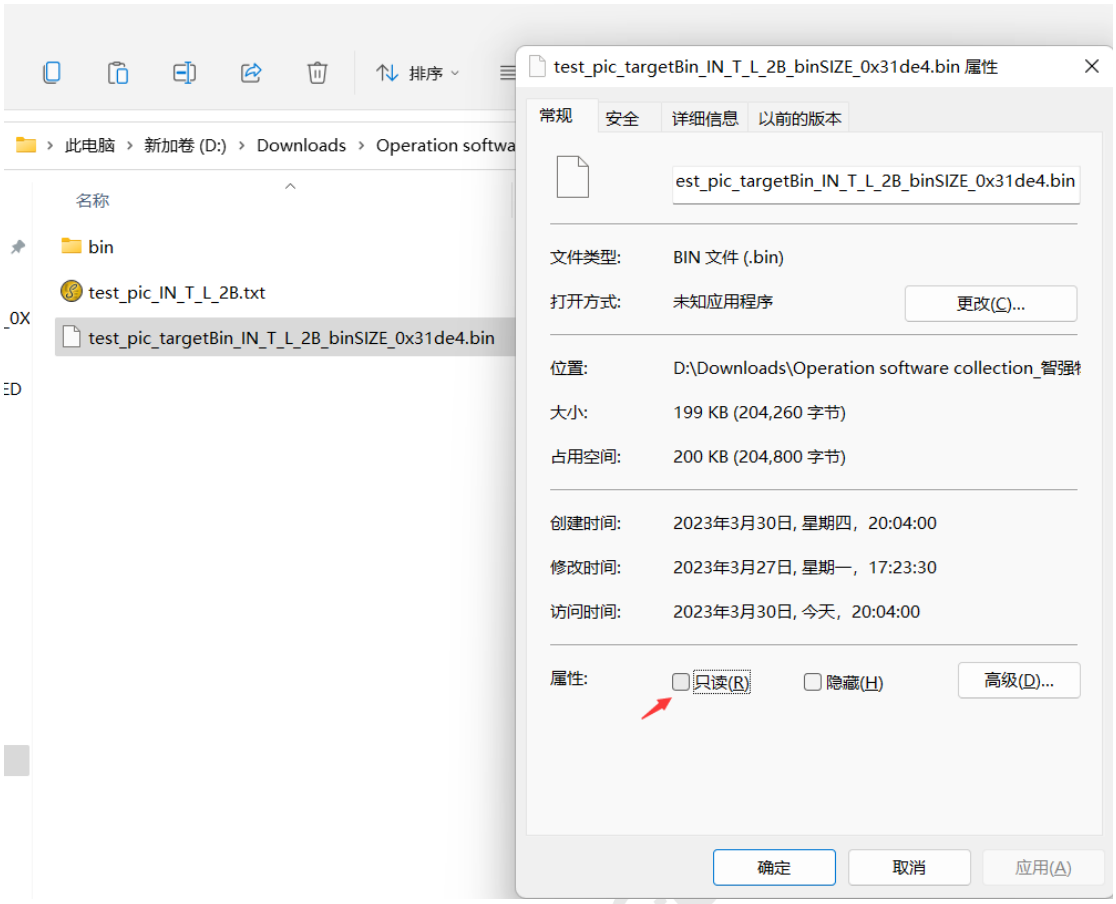
2、若是这里有带？或者感叹号的字样，说明需要安装驱动。

If there's symbol of "?" or "!", please install driver.

1.2 需要下载的文件属性问题 File attribute issues that need to be downloaded.

文件属性若为只读，下载时会出错。请检查属性。

If the file attribute is read-only, an error will occur during download. Please check the file attribute.



