ER-TFT028A2-4-5465

Application Note

EastRising Technology Co., Limited

REV	Description	Release Date
1.0	Preliminary Release	Nov-24-2022

CONTENT

1. Overview

This application note mainly explain the application of ER-TFT028A2-4-5465, the small-size UART TFT panel. This application note will provide a step-by-step guidance and detailed introduction of the Graphic Integration Compiler (UartTFT_Tool.exe) and UI Editor (UI_Editor.exe), help the system-side application customers can complete their display product quickly, avoiding long time development.

Before using the ER-TFT028A2-4-5465, you can use two computer tools "UartTFT_Tool.exe" and the "UI_Editor.exe" which provided by EastRising. Both tools are used to set up and display the function. This software will follow the fixed command protocol to integrate user's picture, text, animation and other messages to produce a "Bin" file. Developers can program the Bin file into SPI Flash via USB port and using EastRising ISP program or a dedicated Flash programmer. ER-TFT028A2-4-5465 can also update External SPI Flash with an SD card. Then through the USB to Uart (RS232) control line to simulate and pre-verification.Please refer to Chapter 6 for more flash update detail.

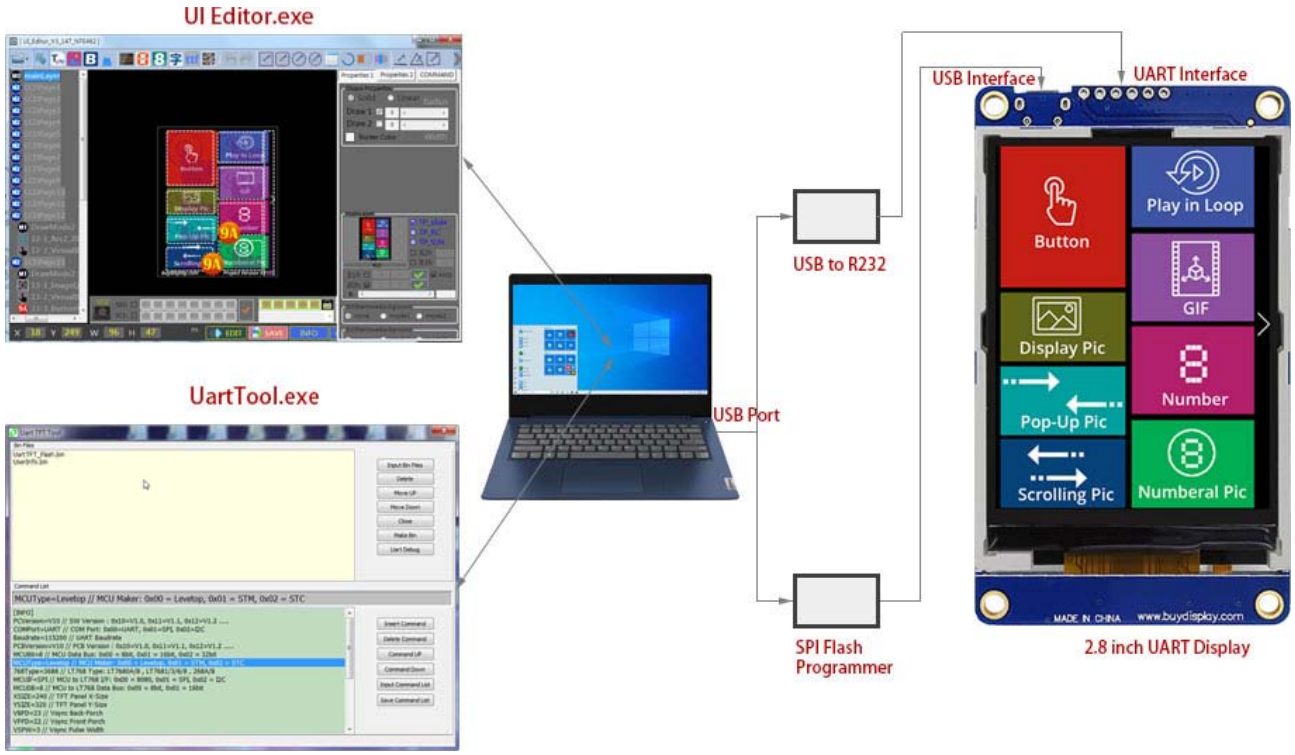


Figure 1-1: Develop Diagram using PC Software

The host computer software will generate the command format according to the order and manner in which the pictures appear. The above-mentioned simulation is to replace the Host through the USB to Uart control line to send commands, so that the developer can perform pre-verification on the PC software. The commands sent by the host computer software can be displayed on the TFT panel and achieve the desired effect of the developer.

The UI_Editor has a fixed command for each display action of serial TFT display, for example, 80h is the command to display pictures. UI_Editor will number the used pictures, and create Bin file for all pictures, texts, animation after compilation. After developers Programming the Bin file into SPI Flash, when PC send 80h, 00h, then will display the first picture on display panel ; when PC send 80h, 01h, the second picture will be displayed. Once commands sent by UI_Editor can be displayed and achieve

desired effect, now we can connect Host with serial TFT panel as photo 1-5 shown. When Host MCU send out command 80h, 00h, 1Bh(CRC1), 98h(CRC2), Serial Uart TFT Panel will display the first picture and send back 80h, 00h(command executed), 1Bh(CRC1), 98h(CRC2) to Host to confirm the protocol is completed. Shown as below:

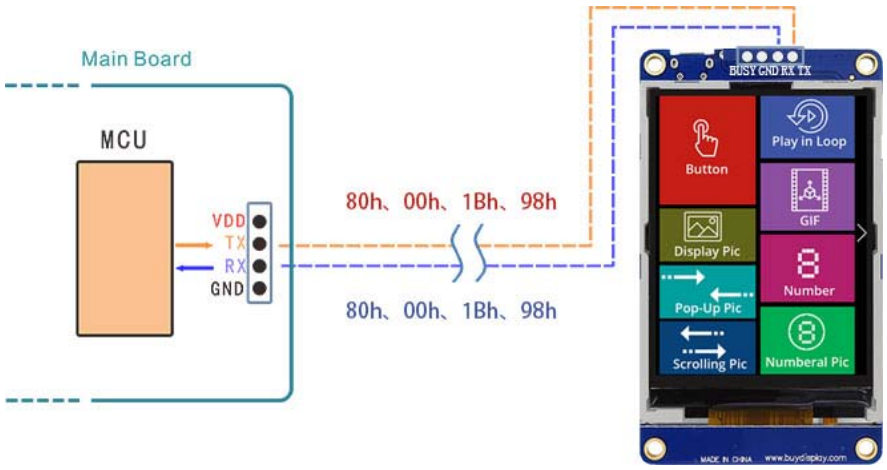


Figure 1-6: Command Protocol Example 1

When Host MCU send out command 80h, 01h, 0Bh(CRC1), B9h(CRC2), Serial Uart TFT Panel will display the second picture and send back 80h, 00h (command executed), 1Bh(CRC1) 98h(CRC2) to Host to confirm protocol is completed. As below figure shows:

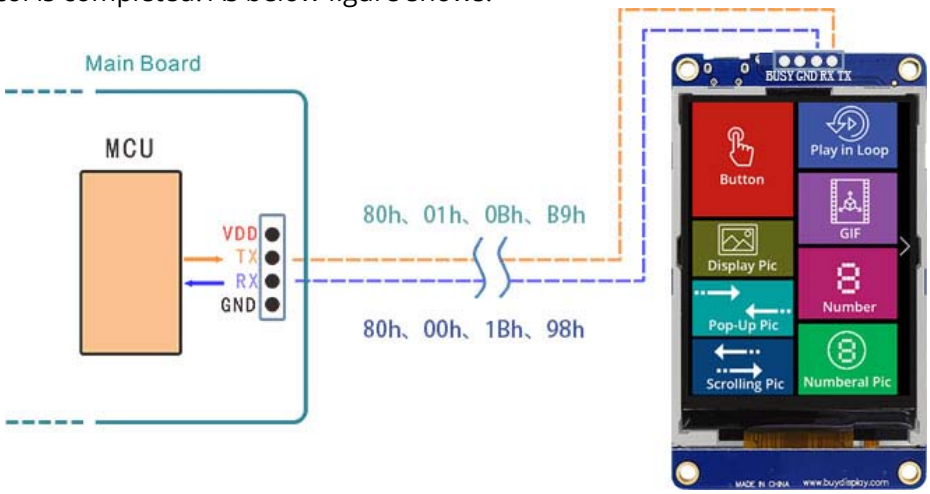


Figure 1-6: Command Protocol Example 2

In order to ensure the correct data transmission between the Host and the Uart TFT Panel, the command sent by the Host MCU program must be added with 1 byte initial code(fixed as 0xAA),2 Byte CRC codes, 4 Byte End code (fixed as 0xE4, 0x1B, 0x11, 0xEE). After the TFT panel receive the information or execute the command, it will return the information to the host MCU. For the command protocol between the Host and TFT panel, please refer to Section 2.2. The generation method of the 2-byte CRC, please refer to Section 2.3.

2. Serial Command

In order to allow the host to easily display pictures or information on the TFT Panel through the serial port such as UART and SPI, a serial command set is planned on the ER-TFT028A2-4-5465. Through the defined command code and parameter changing, user can change the picture on TFT Panel. EastRising provides two kinds of serial Panel development tools: UartTFT_Tool and UI_Editor. Users can choose either of the tools to develop of the TFT serial Panel. And these two tools can simulate the display effect of the TFT Panel in real time, and do the preliminary verification.

2.1 Command Lists

The commands supported by the ER-TFT028A2-4-5465 includes static picture display, dynamic picture display, text display, geometry, etc., as shown in the following table.

Table 2-1: ER-TFT028A2-4-5465 Command List

Main Function	Detail Function	Code (1Byte)
Picture Display	Single/Multi Picture	80h, 8Ah, 8Fh
	Play In Loop	81h, 84h
	GIF Animation	88h, 89h
	Transparent Picture	D8h
	Pop-Up Picture	D9h, DBh
	Numberal Picture	90h, 91h
Display Button Picture	Display Single Button Picture	A0h
	Cancel Single Button Picture	A1h
	Virtual Touch Area	A2h
	Cancel Virtual Touch Area	A3h
Indicator Font Display	Progress Bar Indicator	B0h
	Ring Indicator	DCh
	QR-Code	98h
Font Display	Font-1~4	C0h ~ C3h
Backlight Brightness	Brightness Setting	BAh
	On/Off	BCh
RTC	Set Clock	8Ch
	Read Clock	8Dh
Display Clock	Display Digital Clock	92h
Boot	Boot Command	9Ah/00
Combine	Combine Command	9Ah
Play Wav Music	Play	B8h
	Stop	B9h

Main Function	Detail Function	Code (1Byte)
Geometric	Point	DFh
	Line	E0h
	Hollow Circle	E1h
	Solid Circle	E2h
	Solid Circle With Frame	E3h
	Hollow Ellipse	E4h
	Solid Ellipse	E5h
	Solid Ellipse With Frame	E6h
	Hollow Rectangle	E7h
	Solid Rectangle	E8h
	Rectangle With Frame	E9h
	Hollow Rounded-Rectangle	EAh
	Solid Rounded-Rectangle	EBh
	Rounded-Rectangle With Frame	ECh
	Hollow Triangle	EDh
	Solid Triangle	EEh
	Triangle With Frame	EFh
	Cylinder	F4h
	Table	F6h
Register	Regster Control	CAh ~ CFh
Resistive Panel Verification	Verification Command	8Bh
Panel Check	Online Check	BEh
	Version Check	BFh

2.2 Host and Serial Uart Panel Protocol

Table 2-2: Command Protocol for Host and TFT Panel

Main Function	Detail Function	Host Send (Panel Receive)						Host Receive (Panel Send)					
		Initial Code (1Byte)	Comm. Code (1Byte)	No. (1Byte)	Command Param.	CRC Code (2Bytes)	End Code (4Bytes)	Initial Code (1Byte)	Comm. Code (1Byte)	No. (1Byte)	Comm. Param. (1Byte)	CRC Code (2Bytes)	End Code (4Bytes)
Display Picture	Single/Multi Picture	Start	80h	nn		CRC	End	Start	80h	nn	info code	CRC	End
	Single/Multi Picture	Start	8Ah	nn		CRC	End	Start	8Ah	nn	info code	CRC	End
	Single Picture	Start	8Fh	nn	X, Y, PNG, Pnn	CRC	End	Start	8Fh	nn	info code	CRC	End
	Play In Loop	Start	81h	nn		CRC	End	Start	81h	nn	info code	CRC	End
	Cancel Play In Loop	Start	84h	nn		CRC	End	Start	84h	nn	info code	CRC	End
	Play GIF Animation	Start	88h	nn		CRC	End	Start	88h	nn	info code	CRC	End
	Cancel GIF Animation	Start	89h	nn		CRC	End	Start	89h	nn	info code	CRC	End
	Pop Up Picture	Start	D8h	nn		CRC	End	Start	D8h	nn	info code	CRC	End
	Scroll Picture In Loop	Start	D9h	nn		CRC	End	Start	D9h	nn	info code	CRC	End
	Cancel Scroll Picture	Start	DBh	nn		CRC	End	Start	DBh	nn	info code	CRC	End
	Numberal Picture #1	Start	90h	nn	ddd.d	CRC	End	Start	90h	nn	info code	CRC	End
	Numberal Picture #2	Start	91h	nn	ddd.d	CRC	End	Start	91h	nn	info code	CRC	End
Display Button Picture	Display Single Button Picture	Start	A0h	nn		CRC	End	Start	A0h	nn	info code	CRC	End
		When press the Button picture						Start	A0h	nn	31h	CRC	End
		When release the Button picture						Start	A0h	nn	30h	CRC	End
	Cancel Button Picture	Start	A1h	nn		CRC	End	Start	A1h	nn	info code	CRC	End
	Virtual Touch Area	Start	A2h	nn		CRC	End	Start	A2h	nn	info code	CRC	End
		When press the touch area						Start	A2h	nn	31h	CRC	End
		When release the touch area						Start	A2h	nn	30h	CRC	End
	Cancel Virtual Area	Start	A3h	nn		CRC	End	Start	A3h	nn	info code	CRC	End
Indicator Display String	Progress Bar Indicator	Start	B0h	nn	Vaule (2 Bytes)	CRC	End	Start	B0h	nn	info code	CRC	End

	Ring Indicator	Start	DCh	nn	S_Angle, A_Angle	CRC	End	Start	DCh	nn	info code	CRC	End
	QR-Code	Start	98h	nn	String	CRC	End	Start	98h	nn	info code	CRC	End

Table 2-2: Protocol Table between Host and Uart TFT Panel (continue)

Main Function	Detail Function	Host Send (Panel Receive)						Host Receive (Panel Send)					
		Initial Code (1Byte)	Comm. Code (1Byte)	No. (1Byte)	Command Param.	CRC Code (2Bytes)	End Code (4Bytes)	Initial Code (1Byte)	Comm. Code (1Byte)	No. (1Byte)	Comm. Param. (1Byte)	CRC Code (2Bytes)	End Code (4Bytes)
Display String	Font-1	Start	C0h	nn	String	CRC	End	Start	C0h	nn	info code	CRC	End
	Font-2	Start	C1h	nn	String	CRC	End	Start	C1h	nn	info code	CRC	End
	Font-3	Start	C2h	nn	String	CRC	End	Start	C2h	nn	info code	CRC	End
	Font-4	Start	C3h	nn	String	CRC	End	Start	C3h	nn	info code	CRC	End
Backlight Brightness	Set Brightness	Start	BAh		BL (00~0Fh)	CRC	End	Start	BAh	BL (00~0Fh)	info code	CRC	End
	On/Off	Start	BCh		00 or01	CRC	End	Start	BCh	00 or 01	info code	CRC	End
Play Wav Music	Play	Start	B8h		REP(Bit7) + WAV No#	CRC	End	Start	B8h	REP(Bit7) + WAV No#	info code	CRC	End
	Stop	Start	B9h			CRC	End	Start	B9h	00	info code	CRC	End
Boot	Boot	Start	9Ah	00		CRC	End	Start	9Ah	00	info code	CRC	End
Combine	Command Combine	Start	9Ah	nn		CRC	End	Start	9Ah	nn	info code	CRC	End
RTC	Setup Clock	Start	8Ch		Y, M, D, H, M, S, W (8 Bytes)	CRC	End	Start	8Ch	00	info code	CRC	End
	Read Clock	Start	8Dh			CRC	End	Start	8Dh	Y, M, D, H, M, S, W (8)	info code	CRC	End
Display Clock	Display Digital Clock	Start	92h	nn		CRC	End	Start	92h	nn	info code	CRC	End
Resistive Panel Verify	Resistive Panel Verify	Start	8Bh			CRC	End	Start	8Bh	00	info code	CRC	End
TFT Panel Verify	Online Verify	Start	BEh			CRC	End	Start	BEh	00	5Ah, or 55h	CRC	End
	Version Verify	Start	BFh			CRC	End	Start	BFh	MCU Code(5Bytes) + Module Info. (42)	info code	CRC	End
Register	Execute 9A CMD	Start	CAh	Reg		CRC	End	Start	CAh	nn	info code	CRC	End
	Setup REG	Start	CBh	Reg		CRC	End	Start	CBh	nn	info code	CRC	End
	Write Data	Start	CCh	Data		CRC	End	Start	CCh	nn	info code	CRC	End
	Read Data	Start	CDh	00		CRC	End	Start	CDh	Data	info code	CRC	End
	REG Value + 1	Start	CEh	Reg		CRC	End	Start	CEh	nn	info code	CRC	End

	REG Value - 1	Start	CFh	Reg		CRC	End	Start	CFh	nn	info code	CRC	End

Table 2-2: Protocol Table between Host and Uart TFT Panel (continue)

Main Function	Detail Function	Host Send (Panel Receive)						Host Receive (Panel Send)					
		Initial Code (1Byte)	Comm. Code (1Byte)	No. (1Byte)	Command Param.	CRC Code (2Bytes)	End Code (4Bytes)	Initial Code (1Byte)	Comm. Code (1Byte)	No. (1Byte)	Comm. Param. (1Byte)	CRC Code (2Bytes)	End Code (4Bytes)
Geometric	Dot	Start	DFh	nn		CRC	End	Start	DFh	nn	info code	CRC	End
	Line	Start	E0h	nn		CRC	End	Start	E0h	nn	info code	CRC	End
	Hollow Circle	Start	E1h	nn		CRC	End	Start	E1h	nn	info code	CRC	End
	Solid Circle	Start	E2h	nn		CRC	End	Start	E2h	nn	info code	CRC	End
	Solid Circle With Frame	Start	E3h	nn		CRC	End	Start	E3h	nn	info code	CRC	End
	Hollow Ellipse	Start	E4h	nn		CRC	End	Start	E4h	nn	info code	CRC	End
	Solid Ellipse	Start	E5h	nn		CRC	End	Start	E5h	nn	info code	CRC	End
	Solid Ellipse With Frame	Start	E6h	nn		CRC	End	Start	E6h	nn	info code	CRC	End
	Hollow Rectangle	Start	E7h	nn		CRC	End	Start	E7h	nn	info code	CRC	End
	Solid Rectangle	Start	E8h	nn		CRC	End	Start	E8h	nn	info code	CRC	End
	Rectangle With Frame	Start	E9h	nn		CRC	End	Start	E9h	nn	info code	CRC	End
	Hollow Rounded Rectangle	Start	EAh	nn		CRC	End	Start	EAh	nn	info code	CRC	End
	Solid Rounded Rectangle	Start	EBh	nn		CRC	End	Start	EBh	nn	info code	CRC	End
	Rounded Rectangle With Frame	Start	ECh	nn		CRC	End	Start	ECh	nn	info code	CRC	End
	Hollow Triangle	Start	EDh	nn		CRC	End	Start	EDh	nn	info code	CRC	End
	Solid Triangle	Start	EEh	nn		CRC	End	Start	EEh	nn	info code	CRC	End
	Triangle With Frame	Start	EFh	nn		CRC	End	Start	EFh	nn	info code	CRC	End
	Cylinder	Start	F4h	nn		CRC	End	Start	F4h	nn	info code	CRC	End

	Table	Start	F6h	nn		CRC	End	Start	F6h	nn	info code	CRC	End

2.3 RS-232(UART) Communication Protocol

When the main system transmits a display command to the ER-TFT028A2-4-5465 TFT panel through the UART serial port, it includes Command Code, Code Number, and Command Parameters, 1 Byte Start Code (fixed to 0xAA) and 2 Bytes, CRC Code, 4 Byte End Code (fixed to 0xE4, 0x1B, 0x11, 0xEE), the command information is as below:

Table 2-3: TFT Panel Receive Command Info

Initial Code	Command Code	Serial Code No.	Parameter	CRC Code	End Code
0xAA (1 Byte)	1 Byte	1 Byte	n Bytes	2 Bytes	**0xE4, 0x1B, 0x11, 0xEE** (4 Bytes)

CRC protocol as below:

```
chkSum = Rx_CRC_CCITT(txBuf,txLen);
  txBuf[txLen++] = (chkSum>>8)&0xFF;
  txBuf[txLen++] = chkSum&0xFF;

unsigned int Rx_CRC_CCITT(unsigned char *puchMsg, unsigned int usDataLen)
{
  unsigned char i = 0;
  unsigned short wCRCin = 0x0000;
  unsigned short wCPoly = 0x1021;
  unsigned char wChar = 0;

  while (usDataLen--)
  {
    wChar = *(puchMsg++);
    wCRCin ^= (wChar << 8);
    for(i = 0; i < 8; i++)
    {
      if (wCRCin & 0x8000)
        wCRCin = (wCRCin << 1) ^ wCPoly;
      else
      wCRCin = wCRCin << 1;
    }
  }
  return (wCRCin);
}
```

After receiving the host command, the TFT panel will normally respond to 10 bytes of information, including initial code, command code, information code, CRC code, and end code. The first Byte is the initial code, then the received command, the third is the serial number. Then the fourth is information code that returns the executed result. The fifth and sixth are the CRC code, and the last is the end code of 4 Bytes:

Table 2-4: Feedback Information of TFT Panel

Initial Code	Command Code	Serial Number	Information Code	CRC Code	End Code
0xAA (1 Byte)	1 Byte	Normal Command (1 Byte) BFh Command (47 Bytes)	1Byte 0x00: Command executed 0x01: Command parameter error 0x02: Non-exist command 0x03: Command's configuration Overflow 0x04: CRC correction error 0x05: Flash Data Exception BEh Command: 0x5A: Ready 0x55: Not Ready A0h Command: 0x31: Press Button 0x30: Release Button	2 Bytes	**0xE4, 0x1B, 0x11, 0XEE** (4 Bytes)

In the information structure of Serial Uart TFT Panel feedback, serial numbers also represent different meanings in some instructions. For example, the brightness command - BAh its serial number represents the backlight brightness. The Version Check command - BFh has 47 Bytes representing Serial Uart TFT Panel information.

2.4 A Program Example of Host Sends Command

The following is an example of a program in which the host passes a display command to the ER-TFT028A2-4-5465 serial TFT panel through the UART port. This program takes the transmission of the first picture (80h, 00h) as an example. The program will automatically add 0xAA start code, 2 Byte CRC codes and 4 Byte end codes.

```
int main (void)
{
        char c[] = "80 00";                    //Send 80h command and 00 serial number
        Send(c);

        while(1);

}

unsigned short Rx_CRC_CCITT(unsigned char *puchMsg, unsigned int usDataLen) // generate CRC
{
        unsigned char i = 0;
        unsigned short wCRCin = 0x0000;
        unsigned short wCPoly = 0x1021;
        unsigned char wChar = 0;

        while (usDataLen--)
        {
         wChar = *(puchMsg++);
         wCRCin ^= (wChar << 8);
         for(i = 0; i < 8; i++)
         {
          if (wCRCin & 0x8000)
           wCRCin = (wCRCin << 1) ^ wCPoly;
          else
           wCRCin = wCRCin << 1;
         }
        }
        return (wCRCin);
}


void Send(char *c)                              //Send command function
{
        unsigned char Sendbuff[100]={0};
        unsigned short Send_CRC = 0;
        unsigned char C_flag = 0;

        int i = 0, j = 0;

        if(((c[0]>=0x30 && c[0]<=0x39) || (c[0]>=0x41 && c[0]<=0x5A))   ||   ((c[1]>=0x30 &&
c[1]<=0x39) || (c[1]>=0x41 && c[1]<=0x5A)))       {
         while(c[i] != '\0')
         {
          if(c[i] != ' ')
          {
           if(c[i] == '"')                      ,
           {
            C_flag++;
```

```
  i++;
 }
 if(C_flag == 1)
 {
  if(c[i] != '"')
  {
   Sendbuff[j] = c[i];                //ASCII direct output
   i++;
   j++;
  }

 }
 else if(C_flag == 2)
 {
  C_flag = 0;
  i++;
 }
 if(C_flag == 0)
 {
  if(c[i] == '/') break;

  if(c[i]>=0x30 && c[i]<=0x39) //0~9
  {
   Sendbuff[j] = ((c[i] - 0x30)<< 4 );
   i++;

   if(c[i]>=0x30 && c[i]<=0x39)
   {
    Sendbuff[j] += (c[i] - 0x30);
    i++;
    j++;
   }
   else if(c[i]>=0x41 && c[i]<=0x5A)
   {
    Sendbuff[j] += (c[i] - 0x37);
    i++;
    j++;
   }
  }

  else if(c[i]>=0x41 && c[i]<=0x5A) //A~Z
  {
   Sendbuff[j] = ((c[i] - 0x37)<< 4 );
   i++;

   if(c[i]>=0x30 && c[i]<=0x39)
   {
    Sendbuff[j] += (c[i] - 0x30);
    i++;
    j++;
   }
   else if(c[i]>=0x41 && c[i]<=0x5A)
   {
    Sendbuff[j] += (c[i] - 0x37);
    i++;
    j++;
```

```
                }

               }


              }
             }
             else i++;
           }
           Sendbuff[j] = '\0';
//         printf("%s\r\n",Sendbuff);

           /************************ CRC, header and end ***********************/

           Send_CRC = Rx_CRC_CCITT(Sendbuff,j);

           Sendbuff[j] = Send_CRC>>8 & 0xff;
           Sendbuff[j+1] = Send_CRC & 0xff;

           for(i = 0;i<j+2;i++)
             Sendbuff[j+2-i]=Sendbuff[j+1-i];

           Sendbuff[0] = 0xAA;
           Sendbuff[j+3] = 0xE4;
           Sendbuff[j+4] = 0x1B;
           Sendbuff[j+5] = 0x11;
           Sendbuff[j+6] = 0xEE;

           j+=7;

           for(i = 0; i < j; i++)
            {
              USART_DATA(USART0) = (uint8_t) Sendbuff[i];
              while(usart_flag_get(USART0, USART_FLAG_TBE)==0){};
            }

         }
}
```

3. UI Editor (UI_Editor.exe)

3.1 UI_Editor Introduction

"UI_Editor.exe" is a graphic UI compiler for panels provided by EastRising. Its function is to package the picture, text, configuration data and other information used by the TFT panel according to the customer's needs and generate a BIN file. Customers can use UI_Editor to create a UI interface simply and quickly, and then Programming the generated BIN file into SPI Flash.

Remark: The compile environment of UI_Editor is "Microsoft .NET Framework V4.6.2", so the computer must install "Microsoft .NET Framework 4.6.2".

UI_Editor's interface consists of various buttons and screen box, shown as below

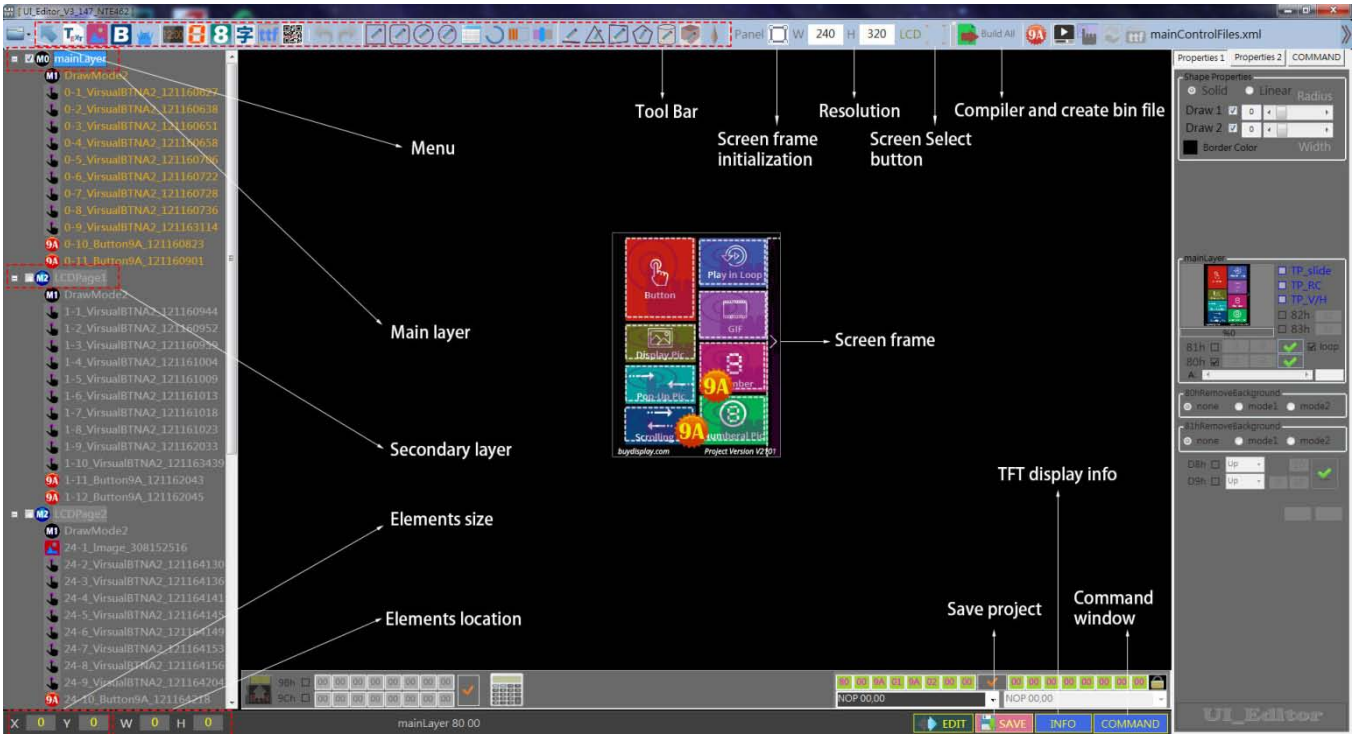


Figure 3-1: UI_Editor Interface

All UI designs are done in the screen box, and users can choose different functions to achieve the design according to their needs. The details of various function keys as follows:

1.  add picture button
2.  add Button button
3.  add GIF button
4.  add number button(graphic)
5.  add number button(graphic)
6.  add text button (font)
7.  add table
8.  add ring (any angle)
9.  add progress bar button
10.  draw rectangle, rounded rectangle, circle, ellipse
11.  Draw line, triangle, cylinder
12.  Retraction operation and recovery operation button

(button not available when there is no operation)

There are several folders at the same level as the UI_Editor tool, and their functions are shown below:

- FONT folder : store the fonts to be used
- PICFILE folder: store the picture files to be used
- PROJECT: backs up each saved and built project file

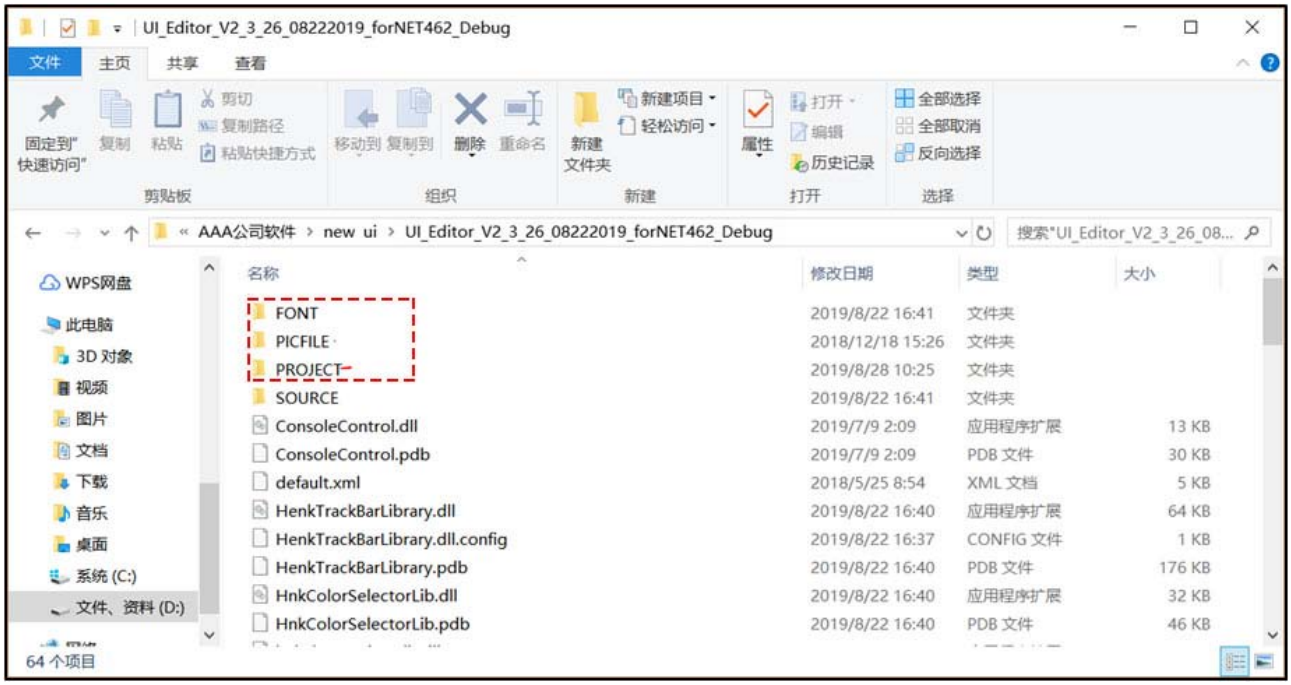


Figure 3-2: UI_Editor Directory Archive

The function of folders under PROJECT folder as below:

- BINFILE: store complied Bin files, its where files UserInfo and UartTFT_Flash stored.
- COMMANDFILE: store project storage file
- PICFILE: store compiled graphic files
- SRCPIC: store graphic files before compiling

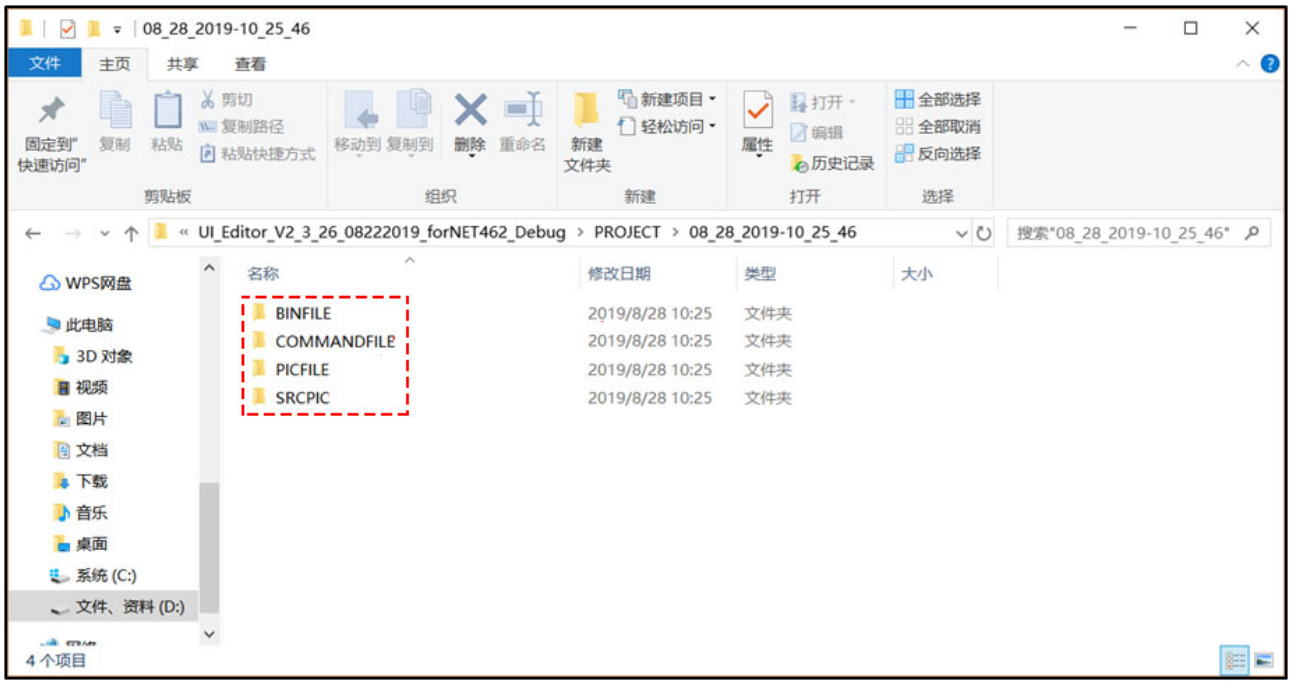


Figure 3-3: Directory Under PROJECT Folder

In Workspace options, there are three buttons: New Project, load and save. They are used to create a new project, load the project file, and save the current project. Press Save will save the project as a mainControlFiles.xml file in the COMMANDFILE folder of a time-named folder in PROJECT. The project can be reloaded by opening the maincontrolfiles.xml in the COMMANDFILE folder in the time-named folder with Load。

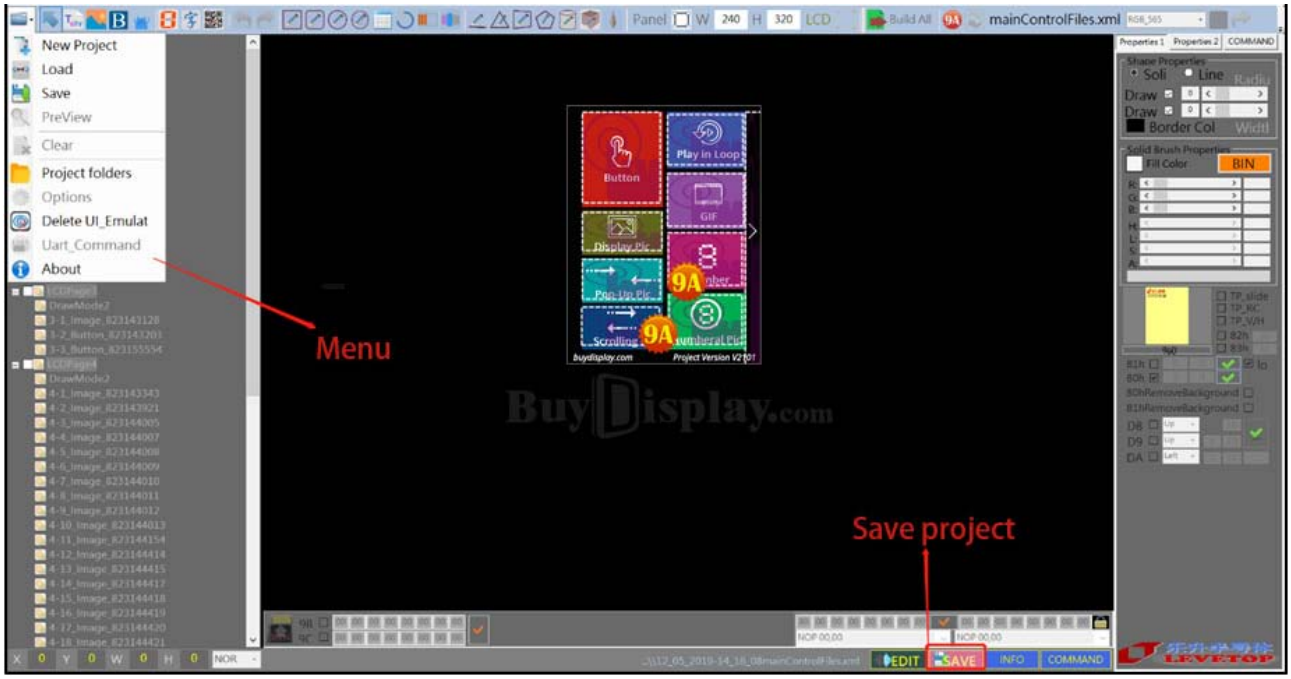


Figure 3-4: UI_Editor Menue

Use the “save” button will save the project as a mainControlFiles.xml file in COMMANDFILE folder under PROJECT subordinate. Use the “Load” function to find the mainControlFiles.xml file in the COMMANDFILE folder and you can reload the project.