1.3 请检查 UART 通信串口线，是否正常 Please check if the UART cable is functioning properly

实际开发时，会有几率出现，UART 通信串口线不良。可以用以下方式测试线路：

UART 线，接入 PC 端，然后短接 TX,RX.随后在 PC 端打开 URAT 通信串口软件。配置 115200 波特率，然后以 16 进制形式，发送例如 0xFE，看接收窗口，是否收到 0xFE，如有，那么则可以判定，线路正常。

During actual development, there is a possibility of poor serial port cables. The circuit can be tested in the following ways:

UART cable, connect to the PC, and short connect TX and RX. Then to open the serial port software on the PC. Configure the 115200 baud rate and send it in hexadecimal format, such as 0xFE. Check the receiving window to see if 0xFE has been received. If received, it can be judged that the connection is proper.

1.4 软件运行异常处理方式 Handling method of abnormal software operation

我司软件，基于 window10 开发，请以 window10 及以上系统运行，敬请理解

若是不能运行，请添加微软的运行库

Run software,if not available like below, please add and run microsoft DSL.

Our software is developed base on Windows 10, please try on computer with system of Windows 10 or above.If not able to run the software, please add and run Microsoft DSL.

PART3:串口屏通信协议 Serial Port Screen Communication Protocol

1、基本概念阐述 Basic Concept Elaboration

1.1 定义解释 Definition Explanation

1.1.1 主控端（HOST），规定为主控板。Main control terminal (HOST), specified as the main control board .

1.1.2 从设备端（SLAVE），显示屏端（供应商）。SLAVE , Display Side (supplier)

1.1.3 采用 UART，波特率 115200；1 个起始位，8 个数据位，1 个停止位，无奇偶校验位，共 10 位 Using UART, baud rate 115200; 1 start bit, 8 data bits, 1 stop bit, no parity bit, 10 bits in total

1.1.4 坐标系以屏幕左上角坐标为 X=0,Y=0, 右下角为终点（以分辨率 240*240 示意，则坐标为 （239，239））

The coordinate system: the upper left corner of the screen with X=0,Y=0,The bottom right corner is the end (for example: resolution: 240*240, the coordinate is (239, 239))

1.1.5 颜色用 2byte 表示，支持的格式为 RGB565 Color is represented in 2byte, and the supported format is RGB565

1.2 数据格式定义 Data Format Definition

1.2.1 在本文档覆盖的内容中，所有和字节序相关的都是用 big-end (大端模式)。例 uint16_t a = 0xABCD，那么传输的时候按照字节流从低到高的顺序为 0x0A，0x0B，0x0C，0x0D。

In the contents of this document, everything related to byte order uses big-end. For example uint16_t a = 0xABCD, then the transmission is 0x0A, 0x0B, 0x0C, 0x0D according to the order of byte stream from low to high.

1.2.2 例字节流中的一个字节（1 Byte)包含了两个值 SUM1=0xA，SUM2=0xB，每一个值占用 4bit，低位为 A，高位为 B。组合成字节的内容 uint8_t test = (SUM2 <<4 + SUM1)

One Byte in byte stream contains two numerical value: SUM1 = 0xA, SUM2 = 0xB, each numerical value occupies 4 bit, the low bit is A, the high bit is B. Combined into the content of the byte uint8_t test = (SUM2 << 4 + SUM1)

1.2.3 关于 Reserve 的定义，无论是字节定义或字节中的位定义，默认是 0

Regarding the definition of Reserve, no matter the byte definition or the bit definition in the byte, the default is 0

2、通信协议及通信模式定义 Definition of Communication Protocol and Communication Mode

2.1 传输格式 Transmission Format

序号 No.	数据内容 Data Content	备注说明 Note
0	HEAD_CODE	固定为 0xAA,帧头 Fixed to 0xAA,frame header
1	COMMAND	协议指令码 Protocol Command Code
2	LENGTH	表示有效数据长度 Indicates the valid data length
3+n	DATA[0]	根据不同的有效数据长度，有着不同的字节代码，存储方式为低字节数据在前，高字节在后。 There are different byte codes according to different valid data length, and the storage method is low byte data first and high byte second.
	DATA[1]	
	.....	
	DATA[N]	
4+n	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF