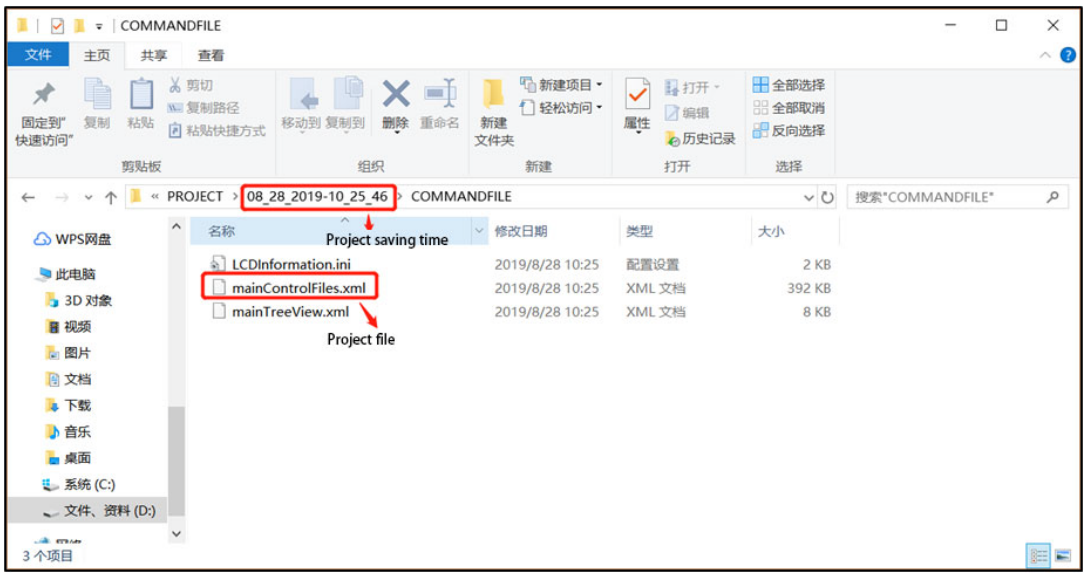


Figure 3-5: UI_Editor Reload Project File

3.1.1 UI_Editor Design Flow

The following figure shows a detailed development flowchart of Graphic UI Compiler – "UI_Editor.exe". Users can also download the UI_Editor example from the our website to learn more about the development mode. Meanwhile it is recommended for users to prepare the materials according to the required functions and TFT panel size. Because these display pictures, animation files, text files, sound files, etc. are stored in SPI Flash, the amount of data is big, and it take a long time to Programming into SPI Flash. We suggest the developer use our simulation tool - "UI_Emulator" to run the pre-validation. In development state, try to avoid repeated programming the "UartTFT_Flash.bin" file into SPI Flash to effect development efficiency. The "UI_Editor" and "UI_Emulator" simulation software can be downloaded from buydisplay.com.

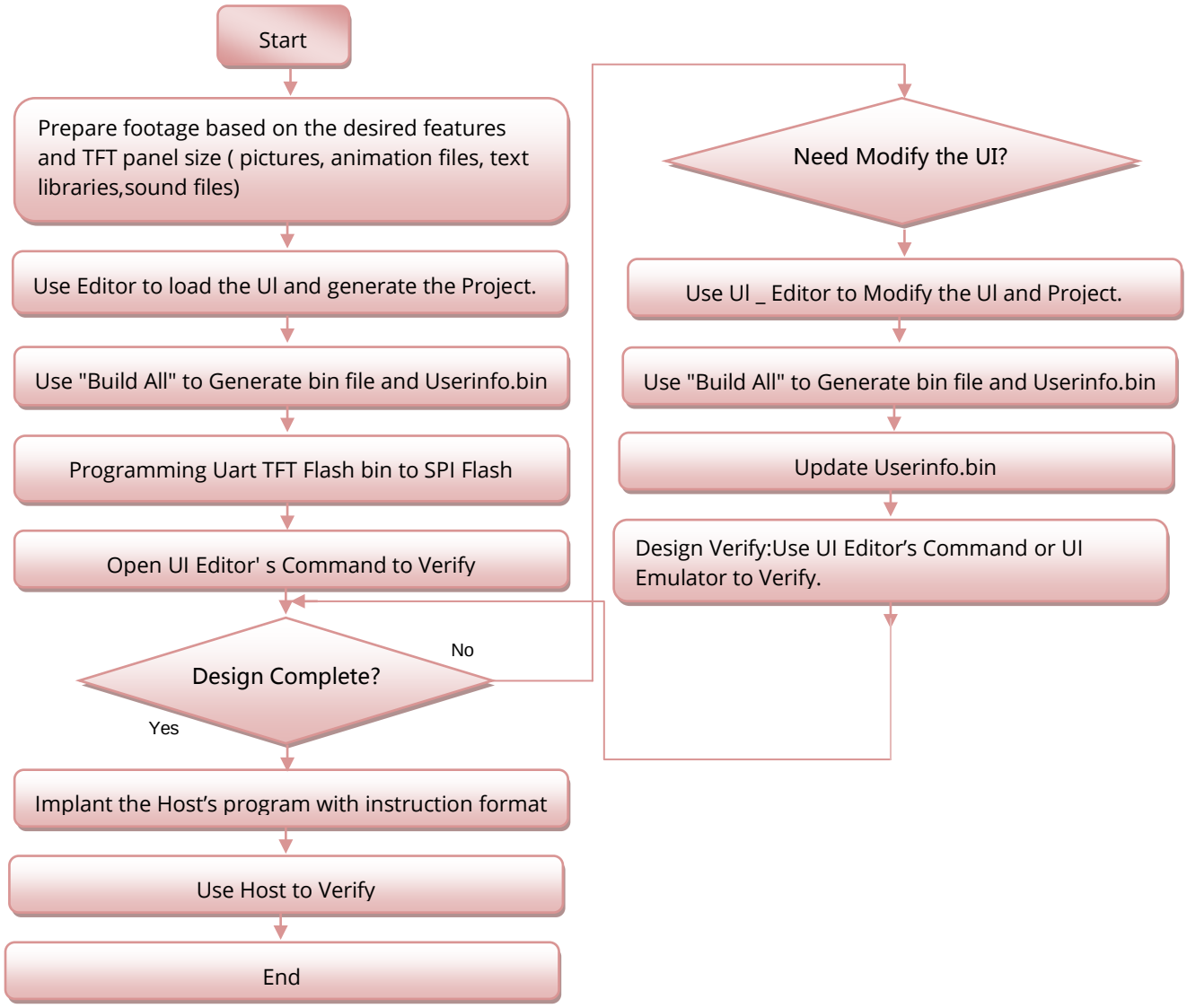


Figure 3-6: UI_Editor Design Flow

For the ER-TFT028A2-4-5465 UI_Editor development environment, users can download the ER-TFT028A2-4-5465 UI_Editor demo case "ER-TFT028A2-4-5465_UI_Editor_Demo_240x320.rar" from the buydislay.com.

3.1.2 Panel Initialize and Background Setting

Open UI_Editor.

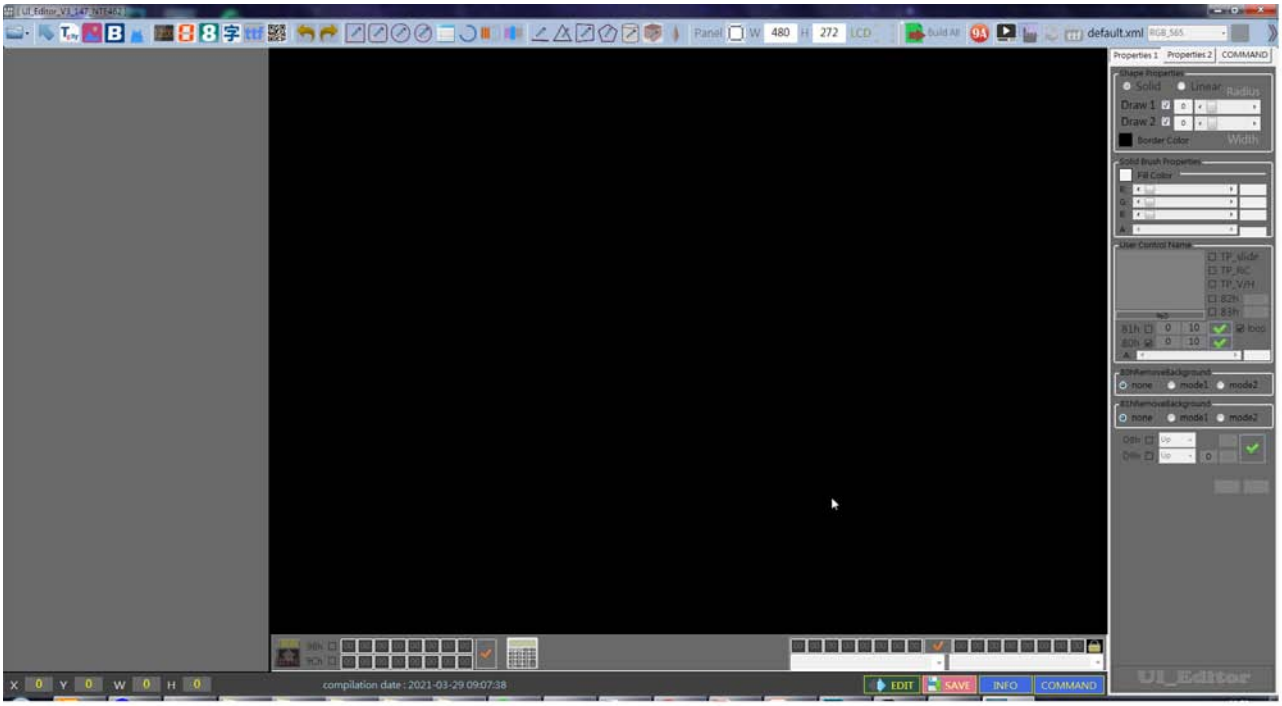


Figure 3-8A: Open UI_Editor

There are two ways to create a new project:
Method 1: First select “New Project (1)” in the menu, then revise the panel resolution(after revise the width, height, press “enter” key to confirm), then click “LCD (2)”button, and double-click anywhere in the box to select the picture to be opened in the layer, as shown below:

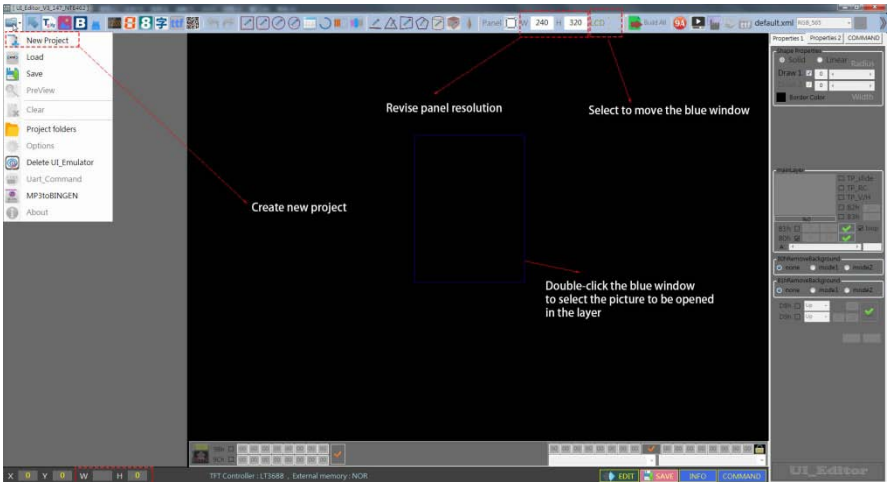


Figure 3-8B: Method 1

Method 2: click ”initialize panel”, then you can directly open the picture in the layer. Then revise the panel resolution(2) and press “enter” key to confirm, see as below:

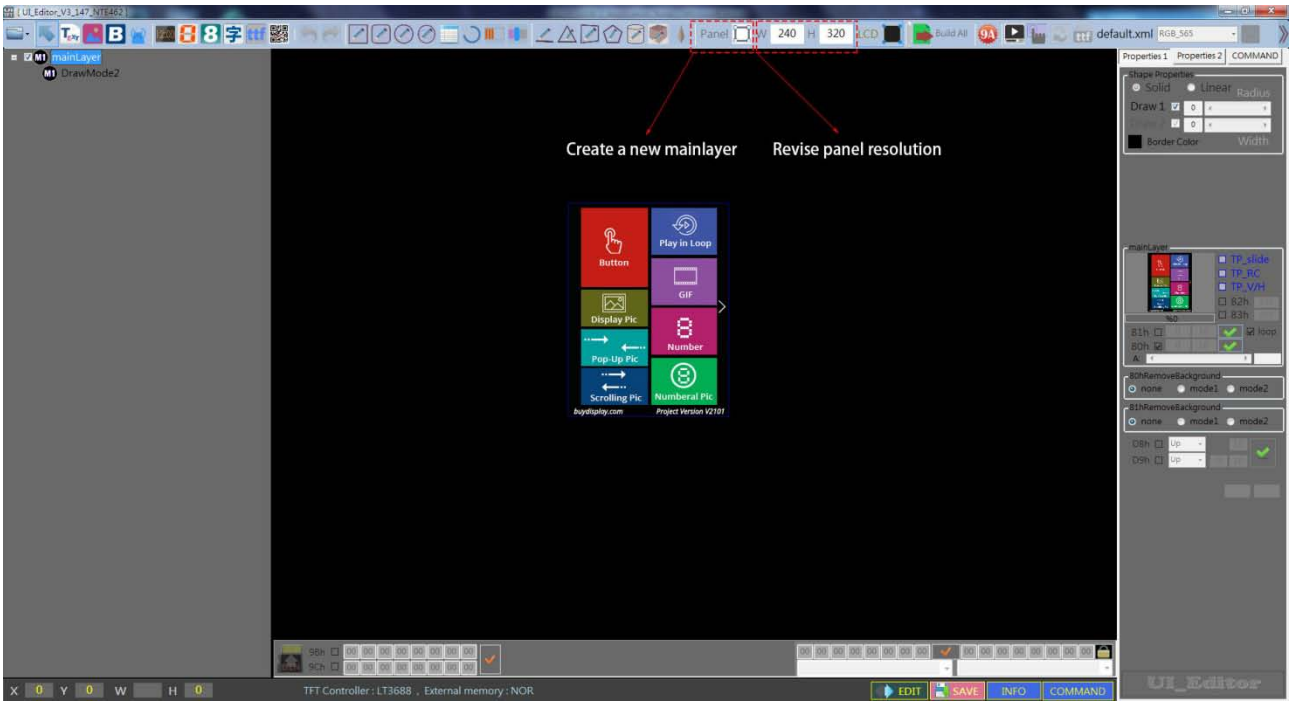


Figure 3-9: Method 2

The length and width of the screen can be changed by modifying the number on the right part of screen. Each time the number has been modified and you have to press Enter to confirm, otherwise you cannot modify it. For example, to set a 2.4-inch 240 X 320 resolution panel, at first, change W to 240, then press Enter to confirm; next, change H to 320 and press Enter to confirm. The panel size can be set at any time. Make sure that the set panel size is correct when you design the UI.

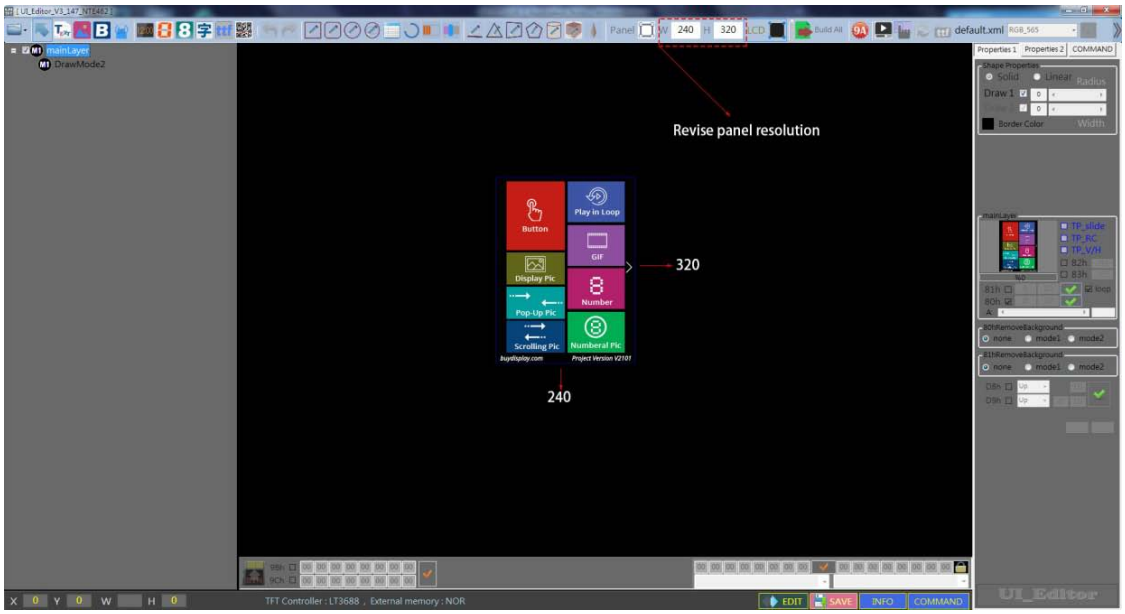


Figure 3-10: Panel Resolution Setting

After clicking the " LCD" button, the entire screen box can be dragged to any position and placed in a position where the field of view is suitable. When the button is clicked again, the screen box selection function is canceled, Now the background image unable to change, and the screen box cannot be dragged.

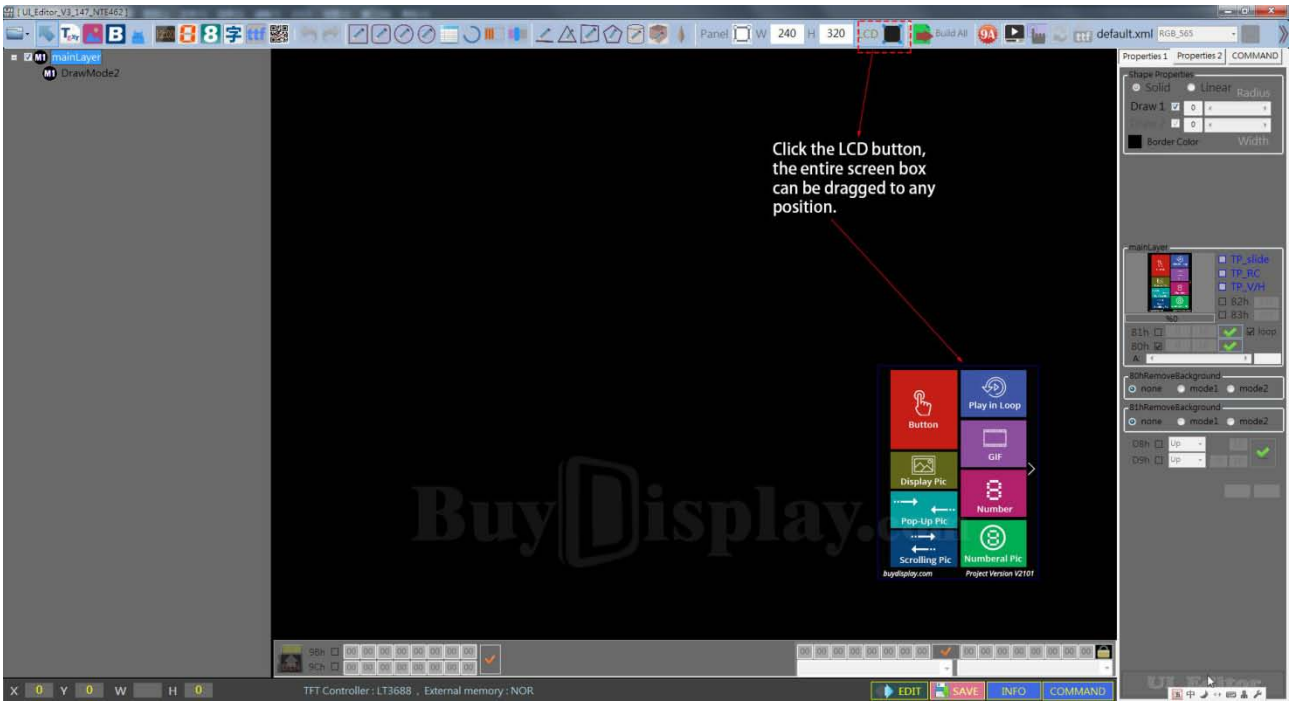


Figure 3-11: Drag Screen Box To Any Position

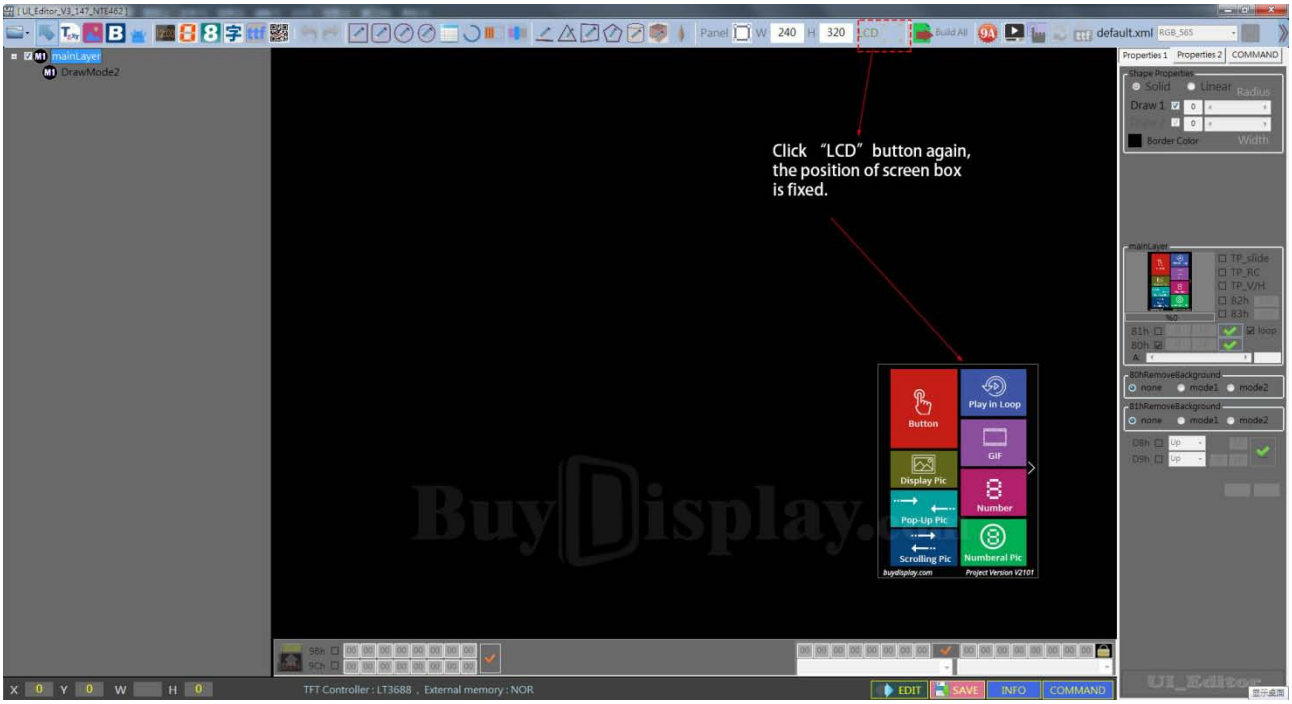


Figure 3-12: Cancel Screen Box Selection

3.1.3 Display Setting

After the screen box is initialized, the screen box shows a main layer by default. We can add layers by right-clicking in the main layer and select option “Add New Page”.

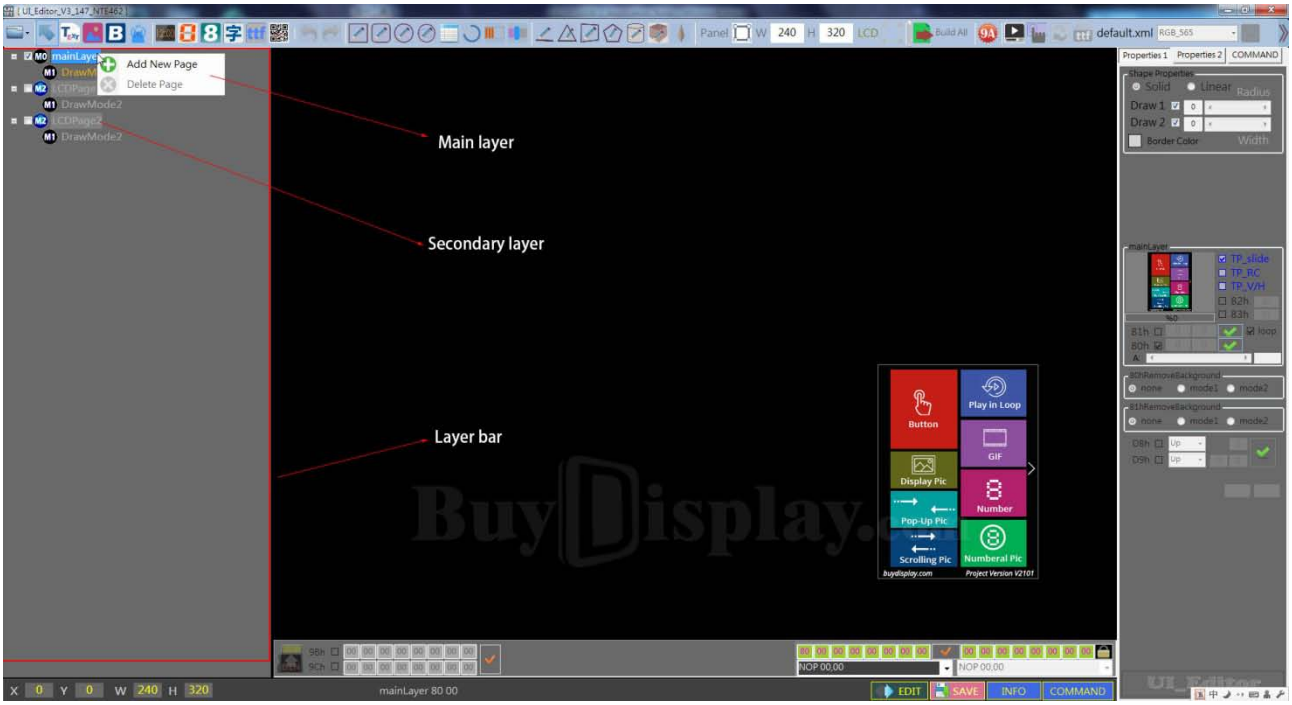


Figure 3-13: Add Layer

If the created layer share the same picture with the main layer, click “Cancel” on this interface.

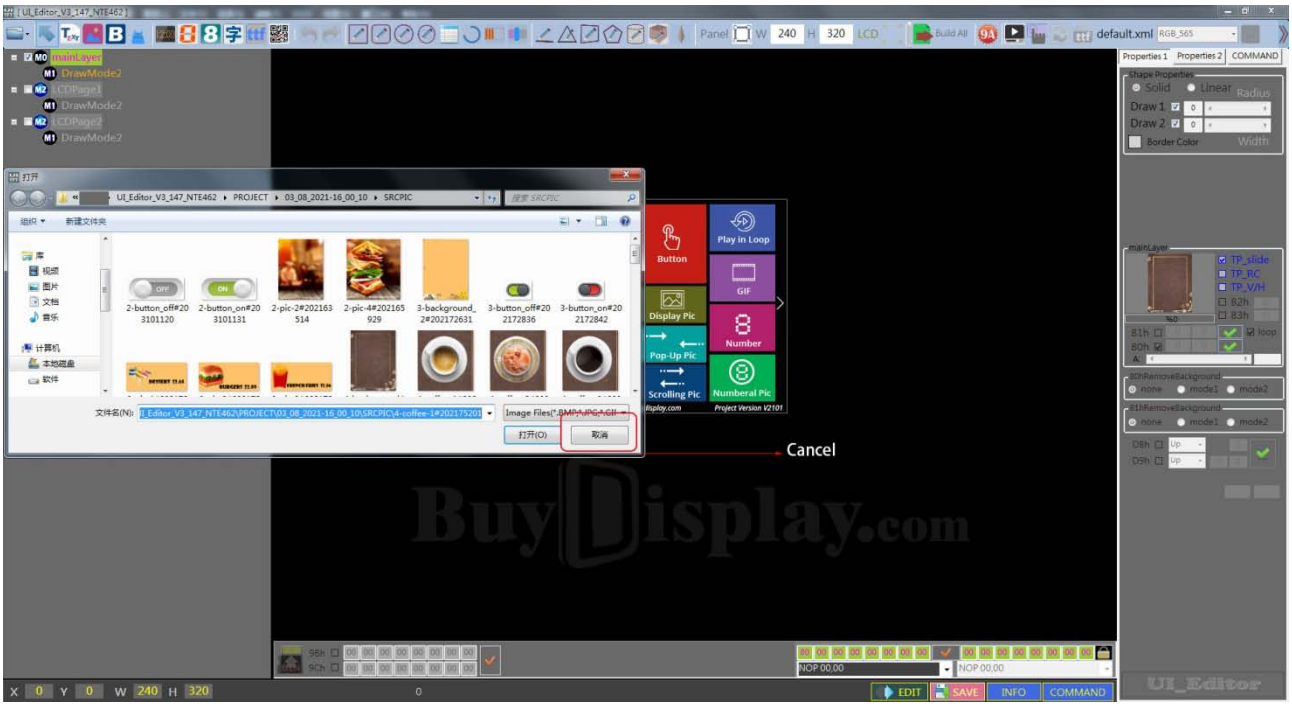


Figure 3-14: New Layer And Main Layer Are The Same

If the created layer needs a new independent picture, then select a picture and click "Open"

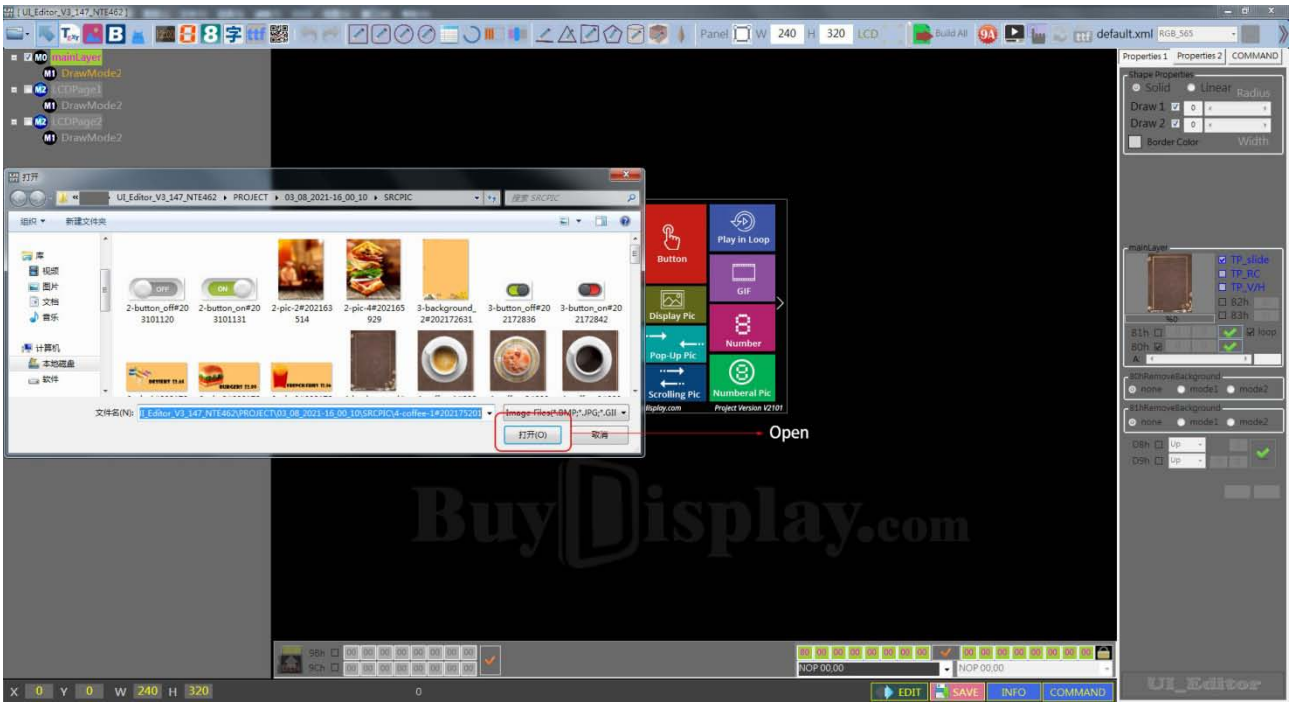


Figure 3-15: New Independent Layer

If you need to change the background picture of the layer, first select the layer you want to change, click on the layer's "DrawMode", then click on "LCDPage", then double-click the thumbnail display box to select the layer background according to your demand.

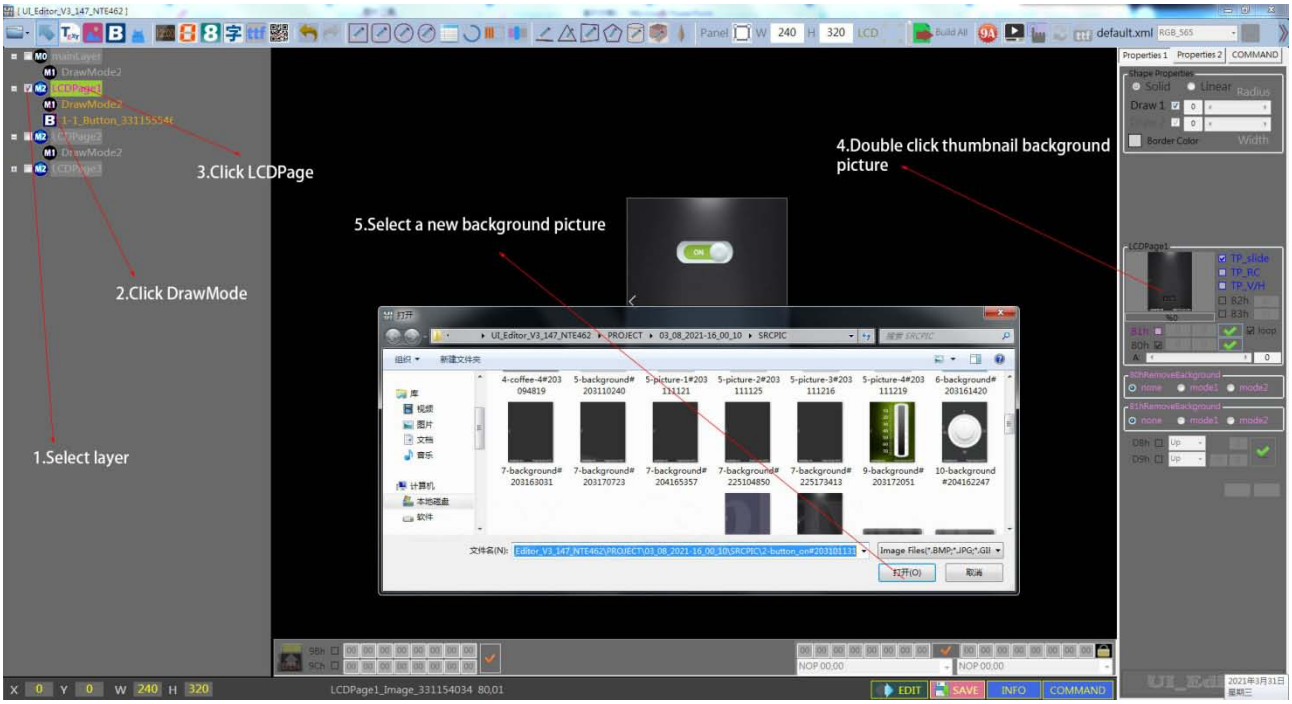


Figure 3-16: Change Layer Background

When there are multiple layers, you can show and hide the current layer by selecting the small squares in front of the layer. In the current layer, right-click on the layer to delete or move the layer.

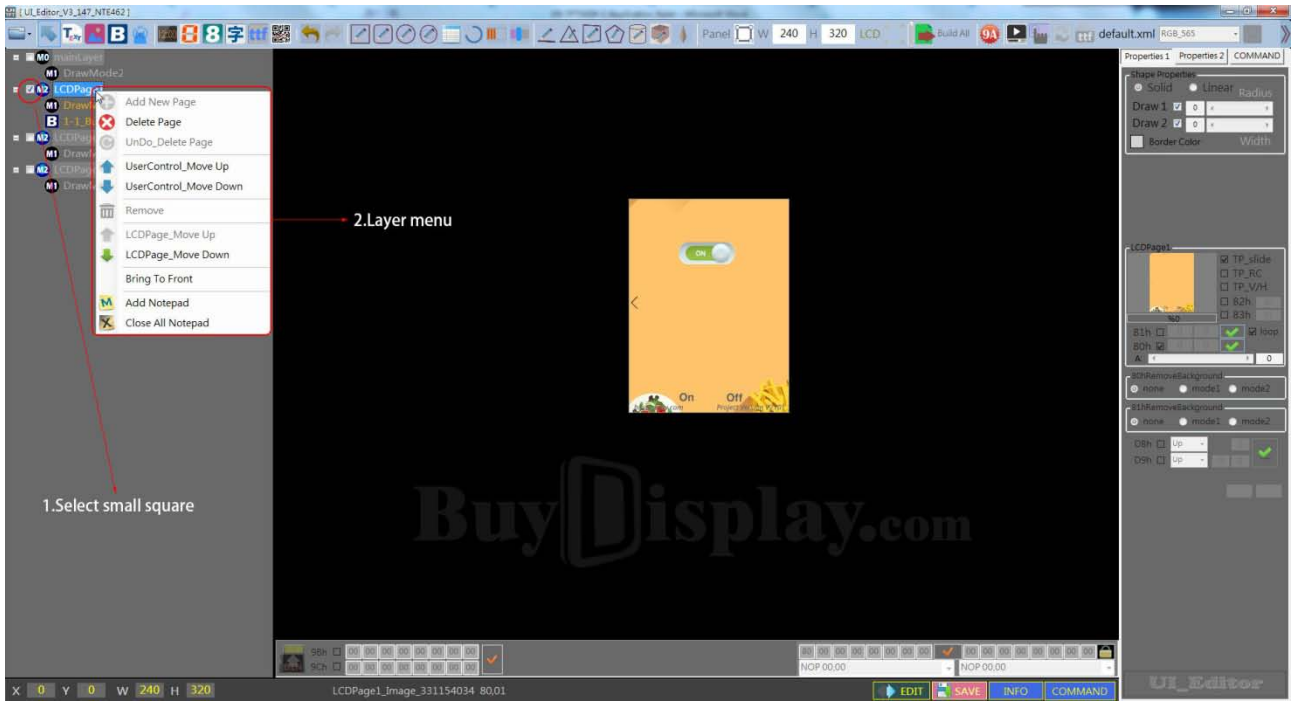


Figure 3-17: Delete Or Move Layer

3.1.4 Interface Edit and Debug

As shown in the following figure, select the control Button with the left mouse button, and then right click "Remove" to remove the Button. You can also use right-click to select the Button on the left of the interface for deletion.

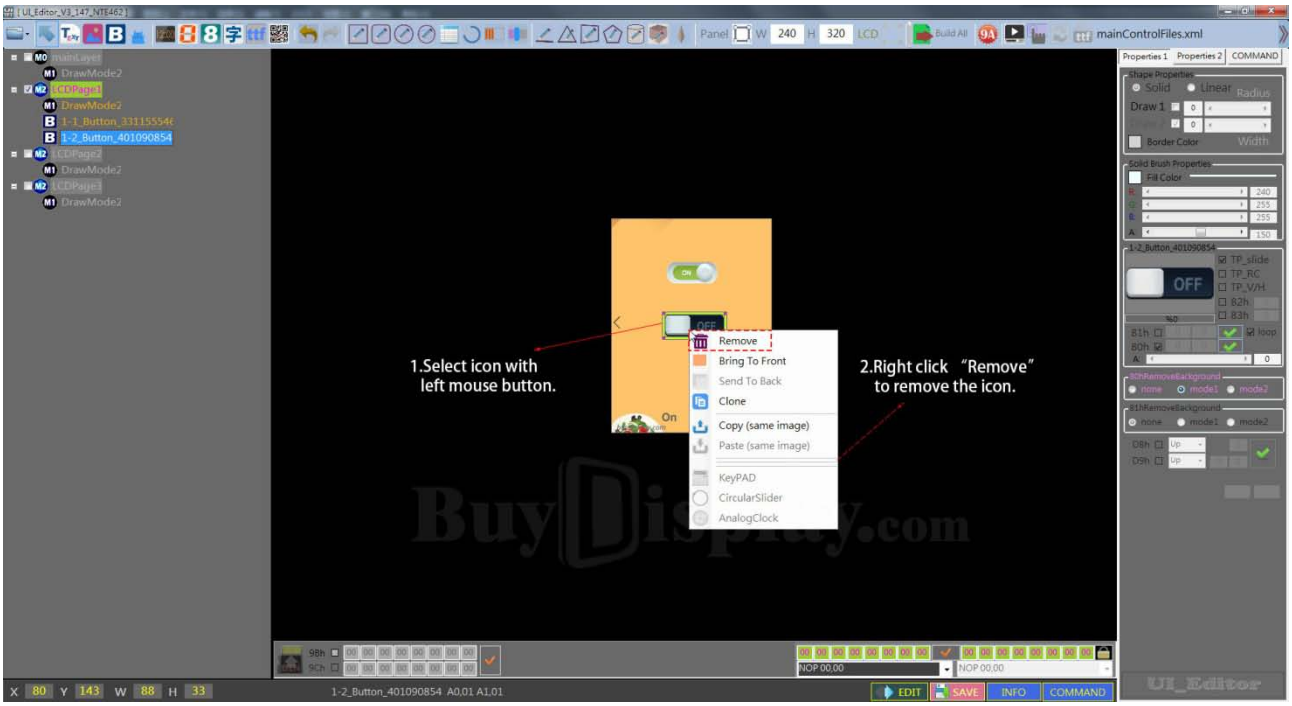


Figure 3-18: Delete Control Button

There are two ways to copy a control Button:

Mode one: As shown in the following figure, click left mouse button and then right button selects "Clone" to generate a same control Button but different location.

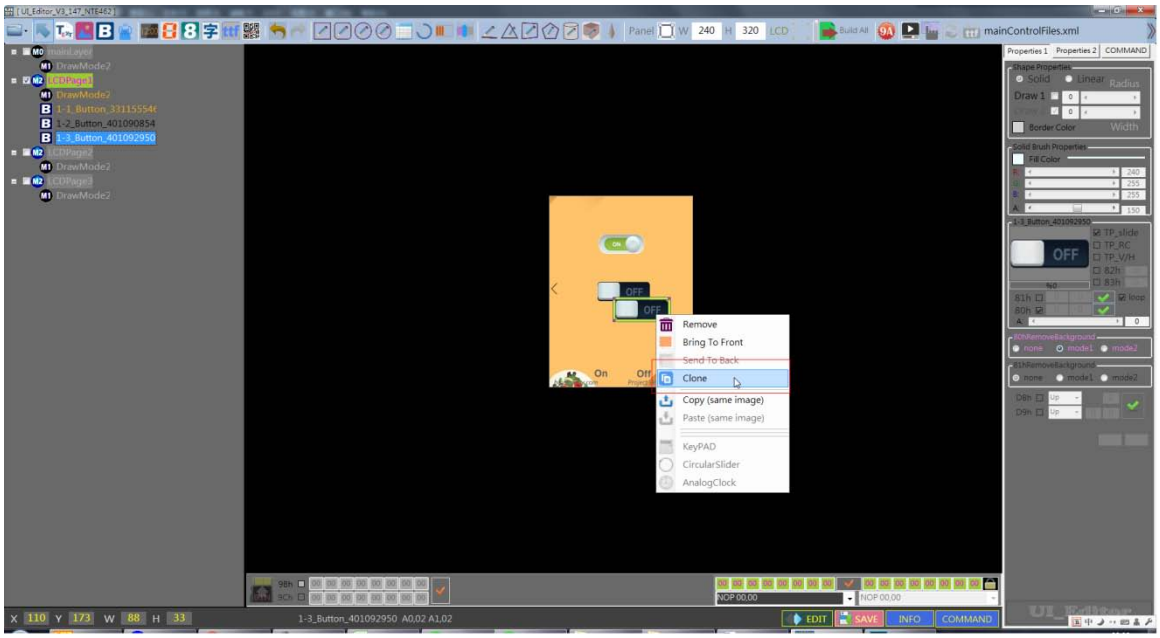


Figure 3-19: Generate an New Control Button

As shown in the figure below, double-click the gray box at the bottom right before copying. The status changes to false and the control to be copied is selected. Right-click on "Clone" and select "Clone" to generate the same control in the same place.

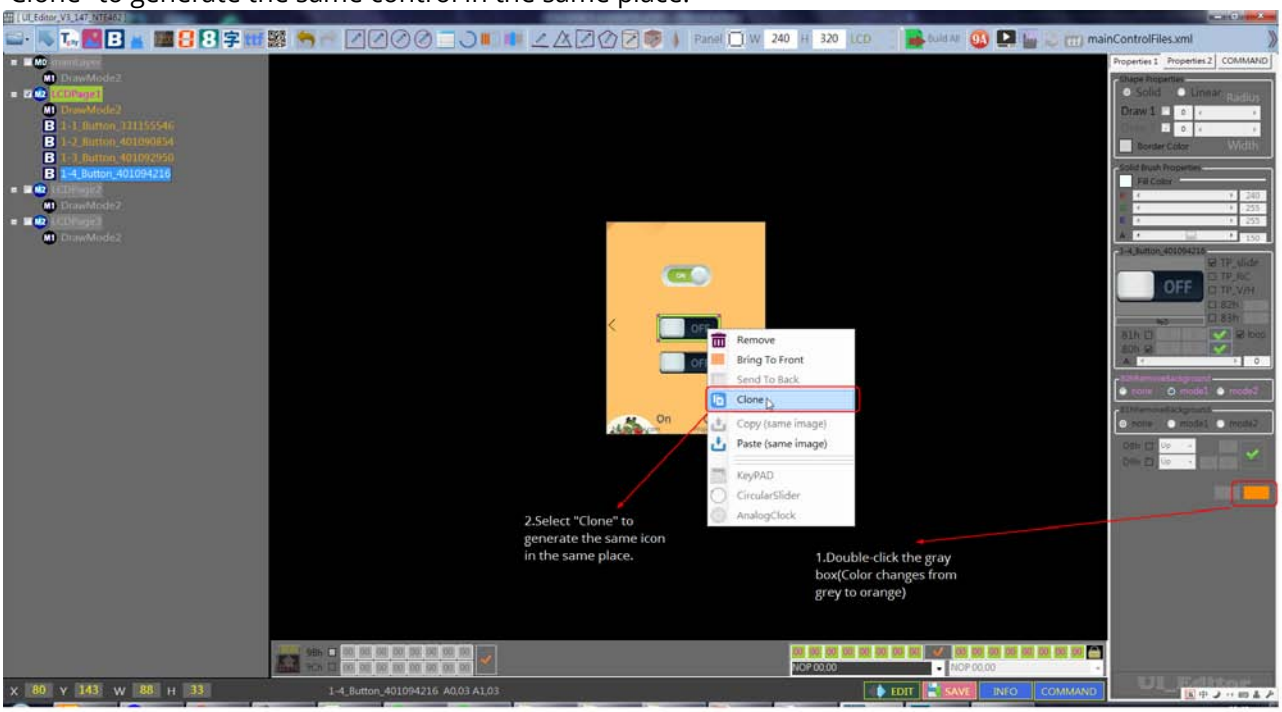


Figure 3-20: Generate an New Control Button in the same palce.

Mode 2: At first use the left mouse button to select the Button, and right-click to select "Copy". Then right button to selects "Paste" to copy the Button.

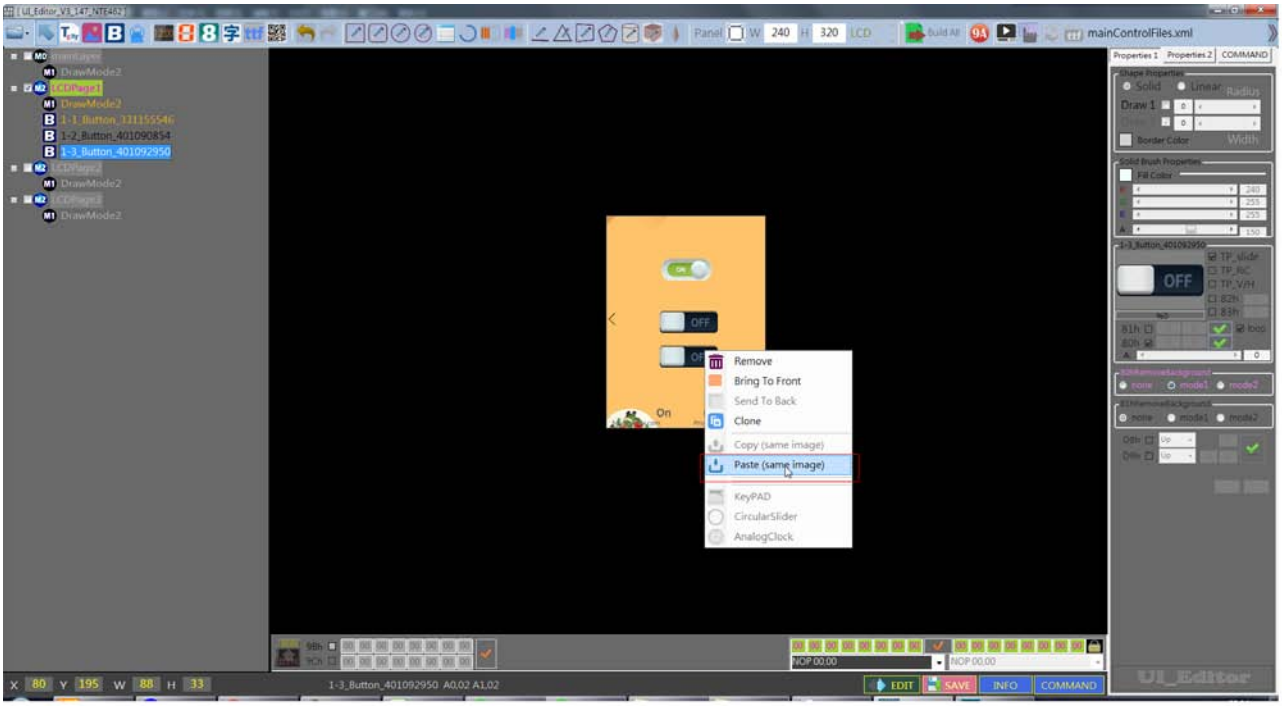


Figure 3-21: Copy to Generate Button

As shown in the following figure, it is currently in a state of normal editing. All add, delete, edit functions can be performed normally.

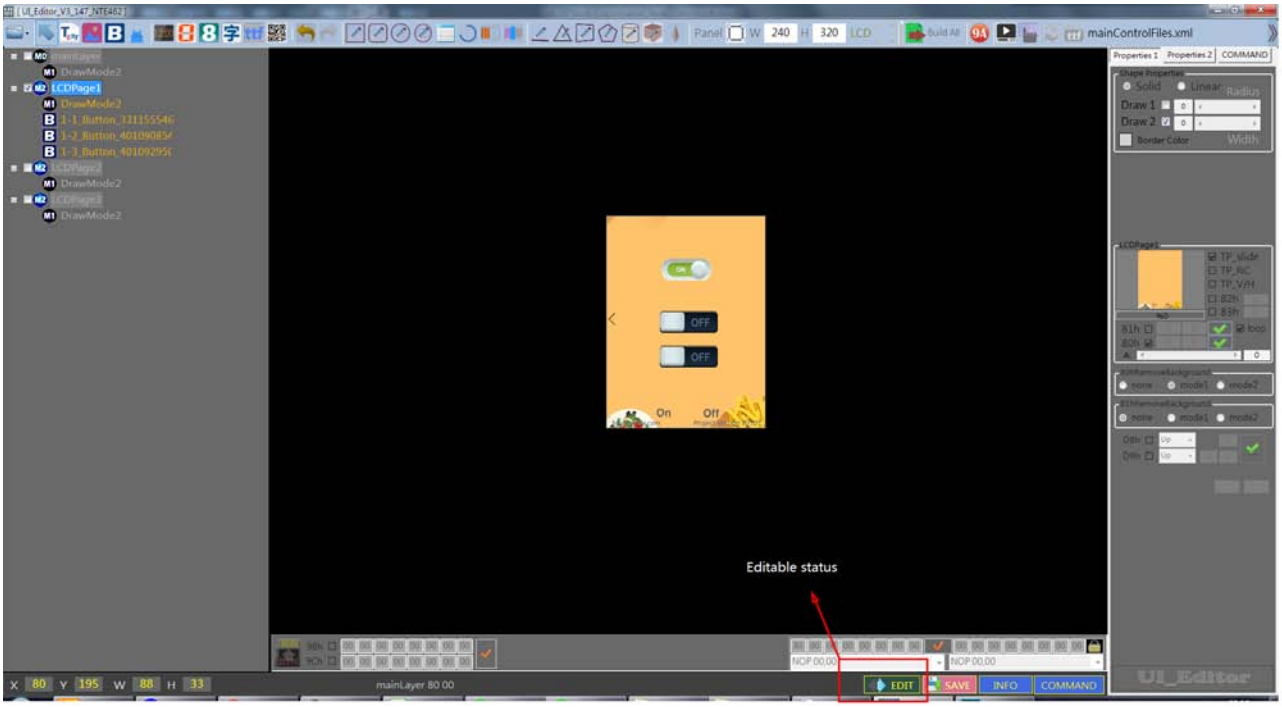


Figure 3-22: Editable Status

As shown in the figure below, it indicates that the interface is currently in debugging state and cannot be edited at this time. Select the corresponding button right click, this time will pop up the relevant command, and what you click is what you send. To edit the interface again, click the Button in the red box below.

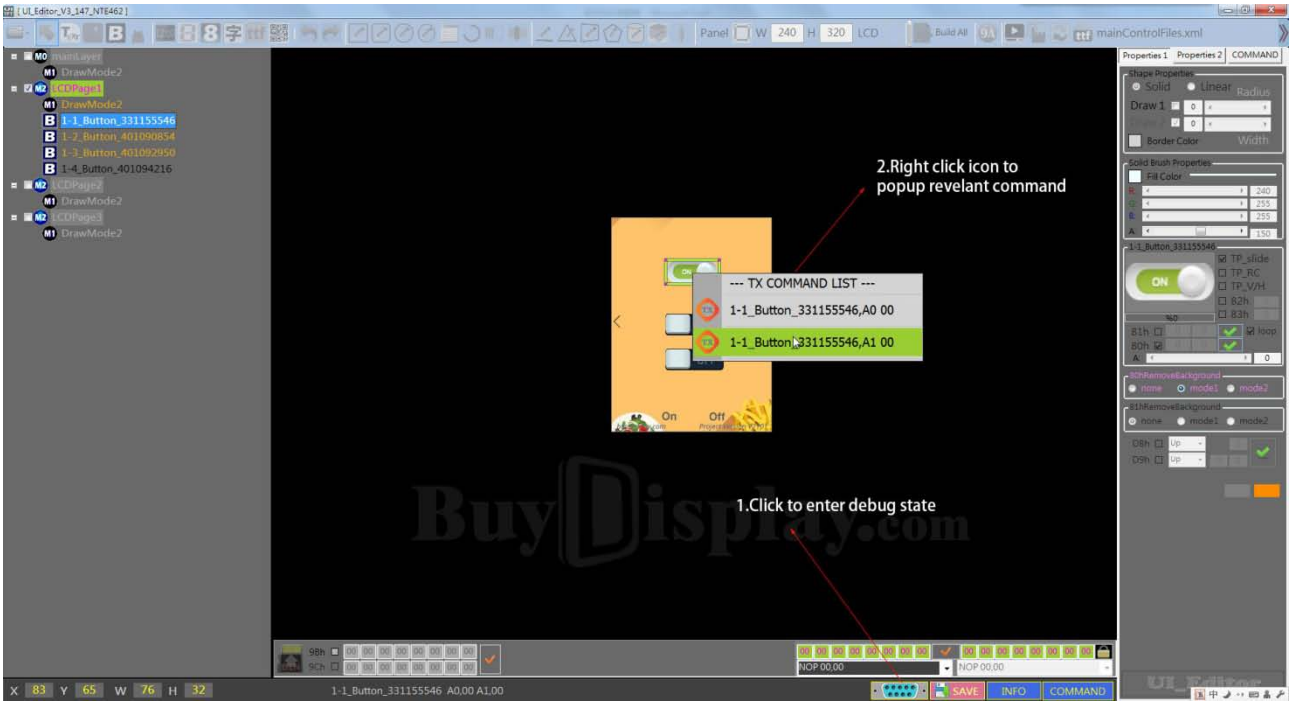


Figure 3-23: Debug state

3.1.5 Compile and Generate Bin File

When the UI interface design was done, press the "Build-All" button to compile.

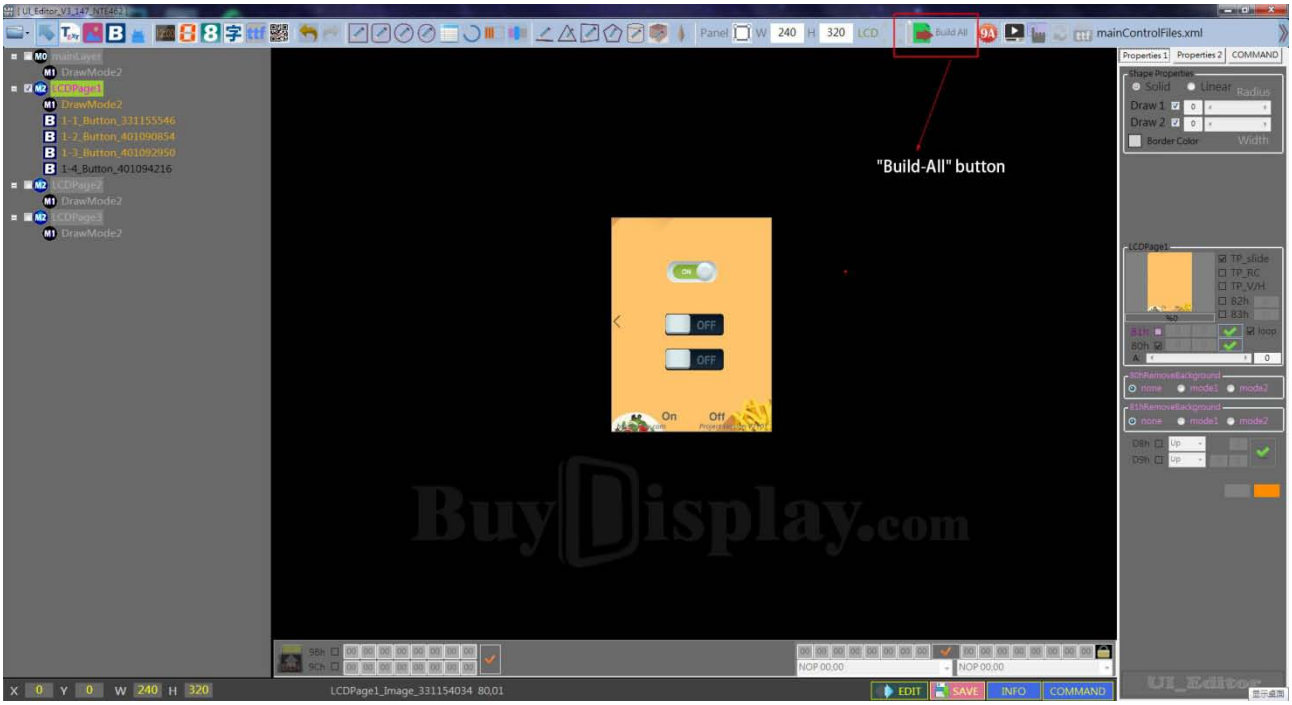


Figure 3-24: Project Compile

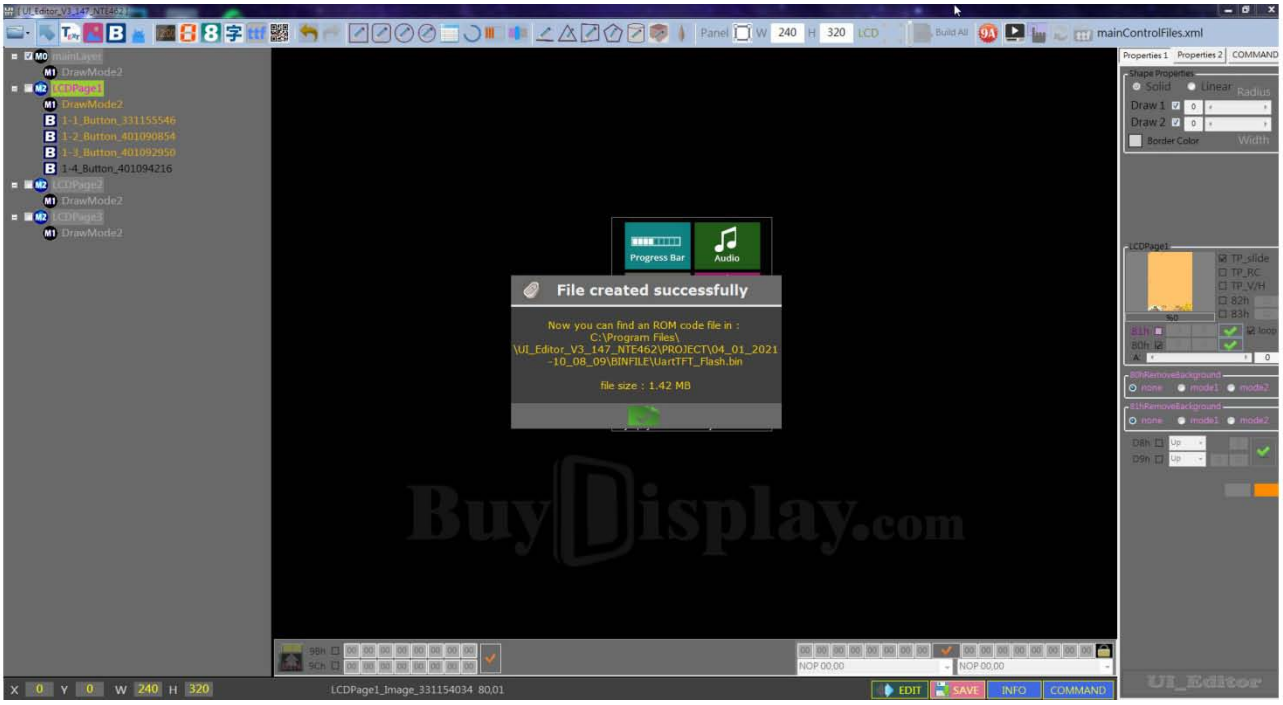


Figure 3-25: Compile Successful

If you want to know the path where the BIN file was just generated, you can click on the "BIN" button. As shown below :

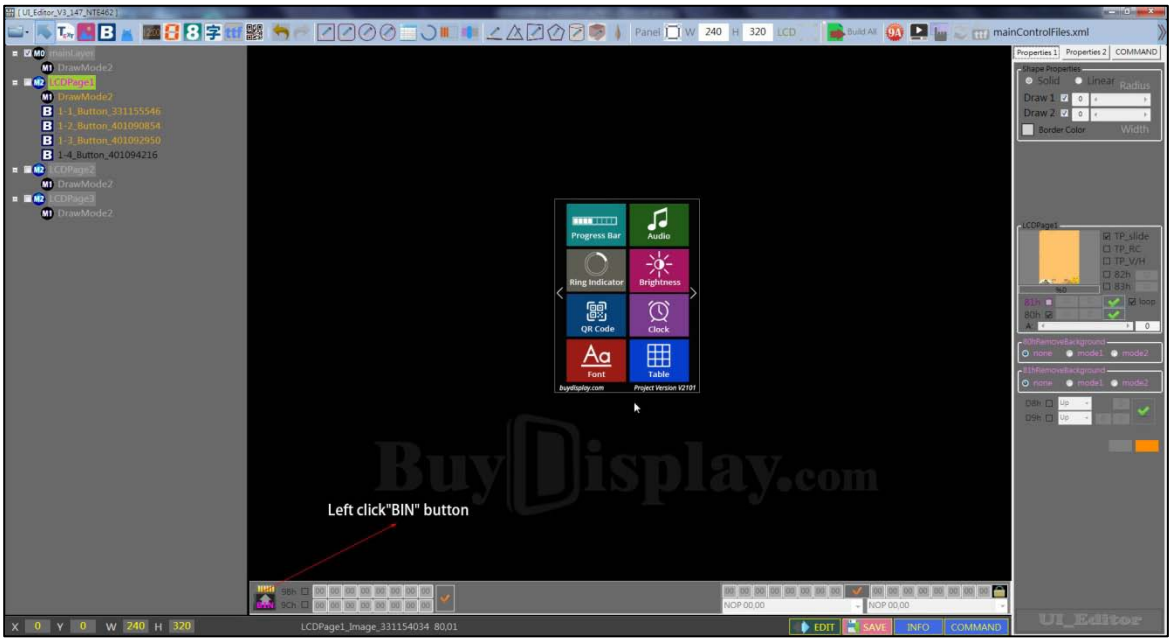


Figure 3-26：BIN File Path

3.2 Picture Display Setting

3.2.1 Single/Multi Picture Setting (80h)

Click the picture button first, click and drag into the screen box, and a white line box with four corners appears. This white line box is the size of the picture. Then select a picture from the pop-up Explorer. The size of the picture can be changed by drag the white line of the frame. If you want to change the picture, you can double-click the picture to change it if the picture is selected. If the picture cannot be selected (the square white line box does not appear), you can click the item in the item bar to select the corresponding picture. Once is picture is added, user can find a function box with 80h command in operation box on the right.

Display single picture: if you want to display single picture after sending command, there is no need to set group No. (default is 0)

Display multi pictures: If you want to display multi-pictures with one command, you need to set a group No., then the pictures with same group No. Will be displayed together. After group No. is settled, must press "confirm" to complete the setting.

If picture is in PNG format, you can select (80h Remove Background-mode 2) to remove the PNG picture background.

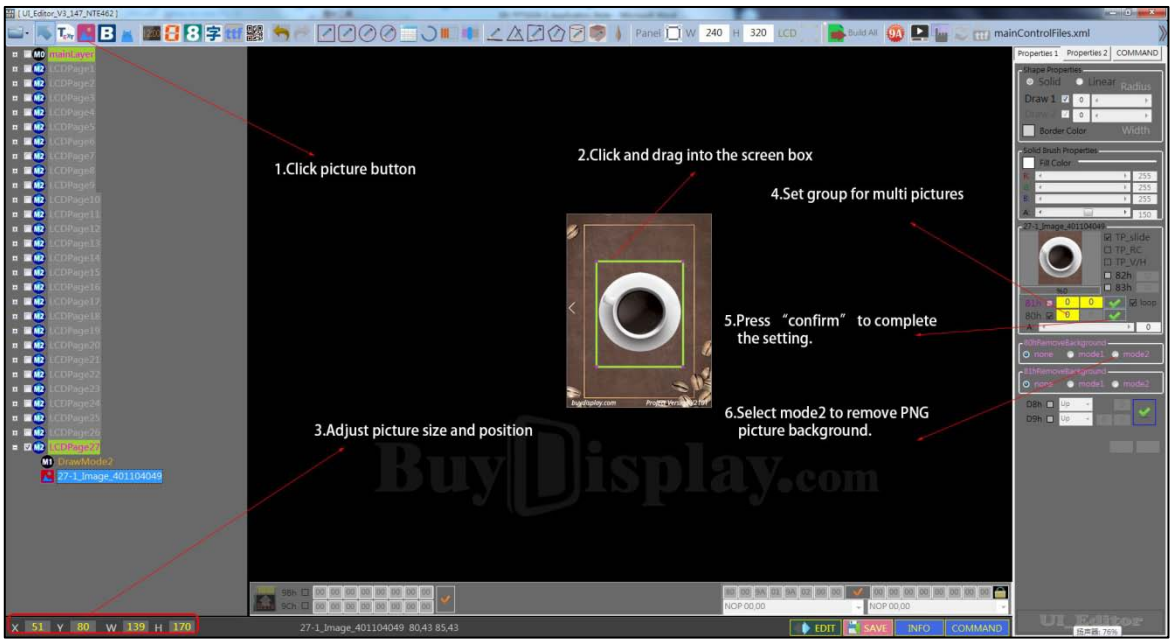


Figure 3-28: Multi-Picture Display Setting

3.2.2 Scroll Picture(in Loop) Setting (D8h, D9h)

Scroll Picture (D8h): The effect of scrolling a picture is to gradually display a picture from a certain place at intervals. After adding the picture, select the small square in the D8h operation box to enable the scrolling function. You can then select the direction in which the picture scrolls. There are four options: scroll up, scroll down, scroll left, scroll right. After selecting the direction you want, fill in the time interval (unit is 10ms) for scrolling, and press the OK button.

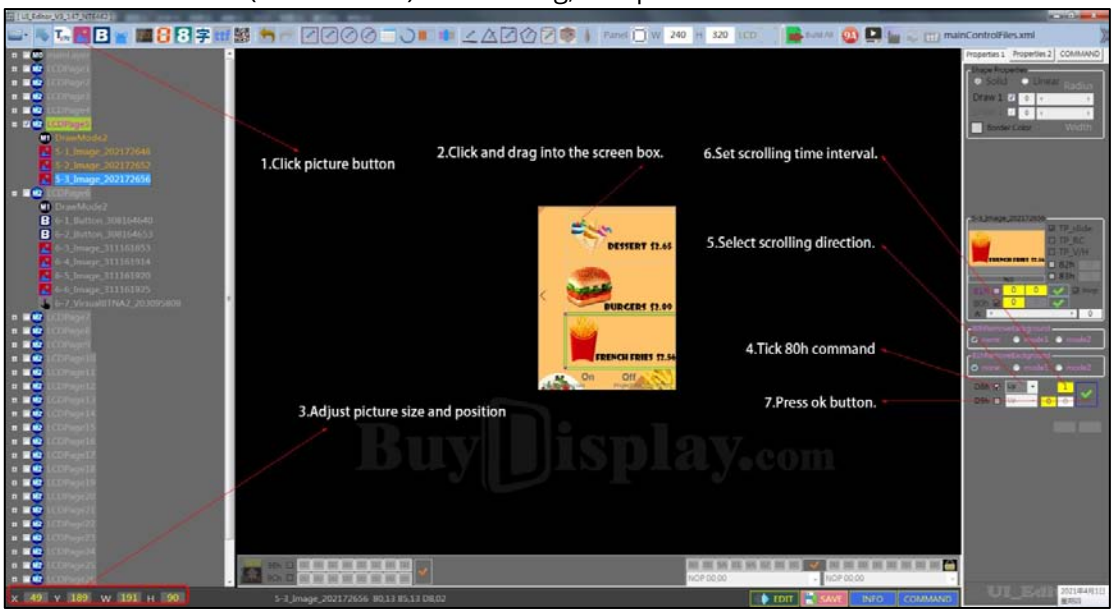


Figure 3-29: Scroll Picture Setting

Scroll Picture in Loop (D9h): Scrolling picture in loop is to realize one picture keep scrolling or multiple pictures scroll in sequence. The specific operation method is similar to the above setting of the scrolling picture. If you want to achieve a scrolling picture in loop, you just need to set the parameters in the D9h command operation bar of the picture. (note: the group No. should set as different value) If you want to achieve scrolling multiple pictures in loop, you can set the pictures in the same group No. in the D9h command operation box, and the time interval can be set separate. As below figure shown:

Figure 3-30: Set Scroll The First Picture

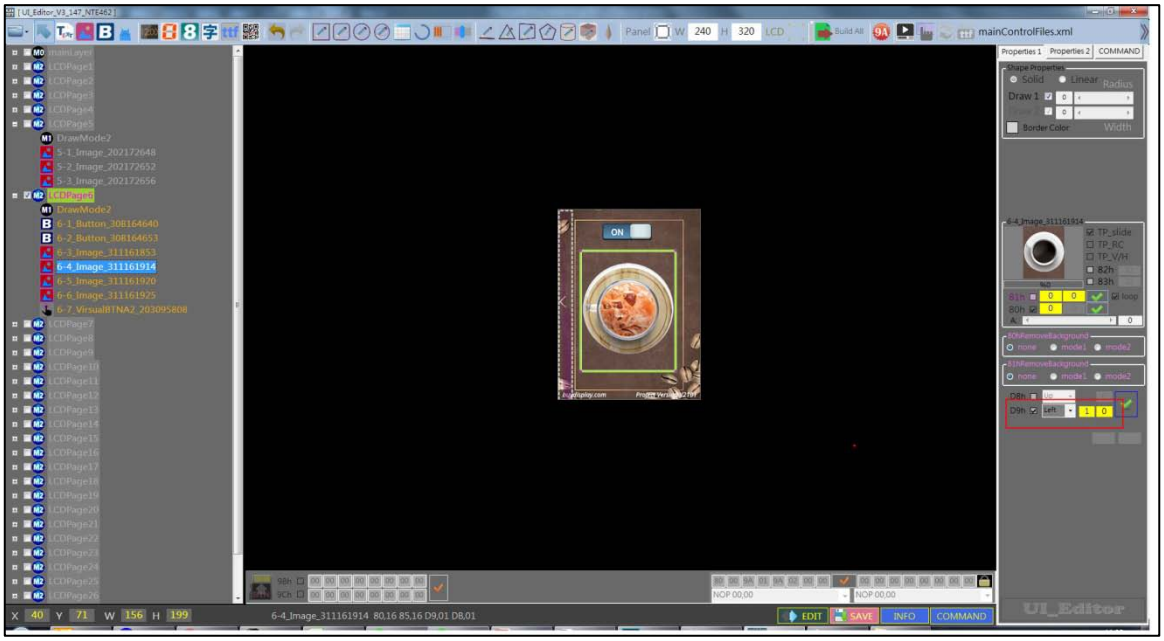


Figure 3-31: Set Scroll The Second Picture

3.2.3 Overlap Picture Display in Loop(81h)

After adding a picture, you can set the time interval between the group number of the picture and the display. The time interval is in units of 100ms. For example, picture A and picture B are to be displayed in loop at intervals of 2500ms. You should set 1 and 25 in the 81h command operation box of picture A and press the OK key. Set 1 and 25 at the 81h command operation frame of picture B, and press the OK key. Picture A and picture B form a combination 1, which is displayed in loop after receiving the corresponding instruction. If the picture is PNG, you can select (81h Remove Background) to remove the background of the PNG image.

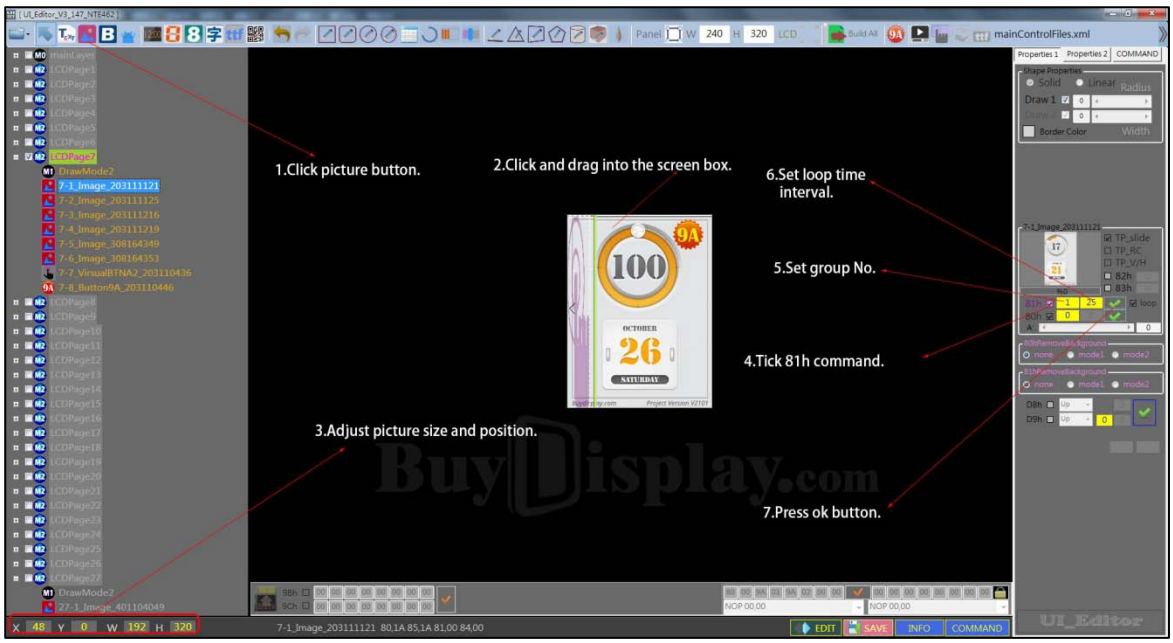


Figure 3-32: Display Overlap Picture In Loop Setting

3.2.4 GIF Animation Setting(88h)

Press the “GIF” button to select a GIF picture . The operation box is in the right. The data box in the lower right corner of the small demo window is the setting box (in 10ms) of the GIF playback interval. “LOOP” is to decide if pay GIF in loop. At this time, the confirmation setting button of the 81h command is changed to the GIF confirmation setting button. Set the playback interval and press the OK button to complete the setup. If user select “Keep looping” means the GIF will repeatedly play in loop; if user select “Loop once” means TFT panel will play the GIF in loop once and back to initial page.

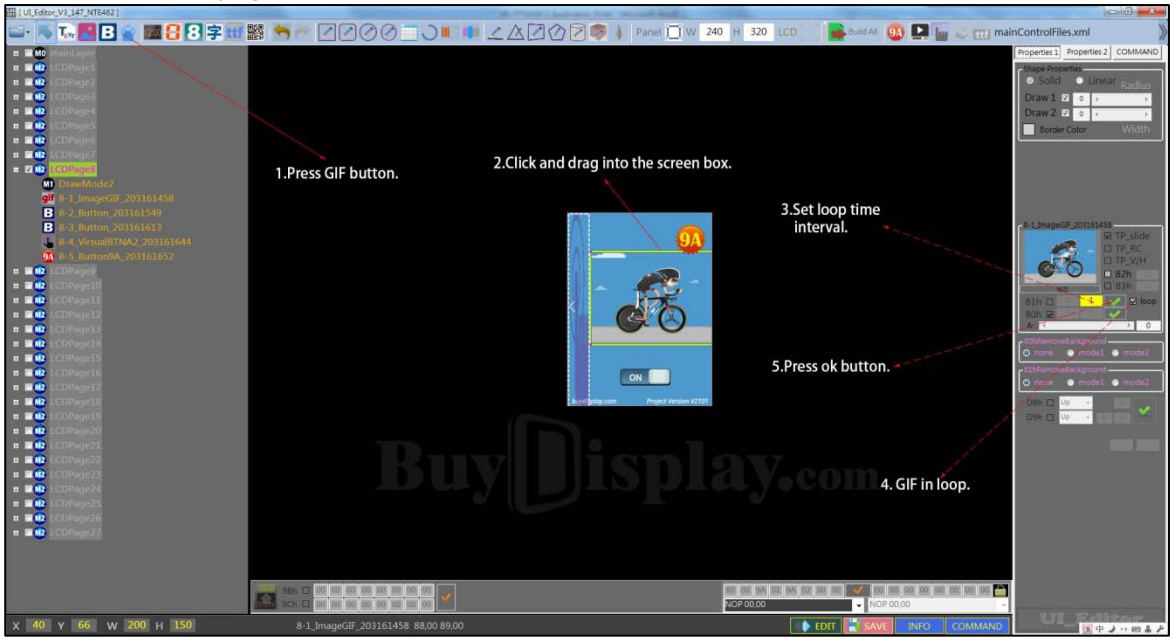


Figure 3-33 GIF Animation Setting

3.2.5 Display Text in the form of Picture (80h)

The text-picture means that the text is displayed in the form of picture, and the processing object is the picture. The UI_Editor transform the text to picture and displayed on TFT panel. The text here refers to Chinese, English, numbers and symbols those can be entered on computer. It is applicable for fixed text only.

Click the "Text" button, then pull a box in the screen, a setting box will pop up . Enter the text and choose your favorite font and size, you can change the color and background, and whether the background is transparent. Note that if the background transparency is selected (if select BackColor is opaque, or if not, it is transparent), then the background color setting is invalid. After confirming the settings, adjust the size of the display frame to make sure text is fully displayed. If select "BackColor" means opaque, if not select, means transparent; if select "Alignment" means align to left, if not select, means align to right.