（说明:HOST 发 SLAVE 和 SLAVE 发 HOST 传输格式是一样的）

（PS: The transmission format is the same from HOST to SLAVE and SLAVE to HOST.）

2.2 应答机制 Response Mechanism

序号 NO.	数据内容 Data Content	备注说明 Note
0	HEAD_CODE	固定为 0xAA,帧头 Fixed to 0xAA,frame header
1	COMMAND	协议指令码（0xFF） Protocol Command Code （0xFF）
2	LENGTH	表示有效数据长度(0x01) Indicates the valid data length(0x01)
3	DATA[0]	[0xFE]:ACK(NORMAL); [0xFD]:NACK(CHECKSUM ERROR); [0xFC]:NACK(NOT SUPPORT); [0xFB]:NACK(BUSY); [0XFA]:NACK(SYSTEM IS STARTING/NOT CONNECT);
4	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF

（说明:接收到一帧数据后 及时作出响应，如果再 50ms 以内没有响应则会重发最多 3 次做出错处理，每次的间隔是 50ms）

(PS: After receiving a frame of data, respond in time, if no response within 50ms, it will resend up to 3 times to make error processing, the interval is 50ms each time)

3、应用层协议 Application Layer Protocol

3.1 由主（HOST）到从（SLAVE） From Host to Slave

序号 No.	指令名称 Command Name	COMMAND	备注说明 Note
1	连接/断开指令 Connect/Disconnect commands	0x01	每次上电或者断开后都要重新建立连接，以确定显示屏 MCU 完成正常初始化等准备，才可以开始 UI 显示 Need to re-establish the connection after power-up or power-off,making sure the display MCU completes normal initialization and then start UI.
2	填背景指令 Fill background instructions	0x02	填入背景图片，指令发送一定在图标发送之前，不然出现覆盖 Fill in the background image, the command must be sent before the icon, otherwise it appears to be overwritten
3	填区域颜色 Fill area color	0x03	填入区域颜色 Fill in the area color
4	屏显示控制指令 Screen display control commands	0x04	开始显示，图片开始显示或者切换 Start display, picture starts display or switch
5	BIN 文件的发送准备 Preparation of BIN files for sending	0x05	打包好的 BIN 文件发送到 MCU（目前文件最大支持 6.8M Byte） Packaged BIN file sent to MCU (At present, the file supports up to 6.8M Byte)
6	获取从机软件版本号 Get the slave software version number	0x06	获取版本号 Get version number

3.2 由从（SLAVE）到主（HOST） From SLAVE to HOST

序号 No.	指令名称 Command Name	COMMAND	备注说明 Note
1	版本信息 Version Information	0xF1	发送 SLAVE 端的基本信息和版本 Send the basic information and version of SLAVE side
2	按键和旋钮等操作 Operation of buttons, knobs, etc.	0xF2	发送按键或者旋钮的操作键值 Send operation values of button or knob

3	填背景和图标已经完成情况 Completion of fill background and icon	0xF3	填写背景或者图标已经完成 Fill in the background or icon has been completed
4			

（注意:所有发送的值一定要 ACK，不然会触发重发机制）
(Note: all values sent must be ACK, otherwise the re-transmission mechanism will be triggered)

4、应用层协议详解 Application Layer Protocol Details

4.1 连接/断开指令【0x01】Connection / Disconnect Instruction [0x01]

序号 No.	数据内容 Data Content	数据编码 Data Encode	备注说明 Note
1	HEAD_CODE	0xAA	数据帧头 Data frame head
2	COMMAND	0x01	数据指令 Data Command
3	LENGTH	0x01	数据长度 Data Length
4	DATA[0]	0x01	建立连接 Connection Establishment
		0x00	断开连接 Disconnection
5	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF	

4.2 填背景和图标指令【0x02】Fill Background and Icon Command 【0x02】

序号 No.	数据内容 Data Content	数据编码 Data Encode	备注说明 Note
1	HEAD_CODE	0xAA	数据帧头 Data frame head
2	COMMAND	0x02	数据指令 Data Command
3	LENGTH		数据长度 Data Length
4	DATA[0]	图序号 Figure No.	H(大端 2byte) H (Big-end 2byte)
5	DATA[1]	图序号 Figure No.	L
6	DATA[2]	X 坐标 X coordinate	H（大端 2byte） H (Big-end 2byte)
7	DATA[3]	X 坐标 X coordinate	L
8	DATA[4]	Y 坐标 Y coordinate	H（大端 2byte） H (Big-end 2byte)
9	DATA[5]	Y 坐标 Y coordinate	L
n	……		
n+0	DATA[n+0]	图序号 Figure No.	H(大端 2byte) H (Big-end 2byte)
n+1	DATA[n+1]	图序号 Figure No.	L
n+2	DATA[n+2]	X 坐标 X coordinate	H（大端 2byte）
n+3	DATA[n+3]	X 坐标 X coordinate	L

n+4	DATA[n+4]	Y 坐标 Y coordinate	H（大端 2byte）
n+5	DATA[n+5]	Y 坐标 Y coordinate	L
n+6	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n+5])^0xFF	

（说明:注意图的先后顺序填入，背景图最先发送后再发送图标，图标序号为图片命名排列序号 0-999，最大长度不够可以等填入完成之后再次重复发送）

(Note: Pay attention to the order in which the images are filled in, the background image is the first to be sent and then the icon is sent, the icon number is the image naming sequence number 0-999. If the maximum length is not enough, you can wait until the filling is completed and then repeat the sending.)

4.3 填区域颜色指令【0x03】Fill Area Color Command 【0x03】

序号 No.	数据内容 Data Content	数据编码 Data Encode	备注说明 Note
1	HEAD_CODE	0xAA	数据帧头 Data frame head
2	COMMAND	0x03	数据指令 Data Command
3	LENGTH	0x0A	数据长度 Data Length
4	DATA[0]	颜色（H） Color(H)	
5	DATA[1]	颜色（L） Color(L)	
6	DATA[2]	X 坐标(H)X coordinate (H)	
7	DATA[3]	X 坐标(L)X coordinate (L)	
8	DATA[4]	Y 坐标(H)Y coordinate (H)	
9	DATA[5]	Y 坐标(L)Y coordinate (L)	
10	DATA[6]	宽度(H) Width(H)	
11	DATA[7]	宽度(L) Width(L)	
12	DATA[8]	高度(H) Height(H)	
13	DATA[9]	高度(L) Height(H)	
14	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF	

4.4 屏显示控制指令【0x04】 Screen Display Control Commands 【0x04】

序号 No.	数据内容 Data Content	数据编码 Data Encode	备注说明 Note
1	HEAD_CODE	0xAA	数据帧头 Data frame head
2	COMMAND	0x04	数据指令 Data Command
3	LENGTH	0x01	数据长度 Data Length
4	DATA[0]	控制显示 Control Display	0x01（显示） 0x00（关闭显示） 0x01 (display) 0x00 (turn off display)
5	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF	

（说明:如果没有填图 显示是的原来的图片，原来没图片显示黑屏）

(Note: If you do not fill in the image, the original image is displayed, if no original image then black screen.)