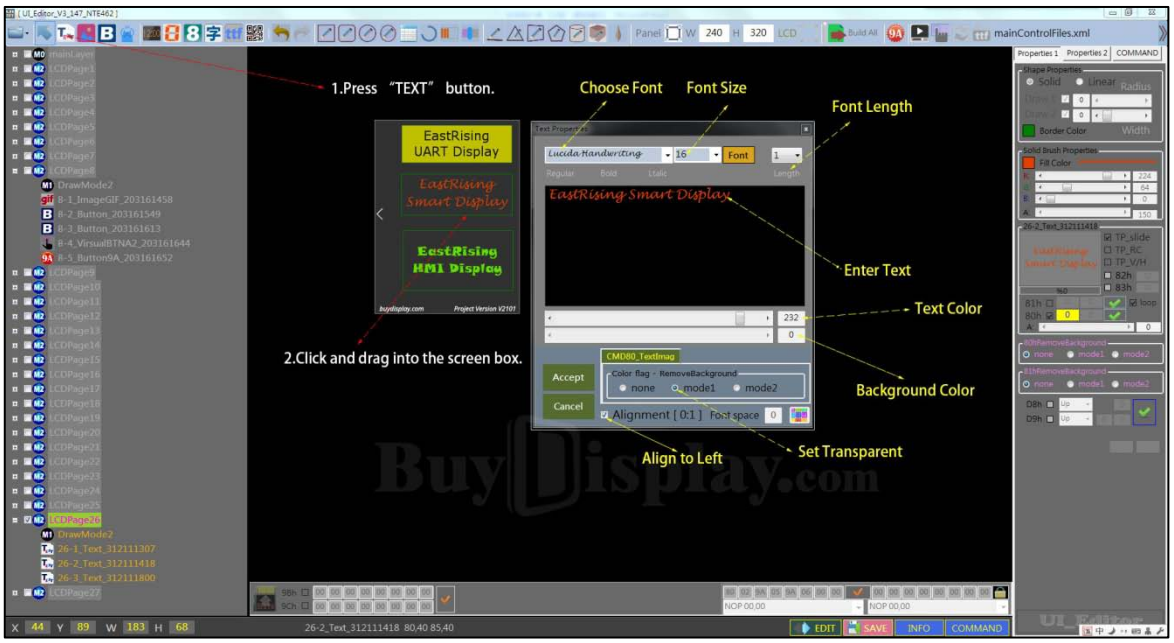
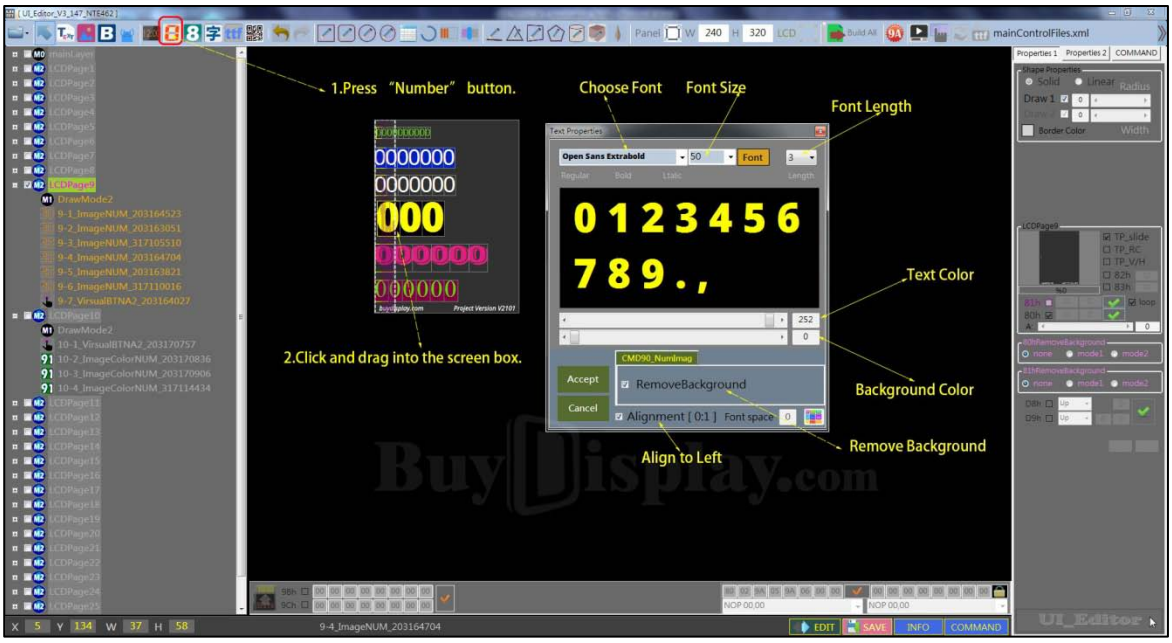


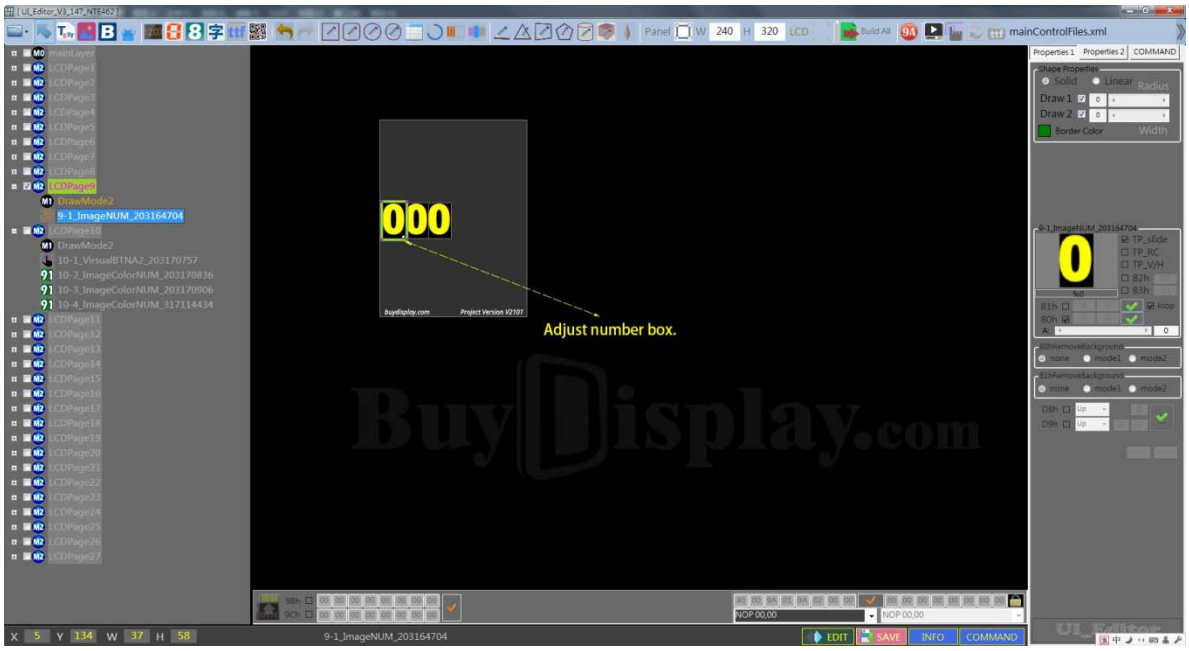
Figure 3-34: Picture- Text Display Setting

3.2.6 Create Number Object(90h)

Click the button  in UI_Editor. Pull a box in the screen, then pop up a setting box. The text in this setting box cannot be changed, only the alignment of the numbers (left or right) can be set. If select Alignment stands for left alignment, if not select, stands for right alignment.



After the setting is completed, adjust the number box to just display a number. As below shown, each small box represents the size of the area occupied by a number. You only need to adjust the size of the first number box, and the other number boxes will change accordingly. After the BIN file is generated, the digital sent by serial port during communication will be displayed on the TFT panel.



3.2.7 Create Image Number(91h)

The image-number refers to the number that should be displayed according to the data received by the serial port by using the picture-number prepared in advance. So this digital display has the advantages of multiple fonts and dynamic display.

Click the button in UI_Editor. Pull a box in the screen, then pop up a setting box. The text in this setting box cannot be changed, only the alignment of the numbers (left or right) can be set. If select Alignment stands for left alignment, if not select, stands for right alignment.

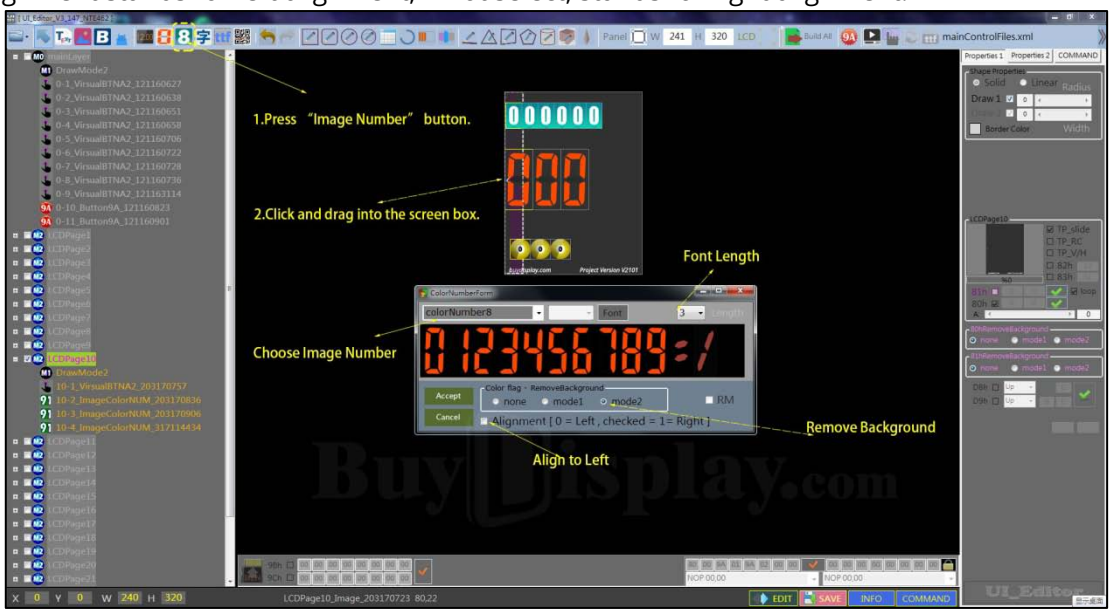


Figure 3-35: Image-Number Display Setting

After the setting is completed, adjust the text box to just display a number. As below shown, each small box represents the size of the area occupied by a number. You only need to adjust the size of the first number box, and the other number boxes will change accordingly. After the BIN file is generated, the digital sent by serial port during communication will be displayed on the TFT panel.

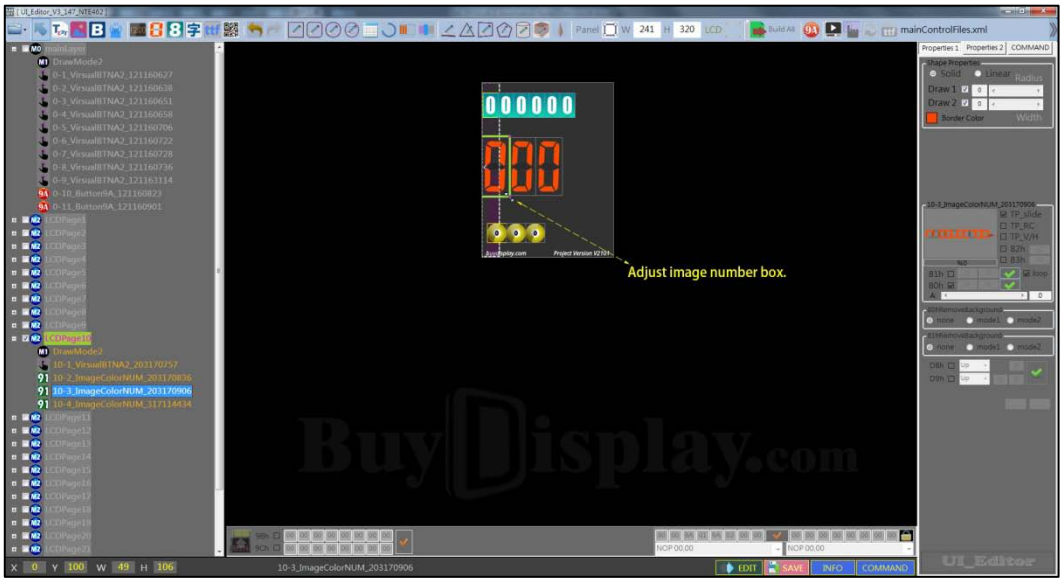


Figure 3-36: Adjust Image Nubmer Box

3.2.8 Display Text by Font(C0h~C3h)

The dynamic Chinese and English digital is directly displayed by the ER-TFT028A2-4-5465 using internal or Flash fonts. Up to 8 fonts can be selected, among which C0-C1 fonts can display numbers, English, Chinese, and C2-C3 fonts can only display Chinese.

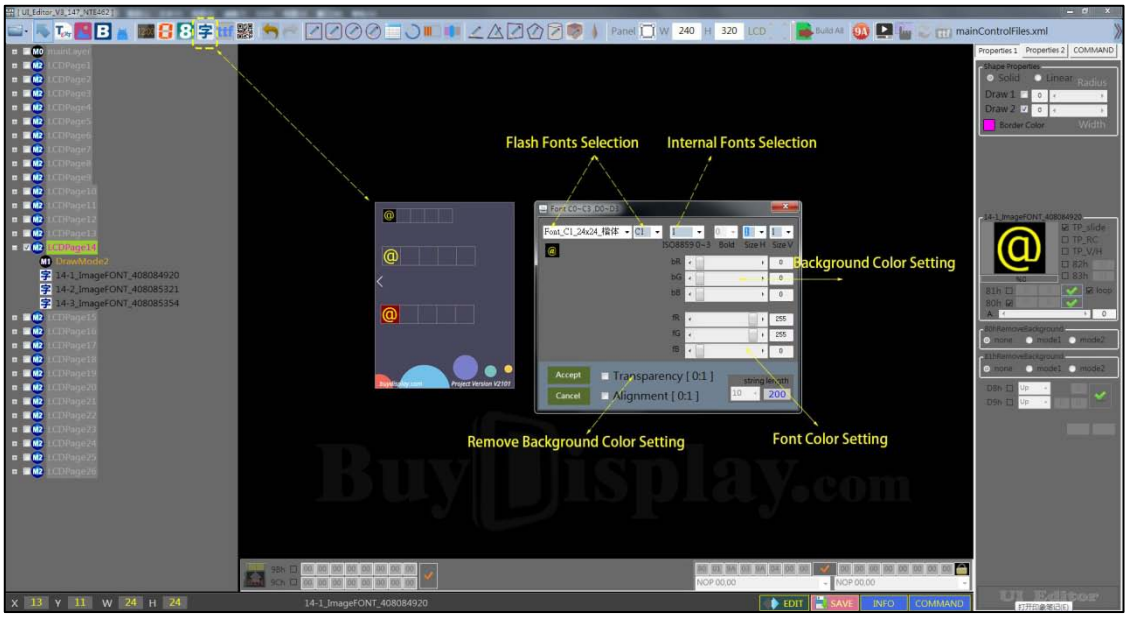


Figure 3-37: Font Text Setting

Click the “Font” button, then click on the screen, and the settings box will pop up, including settings for background color, font color, font alignment, etc. are the same as the settings above. Note: C0 ~C3 font cannot be set as bond.

The background transparent setting is different from the previous one. Transparency is selected means background transparency, and not select means background opacity. After the setting is completed, the size of the small box in the text box cannot be changed. After the BIN file is generated, the digital sent by serial port during communication will be displayed on the TFT panel.

3.2.9 Button Picture Setting (A0h)

Button picture button can be added on the screen to realize touch key function. When touch the button picture, user can execute a series action: display picture, display GIF, etc.

Click “Create a Button Object" button, click and drag into the screen to generate a green line frame. Select a picture in the Explorer as an button picture. The operation box is in the bottom of the screen, and it will only be available when the button picture is selected. Click the command inputs area of the first group(a command has two grids, utmost 8 commands can be executed) and select the command in the pull-down list and execute. The command option list is composed of other generated action commands in the current project. For example, before setting the button function, a command to display a picture and a GIF has been set. Then there will be two commands in the command list. In particular, the two button operation bars are used in the same way. If the button picture is a 32-bit PNG format and you want to remove the background, you can select “remove background” in the 80h command.

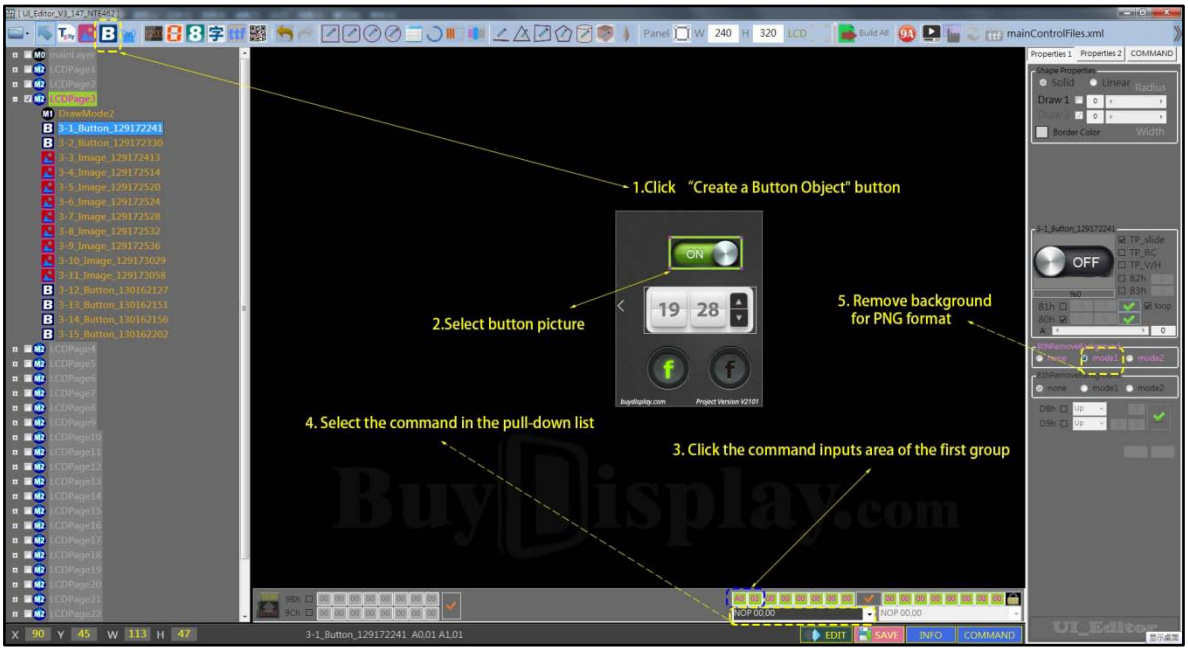


Figure 3-38: Button Picture Setting

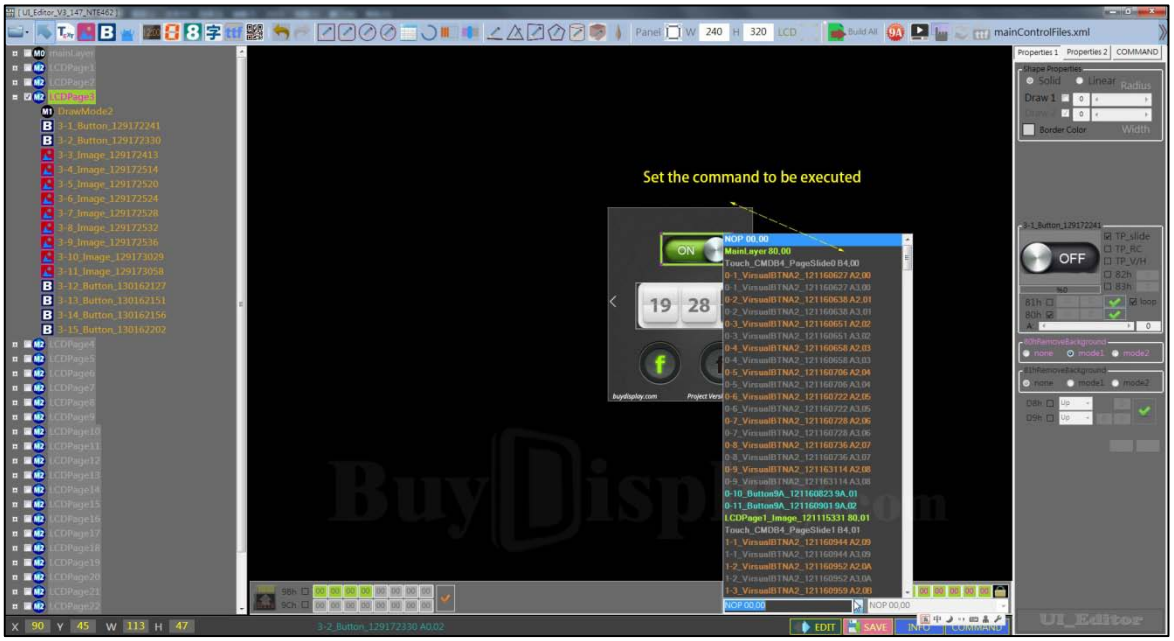


Figure 3-39: Set The Command To Be Executed When The Button Pressed

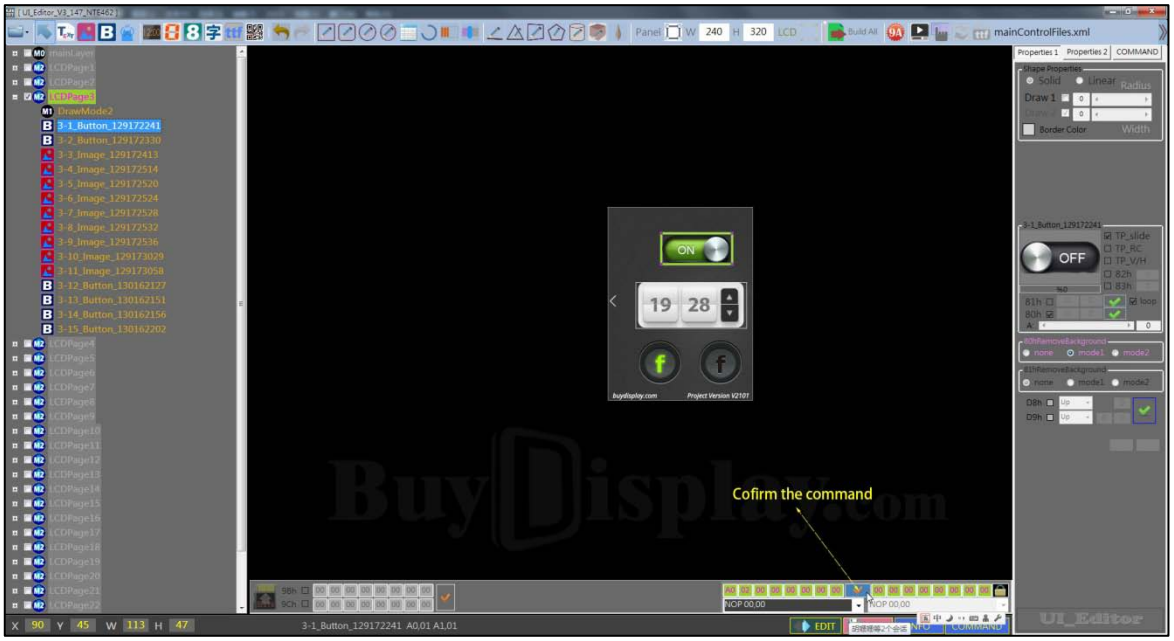


Figure 3-40: Confirm The Command To Display Button

3.2.10Boot Picture Setting(9Ah)

The boot picture setting is used to select those Buttons to be pre-executed during boot time, without receiving commands from the host computer. The following examples assume that the Button already exist:

1. First click “mainLayer” in the upper left corner. At this time, there will be 8 groups of pre-selected commands to be sent during boot time.

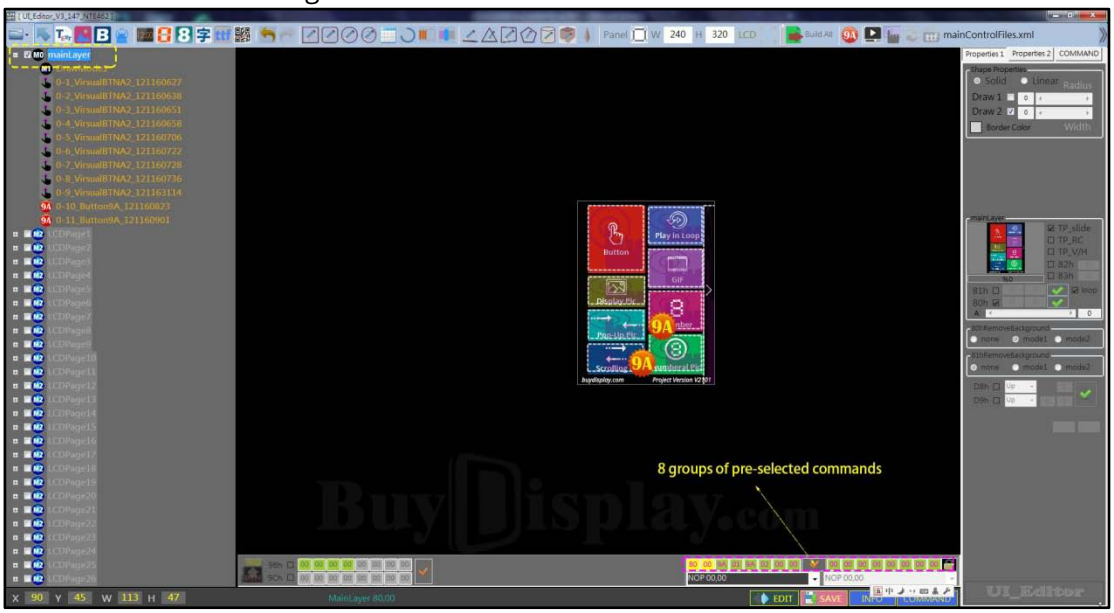


Figure 3-41: Click “mainLayer”

2. Just click on any group of numbers, the yellow box background and the red font will be displayed, and then click on the position shown in the figure below, the command group will pull up automatically. At this point, you can select one of the command group.

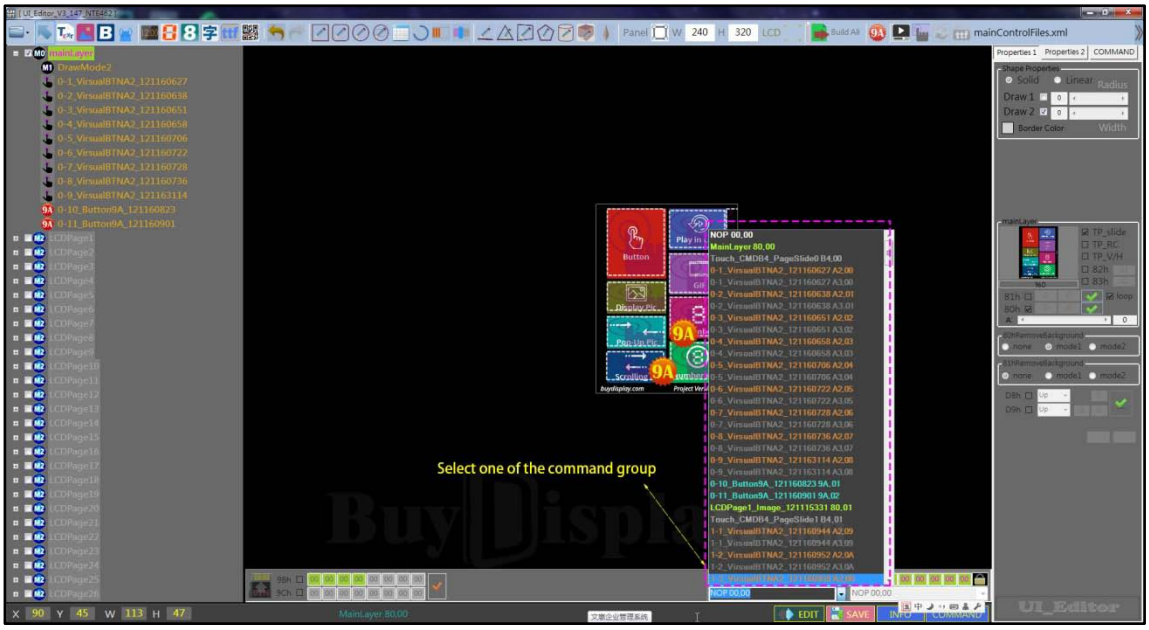


Figure 3-42: Select A Group Of Command Combination

3. Boot picture setting as below selected command (User Command)

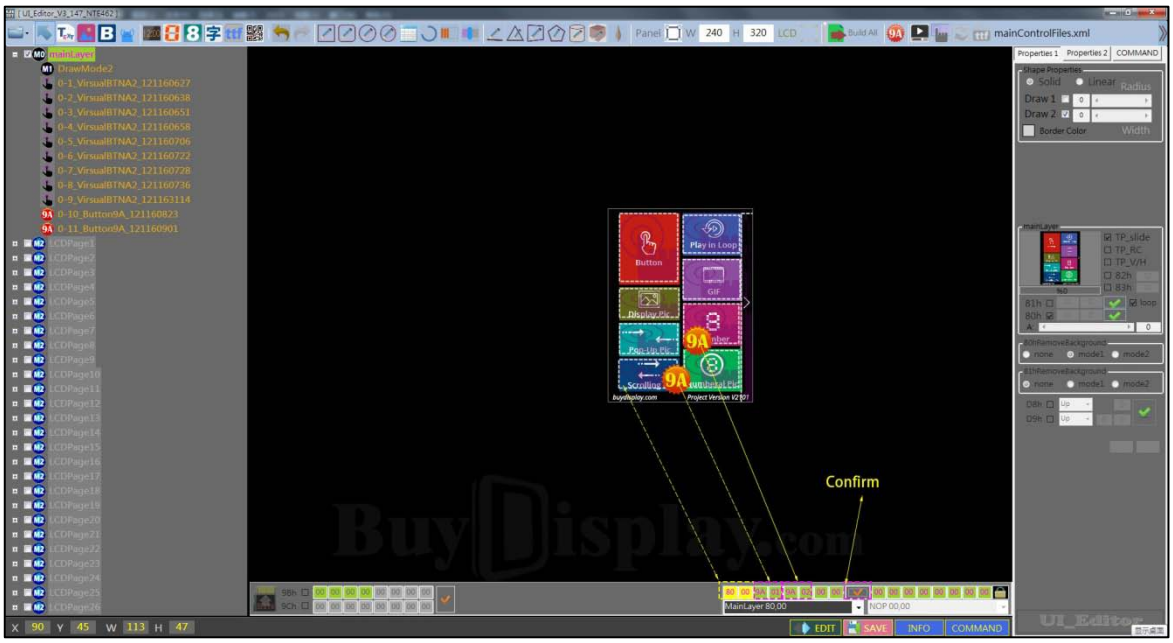


Figure 3-43: Boot Picture Command

4. After select, press “OK” to confirm.

Among the commands in 9A, the command 9A, 00 is power-on command, it also can be set to execute multiple group command,such as commands 9A 01, 9A 02 . Users can directly output 9A 01, 9A 02 from the serial port to control the other commands to be called when the UI_Editor is edited. The example is shown in the following figure (actually, the LCD does not display the 9A Button). Each 9A includes 8 groups of commands.

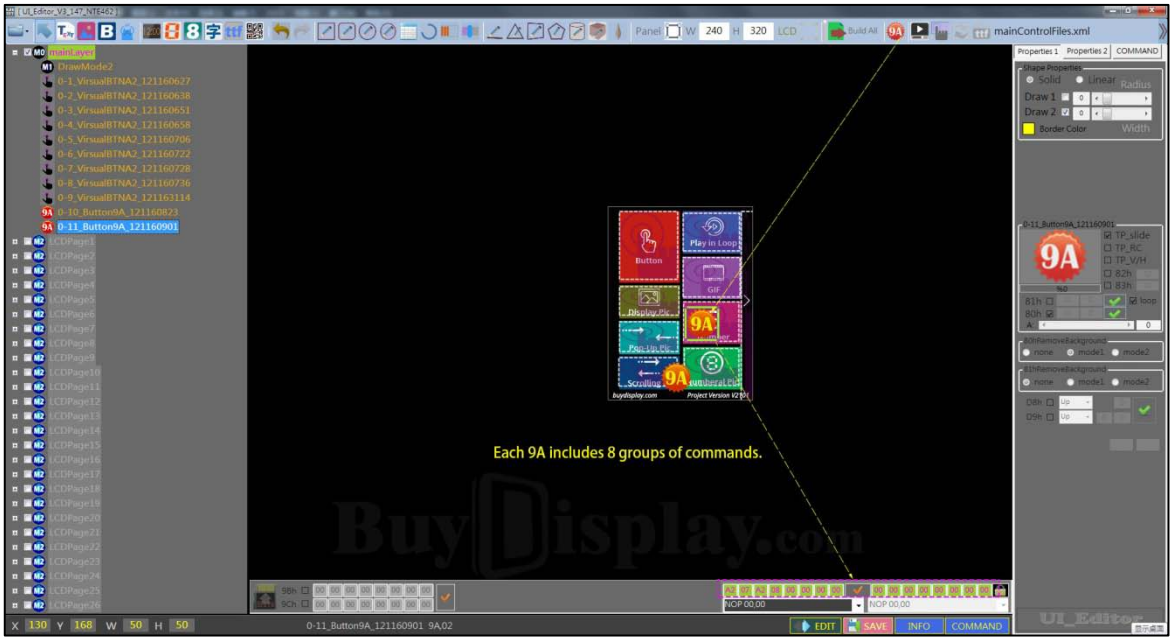


Figure 3-44: Execute Multi-Group Command Via 9A

3.2.11Progress Bar Picture Setting(B0h)

This progress bar function is similar to the pointer. The information sent by the host computer can change the display length of the progress bar.

Figure 3-45: Click “Progress Bar” Indicator

1. Click the progress bar Button and drag to anywhere on the screen. At this time, you can adjust the color of the background and the color during movement through the palette.

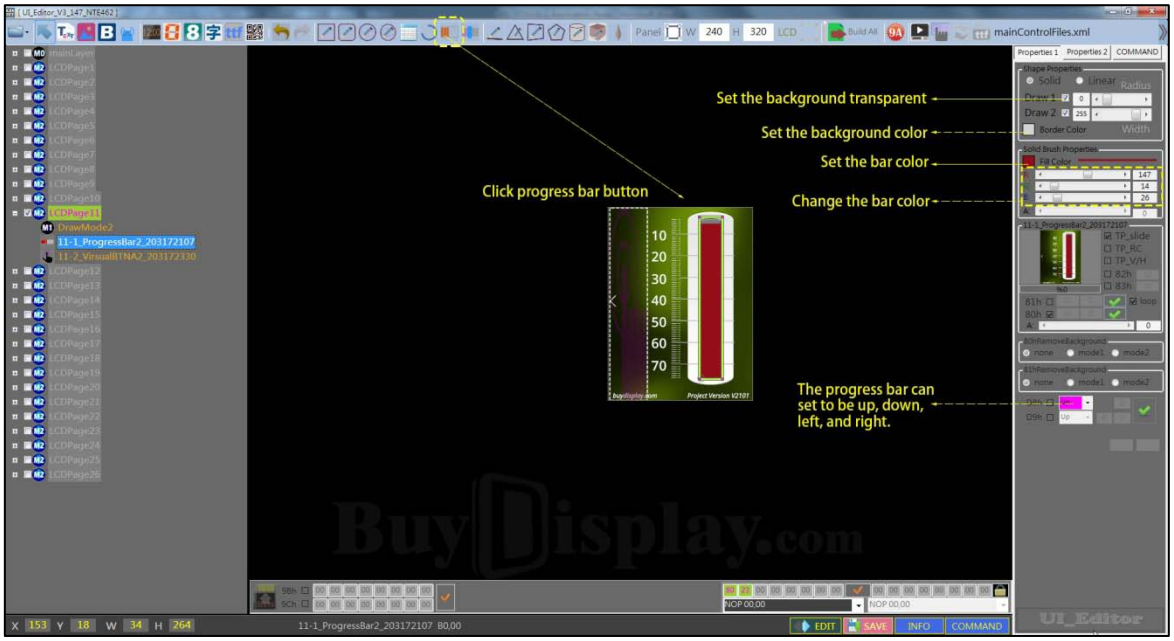


Figure 3-46: Set Progress Bar

3.2.12Create a Circular Progress Bar(DCh)

Click the “create a circular progress bar” button and click any point on the screen frame. A ring with an adjustment box will appear. Changing the size of the adjustment box can change the radius of the ring. The thickness and color of the ring can be changed by changing the contents of the corresponding button. After the host computer is connected to the TFT panel, the starting angle and the rotation angle of the ring can be changed by sending command and displayed on the TFT panel accordingly. The direction of rotation of the ring is clockwise, with a 0 angle point at 12 o'clock.

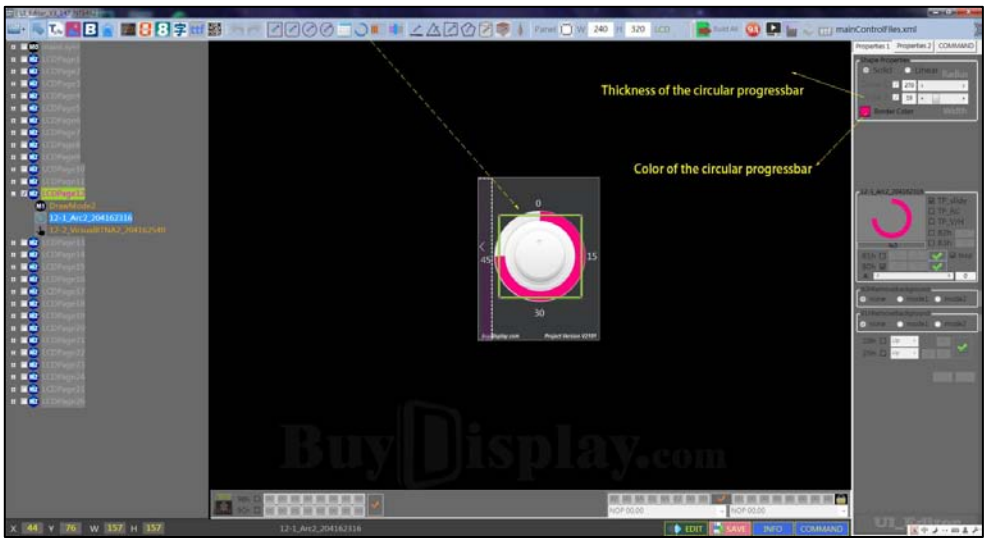


Figure 3-56: Circular Progress Bar Setting

3.2.13Line Drawing (E0h)

Draw a line: Click the “Line” button and click any point on the screen frame, then a line is created. . Drag the two endpoints on the line to change the length and direction of the line. You can change the thickness of the line by changing the value in the Line Thickness setting box. The color of the line can be changed by selecting the color in the color button.

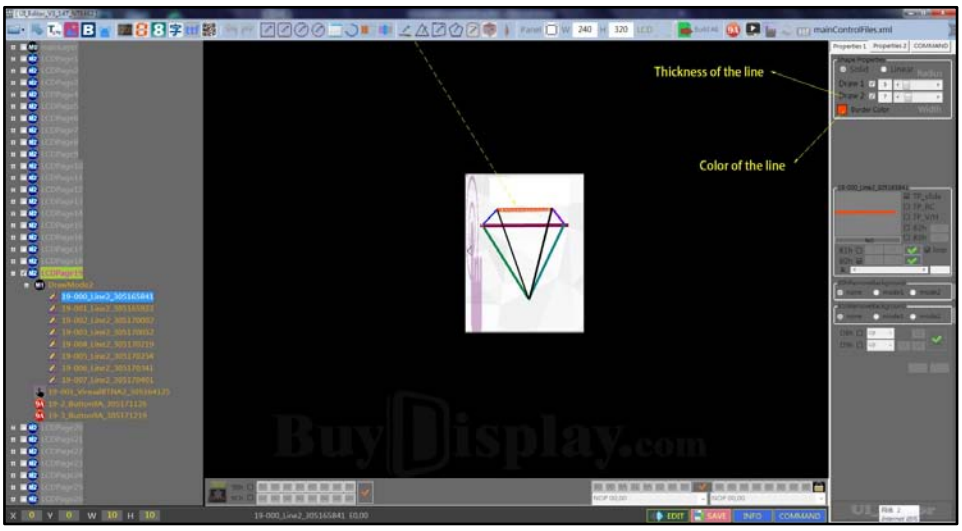


Figure 3-55: Draw A Line

3.2.14Basic Geometric Drawing

Currently ER-TFT028A2-4-5465 support 7 kinds of geometric, can be divided into 3 types:

Table 3-1: Geometric Drawing Function

Geometric Drawing Function	Hollow (Command)	Solid (Command)	Solid With Frame (Command)
Ring	-	✓ (DCh)	-
Circle	✓ (E1h)	✓ (E2h)	✓ (E3h)
Ellipse	✓ (E4h)	✓ (E5h)	✓ (E6h)
Rectangle	✓ (E7h)	✓ (E8h)	✓ (E9h)
Rounded-Rectangle	✓ (EAh)	✓ (EBh)	✓ (ECh)
Triangle	✓ (EDh)	✓ (EEh)	✓ (EFh)
Cylinder	-	-	✓ (F4h)

 draw ring (any angle)

 draw rectangle, rounded rectangle, circle, ellipse

 draw triangle, cylinder

Draw Circle: click “Circle” button, click any point of the screen frame and pull operation box, a circle will display. Adjust the operation box can change the circle size, the other setting can be changed in “Properties1” box.