4.5 ------

4.6 获取从机软件版本号【0x06】Get the Slave Software Version Number 【0x06】

序号 No.	数据内容 Data Content	数据编码 Data Encode	备注说明 Note
1	HEAD_CODE	0xAA	数据帧头 Data frame head
2	COMMAND	0x06	数据指令 Data Command
3	LENGTH	0x01	数据长度 Data Length
4	DATA[0]	0x00	保留 Reservation
5	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF	

4.7 版本信息【0xF1】 Version Information 【0xF1】

序号 No.	数据内容 Data Content	数据编码 Data Encode	备注说明 Note
1	HEAD_CODE	0xAA	数据帧头 Data frame head
2	COMMAND	0xF1	数据指令 Data Command
3	LENGTH	0x0F	数据长度 Data Length
4	DATA[0]	DATA	为 ascii 码，长度可变，例如“ZQWL-221020-01” For the ascii code, with a variable length, such as "ZQWL-221020-01"
5	DATA[1]	DATA	
6	DATA[2]	DATA	
7	DATA[3]	DATA	
8	...	DATA	
9	DATA[15]	DATA	
10	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF	

4.8 按键和旋钮等操作【0xF2】Operation of Buttons, Knobs, etc.【0xF2】

序号 No.	数据内容 Data Content	数据编码 Data Encode	备注说明 Note
1	HEAD_CODE	0xAA	数据帧头 Data frame head
2	COMMAND	0xF2	数据指令 Data Command
3	LENGTH	0x01	数据长度 Data Length
4	DATA[0]	0x00	0x01：短按 0x02：长按 0x03:左旋 0x04：右旋等 0x01: short press 0x02: long press 0x03: left turn 0x04: right turn, etc.
5	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF	

(说明 Note:

示意：用户正面面对旋钮模组 example: holding the knob in hand to do below actions 短按，旋钮端上传 AA F2 01 01 0B

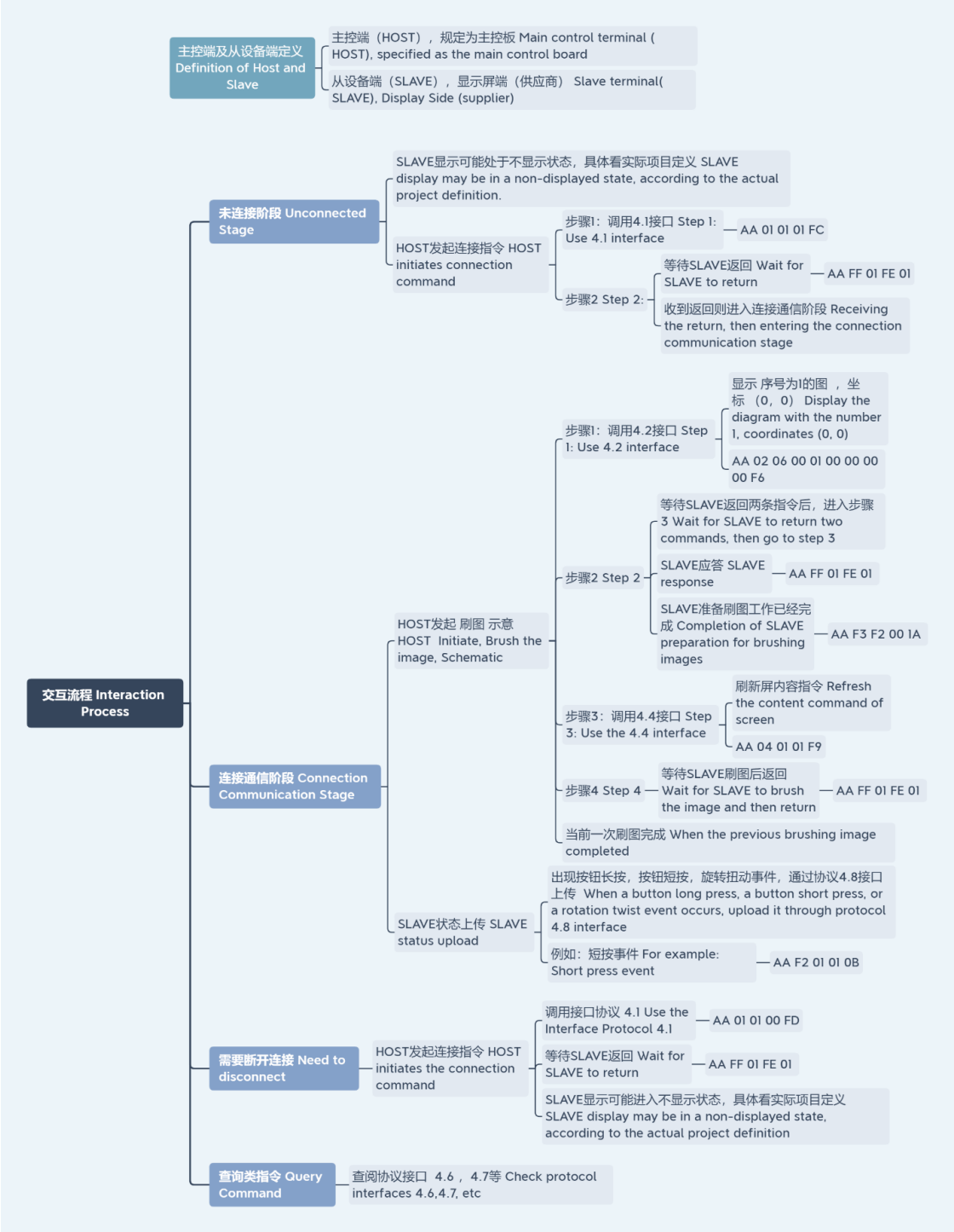
short press　the knob will send AA F2 01 01 0B to the main device
长按，　旋钮端上传　AA F2 01 02 0A
long press　the knob will send AA F2 01 02 0A to the main device
逆时针旋转，旋钮端上传　AA F2 01 03 09
turn anticlockwise　the knob will send AA F2 01 03 09 to the main device
顺时针旋转，旋钮端上传　AA F2 01 04 08 ）
turn clockwise　the knob will send AA F2 01 04 08 to the main device）