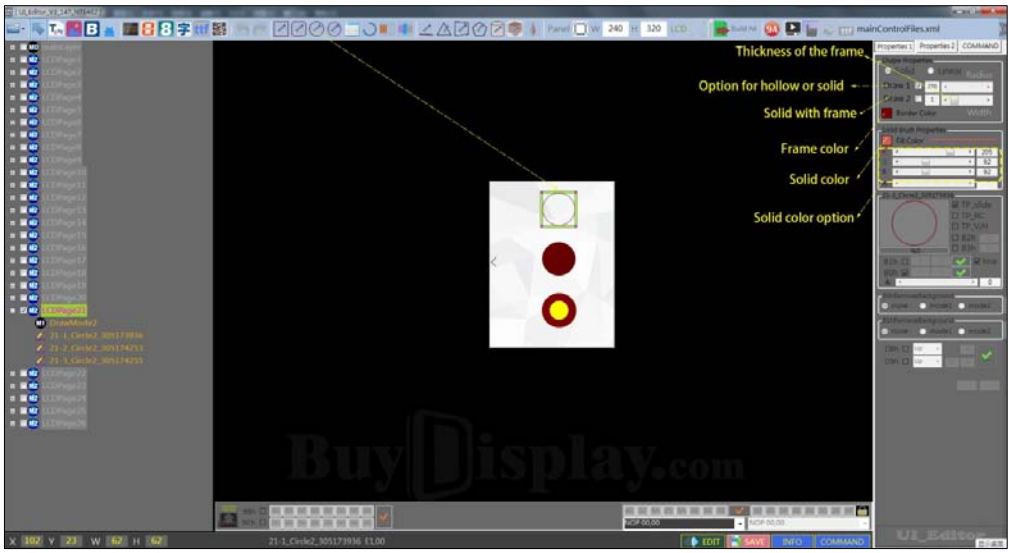


Figure 3-57: Circle Setting

The specific function of Draw1 and Draw2 are as follows:

Draw1: Hollow /solid. If Draw2 is not selected, select Draw1 means choose hollow; if Draw1 is not selected, means choose solid. If Draw2 is selected,, Draw1 will unable to select.

Draw2: Solid with frame. Select Draw2, means choose solid with frame. If Draw2 is not selected, means choose hollow or solid . The thickness of the frame can be adjusted.

To change the color of the frame, just click on the frame color option and choose a favorite color. To adjust the internal color, you can change the value of RGB color. Once color is chosen, press the "confirm" button.

Draw Ellipse: similar with draw circle

Draw Rectangle, Rounded Rectangle: similar with draw circle. When set rounded rectangle, the double value of round value can't over the width or length, otherwise it will not display properly.

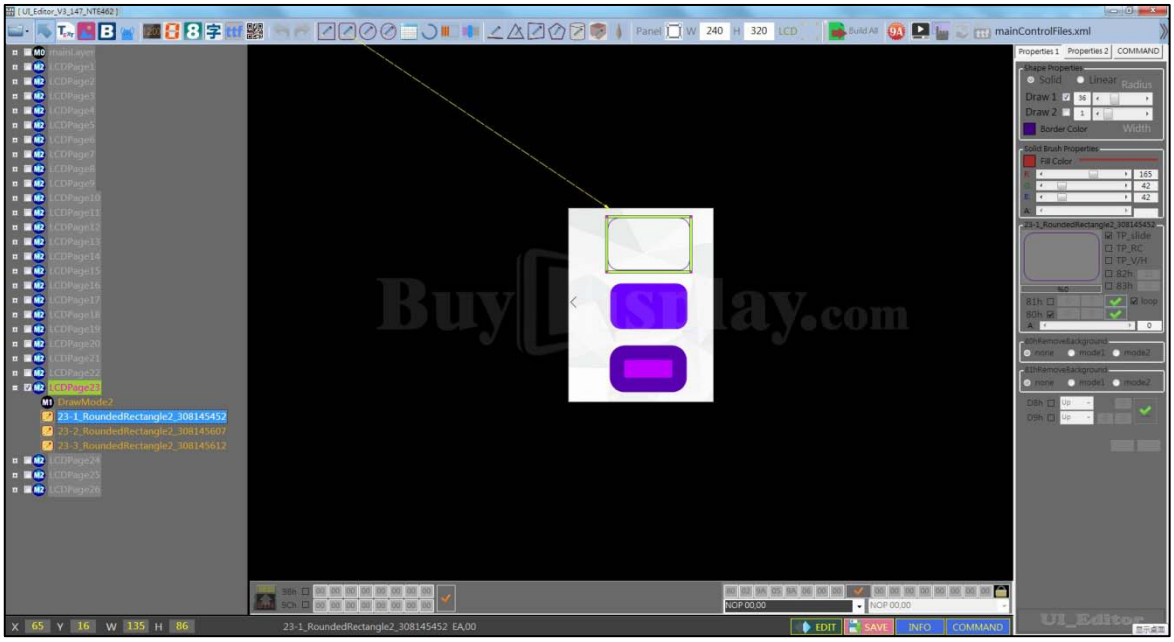


Figure 3-58: Rounded-Rectangle Drawing Setting

Draw Triangle: similar to draw cylinder. The adjustment of triangle is realized by pull the 3 vertices of the triangle. But triangle do not support frame thickness adjustment.

Draw Cylinder: click Cylinder button, click on the screen, a cylinder will appear, change the three points on the cylinder to change the shape of the cylinder. The ER-TFT028A2-4-5465 Uart TFT Panel only supports solid cylinders with frame, both Draw1 and Draw2 are invalid. The frame and interior color are the same as for other drawing functions.

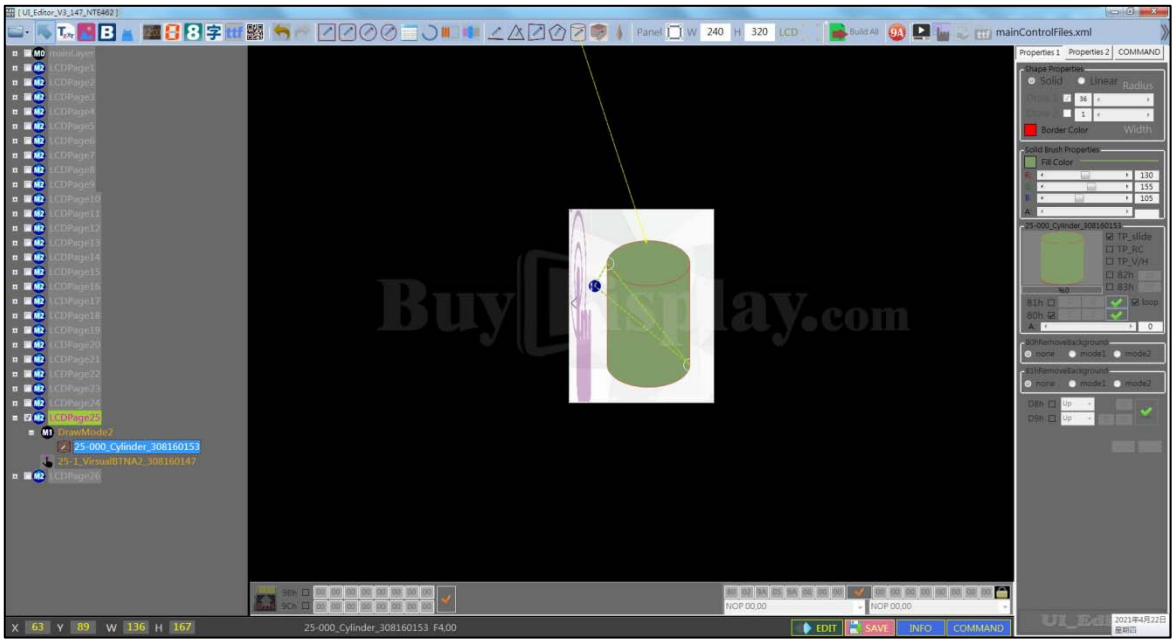


Figure 3-59: Cylinder Drawing Setting

3.2.15Table Drawing (F6h)

Click “Table” button, and click on the screen, a table will pop up in the screen. The size of the table must be adjusted by using N-Col and N-Row in the Properties2 column on the right. Each parameter of the table can be set in Properties2. You can change the direction of the project table (horizontal, vertical) by “Mode” button in Properties2 (selected: horizontal, un-selected: portrait). If you want to change the background color of the item bar and content bar, first select the color you want by adjusting RGB parameter, then click the color option in front of the Fill color.

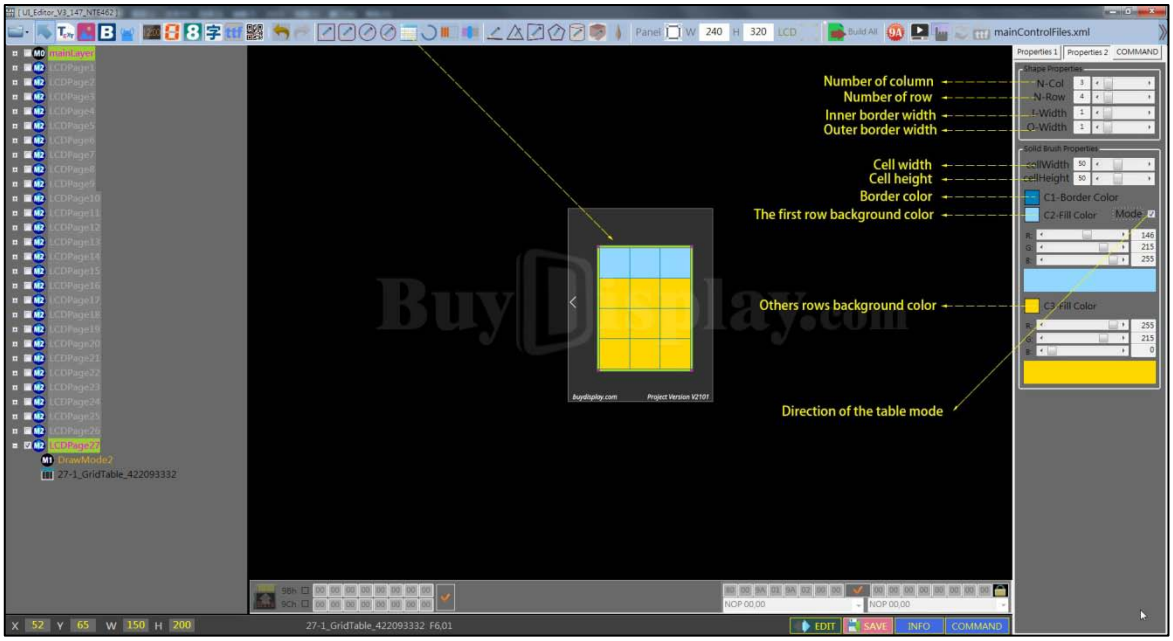


Figure 3-60: Table Setting

3.3 Other Functions

3.3.1 Backlight Control Command (BAh)

The BAh command list is at the bottom of the instruction option, as shown in the following figure:

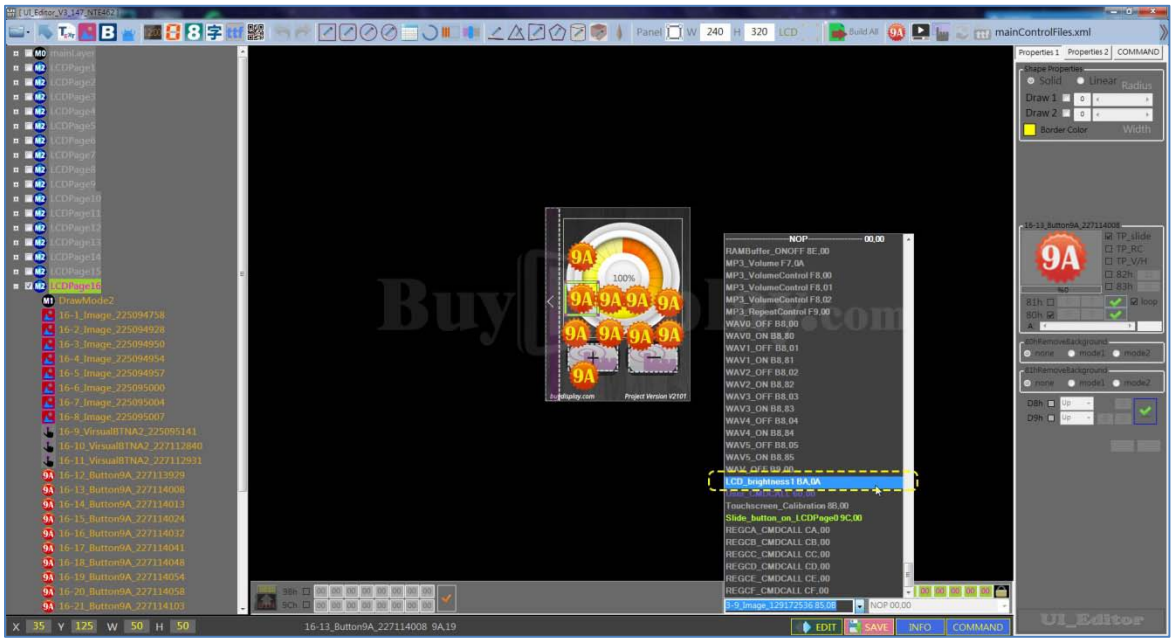


Figure 3-61：Backlight Control “BAh” Command

If any of the BA instructions are selected, a back brightness selection box will appear at the BA instruction.

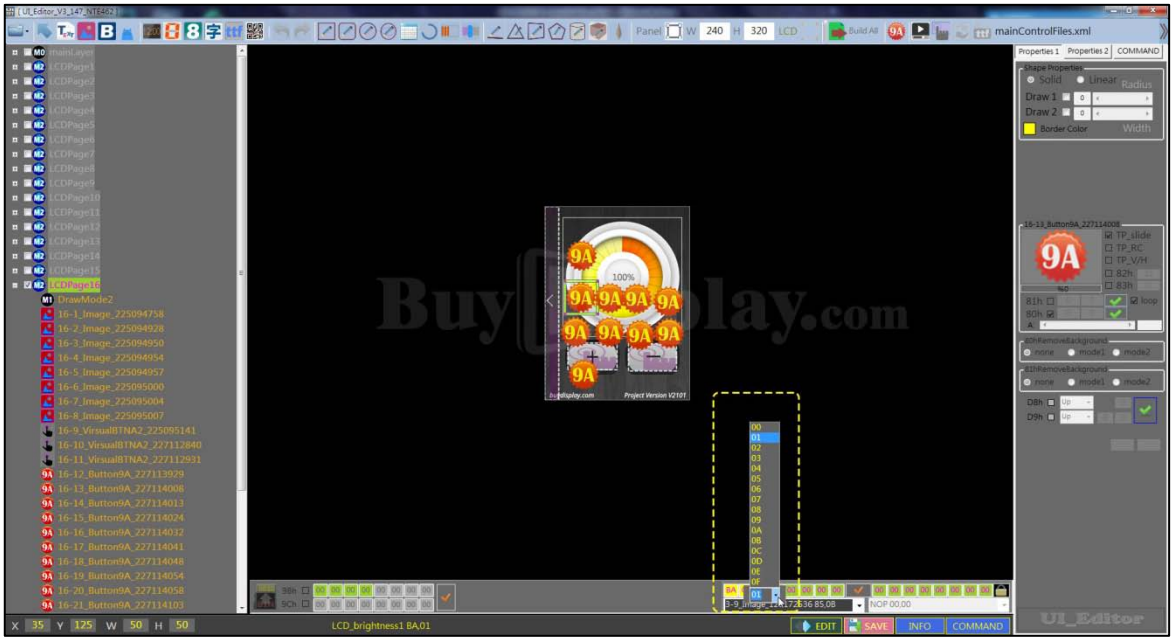


Figure 3-62：Select Backlight Level

3.3.2 Resistive Panel Control Command (8Bh)

Resistive panel control commands only need to be transmitted to the ER-TFT028A2-4-5465's TFT serial port via UART or SPI. It is a fixed command of the host. This command does not need to be set in the UI_Editor programming software.

Table 3-2: Resistive Panel Control Command

Command Function	Code	No.	Parameter	Description
Check Resistive Panel	8Bh	--		conduct the checkpoint checking on 4 corners.

For example, when the UART transmits the control command 8Bh to the TFT panel, it will automatically conduct the four corner verification procedures . User should touch each corner follow the panel instruction to complete the verification program.

Figure 3-65: Resistive Panel Verification

3.3.3 TFT Panel Verify Command (BEh)

The verify command only needs to be transmitted to the ER-TFT028A2-4-5465 TFT panel through UART or SPI. It is a fixed command of the host. This command does not need to be in the UartTFT_Tool host computer software.

Table 3-3: TFT Panel Verify Command

Command Function	Code	No.	Parameter	Description
Verify TFT Panel	BEh	--		TFT panel initialization completed or in Ready status: 5Ah → Ready; A5h → Not Ready (busy state) ;
Check TFT Panel Version	BFh	--		Read ER-TFT028A2-4-5465 TFT panel version information: MCU Code version (5Bytes) + TFT module (42Bytes)

When the UART transmits the command BEh to TFT panel, if the TFT panel is initialized or in the Ready state, the panel will respond 5Ah to the host computer. If the panel is in Busy state, the panel will respond A5h to the host computer. If the TFT panel is not connected to the Uart port of the host computer, it will not respond any information.

The serial command BFh is used to read the ER-TFT028A2-4-5465 TFT panel version, including the 5 Byte ER-TFT028A2-4-5465 program code version and 42 Bytes TFT module information. When the UART transmits the command BFh to TFT panel, the TFT panel sequentially sends the information to the host. Detailed version information can be found in Table 4-23 in Section 4.2.18.

3.3.4 Description of Font File

Font file saved in the path “UI_Editor_V1.0\FONT”. The content of the fontList.txt file is sorted by the name of all the font files, shown as below

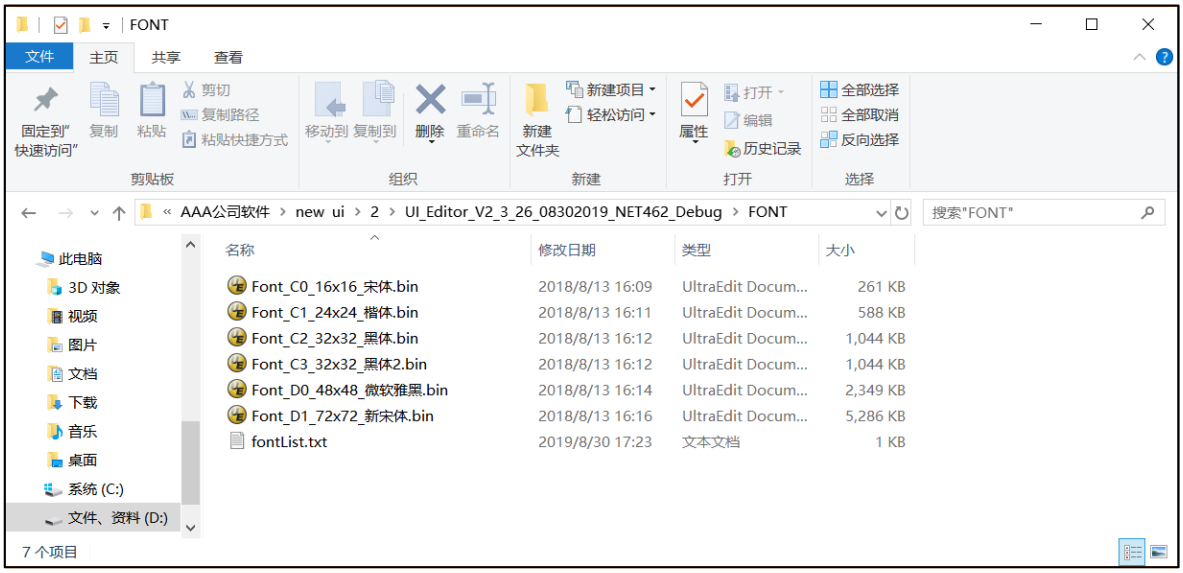


Figure 3-66: Fontlist.Txt File

3.3.5 Audio Control (B8h)

UI_Editor will generate a B8h Command for each of the three WAV audio files under UI_Editor\SOURCE\WAV, open the Command and connect the serial port. Click the SEND key corresponding to the B8h, and the TFT panel will play the corresponding WAV audio.

Figure 3-67A：WAV Files in UI_Editor

B8	00	Wav-1:ON & RP=B7	SEND
B8	01	Wav-2:ON & RP=B7	SEND
B8	02	Wav-3:ON & RP=B7	SEND
B9		Wav-1~3-OFF	SEND

Figure 3-67B：Audio Control

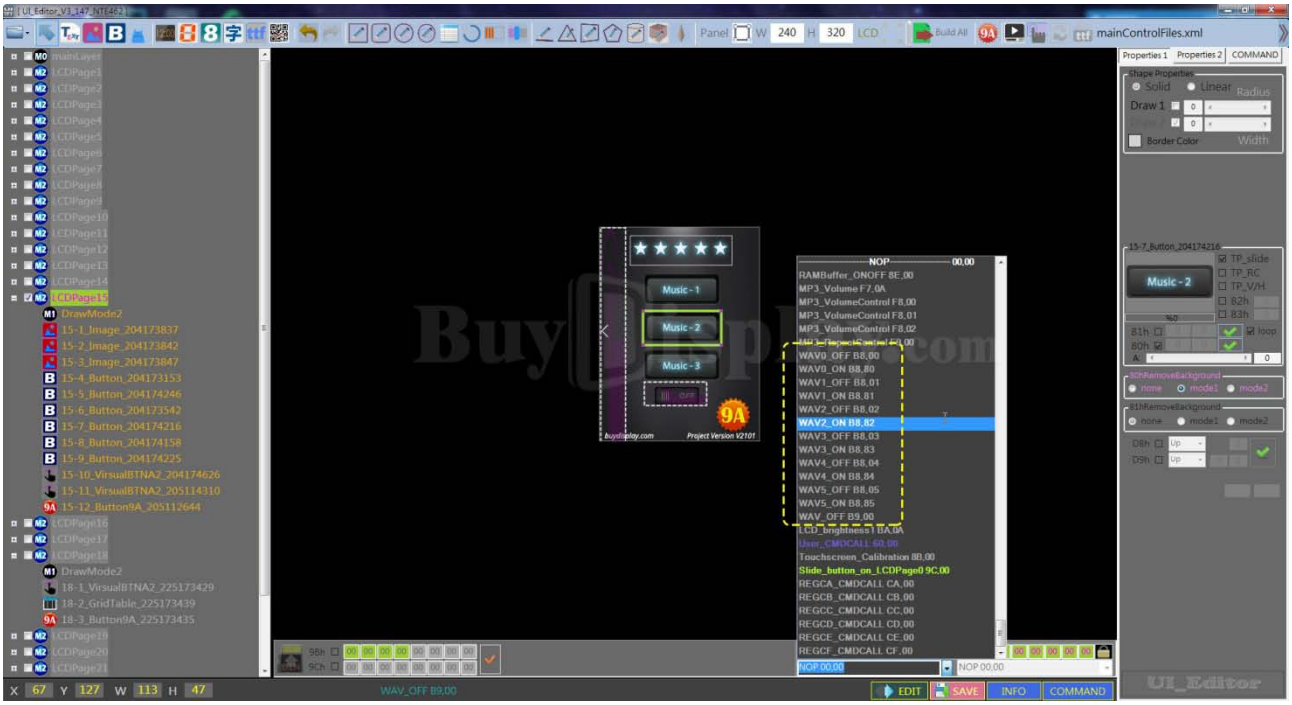


Figure 3-67C：Audio Control in UI_Editor

3.3.6 RTC Digital Clock Command (92h)

The digital clock command 92h can display the time and date. After selecting a suitable font, the UI will automatically obtain the current information of the system. When the time and date are displayed at the same time, the time coordinates can be set separately in the setting interface, and the date coordinates can be set separately in the lower left corner of the UI. The effect will be displayed on the simulator and the board.

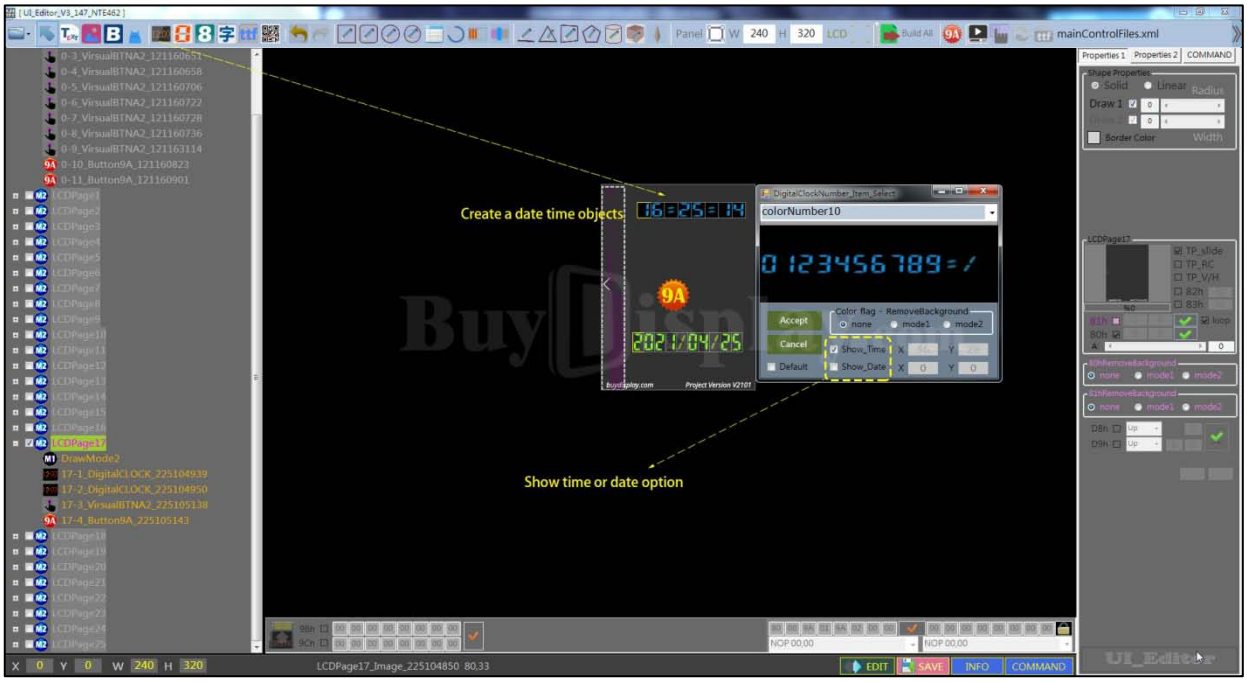


Figure 3-68A: Digital Clock Command 92h Setting

3.3.7 Register Operation Instructions (CA)

CAh ~ CFh instructions are mainly used to manipulate registers, which are suitable for digital changes, brightness adjustment, volume adjustment, etc.

CAh: Call the 9A instruction according to the value of the register, CAh 00h is the call instruction 9Ah [00]

CBh: This instruction points to register, CBh 00h points to register 00;

CCh: This instruction is to write the register, CCh 01h and CBh 00h are used together to write the value 01 to the register 00, at this time [00] becomes 01;

CDh: This instruction is to read the register, CDh 03h is to read the value of the register 03 at this time, and then upload it to the host;

CEh: This instruction adds one to the value in the register, CEh 02h is the value of register 02 at this time plus one, [02] + 1;

CFh: This instruction is the value in the register minus one, CFh 05h is the value of the register 05 at this time minus one, [05]-1.

Please refer to project example for more detail.

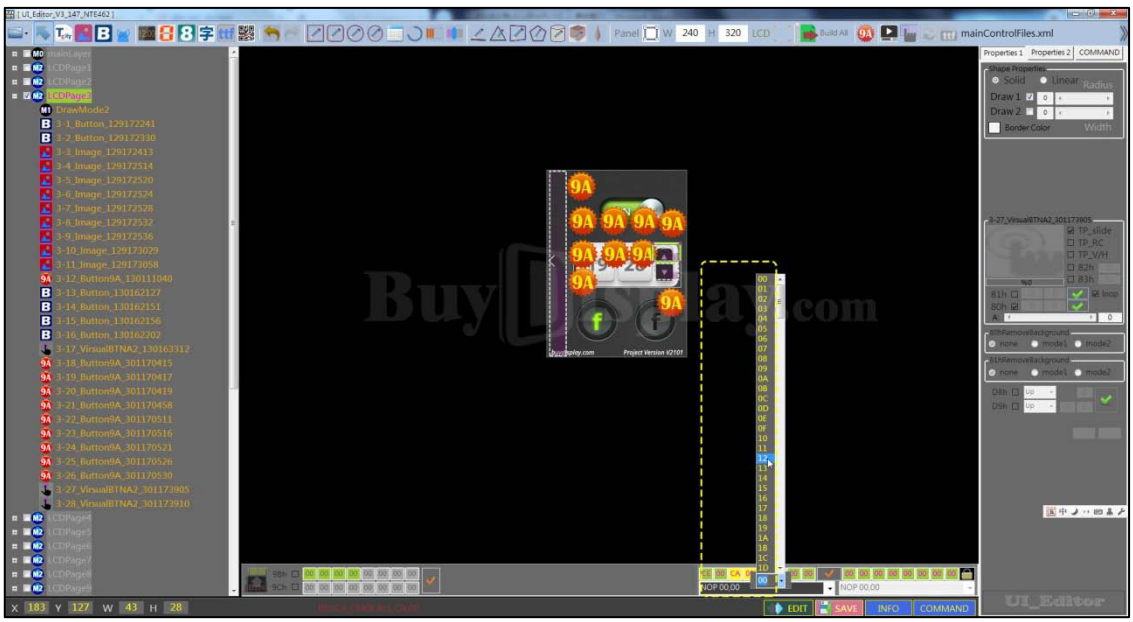
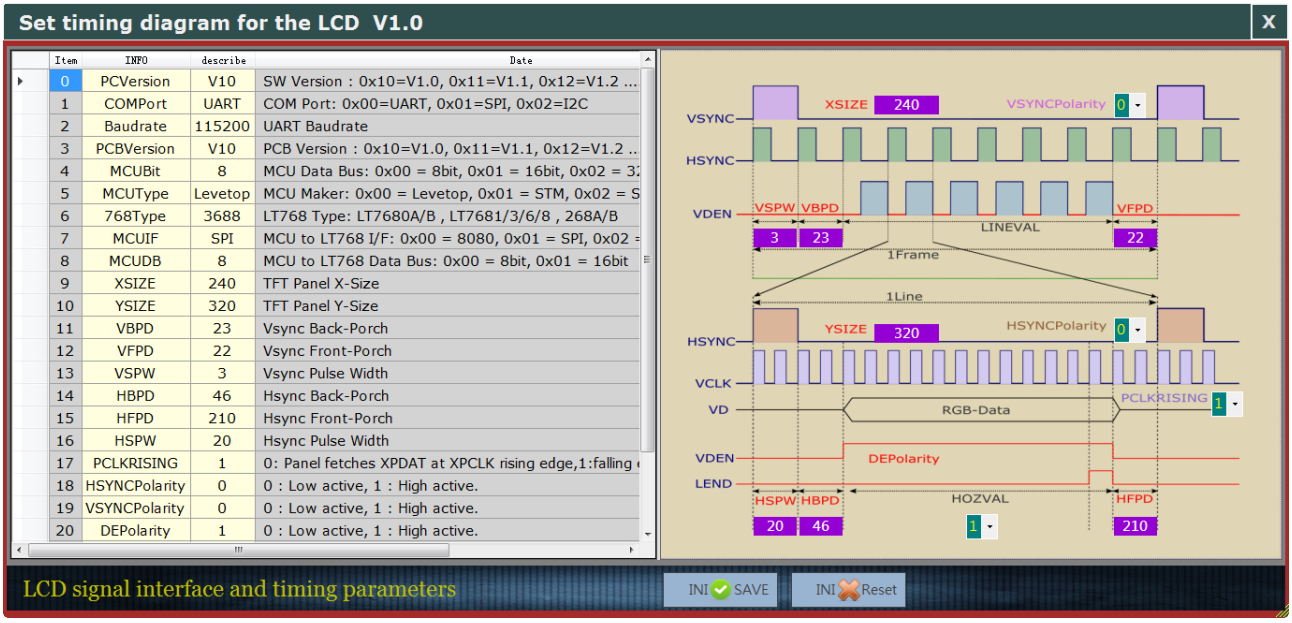


Figure 3-68B: CA-CF Operation Example

3.4 BIN File Generation and Command Send

Before generating the BIN file, set the communication parameters of the TFT panel and the host computer. Open the parameter settings by clicking the INFO button in the UI_Editor. After setting, click the INI SAVE button to confirm the settings.



Item	INFO	describe	Date
0	PCVersion	V10	SW Version : 0x10=V1.0, 0x11=V1.1, 0x12=V1.2 ...
1	COMPort	UART	COM Port: 0x00=UART, 0x01=SPI, 0x02=I2C
2	Baudrate	115200	UART Baudrate
3	PCBVersion	V10	PCB Version : 0x10=V1.0, 0x11=V1.1, 0x12=V1.2 ..
4	MCUBit	8	MCU Data Bus: 0x00 = 8bit, 0x01 = 16bit, 0x02 = 3
5	MCUType	Levetop	MCU Maker: 0x00 = Levetop, 0x01 = STM, 0x02 = S
6	768Type	3688	LT768 Type: LT7680A/B , LT7681/3/6/8 , 268A/B
7	MCUIF	SPI	MCU to LT768 I/F: 0x00 = 8080, 0x01 = SPI, 0x02 =
8	MCUDB	8	MCU to LT768 Data Bus: 0x00 = 8bit, 0x01 = 16bit
9	XSIZE	240	TFT Panel X-Size
10	YSIZE	320	TFT Panel Y-Size
11	VBPD	23	Vsync Back-Porch
12	VFPD	22	Vsync Front-Porch
13	VSPW	3	Vsync Pulse Width
14	HBPD	46	Hsync Back-Porch
15	HFPD	210	Hsync Front-Porch
16	HSPW	20	Hsync Pulse Width
17	PCLKRISING	1	0: Panel fetches XPDAT at XPCLK rising edge,1:falling
18	HSYNCPolarity	0	0 : Low active, 1 : High active.
19	VSYNCPolarity	0	0 : Low active, 1 : High active.
20	DEPolarity	1	0 : Low active, 1 : High active.

Figure 3-69A: Parameter Setting

Once the INFO parameter is settled, press “Build ALL” to compile. (Need to open the compiled project, click the INFO button to see the modified INFO information.)

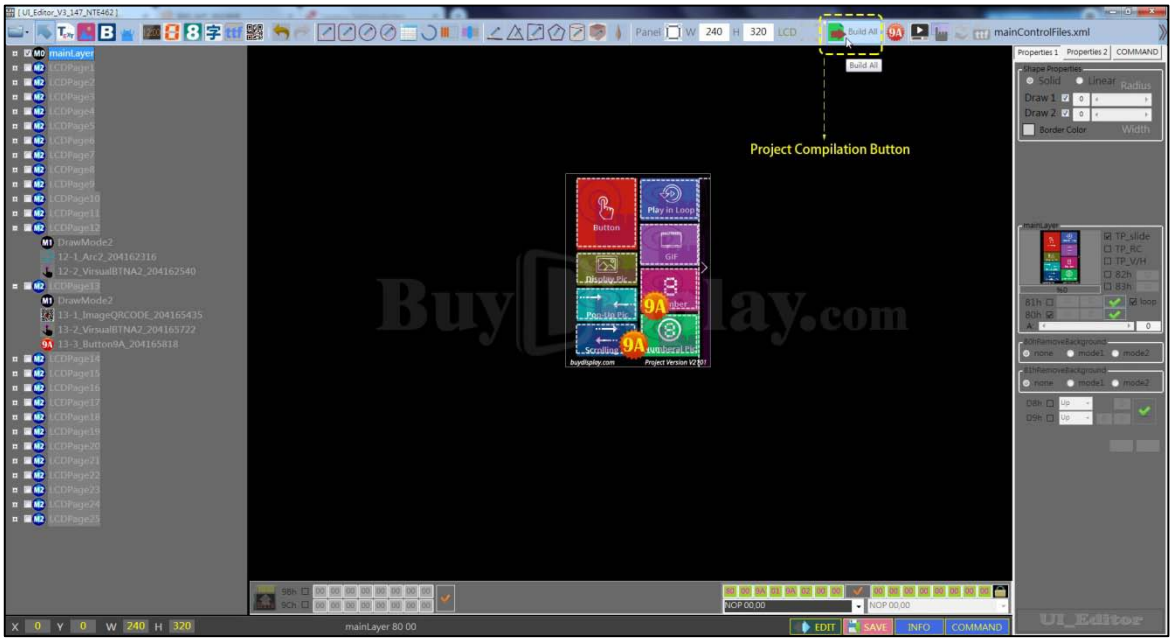


Figure 3-69B: Project Compile

The generated BIN file is Programmed to the TFT panel by the Programming tool, and connect TFT panel and the host computer Click the Command button and pop up the command sending interface. Set the serial port baud rate, port number, open the serial port, you can send commands. If it is a command with value, the Value box will have a default value, which can be changed to achieve other effects. Press the SEND button to send a command to TFT panel.

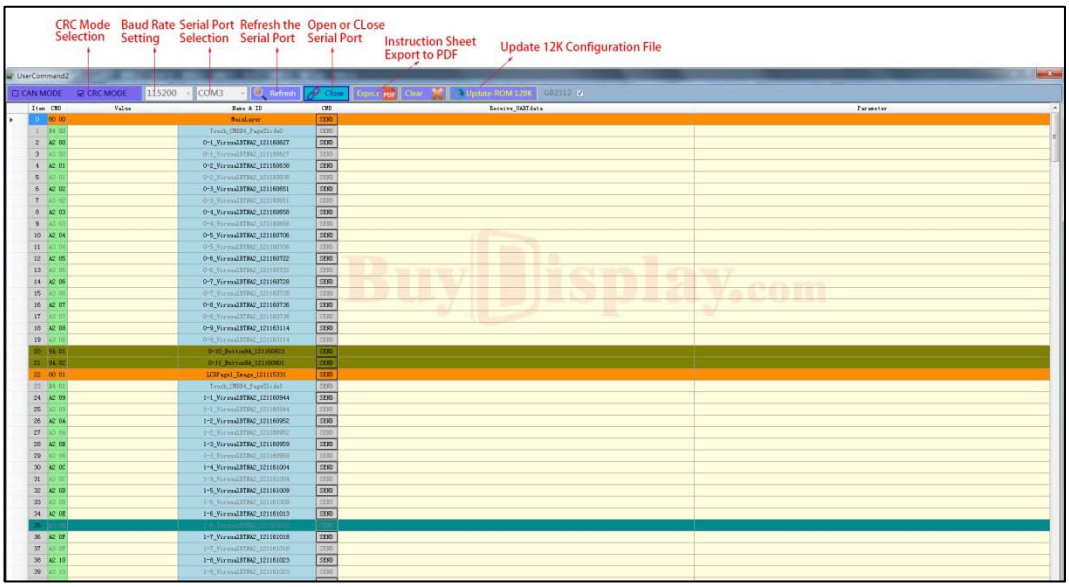


Figure 3-71: Command Sent To TFT Panel

Once the developer uses UI_Editor to plan and verify the product UI interface, the entire UI command table can be exported. The host can embed these commands code in the MCU, then send the respective command or CRC code to display picture or related action on TFT panel. And the host can judge whether it is correctly executed according to the response from the TFT panel. Figure 3-64 below shows the exported command list after the design is completed.