4.9 填图完成【0xF3】 Complete the Graph 【0xF3】

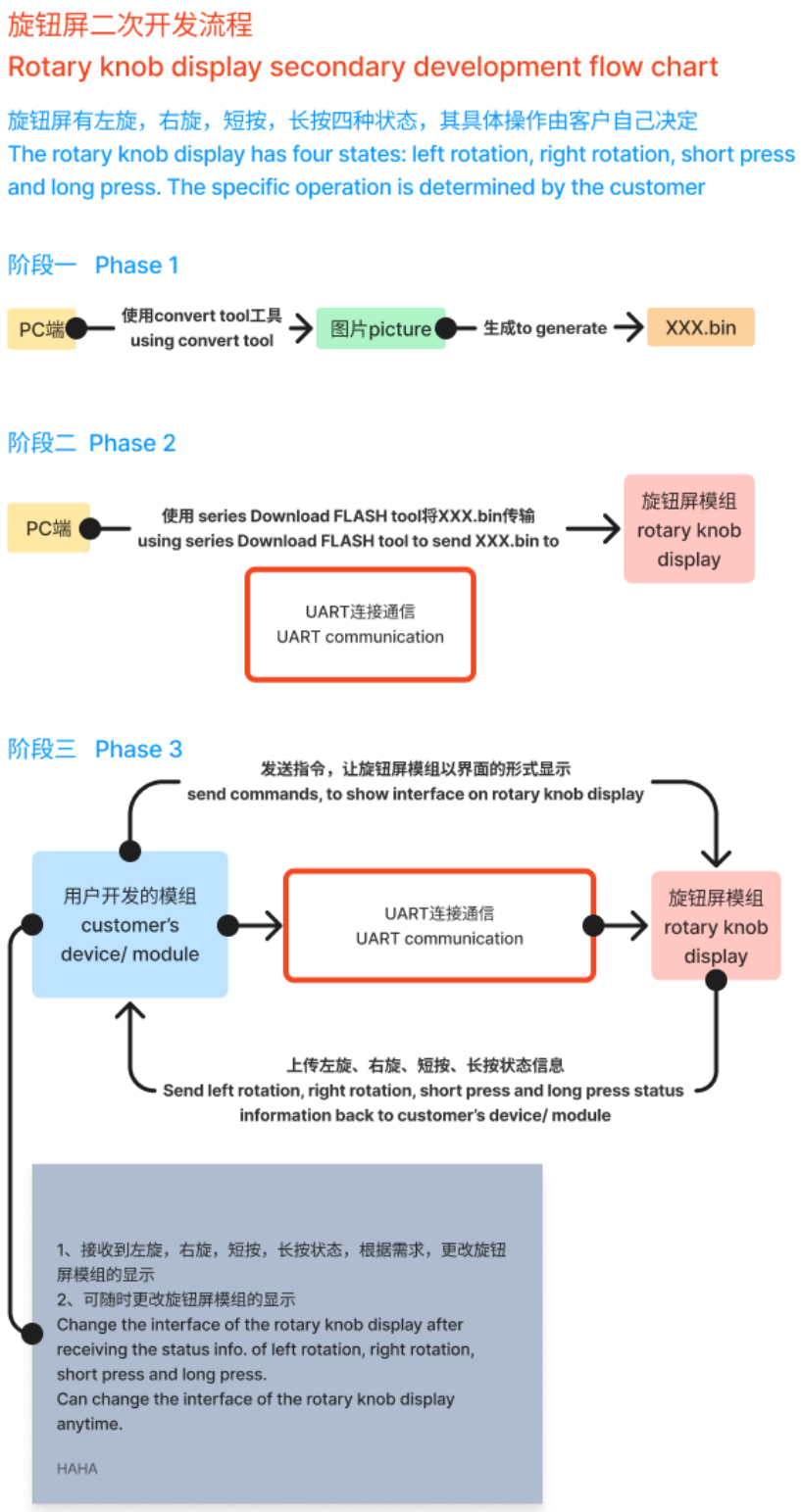
序号 No.	数据内容 Data Content	数据编码 Data Encode	备注说明 Note
1	HEAD_CODE	0xAA	数据帧头 Data frame head
2	COMMAND	0xF3	数据指令 Data Command
3	LENGTH	0x01	数据长度 Data Length
4	DATA[0]	0x00	保留　Reservation
5	CHECKSUM	BYTE(COMMAND+LENGTH+DATA[0] +…+DATA[n])^0xFF	

附录 1（Appendix 1） 主控端和从设备端交互流程示意

Interaction process schematic of Host and Slave



附录 2（Appendix 2） 开发流程示意图 Schematic Diagram of Development Process



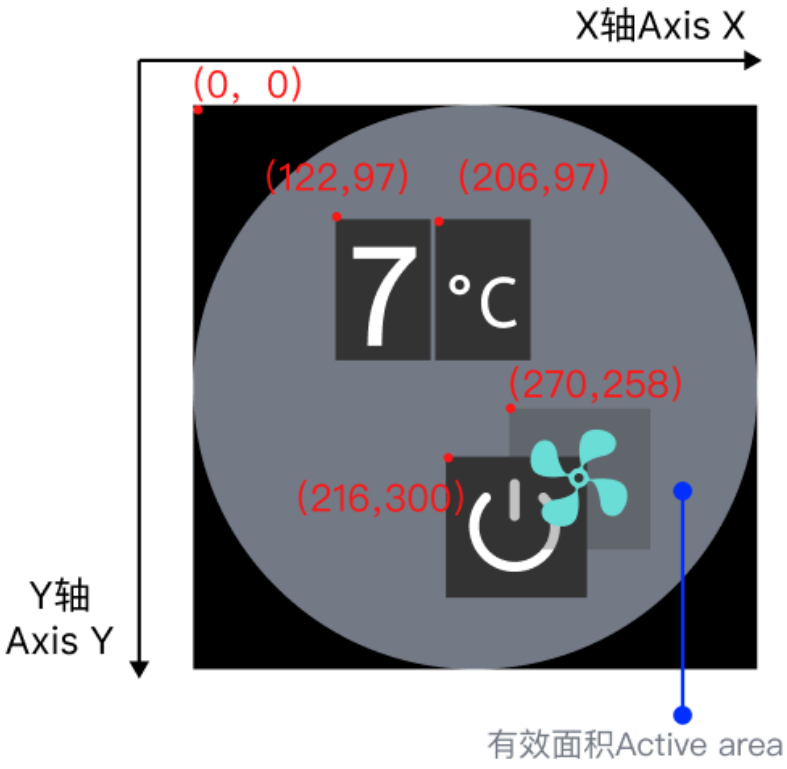
附录 3（Appendix 3） 界面由多张图片组成是各图片的坐标示意

Example of the coordinates of each picture when the interface is composed of multiple pictures

界面由多张图片组成时各图片的坐标示意。
Example of the coordinate of each picture when the interface is composed of multiple pictures.

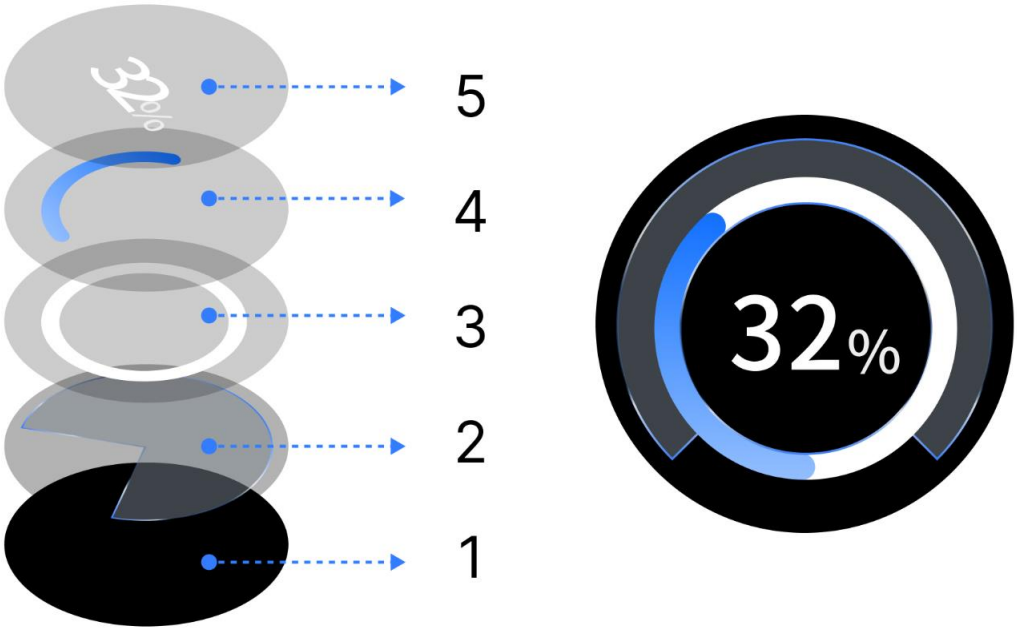
图片Picture

分辨率为480*480
Picture with resolustion of 480*480



图片设计请在有效面积内
Pictures supposed to be located within the active area.

附录 4（Appendix 4） 界面设计示意，界面可由多张图片组成，注意图片叠加顺序 Example of interface design, the interface can be composed of multiple images, pay attention to the order of images when there are multiple images



版本更新记录 Version Upgrade Record

V1.0.3	20230512	update version
V1.0.2	20230512	update version
V1.0.1	20230510	Preliminary Design