LCD Serial Communication Command Reference

Author : UI_Editor

Run Date : 2021-04-25

Item	CMD	Value	Name & ID	CMD	Receive_UARTdata	Parameter
0	80 00		MainLayer	SEND		
1	B4 00		Touch_CMDB4_PageSlide0	SEND		
2	A2 00		0-1_VirsualBTNA2_121160627	SEND		
3	A3 00		0-1_VirsualBTNA2_121160627	SEND		
4	A2 01		0-2_VirsualBTNA2_121160638	SEND		
5	A3 01		0-2_VirsualBTNA2_121160638	SEND		
6	A2 02		0-3_VirsualBTNA2_121160651	SEND		
7	A3 02		0-3_VirsualBTNA2_121160651	SEND		
8	A2 03		0-4_VirsualBTNA2_121160658	SEND		
9	A3 03		0-4_VirsualBTNA2_121160658	SEND		
10	A2 04		0-5_VirsualBTNA2_121160706	SEND		
11	A3 04		0-5_VirsualBTNA2_121160706	SEND		
12	A2 05		0-6_VirsualBTNA2_121160722	SEND		
13	A3 05		0-6_VirsualBTNA2_121160722	SEND		
14	A2 06		0-7_VirsualBTNA2_121160728	SEND		
15	A3 06		0-7_VirsualBTNA2_121160728	SEND		
16	A2 07		0-8_VirsualBTNA2_121160736	SEND		
17	A3 07		0-8_VirsualBTNA2_121160736	SEND		
18	A2 08		0-9_VirsualBTNA2_121163114	SEND		
19	A3 08		0-9_VirsualBTNA2_121163114	SEND		
20	9A 01		0-10_Button9A_121160823	SEND		
21	9A 02		0-11_Button9A_121160901	SEND		
22	80 01		LCDPage1_Image_121115331	SEND		
23	B4 01		Touch_CMDB4_PageSlide1	SEND		
24	A2 09		1-1_VirsualBTNA2_121160944	SEND		
25	A3 09		1-1_VirsualBTNA2_121160944	SEND		
26	A2 0A		1-2_VirsualBTNA2_121160952	SEND		
27	A3 0A		1-2_VirsualBTNA2_121160952	SEND		
28	A2 0B		1-3_VirsualBTNA2_121160959	SEND		
29	A3 0B		1-3_VirsualBTNA2_121160959	SEND		

Figure 3-72: Exported Command Table

Figure 3-73: First Mainlayer Picture

When the host send command 80h, 31h, 1Bh(CRC1), 98h(CRC2), TFT panel will display two pictures with the same group number.

The following table is a list of the commands that the ER-TFT028A2-4-5465 can support after designing with UI_Editor. If the UI_Editor is not used in the design, it will not appear in the exported PDF.

Table 3-4: Command Table

Command Code	No.	Parameter	Function
80h	nn		Display picture
81h	nn		Display overlap picture in loop
84h	nn		Cancel 81h Command
88h	nn		Display GIF picture
89h	nn		Cancel Display GIF (88h Command)
8Bh			Perform resistive panel verification
90h	nn	ddd.d	Display picture-number
91h	nn	ddd.d	Display picture-number
98h	nn	String	Display QR-Code
9Ah	nn		Execute multi group command, when nn=00, execute boot command
A0h	nn		Display Button picture
A1h	nn		Cancel Button display function
A2h	nn		Setup Virtual touch area
A3h	nn		Cancel Virtual touch area
B0h	nn	Vaule(2Bytes)	Display progress bar indicator
B8h		REP(Bit7) + WAV	Play wav music
B9h			Stop play wav music
BAh		BL (00~1Fh)	Adjust backlight brightness
BCh		0/1	Display On/Off
BEh			Verify panel
BFh			Version verify
C0h	nn	String	Display font-1 text
C1h	nn	String	Display font-2 text
C2h	nn	String	Display font-3 text
C3h	nn	String	Display font-4 text

Table 3-4: Command Table (continue)

Command Code	No.	Parameter	Function
D8h	nn		Display scroll picture
D9h	nn		Scroll picture in loop
DBh	nn		Cancel Scroll picture(D9h Command)
DCh	nn	S_Angle, A_Angle	Display ring indicator
E0h	nn		Display a line
E1h	nn		Display hollow circle
E2h	nn		Display solid circle
E3h	nn		Display solid circle with frame
E4h	nn		Display hollow ellipse
E5h	nn		Display solid ellipse
E6h	nn		Display solid ellipse with frame
E7h	nn		Display hollow rectangle
E8h	nn		Display solid rectangle
E9h	nn		Display solid rectangle with frame
EAh	nn		Display hollow rounded rectangle
EBh	nn		Display solid rounded rectangle
ECh	nn		Display solid rounded rectangle with frame
EDh	nn		Display hollow triangle
EEh	nn		Display solid triangle
EFh	nn		Display solid triangle with frame
F4h	nn		Display a cylinder
F6h	nn		Display table window

3.4.1 SPI Flash Structure

After the project is compiled, press BIN GEN button to generate the “UartTFT_Flash.bin” file and the “UserInfo.bin” file in the Binfile folder. These two files are used to Programming into SPI Flash. The following figure shows the structure of SPI Flash. It can be seen that the “UartTFT_Flash.bin” file actually includes the contents of the “UserInfo.bin” file, while the “UserInfo.bin” file stores the Command parameters. Other areas are pictures, animation files, text files, and audio files. If only modify Command parameter, the “UartTFT_Flash.bin” file and the “UserInfo.bin” file will be generated at the same time, but only the “UserInfo.bin” file needs to be updated. The size of the “UserInfo.bin” file is fixed at 128Kbytes. Therefore, you can use the USB to RS232 cable to update quickly in the UI_Editor environment without using SPI Flash Programmer.

In addition, developers can programming Bin file into SPI Flash through the PC's USB and using the "ER-TFT028A2-4-5465_ISP_Vxx.exe" program. Please refer to the description in Chapter 6 for details.

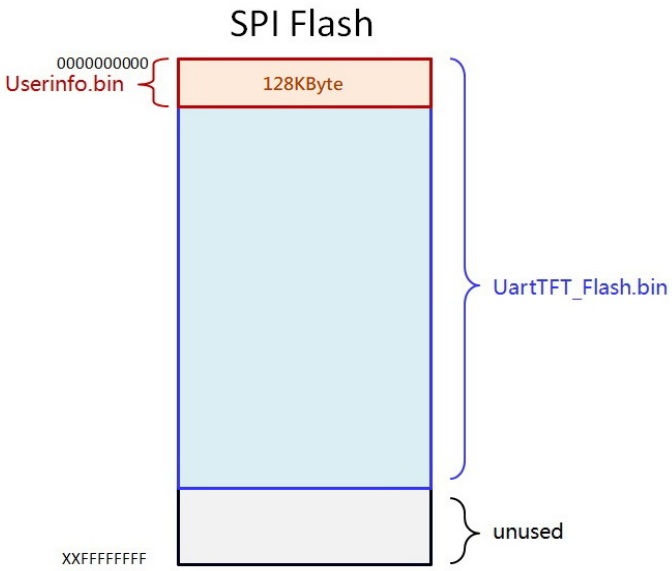


Figure 3-76: SPI Flash Structure

3.4.2 Userinfo.bin (128K) Update

Figure 3-77: “Userinfo.Bin” Update Button

If you only update the individual parameters of partial commands, such as the display position of a picture, the playback speed of the GIF animation, the commands executed by the button control, etc., you do not need to Programming the flash to update the changes. You can recompile the project after changing these parameters and generate a BIN file. Open the Command and use the “128K Update” to change the “UserInfo.bin” in the SPI Flash, Now the parameters in the TFT panel is changed.

3.5 Download a UI_Editor Demo

For the use of UI_Editor, users can download ER-TFT028A2-4-5465's UI_Editor examples from EastRising SemButtonductor website, Like as file "ER-TFT028A2-4-5465_UI_Editor_Demo_240x320.rar" .

1. Download the UI_Editor compressed file "UI_Editor_Vx_x_x " from the our website (www.buydisplay.com) and unzip the file .

2. Download UI_Editor examples such as "ER-TFT028A2-4-5465_UI_Editor_Demo_240x320.rar" , then decompress and open the compression package.

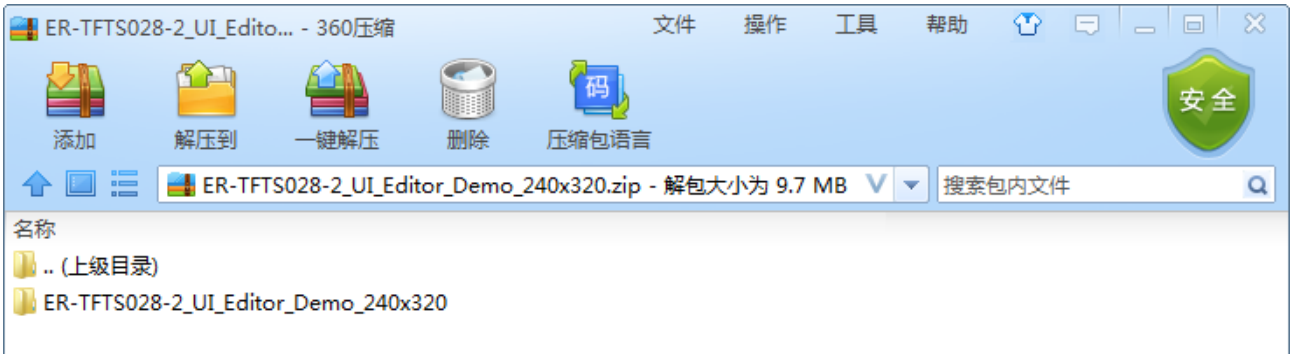


Figure 3-78: Decompress And Open The Compression Package

3. Unzip the demo sample directory, such as the "09_02_2019-14_22_21" folder, into the PROJECT folder of the UI_Editor.

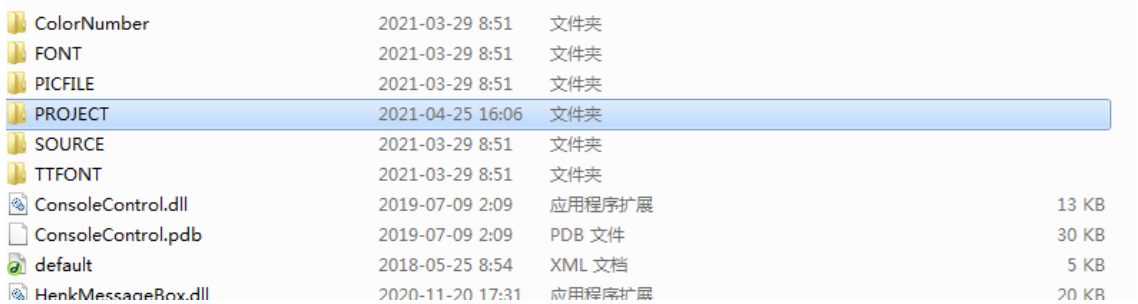


Figure 3-79: Copy the Demo to PROJECT Folder of UI_Editor.

Attention:

(1) The name and content of the compressed package folder cannot be modified.

(2) The folder inside the compressed package must be unzipped to the PROJECT folder of UI_Editor.

4. Execute UI_Editor, then open the menu option and click“Load”:

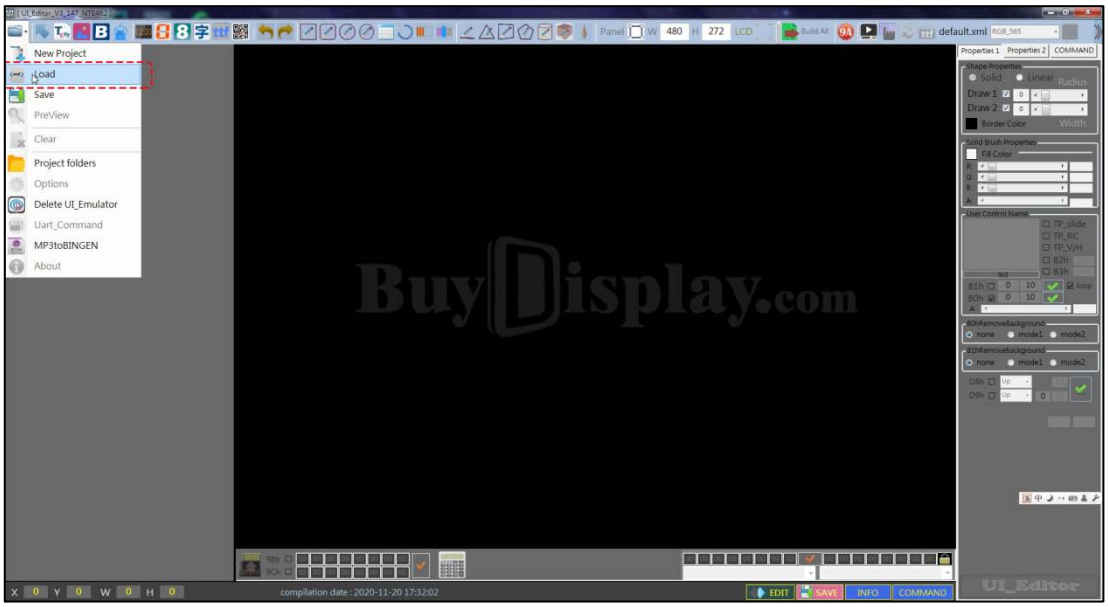


Figure 3-80: Open Menu And Click “Load”

5. Open the "COMMANDFILE " in the folder, select the project file and click open.

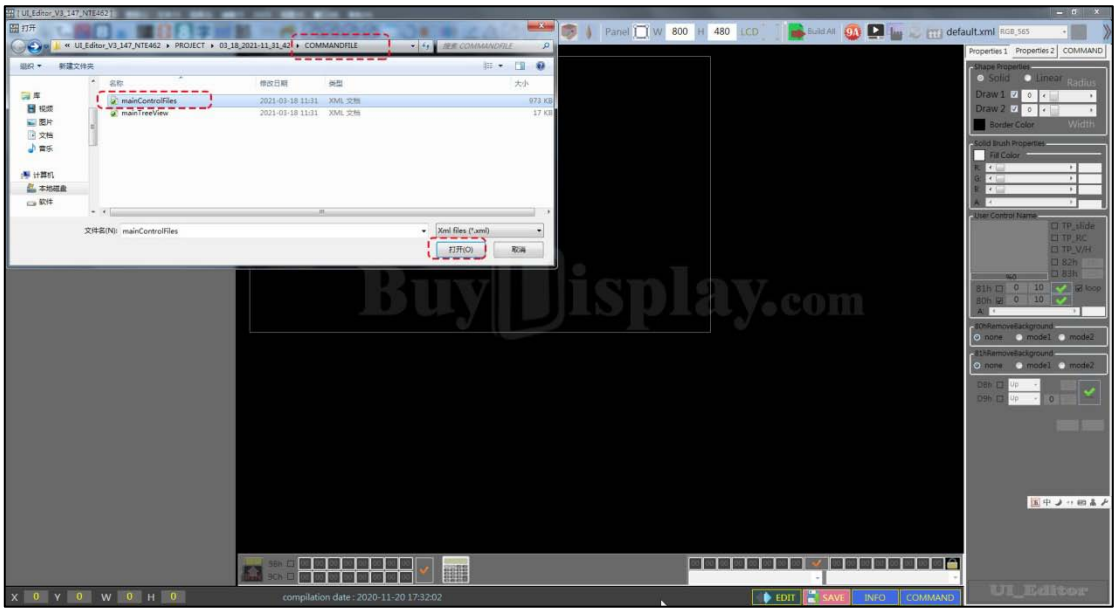


Figure 3-81: Load the Demo Project

4. Graphic Integration Compiler(UartTFT_Tool.exe)

Another method to develop the display function using the ER-TFT028A2-4-5465 TFT panel is to use "UartTFT_Tool.exe". This chapter introduces the program format and usage defined by "UartTFT_Tool.exe". The graphic integration compiler provided by EastRising allows the user to write command in text mode without using the graphic UI_Editor, the compiler will compile the user's command file, and then integrate the it with the picture, fonts to a Bin file, and then the Bin file is Programmed into the SPI Flash through the SPI Flash Programmer. The diagram is shown below.

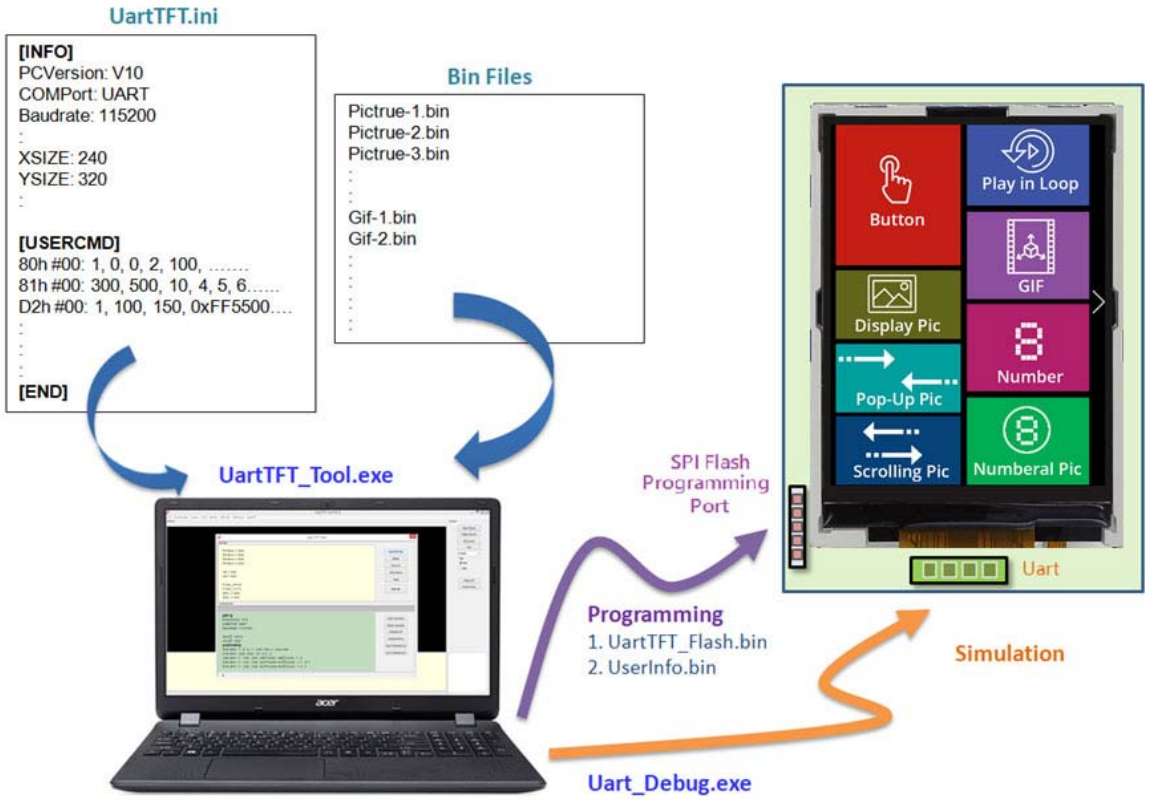


Figure 4-1: Graphic Integration Compiler Diagram

At first, user prepares the picture, font, or GIF file used by the TFT panel, and then start editing the command file - "UartTFT.ini". After editing, click on the compiler function of the graphic integration compiler to generate "UartTFT_Flash.bin" and "UserInfo.bin" files. "UartTFT_Flash.bin" is used to store data such as pictures, fonts, or GIF files, "UserInfo.bin" is used to store command data. Programming these two Bin files into SPI Flash with a Programmer. After that, the host just need to transfer commands to TFT panel, the ER-TFT028A2-4-5465 in TFT panel will analysis the command code, and read the command action stored in SPI Flash and realize the displaying of text and picture. User and use USB to RS232 converter, connect to "UartDebug.exe" via "UartTFT_Tool.exe" to pre-verify the command and its effect. User may refer to Chapter 5 in the manual for the details description of "UartDebug.exe".

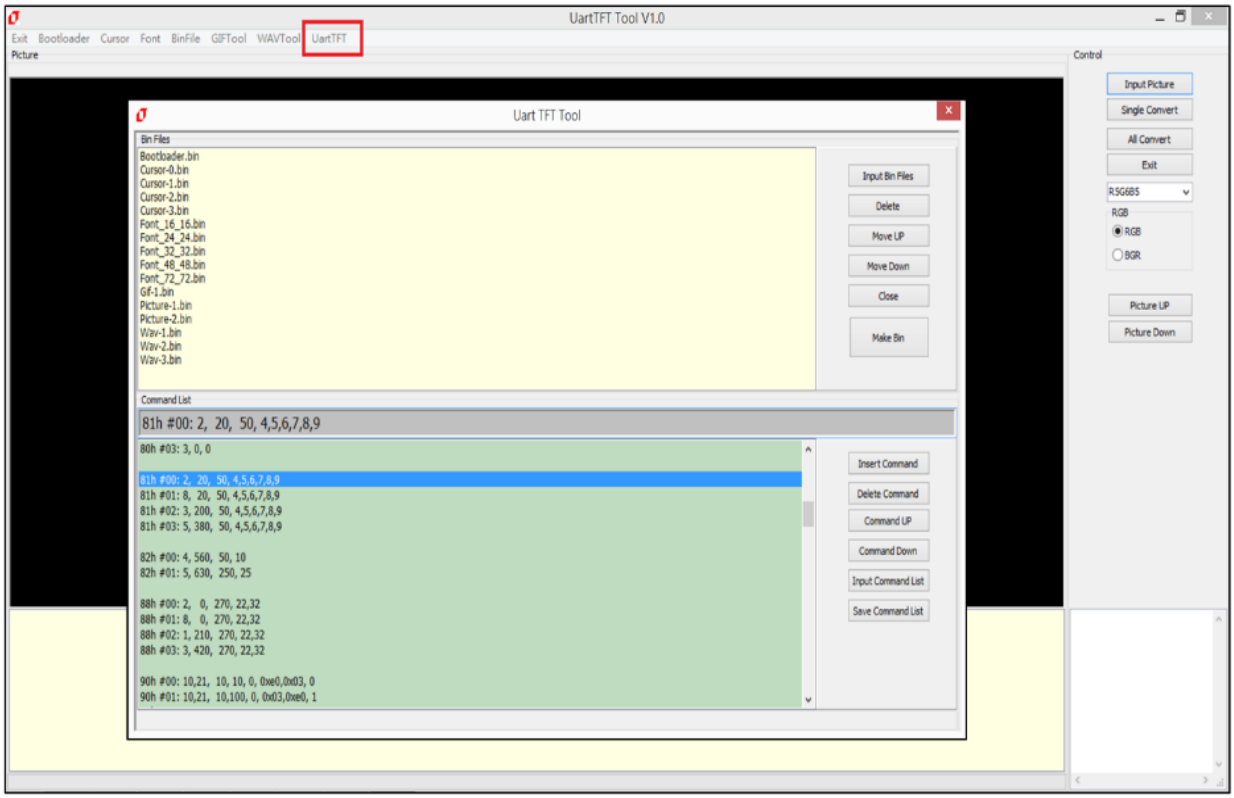


Figure 4-2: Graphic Integration Compiler (UartTFT_Tool.Exe)

User may refer to our program demo "ER-TFT028A2-4-5465_UartTFT_Tool_Demo_240x320.rar", which can be download from our website, regarding the UartTFT-tool development environment.

4.1 Edit Command Setting File

Before using the graphic integration compiler, you can use a text editor to write the command file - “UartTFT.ini”. The command file consists of two parts, one is the TFT serial panel information setting [INFO], and the other is the TFT serial panel command setting [USERCMD] detail explanation as follow:

4.1.1 Information Setting [INFO]

```
[INFO]
PCVersion: V10          // SW Version : 0x10=V1.0, 0x11=V1.1, 0x12=V1.2 .....
COMPort: UART           // COM Port: 0x00=UART, 0x01=SPI, 0x02=I2C
Baudrate: 115200        // UART Baudrate
PCBVersion: V10         // PCB Version : 0x10=V1.0, 0x11=V1.1, 0x12=V1.2 .....
MCUBit: 32              // MCU Data Bus: 0x00 = 8bit, 0x01 = 16bit, 0x02 = 32bit
MCUType: EastRising     // MCU Maker: 0x00 = EastRising, 0x01 = STM, 0x02 = STC
768Type: 268B           // 0x00: 7680A, 0x01: 7680B, 0x02: 7681, 0x03: 7683,
                        // 0x04: 7686, 0x05: 7688, 0x06: 268A, 0x07: 268B
768IF: SPI              // MCU to LT768 I/F: 0x00 = 8080-8,0x01 = 8080-16,
                        // 0x02 = SPI, 0x03 = I2C
XSIZE: 240              // TFT Panel X-Size
YSIZE: 320              // TFT Panel Y-Size
VBPD: 23                // Vsync Back-Porch
VFPD: 22                // Vsync Front-Porch
VSPW: 3                 // Vsync Pulse Width
HBPD: 46                // Hsync Back-Porch
HFPD: 210               // Hsync Front-Porch
HSPW: 20                // Hsync Pulse Width
PCLKRISING: 1           // 0: Panel fetches XPDAT at XPCLK rising edge,1:falling edge
HSYNCPolarity: 0        // 0 : Low active, 1 : High active.
VSYNCPolarity: 0        // 0 : Low active, 1 : High active.
DEPolarity: 1           // 0 : Low active, 1 : High active.
RGBSequence: RGB        // 000b : RGB,001b : RBG,010b : GRB,011b : GBR,
                        // 100b : BRG,101b : BGR
ColorDepth: 16          // Color Depth: 0x00 = 8bit, 0x01 = 16bit, 0x02 = 24bit
FlashType: NOR          // FlashType: 0x00 = NOR Flash, 0x01 = NAND Flash
FlashSize: 16           // Flash Size, Unit: 1MByte
```

Most of the above information settings are provided by ER-TFT028A2-4-5465 TFT serial panel manufacture . The manufacturer of the TFT panel will provide the above information according to the characteristics of the TFT panel and the hardware design. With the information, users only need to add them to the beginning of the command file. For example, if the TFT serial Panel is a 240*320 TFT Panel, the XSIZE and YSIZE must be set as follows:

```
XSIZE: 240
YSIZE: 320
```

The resolution of the TFT panel is fixed at the factory. The user only needs to add the [INFO] information provided by the manufacture to the front of the command file, so that the information of [INFO] is settled.

4.1.2 Command Parameter Setting [USERCMD]

The other part of the command file is the command setting [USERCMD]. The serial command as mentioned in sector 4.2 is expressed in the way of text, for example:

80h #00: 0, 0, 10, 20 // display P0 at (10, 20)

It is designed to display the picture No. 0 at (10, 20). Once the far end MCU send Start(1Byte) + 80h + 00+ CRC(2Bytes) + End(4Bytes), then picture 0 will be displayed immediately at (10, 20), which is the top left corner of picture 1 will be at (10, 20).

80h #01: 1, 0, 50, 30, 2, 1, 50, 150 // display P1 at (50, 30) ;display P2 at (50, 150)

The above example is designed to display the No. 1 picture at (50, 30), and the No.2 picture at (50, 150), that is, once the far end MCU sends tart(1Byte) + 80h + 01 + CRC(2Bytes) + End(4Bytes), then the picture 1 will be displayed at (50, 30) immediately, and picture 2 will be displayed at (50, 150) immediately in PNG form. For example:

88h #00: 1, 20, 180, GIF0, 0 // display GIF 0 animation at (20, 180)

The above example is designed to display the GIF 0 at (20, 180) with a speed of 1. Once the far end MCU sends Start(1Byte) + 88h + 00 + CRC(2Bytes) + End(4Bytes), then GIF 0 will be displayed at (20, 180)

C0h #00: 1, 0, 10, 200, 0xFF5500, 0xEE3355, 1, 1, 0, 1
C0h #01: 1, 0, 100, 200, 0x335500, 0x883355, 1, 1, 0, 1

The above example is design too display two strings. Once the far end MCU send “Start(1Byte) + C0h + 00 +“电子有限公司-ER-TFT028A2-4-5465”+ CRC(2Bytes) + End(4Bytes)”, TFT panel will display “电子有限公司-ER-TFT028A2-4-5465” at (0, 10) in font 1, with foreground color 0xFF5500, background color 0xEE3355, non-magnified, opaque mode.

Once MCU send “Start(1Byte) + C0h + 01 + “工业串口屏” + CRC(2Bytes) + End(4Bytes)”. TFT panel will display “工业串口屏” at position (100,100) in front1, with foreground color 0x335500, background color 0x88335, non-magnified, opaque mode. The instruction content “200” is the width of text window.

Below is an example of [[USERCMD] :

[USERCMD]

80h #00: 1, 0, 10, 20, 3, 100, 200
// display P1 at (0,0) ； display P2 at (10,20), display P3 at (100, 200)

81h #00: 100, 50, 10, 4, 5, 6
// display P4, P5, P6 at (100,50) Time interval: 1sec

90h #00: 1, 20, 30, 0xFF5500, 0xEE3355, 2, 0
// display "91h Number" at left point of (20,30) with PictureNumber-1, FC=0xFF5500,
// BC=0xEE3355, pitch=2,

C0h #00: 1, 10, 20, 100, 0xFF5500, 0xEE3355, 1, 1, 0, 1
// display "C0h String" at (10,20) with Font-1, IntF-1, FC=0xFF5500, BC=0xEE3355,
// HS=1, VS=1, opaque, aligned. The "100" is the width of text window.

C1h #00: 1, 10, 80, 100, 0xFF5500, 0xEE3355, 1, 1, 0, 1
// display "C1h String" at (10,80) with Font-2, IntF-1, FC=0xFF5500, BC=0xEE3355,
// HS=1, VS=1, opaque, aligned. The "100" is the width of text window.

Adding [INFO] at the front of the command file indicates that the following description is the information setting; and [USERCMD] indicates that the following description is the command setting; add [END] at the end of the command file represents the ending of the entire command file. So that the compiler knows what each chapter of file represents.

4.2 Command Parameter Setting

4.2.1 Fixed Picture Setting and Display Command

The graphic display is the main function of the ER-TFT028A2-4-5465 has several picture setting commands listed in Table 4-1A, 4-1B and 4-2. Usually, users can design these pictures according to the resolution of the panel and the display content required by the product. These pictures can be imported by the Graphic compiler after the user designs them. Each picture will be given a picture number, and the Bin document is generated at the same time, and then written into the SPI Flash by the Programmer. Therefore, after receiving the commands, the TFT panel will find the picture information in the SPI Flash according to the command parameters, and then display the picture on the TFT Panel through the ER-TFT028A2-4-5465 hardware acceleration function.

Table 4-1A: Fixed Picture Setting Command

Command Function	Code	No.	Command Parameter	Command Description
Set to Display Multi-picture	**80h**	**#nn:**	Paa(2), PNGaa(1), Xaa(2), Yaa(2), Pbb, PNGbb, Xbb, Ybb, Pcc, PNGcc, Xcc, Ycc	Display picture P at (X, Y) position. PNG=1 means the background is transparent (PNG file), PNG=0 is not, nn is the sequence number of all commands, starting from 0; aa, bb, cc represent picture numbers. This feature supports up to 10 pictures. Note: ( ) The number in represents the number of bytes occupied.
Set to Display Multi-picture	**8Ah**	**#nn:**	Paa(2), PNGaa(1), Xaa(2), Yaa(2), Pbb, PNGbb, Xbb, Ybb, Pcc, PNGcc, Xcc, Ycc	This is an extension instruction of 80h, the same usage as 80h.

Input below command in "UartTFT.ini":

```
80h #00: 1, 0, 50, 20, 2, 0, 50, 120      // display P1 at (50, 20) ； display P2 at (50, 120)
80h #01: 3, 0, 180, 20                    // display P3 at (180, 20)
```

After the setting command is compiled, the host sends commands Start(1Byte) + 80h + 00 + CRC(2Bytes) + End(4Bytes) to TFT panel through UART, then the first picture will be displayed on the TFT at (50, 20), display the second picture on TFT at (50,120); when the Host sends commands Start(1Byte) + 80h + 01+ CRC(2Bytes) + End(4Bytes) to TFT panel through UART, the third picture will be displayed on the TFT at (180, 20), shown as below figure (Example based on 320*240 TFT).

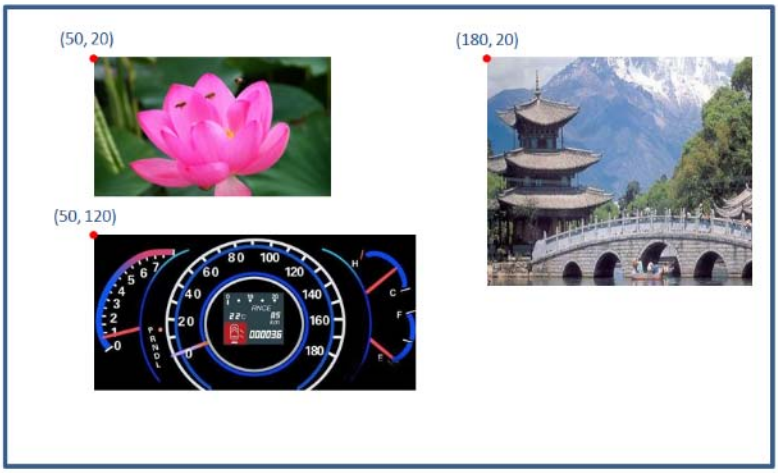


Figure 4-3: 80h Command Picture Example

Note: the host send command through UART need to add Start(1Byte) on front end, and CRC(2Bytes) /End(4Bytes) on back end. Please refer to Table 2-2. in order to avoid lengthy instructions, the following examples will omit Start (1Byte), CRC (2Bytes) and End (4Bytes)

In addition to the 80h and 8Ah instructions, the host can also directly use 8Fh command sending picture number to display picture on panel directly. This command does not need to be set in the "UartTFT_Tool" tool or in the "UartTFT.ini" file.

Table 4-1B: Fixed Picture Setting Command

Command Function	Code	No.	Command Parameter	Command Description
Display Picture on Panel Directly	**8Fh**	**nn**	X(2), Y(2), PNG(1), Pnn(2)	Display picture P at (X, Y) position. PNG=1 means the background is transparent (PNG file), PNG=0 is not, nn is the sequence number.

For example, the host transmits display commands through the UART serial port: "Start(1Byte) + 8Fh + 00 + 0064h(2Bytes) + 0032h(2Bytes) + 00h(1Bytes) + 0001h(2Bytes) + (CRC(2Bytes) + End(4Bytes)"to TFT panel, then the first picture within bmp format will be displayed on the Coordinate (100, 50) of panel.

If transmits "Start(1Byte) + 8Fh + 00 + 0064h(2Bytes) + 00F0h(2Bytes) + 01h(1Bytes) + 0002h(2Bytes) + (CRC(2Bytes) + End(4Bytes)" to TFT panel, then the 2nd picture within "png" format will be displayed on the Coordinate (100, 240) of panel.

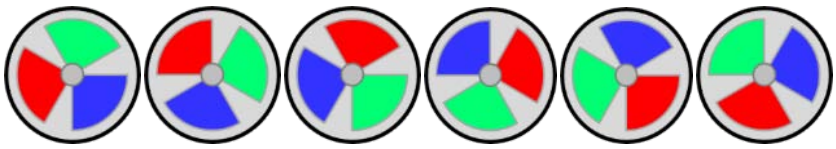
The host transmits commands through the UART serial port must add "Start", " CRC" and "End" to TFT panel. Please refer to Table 2-2: command protocol for detail. To avoid lengthy explanations, subsequent examples will omit Start , CRC and End.

4.2.2 Dynamic Picture Setting and Display Command

Table 4-2: Dynamic Picture Setting

Command Function	Code	No.	Command Parameter	Command Description
Display Overlap Picture in loop Setting	**81h**	**#nn:**	Delay(1), X(2), Y(2), PNG(1), Paa(2), Pbb(2), Pcc(2)	Display single picture in loop at position (X, Y) ； switch time is Delay*10ms. PNG=1 means background is transparent (PNG), PNG=0 is not. Each code support upto 10 pictures. 
Cancel 81h Command	**84h**	**nn**		Cancel the 81h command that display overlap picture.
Display GIF Animation setting	**88h**	**#nn:**	Loop(1), Delay(1), X(2), Y(2), GIFaa(1) , PNG	Display GIF in loop at position (X, Y); switch time is Delay*10ms. aa means GIF number, Loop means cycle mode, Loop=0 means cycle once; Loop-1 means cycle all the time. PNG=0 means the background is opaque; PNG=1 means the background is transparent (software Png image file); PNG=2 means the background is transparent (hardware Png image file). 
Cancel Display Gif	**89h**	**nn**		Cancel the 88h command that setting for display Gif animated pictures.

If you want to display a similar loop animation effect on the TFT Panel, you can use the 81h setting command. In the following picture, P4~P9 are the same size pictures, and the 81h command can produce the display effect of the cycling fan.



P4 P5 P6 P7 P8 P9

Figure 4-4: Cycling Fan

Input below command in"UartTFT.ini":

81h #00: 5, 50, 50, 1, 4, 5, 6, 7, 8, 9 // display P4~P9 at (50, 50), with speed @50ms

After commands is compiled, Host sends command 81h and 00 to TFT panel, then TFT will display picture P4 ~P9 in loop with transparent background in each 50ms.

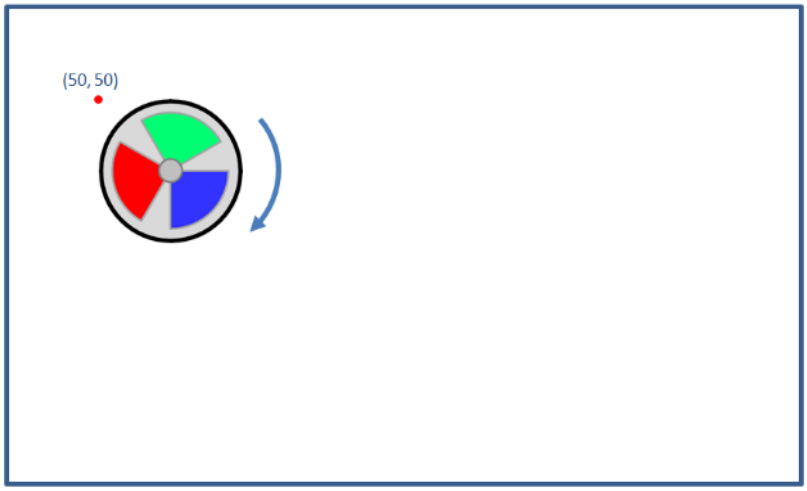


Figure 4-5: 81h Command Example

When the host transmits display command "84h, 00" to TFT panel, then the original "81h, 00" display picture will be canceled.

The above command 88h in table 4-2 which support GIF animation function is imported by the UI_Editor or the graphic integration compiler after the user design completed. It will automatically generate a number of consecutive numbered pictures, These numbered pictures and other pictures or font will be integrated into a Bin file, and then written into the SPI Flash. After the compilation is completed, the Host sends the display command 88h to the TFT panel through UART. After receiving the command, the TFT Panel will find the consecutive numbered picture in GIF file in the SPI Flash according to the command parameters, and then display on TFT Panel through the ER-TFT028A2-4-5465 hardware acceleration function. This function is often used in boot animation similar application.

88h #00: 1, 3, 50, 100, Gif-1, 0 // display GIF-1 at (50, 100), with speed @30ms

In the above example, after the setting command is compiled, the Host sends the display commands 88h and #00 to TFT Panel through UART, then the GIF-1 will be displayed in loop at (50, 100)

If user want to play GIF animation one time, send below command:

88h #00: 0, 3, 50, 100, Gif-1, 0 // display GIF-1 at (50, 100), with speed @30ms

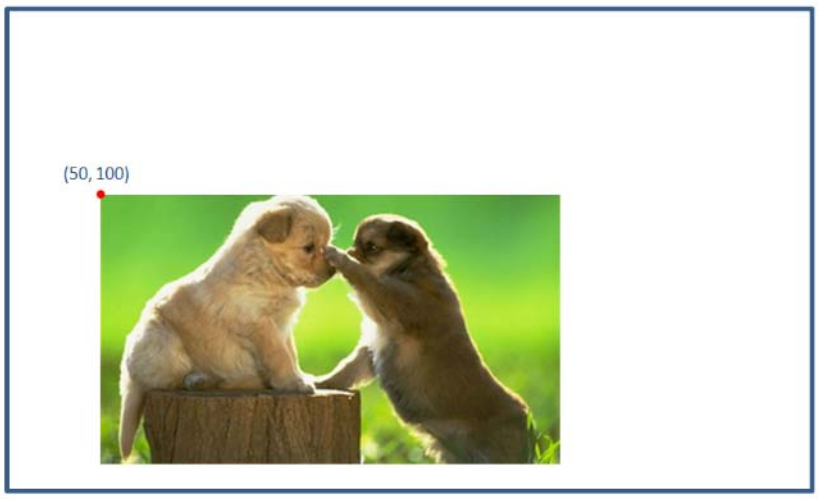


Figure 4-6: 88h Command GIF Example

When the host transmits display command “89h, 00” to the TFT panel, then the original "88h, 00" display Gif animation picture will be canceled.

4.2.3 Button Picture Setting and Display Command

Table 4-3: Button Picture Setting Command

Command Function	Code	No.	Command Parameter	Command Description
Button Picture Display Setting	**A0h**	**#nn:**	P(2), PNG(1), X(2), Y(2), CM1(1), NU1(1), CM2, NU2, CM3, NU3, CM4, NU4, CM5, NU5, CM6, NU6, CM7, NU7, CM8, NU8	Display picture P at position (X, Y), PNG = 1 means the background is transparent (PNG), and PNG = 0 is not. When touch Button picture P, the TFT Panel will automatically execute the CM command, and NU is the serial number after the CM command. This command can execute 8 sets of commands simultaneously.
Cancel Button Picture	**A1h**	**nn**		Cancel the A0h command.

For examples, input below command in "UartTFT.ini":

80h #01: 3, 0, 180, 20 // display P3 at (180, 20)

88h #00: 3, 50, 100, Gif-1 // display GIF-1 at (50, 100), with speed @30ms

A0h #00: 7, 1, 50, 50, 0x80, 0x01, 0x88, 0x00

// display P7 at (50, 50) 7 when touch P7, it will execute command 80h 01, and 88h 00 to play Gif

After compiling the setup command, the host sends the display commands A0h and 00 to TFT Panel through UART, then the TFT will display the 7th picture at (50, 50) (with transparent background), and when press on the 7th pictures, the TFT will execute the commands 80h and 01, then the third picture will be displayed on the TFT (180, 20) (refer to Section 4.2.1). Meanwhile, the TFT panel will display GIF-1 at (50, 100), shown as in the figure below.

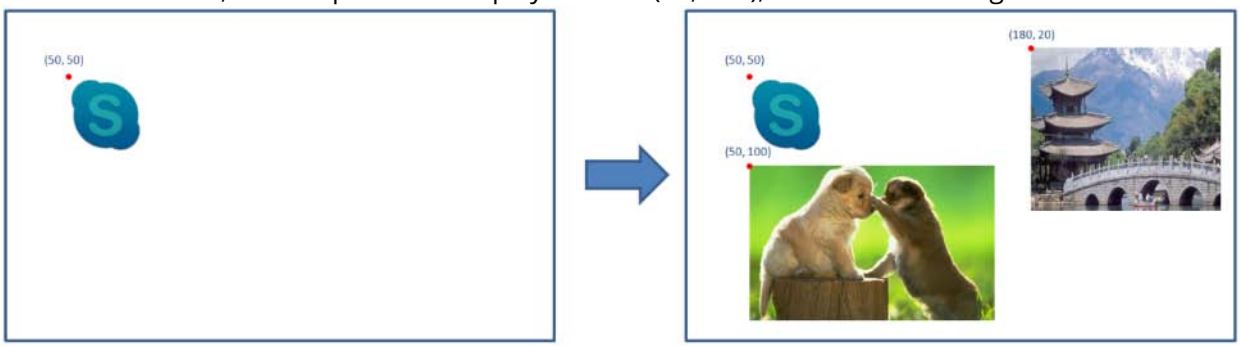


Figure 4-7A: A0h Command Example

If the host sends the display commands A1h and 00 to TFT Panel through UART, then the original command A0h 00 function(Button picture and touch control) will be cancelled.

The A0 control command can support 8 sets of commands simultaneously after pressing the touch Panel. Each set of commands includes 2 Bytes, one is the command code CM, the other is the command code serial number NU, and the unused part do not need to filled 0x00, 0x00.

When the TFT panel is pressed at the Button picture touch position, it responds to 10 Bytes feedback information. Including Start code, Command code, Serial number, status Feedback code, CRC code, End code. At this time the serial number represents the Button number, when pressed the status feedback code is 0x31. As shown in the format table below:

Table 4-4A: The Feedback Information of Press Button

Initial Code	Command Code	Serial Number	Feedback Code	CRC Code	End Code
0xAA (1 Byte)	A0h (1 Byte)	Button Picture Number (1 Byte)	**0x31**	(2 Bytes)	0xE4, 0x1B, 0x11, 0xEE(4 Bytes)

When the Button picture touch position is released, 10 Byte feedback messages are also responded to. The difference is that the status feedback code is 0x30. Please refer to Section 2.2 - Host and Serial Uart Panel Protocol.

Table 4-4B: The Feedback Information of Release Button

Initial Code	Command Code	Serial Number	Feedback Code	CRC Code	End Code
0xAA (1 Byte)	A0h (1 Byte)	Button Picture Number (1 Byte)	**0x30**	(2 Bytes)	0xE4, 0x1B, 0x11, 0xEE(4 Bytes)

In addition to the A0h command, the ER-TFT028A2-4-5465 also provides a virtual control command without pictures - A2h. This command allows the user to set an area on the TFT panel, where the panel automatically executes 8 sets of commands when the touch is pressed.

Table 4-5A: Virtual Touch Area Setting Command

Command Function	Code	No.	Command Parameter	Command Description
Setup Virtual Touch Area	**A2h**	**#nn:**	X(2), Y(2), Width(2), Height(2), CM1(1), NU1(1), CM2, NU2, CM3, NU3, CM4, NU4, CM5, NU5, CM6, NU6, CM7, NU7, CM8, NU8	Setup a virtual area that with Width and Height at position (X, Y). When touch this area, the TFT Panel will automatically execute the CM command, and NU is the serial number after the CM command. This command can execute 8 sets of commands simultaneously.
Cancel Virtual Touch Area	**A3h**	**nn**		Cancel the A2h command.

For examples, input below command in "UartTFT.ini":

80h #01: 3, 0, 500, 50 // at (500, 50) show P3

88h #00: 1, 3, 100, 200, Gif-1 // at (100, 200) show GIF-1, @30ms

A2h #00: 100, 100, 200, 75, 0x80, 0x01, 0x88, 0x00

// setup a 200*75 virtual area at (100, 100). When touch pressed, it will execute command 80h 01, and 88h 00 to play Gif

The host transmits"A2h, 00" to TFT panel. When the virtual area is pressed, then the third picture will be displayed at (180, 20) and display GIF-1 at (50, 100), shown as in the figure below.

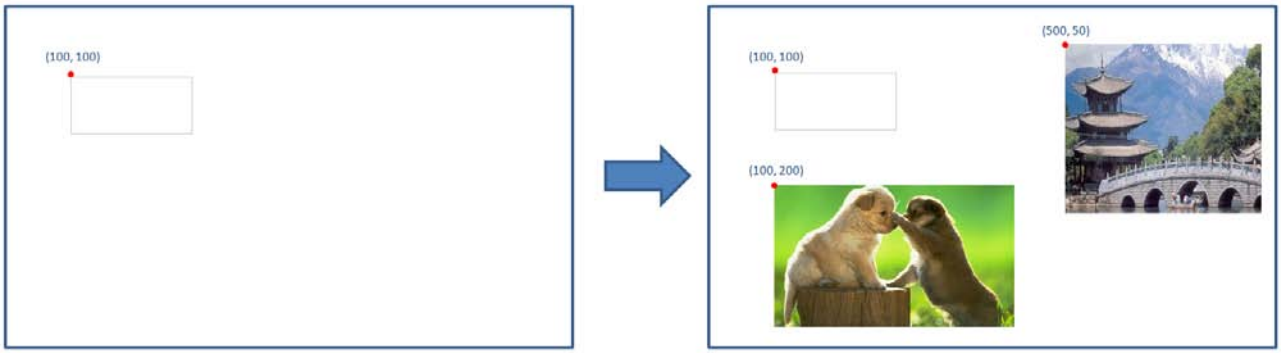


Figure 4-7B: A1h Command Example

If host sends the commands A3h and 00 to TFT Panel through UART, then the original command A1h 00 function will be cancelled.

When the TFT panel is pressed at Virtual area touch position, it responds to 10 Bytes feedback information. Including Start code, Command code, Serial number, status Feedback code, CRC code, End code. At this time the serial number represents the Button number, when pressed the status feedback code is 0x31. As shown in the format table below:

Table 4-5B: The Feedback Information of Press Button

Initial Code	Command Code	Serial Number	Feedback Code	CRC Code	End Code
0xAA (1 Byte)	A0h (1 Byte)	Button Picture Number (1 Byte)	**0x31**	(2 Bytes)	0xE4, 0x1B, 0x11, 0xEE(4 Bytes)

When the Virtual area touch position is released, 10 Byte feedback messages are also responded to. The difference is that the status feedback code is 0x30. Please refer to Section 2.2 - Host and Serial Uart Panel Protocol.

Table 4-5C: The Feedback Information of Release Button

Initial Code	Command Code	Serial Number	Feedback Code	CRC Code	End Code
0xAA (1 Byte)	A0h (1 Byte)	Button Picture Number (1 Byte)	**0x30**	(2 Bytes)	0xE4, 0x1B, 0x11, 0xEE(4 Bytes)

4.2.4 Picture-Number Display Command

Number display is a normal function of TFT panel. It can be established in the way of picture or font. Imported from PC. The user can display a number in the form of picture on the TFT panel via this command by using a monochrome image. For example, if you want to display a number on the application, but there is no suitable size in the font library, then the user can build a set of 0~9 digital pictures, and then use the command to call these numbers (pictures) where they want to be displayed, and the foreground and background of the numbers can be specified by the command parameters.

Table 4-6: Picture-number Command

Command Function	Code	No.	Command Parameter	Command Description
Setup the Picture-number (Customize-1) Display	90h	#nn:	PT(2), X(2), Y(2), Dir(1), Color-F(1), Color-B(1), EN-B(1)	Display picture-number at (X, Y) position, the foreground color is Color-F, the background color is Color-B, the display direction is Dir (0: left, 1: right), where PT stands for ID of picture-number, EN-B=0 means the background is transparent, and EN-B=1 means the remove the background (transparent).
Setup the Picture-number (Customize-2) Display	91h	#nn:	CPT(2), X(2), Y(2), Dir(1), EN-B(1)	Display picture-number at (X, Y) position, the display direction is Dir (0: left, 1: right), where CPT stands for ID of picture-number, EN-B=0 means the background is transparent, and EN-B=1 means the remove the background (transparent).

When using picture-number (customized), the size of the number displayed on the TFT panel depends on the picture resolution, and the picture must be monochrome when designing. After designing, user can use upper PC software or graphic integration software to import the picture and generate a Bin document, and then written into the SPI Flash by the programmer. With the BTE function of the ER-TFT028A2-4-5465, user can set the picture-numbers with foreground, background, or background transparency in different colors by the above commands. The following are two groups of picture-number of different sizes, each of which represents a picture file:

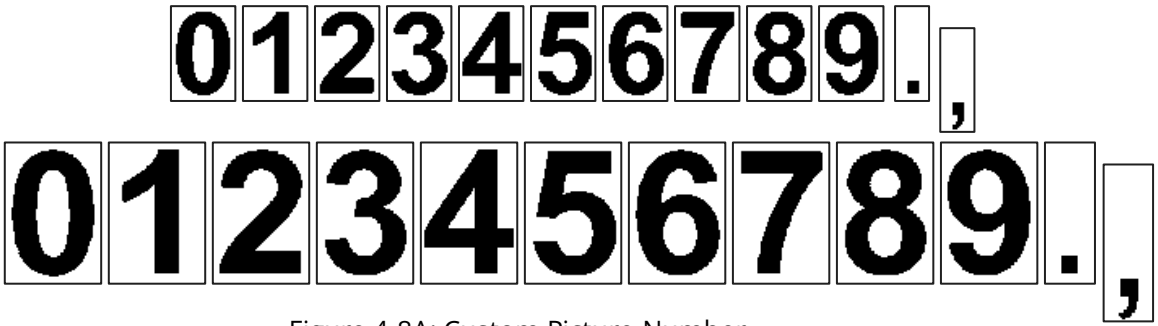


Figure 4-8A: Custom Picture-Number

For example, input below command in "UartTFT.ini":

90h #00: 0, 40, 020, 0, 0xE0, 0x03, 0
90h #01: 0, 40, 120, 0, 0x03, 0xE0, 1

After command compilation is completed, the Host transmits the display commands 90h, 00 and "867.3" to TFT panel through UART, then the TFT will displays the picture-number "867.3" at the position (100, 050), with a foreground color of 0xE3 (red) and a background color of 0x03 (blue). When the UART transmits commands 90h, 01 and "4,567" to the Serial Uart TFT Panel, the TFT will display picture number"4,567"at the position (100, 240) with the foreground color as 0x03 (blue). Since EN-B=1 means to remove the background (transparent), so the set background color 0xE3 (red) will not show.

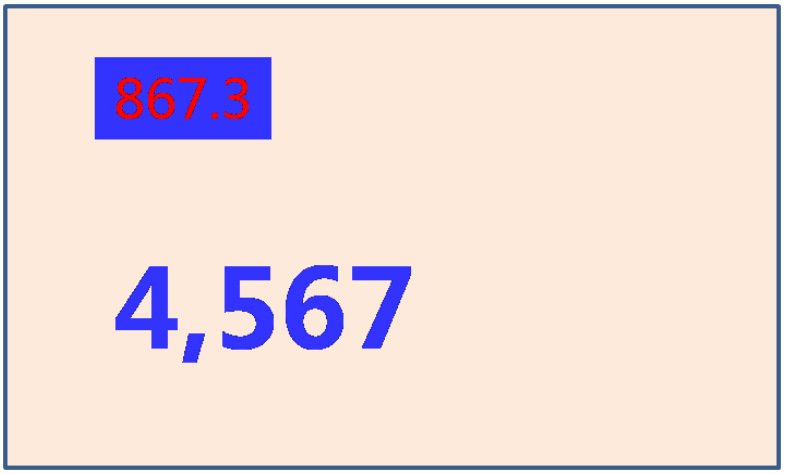


Figure 4-8B: Picture-Number Example

The 91h command is used similar to the 90h, except that there is no need to set the foreground and background color. The digital color displayed by the 91h directive is exactly the same as the picture. For example, the customized picture number sits with a set of 91h command:

Figure 4-9A: Customized Picture-Number of 91h Command

For example, input below command in "UartTFT.ini" :

91h #00: CPT0, 100, 50, 0, 0

After compiling the setup command, the host transmits commands 91h, 00 and "867.3" to the TFT panel through the UART serial port. Then the position (100, 50) on the TFT will be based on the first picture number group (CPT0) to display the number 867.3 as following figure:

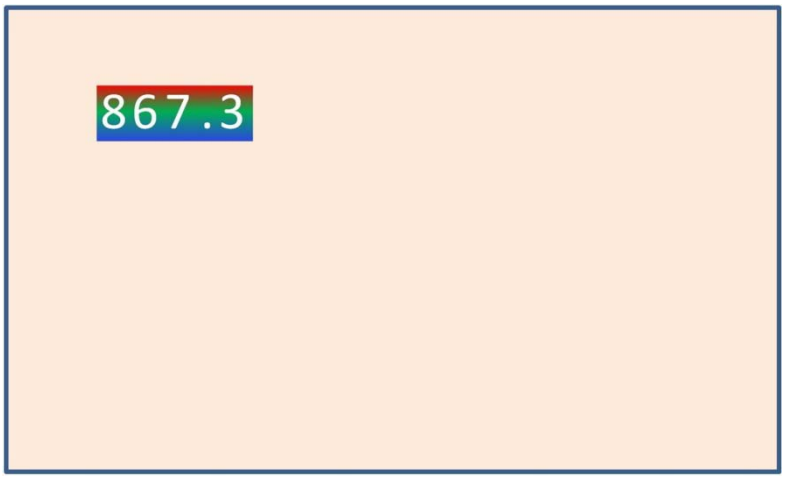


Figure 4-9B: Customized Picture-Number Example of 91h Command

4.2.5 Font Text Setting and Display Command

Font text means the displaying text or number come from the font library imported from PC. For example, if the application wants to display a string of characters, user can use the graphic compiler software generates a Bin file from the desired font. For example, generate a set 16*16 Font_16_16.bin file, a set of 24*24 Font_24_24.bin, and a set of 32*32 Font_32_32 .bin file, then Programmed into the SPI Flash, and use command to call the text where it is intended to be displayed. The resolution of the fonts called by C0~C3 is limited to 16*16, 24*24, 32*32. If the external SPI Flash capacity is big enough, 4 groups of Chinese fonts (font 1 ~ font-4) can be used.

Table 4-7: Font Text Command

Command Function	Code	No.	Command Parameter	Command Description
Display Fnt-1 Text Setting	C0h	#nn:	F01(1), X(2), Y(2), W(2), Color-F(3), Color-B(3), Size-H(1), Size-V(1), Transparency(1), Alignment(1)	The font-1 text is displayed at the (X, Y) position, the foreground color is Color-F, the background color is Color-B, and the horizontal and vertical magnifications are Size-H and Size-V, respectively. Transparency = 0 : opaque; 1: transparent. Alignment = 0 : not aligned; 1: aligned. The "W is the width of text "window.
Display Font-2 Text Setting	C1h	#nn:	F02(1), X(2), Y(2), W(2), Color-F(3), Color-B(3), Size-H(1), Size-V(1), Transparency(1), Alignment(1)	The font-2 text is displayed at the (X, Y) position, the foreground color is Color-F, the background color is Color-B, and the horizontal and vertical magnifications are Size-H and Size-V, respectively. Transparency = 0 : opaque; 1: transparent. Alignment = 0 : not aligned; 1: aligned. The "W is the width of text "window.
Display Font-3 Text Setting	C2h	#nn:	F03(1), X(2), Y(2), W(2), Color-F(3), Color-B(3), Size-H(1), Size-V(1), Transparency(1), Alignment(1)	The font-3 text is displayed at the (X, Y) position, the foreground color is Color-F, the background color is Color-B, and the horizontal and vertical magnifications are Size-H and Size-V, respectively. Transparency = 0 : opaque; 1: transparent. Alignment = 0 : not aligned; 1: aligned. The "W is the width of text "window.
Display Font-4 Text Setting	C3h	#nn:	F04(1), X(2), Y(2), W(2), Color-F(3), Color-B(3), Size-H(1), Size-V(1), Transparency(1), Alignment(1)	The font-4 text is displayed at the (X, Y) position, the foreground color is Color-F, the background color is Color-B, and the horizontal and vertical magnifications are Size-H and Size-V, respectively. Transparency = 0 : opaque; 1: transparent. Alignment = 0 : not aligned; 1: aligned. The "W is the width of text "window.

4.2.6 Point Drawing Command

The ER-TFT028A2-4-5465 contains a powerful geometric drawing hardware accelerator, so it is very efficient to perform geometric drawing. User only need to input simple graphic parameters to draw geometric figures. The following is the serial command for drawing geometry:

Table 4-8: Geometric Drawing Command - Point

Command Function	Code	No.	Command Parameter	Command Description
Point Drawing Setting	**DFh**	**#nn:**	Type(1), R(1), Color(3)	Draw a circle point with a color (Type=0) or a square point (Type=1). When drawing a circle, R represents the radius, and a square point R represents the width.

Input below command in "UartTFT.ini":

```
DFh #00: 0, 3, 0xFF0000          // display a red point with radius at 3
DFh #01: 1, 5, 0x0000FF          // display a blue square point with width at 5
```

After the compilation is completed, the host transmits the display commands DFh, 00, 0010, and 0010 to the Serial Uart TFT Panel through the UART serial port, then the TFT displays a red circle point with a radius of 3 at position (10, 10). The host transmits the display commands DFh, 01, 0020, and 0020 to the Serial Uart TFT Panel through the UART serial port, then the TFT displays a blue square point with a length and width of 5 at position (20, 20).

Figure 4-11: Point Drawing Example

4.2.7 Circle/Ellipse Drawing Command

Table 4-9: Geometric Drawing Command - Circle

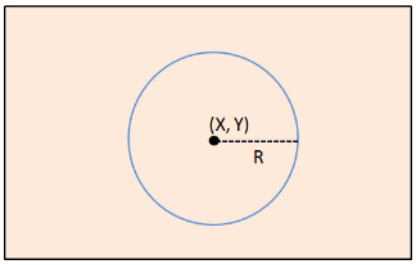
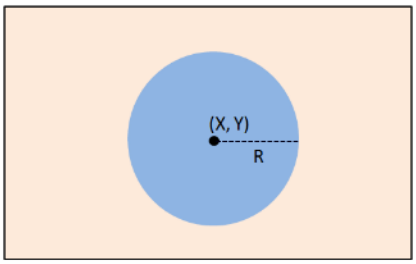
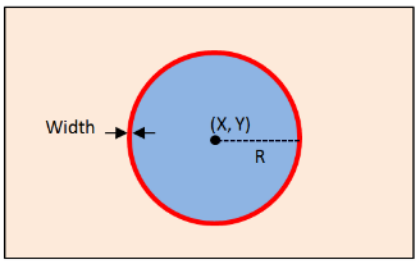
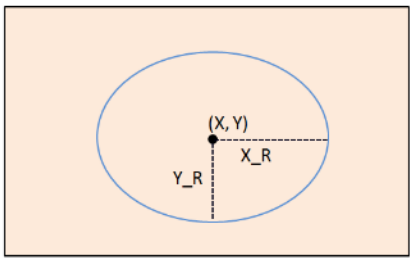
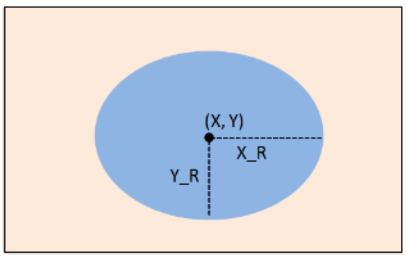
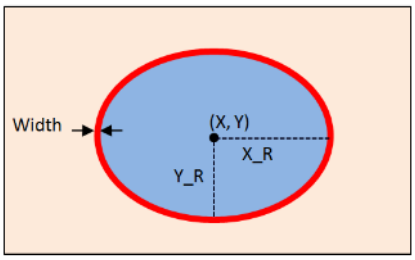
Command Function	Code	No.	Command Parameter	Command Description
Draw Hollow Circle	**E1h**	**#nn:**	X(2), Y(2), R(2), Color(3)	Draw a hollow circle around (X, Y) as the center. R: radius, color: circle color 
Draw Solid Circle	**E2h**	**#nn:**	X(2), Y(2), R(2), Color(3)	Draw a solid circle around (X, Y) as the center. R: radius Color: circle color 
Draw Solid Circle With Frame	**E3h**	**#nn:**	X(2), Y(2), R(2), Color(3), Color-F(3), Width(1)	Draw a solid circle with frame around (X, Y) as the center, R: radius, Color: fame color, Color-F: solid color 

Table 4-10: Geometric Drawing Command - Ellipse

Command Function	Code	No.	Command Parameter	Command Description
Draw Hollow Ellipse	**E4h**	**#nn:**	X(2), Y(2), X-R(2), Y-R(2), Color(3)	Draw a hollow ellipse around (X, Y), X-R: X radius, Y-R: Y radius, Color: ellipse color 
Draw Solid Ellipse	**E5h**	**#nn:**	X(2), Y(2), X-R(2), Y-R(2), Color(3)	Draw a solid ellipse around (X, Y), X-R: X radius, Y-R: Y radius, Color: ellipse color 
Draw Solid Ellipse With Frame	**E6h**	**#nn:**	X(2), Y(2), X-R(2), Y-R(2), Color(3), Color-F(3), Width(1)	Draw a solid ellipse with frame around (X, Y), X-R: X radius, Y-R: Y radius, Color: frame color, Color F: solid ellipse color. 

Input below geometric drawing command:

E1h #00: 40, 40, 30, 0x00F800
E2h #00: 120, 40, 30, 0x00F800
E3h #00: 200, 40, 30, 0x00F800,0x00001F, 5
E4h #00: 40, 160, 30, 18, 0x00F800
E5h #00: 120, 160, 30, 18, 0x00F800
E6h #00: 200, 160, 30, 18, 0x00F800,0x00001F, 5

When the UART serial port transmits the display commands E1h 00, E2h 00, E3h 00 to TFT panel, the TFT will display the hollow circle/solid circle/solid circle with frame of the specified color at the position from (40, 40) (120, 40) (200, 40).. When the UART serial port transmits the display commands E4h 00, E5h 00, E6h 00 to TFT panel, the TFT will display a hollow ellipse/solid ellipse/solid ellipse with frame of the specified color at the position from (40, 160) (120, 160) (200, 160), shown as below:

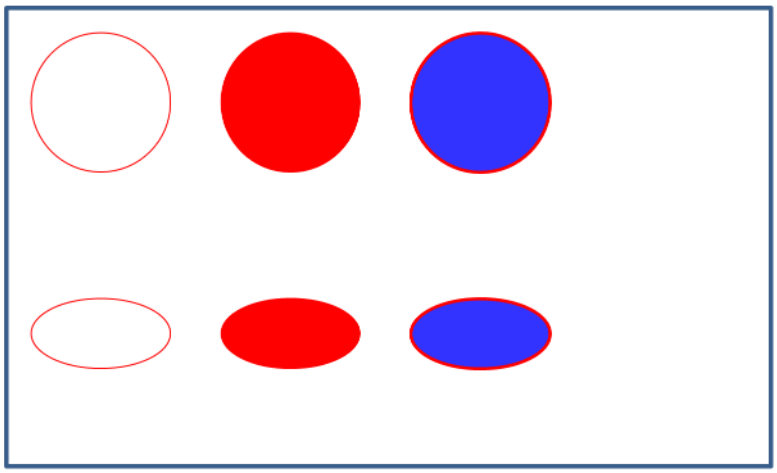
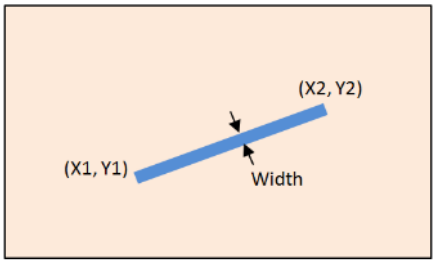


Figure 4-12A: Circle and Ellipse Example

4.2.8 Line Drawing

Table 4-11: Geometric Drawing Command - Line

Command Function	Code	No.	Command Parameter	Command Description
Draw A Line	**E0h**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), Color(3), Width(1)	Draw a line from (X1, Y1) to (X2, Y2), Width: line width, Color: line color 

For example, input below command in "UartTFT.ini":

E0h #00: 40, 40, 160, 200, 0xFF0000, 3 // display a red line with width at 5

After compilation, the host send command E0h, 00 to TFT panel through UART, TFT will display a red line from (40, 40) to (160, 200), with width at 3.

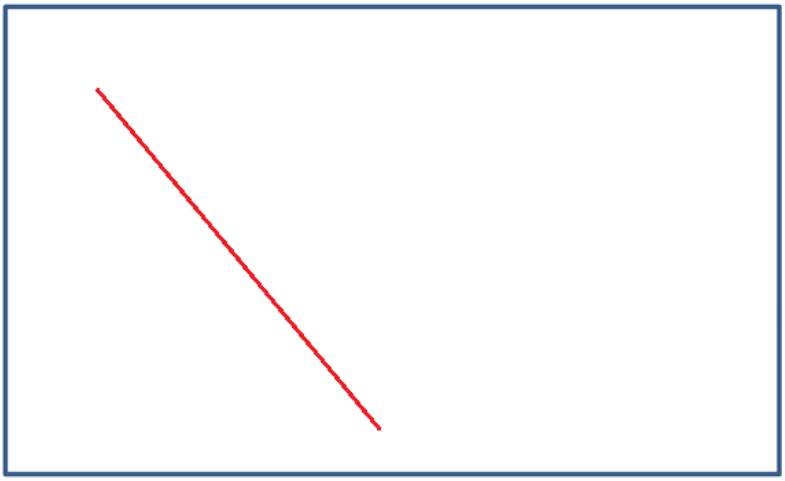


Figure 4-12B: Line Example

4.2.9 Rectangle/Rounded-Rectangle Drawing Command

Table 4-12: Geometric Drawing Command - Rectangle

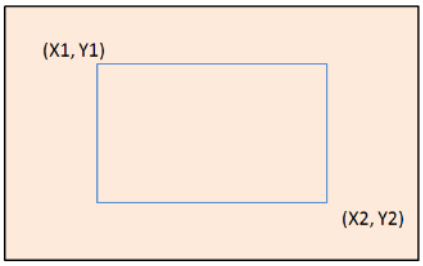
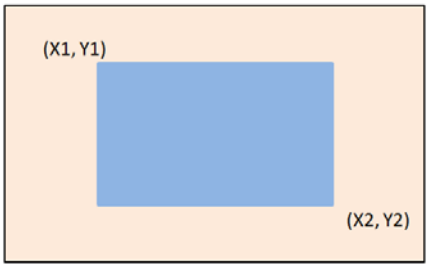
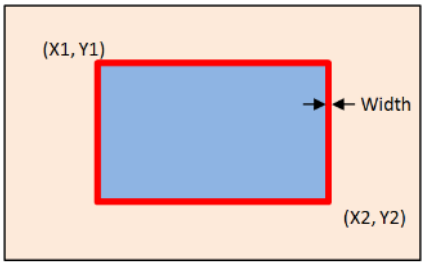
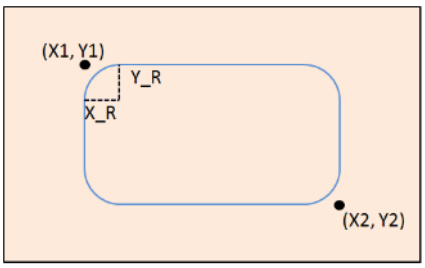
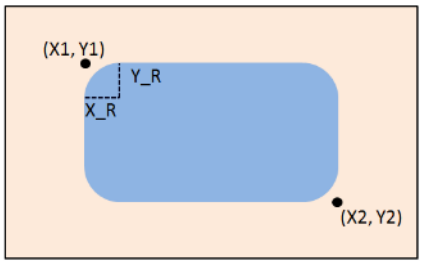
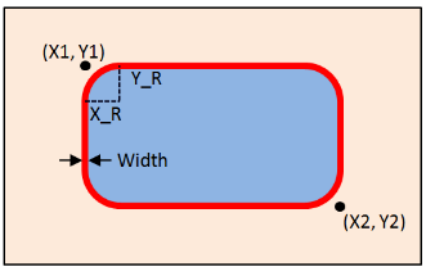
Command Function	Code	No.	Command Parameter	Command Description
Draw Hollow Rectangle	**E7h**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), Color(3)	Use (X1, Y1) (X2, Y2) as diagonal and draw a hollow rectangle, color: rectangle color 
Draw Solid Rectangle	**E8h**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), Color(3)	Use (X1, Y1) (X2, Y2) as diagonal and draw a solid rectangle, color: rectangle color 
Draw Solid Rectangle With Frame	**E9h**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), Color(3), Color-F(2), Width(1)	Use (X1, Y1) (X2, Y2) as diagonal and draw a solid rectangle with frame, color: frame color, Color-F: rectangle color, width: frame width 

Table 4-13: Geometric Drawing Command - Rounded Rectangle

Command Function	Code	No.	Command Parameter	Command Description
Draw Hollow Rounded Rectangle	**EAh**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), X-R(2), Y-R(2), Color(3)	Use (X1, Y1) (X2, Y2) as diagonal and draw a hollow rounded rectangle. X-R: X radius, Y-R: Y radius, Color: rectangle color 
Draw Solid Rounded Rectangle	**EBh**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), X-R(2), Y-R(2), Color(3)	Use (X1, Y1) (X2, Y2) as diagonal and draw a solid rounded rectangle. X-R: X radius, Y-R: Y radius, Color: rectangle color 
Draw Solid Rounded Rectangle With Frame	**ECh**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), X-R(2), Y-R(2), Color(3), Color-F(3), Width(1)	Use (X1, Y1) (X2, Y2) as diagonal and draw a hollow rounded rectangle. X-R: X radius, Y-R: Y radius, Color :frame color, Color-F: rectangle color, Width: frame width 

As above command E7h~ECh mentioned, input below command in "UartTFT.ini":

E7h #00: 42, 25, 80, 105, 0x00F800

E8h #00: 120, 25, 158, 105, 0x00F800
E9h #00: 200, 25, 238, 105, 0x00F800, 0x00001F, 5
EAh #00: 42, 145, 80, 225, 15, 10, 0x00F800
EBh #00: 120, 145, 158, 225, 15, 10, 0x00F800
ECh #00: 200, 145, 238, 225, 15, 10, 0x00F800, 0x00001F, 5

When the UART serial port transmits the display commands E7h 00, E8h 00, E9h 00 to the Serial Uart TFT Panel, the TFT will display respectively a hollow rectangle, a solid rectangle and a solid rectangle with a specified color at the positions of (42, 25) and (80, 105) 2 diagonals, (120, 25) and (158, 105) 2 diagonals, (200, 25) and (238, 105) 2 diagonals. When the UART serial port transmits the display commands EAH 00, EBh 00, ECh 00 to the TFT panel, the TFT will respectively display rounded rectangles/solid rounded rectangles/solid Rounded Rectangle with frame at the position of (42, 145) and (80, 225) 2 diagonals, (120, 145) and (158, 225) 2 diagonals, (200, 145) and (238, 225) 2 diagonals, with specific color, radius at 15, 10. Shown as below:

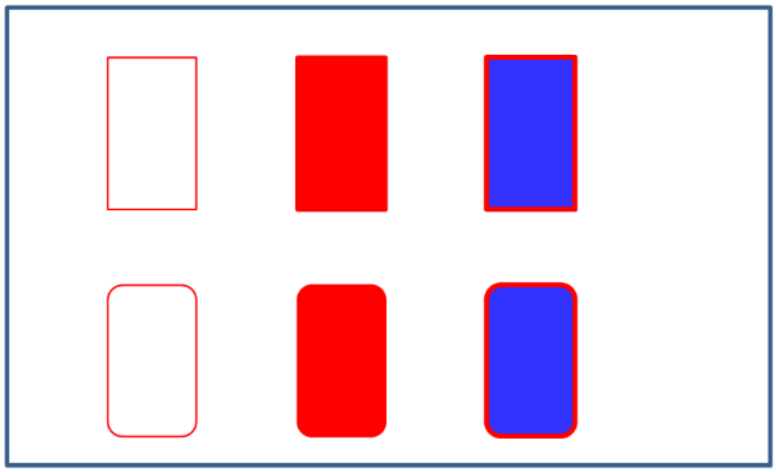
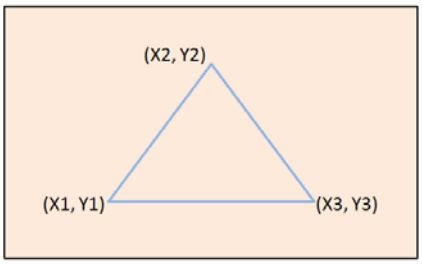
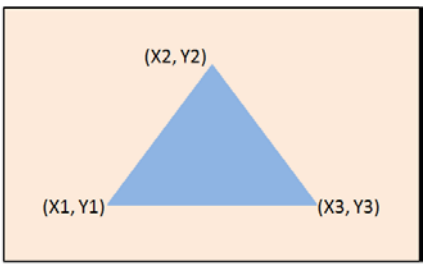
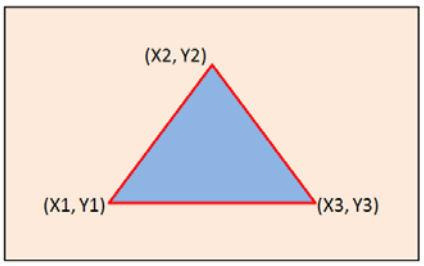


Figure 4-13: Rectangle And Rounded Rectangle Example

4.2.10Triangle Drawing Command

Table 4-14: Geometric Drawing Command - Triangle

Command Function	Code	No.	Command Parameter	Command Description
Draw Hollow Triangle	**EDh**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), X3(2), Y3(2), Color(3)	Draw a hollow triangle with (X1, Y1) (X2, Y2) (X3, Y3) as the diagonal, color: triangle color 
Draw Solid Triangle	**EEh**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), X3(2), Y3(2), Color(3)	Draw a solid triangle with (X1, Y1) (X2, Y2) (X3, Y3) as the diagonal, color: triangle color 
Draw Solid Triangle With Frame	**EFh**	**#nn:**	X1(2), Y1(2), X2(2), Y2(2), X3(2), Y3(2), Color(2), Color-F(3)	Draw a solid triangle with frame use (X1, Y1) (X2, Y2) (X3, Y3) as the diagonal, color: frame color, color F: rectangle color 

As above command EDh~EFh mentioned, input below command in "UartTFT.ini":

EDh #00: 80, 25, 40, 105, 120, 105, 0x00F800
EEh #00: 160, 25, 120, 105, 200, 105, 0x00F800
EFh #00: 240, 25, 200, 105, 280, 105, 0x00F800, 0x00001F

When the host transmits the display commands EDh 00, EEh 00, EFh 00 to TFT panel, the TFT will display the hollow triangle, solid triangle and solid triangle with the set color in the three specified coordinate positions. Shown as below:

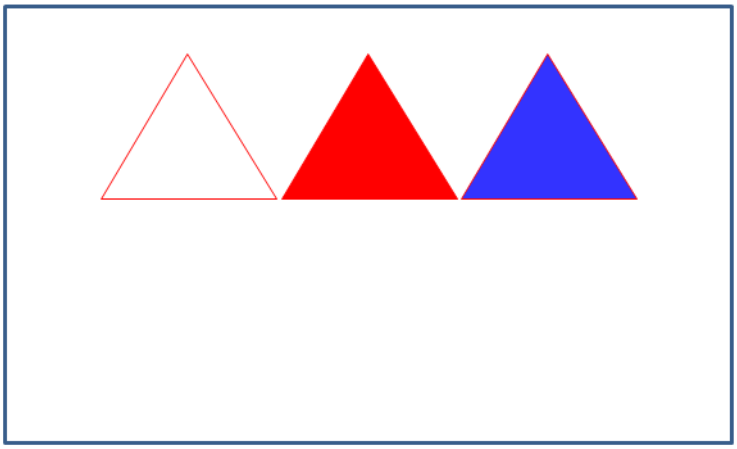
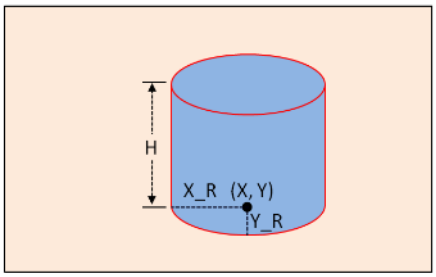
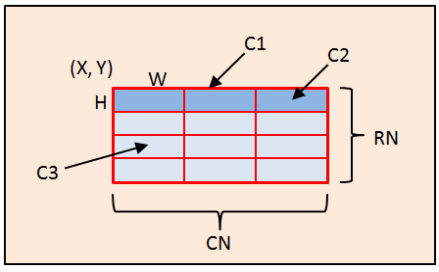
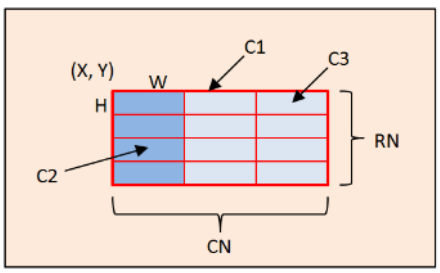


Figure 4-14: Triangle Example

4.2.11Cylinder/Table Drawing Command

Table 4-15: Geometric Drawing Command - Cylinder

Command Function	Code	No.	Command Parameter	Command Description
Draw Cylinder	F4h	#nn:	X(2), Y(2), X-R(2), Y-R(2), Height(2), Color(3), Color-F(3), Width(1)	With (X, Y) as the bottom center, draw a cylinder, X-R: X radius of bottom circle, Y-R,: Y radius of bottom circle, Height: cylinder height, Color: frame color, Color-F: solid color, Width: frame width 
Draw Table Window	F6h	#nn:	X(2), Y(2), Width(2), Height(2), RN(1), CN(1), C1(3), C2(3), C3(3), I-Width(1), O-Width(1), Mode(1)	Start with (X, Y), draw a table window. Width: table width, Height: table height, CN: number of column, RN: number of row,C1: frame color, C2: background color, C3: internal window background color, I-Width: inner frame width (Mode=0) or horizontal (Mode=1), O-Width: outside frame width, Mode=0: vertical, Mode=1: horizontal  

For example, input below command in "UartTFT.ini":

F4h #00: 256, 148, 35, 20, 110, 0x00F800, 0x00001F, 3
F6h #00: 20, 25, 35, 15, 5, 6, 0x00F800, 0x0007E, 0x00001F, 2, 4, 0

When the UART transmits the display command F4h 00 to TFT panel, the TFT will display the table window with the set color start from the coordinate position (20, 25). The following figure shows an example of cylinder, square cylinder and table window, shown as below:

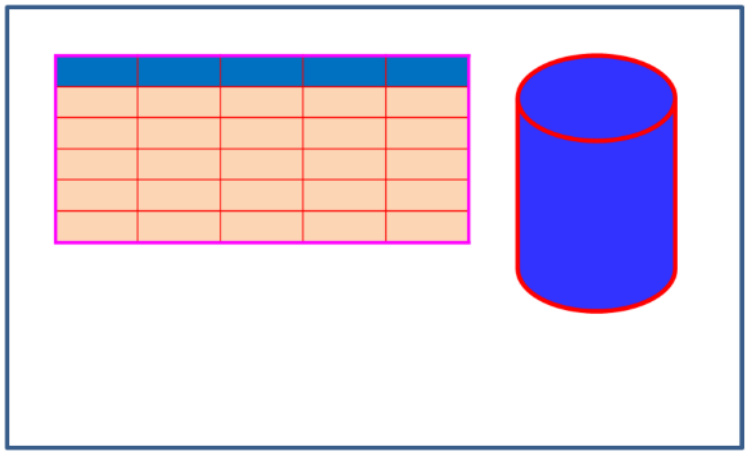


Figure 4-15: Cylinder /Table Window Example

4.2.12Boot Setting Command

The boot setting command is used to set the command automatically executed after the TFT panel is turned on. It does not need to be transmitted to the ER-TFT028A2-4-5465 TFT panel through UART or SPI and will be automatically executed at boot time.

Table 4-16: Boot Command

Command Function	Code	No.	Command Parameter	Command Description
Set Commands To Be Executed After Booting	**9Ah**	**00**	CM1(2), NU1(2), CM2, NU2, CM3, NU3, CM4, NU4, CM5, NU5, CM6, NU6, CM7, NU7, CM8, NU8	Set the command to be executed after booting, the command can be executed upto 8 group

When the 9Ah, #00 commands are set in the command file - "UartTFT.ini", the MCU on the UART TFT panel will automatically execute the commands listed in the 9Ah, #00 commands when booting, for example, the text compiler enters the following setting command:

9Ah #00: 0x80, 0x02, 0x81, 0x01, 0xB8, 0x00

When the TFT panel booted, it is equivalent to the Host executed commands 80h and 02 (display command), 81h and 01(command to display overlap picture in circular), and 0xB8, 0x00 commands (play Wav command) . The purpose of this command is to enable the boot image can be displayed on TFT panel before the Host connect or send information to TFT panel

4.2.13Combination Command

9Ah, #nn command can also be used to execute multiple groups, for example, enter the following set commands:

Table 4-16B: Boot Command

Command Function	Code	No.	Command Parameter	Command Description
Multi-Commands Groupping	**9Ah**	**#nn:**	CM1(2), NU1(2), CM2, NU2, CM3, NU3, CM4, NU4, CM5, NU5, CM6, NU6, CM7, NU7, CM8, NU8	nn ≠00: This instruction is combined as a command, and can execute up to 8 sets of commands at the same time.

9Ah #01: 0x80, 0x03, 0x81, 0x02, 0xB8, 0x01

When the Host transmits 9Ah and 01 through the UART, TFT panel will execute 80h and 02 (display command), 81h and 02(command to display overlap picture in circular), and 0xB8, 0x01 commands (play Wav command) . This instruction is intended for commands that require repeated execution and can simplify the text compiler.

4.2.14Scroll Picture Setting and Display Command

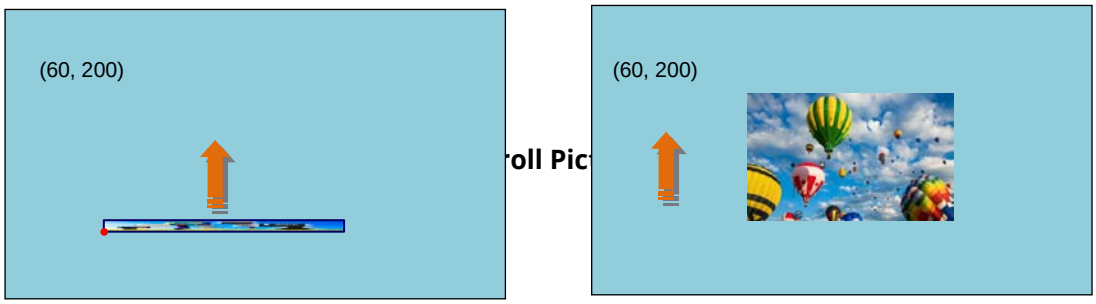
The picture scrolling control command mainly enable the picture to scroll in different directions of up, down, left and right in a certain display area of the TFT panel to achieve a more vivid effect.

Table 4-17: Scroll Picture Command

Command Function	Code	No.	Command Parameter	Command Description
Scroll Picture Setting	**D8h**	**#nn:**	X(2), Y(2), Dir(1), Speed(1), Paa(2)	Scroll a single picture appear at the (X, Y) position; aa: picture ID., Dir: the appear direction 0: up; 1: down; 2: left; 3: right, Speed: speed of appearance (unit: 10ms)
Scroll Multiple Picture In Loop	**D9h**	**#nn:**	X(2), Y(2), Dir(1), Speed(1), Paa(2), Pbb, Pcc	Scroll multiple picture in loop at position (X, Y) ; aa/bb/cc: picture ID., Dir: the scroll direction 0: up; 1: down; 2: left; 3: right, Speed: speed of appearance (unit: 10ms)
Cancel Scroll Multiple Picture In Loop	**DBh**	**nn**		Cancel theD9h command that display Multiple Picture In Loop.

For example: input below command in "UartTFT.ini":
D8h #00: 60, 200, 0, 2, 6 // P6 scroll up and display at position (60, 200) with 20ms speed

After the compilation is completed, the host transmits the command D8h, 00 to TFT panel through the UART serial port, then the TFT will scroll up and display the P6 picture at (60, 200). Note: the picture cannot exceed the TFT display area



For example, input below command in "UartTFT.ini":

D9h #00: 80, 50, 0, 2, 5, 6 // scroll P5, P6 upward in loop at (80, 50) with speed 20ms

D9h #01: 150, 60, 2, 5, 7, 8, 9 // scroll P7, P8, P9 to left in loop at (150, 60) with speed 50ms

After compile finished, the host send command D9h, 00 through UART to TFT panel, TFT panel will scroll P6, P6 upward in loop at (80, 50) . If send command D9h, 01 TFT panel, TFT panel will scroll P7,P8,P9 to left at (150, 60) . Note: that the scrolled picture must be the same

size and cannot exceed the TFT display area.

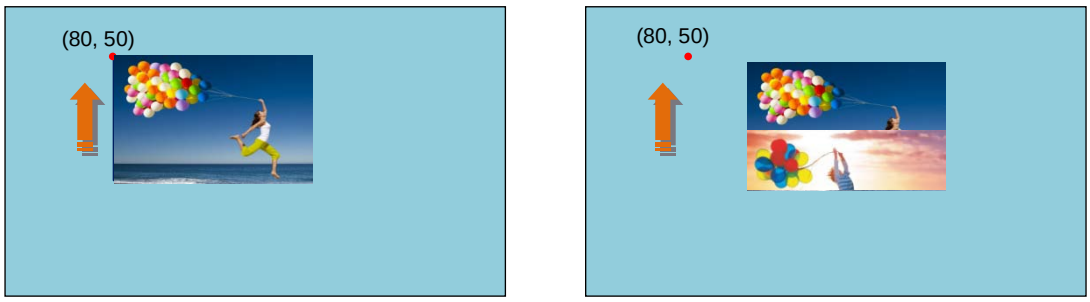


Figure 4-17: Scroll Picture Example

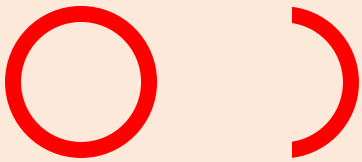
If the main system passes the display command “DBh” and “00h” to the serial TFT panel through the UART serial port, then the original “D9h”, “00h” display of the picture roll will be canceled.

Note: Pop-up pictures (D8h), loop pictures (D9h) and the earlier mentioned pop-up picture loop display (81h), GIF animation (88h) these instructions should be avoid overlap on the display area, so as not to cause interactive display and confusion!

4.2.15Ring Drawing Setting and Display Command

Ring Drawing command is to display a ring indicator in TFT panel

Table 4-18: Ring Indicator Command

Command Function	Code	No.	Command Parameter	Command Description
Ring Indicator Setting	DCh	#nn:	X(2), Y(2), R(2), Width(2), Color(3), Speed(1)	Display a ring indicator around the center point (X, Y) ; R: radius, Width: circular width; Color: circular color, Speed: display speed (unit1ms), Angle: circular angle.
Display the Arc	DCh	nn	S_Angle(2), A_Angle(2)	Display the Arc set above. S_Angle represents the initial angle; A_Angle is the angle of the action, both of which are two Byte hexadecimal units. 

For example, input below command in "UartTFT.ini":

```
DCh #00: 160, 100, 45, 8, 0xFF0000, 5      // display a red ring around (160, 100)
                                           // with radius is 45；width is 8；speed is 5ms
```

After the compilation is completed, the host transmits the commands DCh, 00, 0000, 010E to TFT panel through UART, then the TFT will display a red ring around the center point (160, 100) with a radius of 45, from 0° to 270° in 5ms.

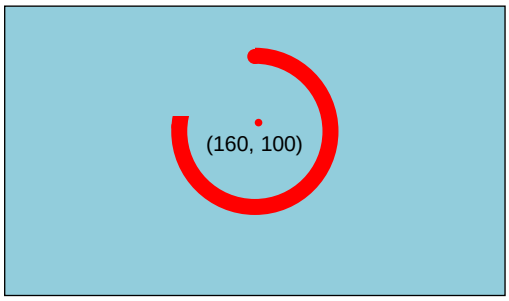
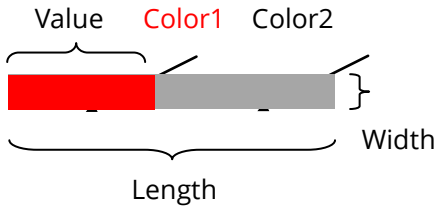


Figure 4-18: Ring Indicator Example

4.2.16Progress Bar Setting and Display Command

This command is used t display a rectangle indicator on TFT panel.

Table 4-19: Progress Bar Setting And Display Command

Command Function	Code	No.	Command Parameter	Command Description
Progress Bar Setting	**B0h**	**#nn:**	X(2), Y(2), Dir(1), Width(1), Color1(3), Mark(1), COM(2), Length(2), Color2(3)	In the (X, Y) position, draw a progress bar, color: color1; Dir: the direction, 0: up; 1: down; 2: to the left; 3: to the right; Width : the progress bar width; Mark=1: send the 80 command to make the background image; Mark=0: make the rectangular progress bar as base map according to Length and Color2, Length : length of the base image; Color2: base image color. 
Display The Progress Bar	**B0h**	**nn**	Value (2 Bytes)	

For examples, input below command in ""UartTFT.ini":

B0h #00: 55, 120, 3, 20, 0xFF0000, 0, 0x80, 0x05, 200, 0x00FF00

// display a progress bar at (55, 120), the width is 20 Pixel, color is red (0xFF0000) ;
// base map is a rectangle, with length is 200, color is green (0x00FF00)
// Mark = 0, so 0x80, 0x05 means the he background picture will be ignored.

After the compilation is completed, the host transmits the commands B0h, 00, 00, 40 to TFT panel through UART, then the TFT will display a red progress bar at position (55, 120) with the display length is 64 Pixels (0040h = 64), and the base image of the progress bar is a green rectangle with a length of 200. When the UART transmits the command B0h, 00, 01, C0 to TFT panel, the progress bar red part becomes longer. It is 192 Pixel (00C0h = 192), shown as below:

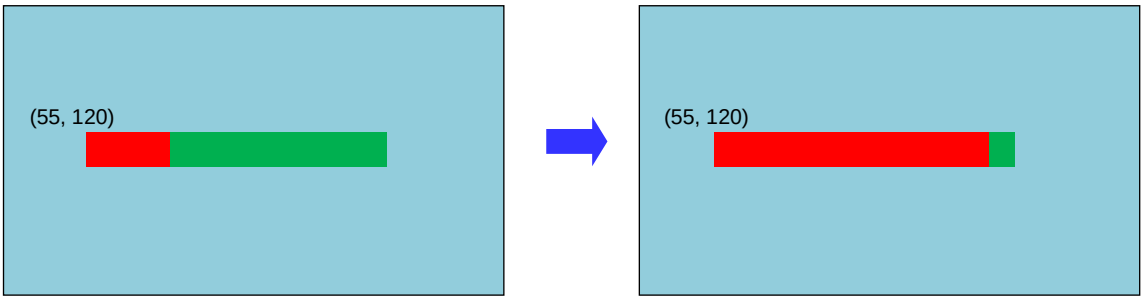


Figure 4-19: Progress Bar Example 1

If set Mark=1, input below command in "UartTFT.ini":

B0h #00: 85, 140, 3, 35, 0xFF0000, 1, 0x80, 0x05, 220, 0x000000
// display a red (0xFF0000) progress bar at (85, 140) from left to right, with width is 35 Pixel;
// length is 220
// Mark = 1, so the progress bar will automatically use the background picture created by
// command 0x80, 0x05
// 0x80, 0x05 is the command to display picture and need to set in command file :

80h #05: 6, 0, 80, 80
// display P6 background picture at (80, 80)

After the compilation is completed, the host transmits the commands B0h, 00, 01, 96 to TFT through UART, then the TFT will display a red progress bar at position (85, 140) with the display length is 150 Pixel (0096h = 150), and the base image of the progress bar is generated by 0x80, 0x05 command; when the UART transmits the command B0h, 00, 00, 3C to TFT, then length of the red progress bar will change to 60 Pixels (003Ch = 60) and the background image does not change, shown as below:

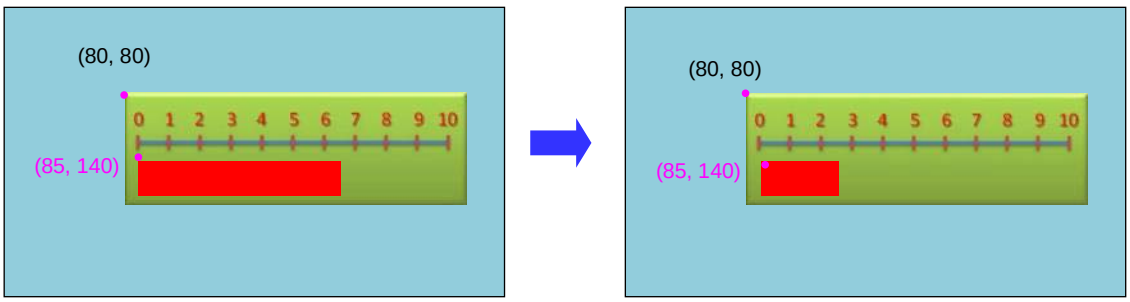


Figure 4-20: Progress Bar Example 2

4.2.17Resistive Panel Control Command

The resistive touch Panel control command only needs to be transmitted to the ER-TFT028A2-4-5465 through UART or SPI, TFT panel will execute itself. It is a fixed command of the host, and no need to set on UartTFT_Tool or program software.

Table 4-20: Resistive Panel Control Command

Command Function	Code	No.	Command Parameter	Command Description
Conduct Verification On Panel	8Bh	--		Conduct verification on four corners of resistant Panel

The touch Panel control command does not need to be written in the "UartTFT.ini". For example, when the UART serial port transmits the l command 8Bh to the TFT serial panel, it will automatically enter the four corner verification program of the resistance Panel. The user must click the four corners in sequence to complete the verification program

Figure 4-21: Verification of RTP on Four Corners

4.2.18Backlight Control Command

Using the PWM export of the ER-TFT028A2-4-5465, can be used to control the brightness of the backlight. The backlight control command only needs to be transmitted to the TFT panel UART or SPI. It is a fixed command of Host, and it is not settled in UartTFT_Tool or "UartTFT.ini".

Table 4-21: Backlight Control Command

Command Function	Code	No.	Command Parameter	Command Description
Adjust Backlight Brightness	**BAh**	**--**	BL	Control the backlight brightness through PWM1. BL represents the brightness (00~1Fh), which is hexadecimal unit of 1 Byte; the larger the value, the brighter the backlight.
Panel Display On/Off	**BCh**	**--**	0/1	0: Display Off; 1: Display On;

The backlight brightness adjustment command does not need to be written in "UartTFT.ini". For example, when the UART transmits commands BAh, 05 to TFT panel, the backlight of the TFT panel becomes dark. When the UART transmits commands BAh, 0E to TFT panel, then the backlight of the TFT panel will be brighter.

When the UART transmits the command BCh, 00 to TFT panel, the display of the TFT panel will be turned off (Display Off); if the command BCh, 01 is sent to the TFT panel, the display of the TFT panel will be turned on (Display On) . Note: After the display is off, the TFT panel will not accept any drawing function instructions until the TFT panel receives the Display On command.

4.2.19TFT Panel Verify Command

The TFT panel verifies command only needs to be transmitted to the ER-TFT028A2-4-5465 TFT panel UART or SPI. It is a fixed command of Host, and it is not settled in UartTFT_Tool or "UartTFT.ini"

Table 4-22: TFT Panel Verify Command

Command Function	Code	No.	Command Parameter	Command Description
Verify TFT Panel	**BEh**	**--**		TFT panel is initialized or in the Ready state: 5Ah → Ready; A5h → Not Ready (Busy state) ;
Verify TTF Panel Version	**BFh**	**--**		Read ER-TFT028A2-4-5465 TFT panel version information: MCU Code version (5Bytes) + TFT module (42Bytes)

When the UART transmits the command BEh to the TFT panel, if the TFT panel is initialized or in Ready state, the TFT panel will respond 5Ah to the host computer. If the TFT panel is in Busy state, the TFT panel will respond A5h to the host computer. If the TFT panel is not connected to the Uart port of the host computer, it will not respond any information.

The serial command BFh is used to read the ER-TFT028A2-4-5465 TFT panel version, including the 5 Byte ER-TFT028A2-4-5465 program code version, and 42 Bytes TFT module information, as shown in Table 4-23. When the UART transmits the command BFh to TFT panel, the TFT panel will sends the information to the host in sequence.

Table 4-23: TFT Panel Version Information

Items	No.	Definition	Description	Example	
MCU Code Version	1	Year		07	07E3=2019
	2			E3	
	3	Month		07	July
	4	Date		05	5th day
	5	Custom number 0～255		CC	
TFT Panel Info	6	Host Version No.	0x10 means V1.0, 0x11 means V1.1, 0x12 means V1.2	10	V1.0
	7	Communication Port	0x00-Uart, 0x01-SPI, 0x02-IIC	00	Uart
	8	Baud Rate	High in the front and low in the back	01	01C200=115200
	9			C2	
	10			00	
	11	PCB Version	0x10 means V1.0, 0x11 means V1.1, 0x12 means V1.2	10	V1.0
	12	MCU	0x00 means 8bit MCU, 0x01 means 16 bit, 0x02 means 32bit	02	32bit
	13	MCU Manufacturer	0x00: EastRising, 0x01: ST, 0x02 = STC	01	EastRising
	14	Part Number	0x00: 7680A, 0x01: 7680B, 0x02: 7681, 0x03: 7683, 0x04: 7686, 0x05: 7688, 0x06: 268A, 0x07: 268B,	06	ER-TFT028A2-4-5465
	15	Communication Port	MCU to LTx68 I/F: 0x00 = 8080-8, 0x01 = 8080-16, 0x02 = SPI, 0x03 = I2C	02	SPI
	16	Horizontal Resolution		01	01E0=480
	17			E0	
	18	Vertical Resolution		01	0110=272
	19			10	
	20	VBPD		00	0014=20
	21			14	
	22	VFPD		00	000C=12
	23			0C	
	24	VSPW		00	0003=3
	25			03	
	26	HBPD		00	008C=140
	27			8C	
	28	HFPD		00	00A0=160
	29			A0	
	30	HFPW		00	0014=20
	31			14	
	32	PCLKRISING		01	1
	33	HSYNCPolarity		00	0
	34	VSYNCPolarity		00	0
	35	DEPolarity		01	1
	36	RGBSequence	000b : RGB,001b : RBG,010b : GRB,011b : GBR,100b : BRG,101b : BGR	00	RGB
	37	ColorDepth	0x00: 8bits, 0x01: 16bits, 0x02: 24bits	01	16Bits
	38	FlashType	0x00: Nor Flash, 0x01: Nand Flash	00	NOR Flash
	39	FlashSize	单位: 1MBytes	00	0080=128Mbyte
	40			80	
	41	UI_Editor/UartTFT_Tool version	0x06: 06 (ex: 06_04_2019-09_24_53)	07	7 月
	42		0x04: 04	05	5 日
	43		0x14: 20	14	2019
	44		0x13: 19	13	
	45		0x09: 09	0A	时
	46		0x18: 24	11	分

	47		0x35: 53	25	秒

4.2.20QR-Code Setting and Display Command

ER-TFT028A2-4-5465 supports QR code function. It can generate the QR code from the character string produced by MCU, and display the QR code image.

Table 4-24: QR Code Command

Command Function	Code	No.	Command Parameter	Command Description
Display QR Code	**98h**	**#nn:**	X(2), Y(2), Size(1)	The text transmitted from Host is displayed as a QR code at the (X, Y) position, Size: vertical /horizontal magnification (1~32).
Send QR Code Data	**98h**	**nn**	String	According to the magnification set by Code 98h, the character string is converted into a two-dimensional code image and displayed at the (X, Y) position

For example, input below command:

98h #00: 100, 200, 4
98h #01: 400, 50, 8

When the UART serial port transmits the command 98h, 0, "www.buydisplay.com" to the TFT serial panel, the TFT panel will display a QR code image link to "www.buydisplay.com" at position (100, 200), using the mobile phone QR code scanning function will link to www.buydisplay.com. When the UART serial port transmits the command 98h, 01, "www.buydisplay.com" to the TFT panel, the TFT panel will display a QR code image link to "www.buydisplay.com" at position (400, 50).

Figure 4-22: QR Code Example

4.2.21Audio Control Command

Using the MCU's PWM export, or the ER-TFT028A2-4-5465's PWM export, to push the buzzer or add a power amplifier or triode to push the horn to play simple music. The audio control commands only need to transmit via the UART or SPI to the TFT panel, then it will be executed. It is a fixed command of the host. And these fixed commands are independent of the host software or programming software.

Table 4-25: Play Audio Control Command

Command Function	Code	No.	Command Parameter	Command Description
Play Wav	B8h	--	REP(Bit7) + WAV	Play Wav music files via PWM2. WAV : the number of the Wav file (0x00~0x7F). Bit7 is used to control whether to play in loop. Bit7=0: play once, Bit7 = 1: loop play
Stop Playing Wav	B9h	--		Stop playing Wav music file

The audio command does not need to be written in the command file. For example, when the UART transmits the command B8h, 00 to the TFT panel,, the speaker or buzzer in the TFT panel will play the music of the first wav file. When the UART transmits commands B8h, 81 to the TFT panel, the TFT panel will play the music of the second wav file in loop. When the UART transmits the command B9h to the TFT panel, the TFT panel will stop playing the music

If you want to use other music formats such as MP3, Midi, etc., you can use the music conversion software to convert on the computer. User can use the graphic compiler (UartTFT_Tool.exe) to generate Bin files in Wav file, please refer to Section 4.4.5 for details.

4.2.22RTC Command

ER-TFT028A2-4-5465 embedded a RTC(Real-Time-Clock) hardware. So ER-TFT028A2-4-5465's TFT panel support RTC command.

Table 4-26: RTC Command

Command Function	Code	No.	Command Parameter	Command Description
Setup RTC Information	8Ch	--	Y(1), M(1), D(1), H(1), M(1), S(1), W(1)	Host setup the RTC information: year/month/day/hour/time/minute/minute/week, and totally 7 Bytes.
Read RTC Information	8Dh	--		Read the RTC information of TFT panel.

RTC command do not need to be written in the instruction file. For example, when the host pass command 8Dh to ER-TFT028A2-4-5465, then ER-TFT028A2-4-5465 will feedback clock data: year/month/day/hour/time/minute/minute/week to the host.

4.2.23Digital Clock Display Command

Displaying the digital clock allows users to create their own numbers in the form of pictures, and then display the time or date on the designated TFT screen. The user first creates a set of 0-9 digital pictures, or uses the same digital picture with the 91h command group.

Table 4-27：Digital Clock Setting Command

Instruction Function	Code	No.	Instruciton Parameter	Instruction Desciption
Set Display Digital Clock	**92h**	**#nn:**	CPT(4), X-T(2), Y-T(2), Flag-T(1), X-D(2), Y-D(2), Flag-D(1), PNG(1)	The time numbers are displayed in the position (X-T, Y-T), the clock date is displayed in the position (X-D, Y-D), when F-T=1, the hours, minutes and seconds are displayed; when F-T=0, the hours, minutes and seconds are not displayed. When Flag-D=1, the date is displayed; when Flag-D=0, the date is not displayed. PNG=2 means that the background is transparent (hardware Png image file), PNG=1 means that the background is transparent (software Png image file), and PNG=0 means that the background is opaque.
Dispaly Digital Clock	**92h**	**#nn:**		Display the digital time and date on the designated TFT screen.

When using the digital clock display, the size displayed on the TFT screen depends on the user's resolution when designing the picture. After the user has designed these picture files, they can use the host computer software or the graphic integration software to import and generate the Bin file. Then burn it into SPI Flash. When using these instructions, you can allow the user to create a picture-like figure with different colors to display the foreground, background, or transparent background. The following is an example of a digital picture group, each word represents a picture file:

Figure 4-23A：92h Command Customized Picture Number

For example, in the text compiler UartTFT.ini, enter the following command to display pictures in text:

92h #00: CPT0, 350, 60, 1, 100, 60, 1, 2

After compiling the setting command, the host system or main board transmits the display command 92h, 00 to the TFT serial screen through the UART serial port, then the position on the TFT will start from (100, 60) according to the first picture format The number group (CPT0) to display the date. And the time is displayed in the position starting from (350, 60).

Figure 4-23B: 92h Command Display Digital Clock Example

4.2.24Register Setting Instructions

The register setting instructions are used to save data. A total of 256 registers can be set. At the same time, it can be used with 9A instructions, allowing the serial screen to execute other instructions set in 9A instructions according to the contents of the registers. These instructions only need to be passed through UART or SPI will be passed to the TFT serial screen of ER-TFT028A2-4-5465 and will be executed. It is a fixed command of the host system or motherboard. This command does not need to be set in the UartTFT_Tool host computer software or UartTFT.ini.

表 4-28：Register Control Instructions

Instruction Function	Instruction Code	No.	Instruction Parameter	Instruction Description
Execute 9A Instruction	CAh	Reg		Execute 9A [Reg] command, this command allows the TFT serial screen to execute other commands according to the contents of the register
Setting Register	CBh	Reg		Set the pointed register, Reg = 00 ~ FF
Data Input	CCh	Data		Write the data Data into the current register. Before executing, use the CB command to select the register.
Read Data	CDh	00		Read the content value of the current register, you need to use the CB command to select the register before execution.
Register Data Plus 1	CEh	Reg		Reg represents which register, add 1 to the data in the register.
Register Data Minus 1	CFh	Reg		Reg represents which register, subtract 1 from the data in the register.

For example, set the following 9A command, 80 display picture command and 88 display GIF0 animation command in the text compiler UartTFT.ini:

9Ah #00: 0x80, 0x00, 0x80, 0x01
9Ah #01: 0x80, 0x02, 0x80, 0x01
9Ah #02: 0x80, 0x03
9Ah #03: 0x80, 0x04, 0x88, 0x00
9Ah #04: 0x80, 0x05, 0xB8, 0x00
80h #03: 10, 0, 100, 100 // The 10th picture with the number displayed in the coordinates.
80h #04: 12, 0, 200, 100 // The 12th picture with the number displayed in the coordinates.
80h #05: 20, 0, 300, 100 // The 20th picture with the number displayed in the coordinates.
88h #00: 1, 3, 400, 150, GIF0, 0 // Display GIF0 animation at (400,150) coordinates

If the host system or the motherboard transmits the following commands in sequence through the UART serial port, the resulting actions are as follows:

CBh、00 → Setting refers to "00" register

CCh、02 → Write data 02 to the "00" register

CAh、00 → Execute 9A [02], because the "00" register data is 02, so the 9Ah #02 instruction will be executed, and this means that the instruction is to execute the action of 0x80 0x03, that is, the number 10 is displayed in the (100,100) coordinate image.

CEh、00 → Add one to the data in the "00" register, so the data in the "00" register becomes 03.

CAh、00 → Execute 9A [03], because the "00" register data has become 03, so the 9Ah #03 instruction will be executed, and this means that the instruction is to execute the action of 0x80 0x04, 0x88 0x00, that is, at (200,100) coordinates Display the picture number 12 and display GIF0 animation at (400,150) coordinates.

CEh、00 → Add one to the data in the "00" register, so the data in the "00" register becomes 04

CAh、00 → Execute 9A [04], because the "00" register data has changed to 04, so the 9Ah #04 instruction will be executed, and this means that the instruction is to execute the action of 0x80 0x05, 0xB8 0x00, which is at (300,100) coordinates Display picture number 20 and play Wav-1 sound.

4.2.25Command Table

☐ Setting command : the command setting format described in the "UartTFT.ini" file when UartTFT_Tool is used;

☐ Display/control command: the command setting format sent by Host to TFT panel

Table 4-27: Command Table

☐ : Setting command ☐ : Display/Control Command

Code	No.	Command Parameter	Feedback Parameter	Command Function
80h	#nn:	Paa, PNGaa, Xaa, Yaa, Pbb, PNGbb, Xbb, Ybb, Pcc, PNGcc, Xcc, Ycc		Display Single Picture Or Multi-Pictures Setting
80h	nn			Display Pictures
81h	#nn:	Delay, X, Y, PNG, Paa, Pbb, Pcc		Display Over-Lap Picture In Loop Setting
81h	nn			Display Over-Lap Picture In Loop
84h	nn			Cancel command 81h
88h	#nn:	Delay, X, Y, GIF		Display GIF Picture Setting
88h	nn			Display GIF Picture
89h	nn			Cancel command 88h
8Ah	#nn:	Paa, PNGaa, Xaa, Yaa, Pbb, PNGbb, Xbb, Ybb, Pcc, PNGcc, Xcc, Ycc		Display Single Picture Or Multi-Pictures Setting
8Ah	nn			Display Pictures
8Bh				Perform Resistive Panel Verification
8Ch		Y, M, D, H, M, S, W		setup RTC : year/month/day/hour/time/minute/minute/week
8Dh			Y, M, D, H, M, S, W	Read the RTC information
8Fh	nn	X, Y, PNG, Pnn		Display a picture directly
90h	#nn:	PT, X, Y, Dir, Color-F, Color-B, EN-B		Display Picture-Number (Customize-1) Setting
90h	nn	ddd.d		Display Picture-Number
91h	#nn:	CPT, X, Y, Dir, EN-B		Display Picture-Number (Customize-2) Setting
91h	nn	ddd.d		Display Picture-Number
98h	#nn:	X, Y, Size		Setup QC-code
98h	nn	String		Display QR-Code

Table 4-27: Command Table (continue)

Code	No.	Command Parameter	Feedback Parameter	Command Function
9Ah	#nn:	CM1, NU1, CM2, NU2, CM3, NU3, CM4, NU4, CM5, NU5, CM6, NU6, CM7, NU7, CM8, NU8		Set To Execute Multiple Groups Commands (8 Groups), When Nn = 00 : The Command Executed After Power On
9Ah	nn			Execute Multiple Groups Commands, When Nn = 00 :Execute The Power-On Command
A0h	#nn:	P, PNG, X, Y, CM1, NU1, CM2, NU2, CM3, NU3, CM4, NU4, CM5, NU5, CM6, NU6, CM7, NU7, CM8, NU8	ID, Status	Set Button Picture And Command To Be Executed After Press The Touch (8 Groups)
A0h	nn			Display Button Picture
A1h	nn			Cancel Display Button Picture And Relate Function
A2h	#nn:	X, Y, Width, Height, CM1, NU1, CM2, NU2, CM3, NU3, CM4, NU4, CM5, NU5, CM6, NU6, CM7, NU7, CM8, NU8	ID, Status	Setup Virtual touch area
A2h	nn			Show Virtual touch area
A3h	nn			Cancel Virtual Touch Area
B0h	#nn:	X, Y, Dir, Width, Color1, Mark, 80h Command, Length, Color2		Set Progress Bar Picture
B0h	nn	Vaule (2 Bytes)		Display Progress Bar Picture
B8h		REP(Bit7) + WAV		Play Wav Music
B9h				Stop Play Wav Music
BAh		BL (00~1Fh)		Adjust Backlight Brightness
BCh		0/1		Display On/Off
BEh			5Ah / A5h	Online Verify TFT Panel
BFh			Version : (47 Bytes)	Version Verify
C0h	#nn:	F01, X, Y, W, Color-F, Color-B, Size-H, Size-V, Transparency, Alignment		Display Font-1 Text Setting
C0h	nn	String		Display Font-1 Text
C1h	#nn:	F02, X, Y, W, Color-F, Color-B, Size-H, Size-V, Transparency, Alignment		Display Font-2 Text Setting
C1h	nn	String		Display Font-2 Text
C2h	#nn:	F03, X, Y, W, Color-F, Color-B, Size-H, Size-V, Transparency, Alignment		Display Font-3 Text Setting
C2h	nn	String		Display Font-3 Text

Table 4-27: Command Table (continue)

Code	No.	Command Parameter	Feedback Parameter	Command Function
C3h	#nn:	F04, X, Y, W, Color-F, Color-B, Size-H, Size-V, Transparency, Alignment		Display Font-4 Text Setting
C3h	nn	String		Display Font-4 Text
D8h	#nn	X, Y, DIR, Speed, Paa		Set Scroll Picture
D8h	nn			Display Scroll Picture
D9h	#nn	X, Y, DIR, Speed, Paa, Pbb, Pcc		Set Scroll Picture In Loop
D9h	nn			Display Scroll Picture In Loop
DBh	nn			Cancel the Scroll Picture
DCh	#nn	X, Y, R, Width, Color, Speed		Set Ring Indicator
DCh	nn	S_Angle, A_Angle		Display Ring Indicator
DFh	#nn	Type, R, Color		Set To Draw A Point
DFh	nn	X, Y		Display A Point
E0h	#nn:	X1, Y1, X2, Y2, Color, Width		Set To Draw A Line
E0h	nn			Display A Line
E1h	#nn:	X, Y, R, Color		Set To Draw Hollow Circle
E1h	nn			Display Hollow Circle
E2h	#nn:	X, Y, R, Color		Set To Draw Solid Circle
E2h	nn			Display Solid Circle
E3h	#nn:	X, Y, R, Color, Color-F, Width		Set To Draw Solid Circle With Frame
E3h	nn			Display Solid Circle With Frame
E4h	#nn:	X, Y, X-R, Y-R, Color		Set To Draw Hollow Ellipse
E4h	nn			Display Hollow Ellipse
E5h	#nn:	X, Y, X-R, Y-R, Color		Set To Draw Solid Ellipse
E5h	nn			Display Solid Ellipse
E6h	#nn:	X, Y, X-R, Y-R, Color, Color-F, Width		Set To Draw Solid Ellipse With Frame
E6h	nn			Display Solid Ellipse With Frame

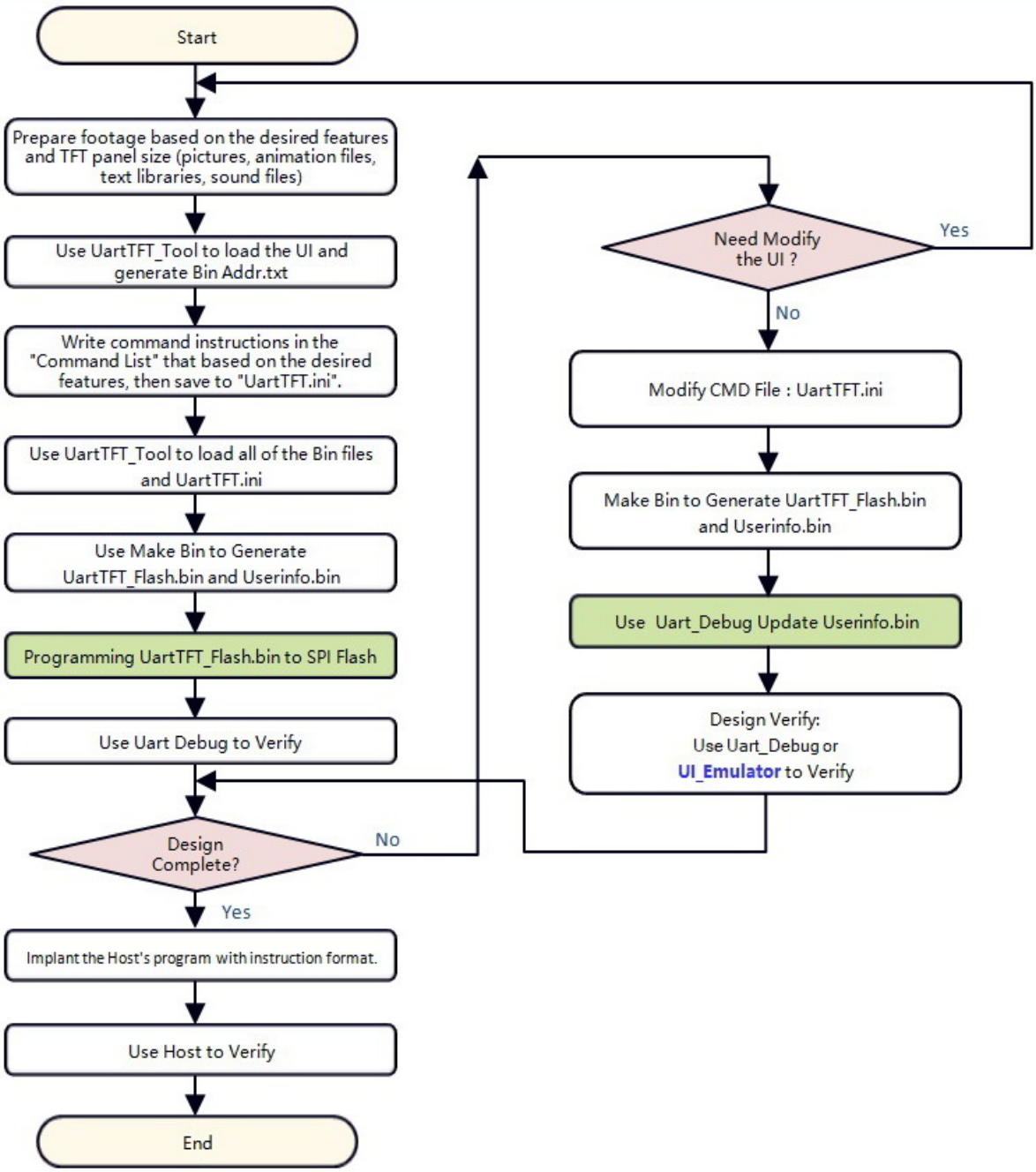
Table 4-27: Command Table (continue)

Code	No.	Command Parameter	Feedback Parameter	Command Function
E7h	#nn:	X1, Y1, X2, Y2, Color		Set To Draw Hollow Rectangle
E7h	nn			Display Hollow Rectangle
E8h	#nn:	X1, Y1, X2, Y2, Color		Set To Draw Solid Rectangle
E8h	nn			Display Solid Rectangle
E9h	#nn:	X1, Y1, X2, Y2, Color Color-F, Width		Set To Draw Solid Rectangle With Frame
E9h	nn			Display Solid Rectangle With Frame
EAh	#nn:	X1, Y1, X2, Y2, X-R, Y-R, Color		Set To Draw Hollow Rounded-Rectangle
EAh	nn			Display Hollow Rounded-Rectangle
EBh	#nn:	X1, Y1, X2, Y2, X-R, Y-R, Color		Set To Draw Solid Rounded-Rectangle
EBh	nn			Display Solid Rounded-Rectangle
ECh	#nn:	X1, Y1, X2, Y2, X-R, Y-R, Color, Color-F, Width		Set To Draw Solid Rounded-Rectangle With Frame
ECh	nn			Display Solid Rounded-Rectangle With Frame
EDh	#nn:	X1, Y1, X2, Y2, X3, Y3, Color		Set To Draw Hollow Triangle
EDh	nn			Display Hollow Triangle
EEh	#nn:	X1, Y1, X2, Y2, X3, Y3, Color		Set To Draw Solid Triangle
EEh	nn			Display Solid Triangle
EFh	#nn:	X1, Y1, X2, Y2, X3, Y3, Color, Color-F		Set To Draw Solid Triangle With Frame
EFh	nn			Display Solid Triangle With Frame
F4h	#nn:	X, Y, X-R, Y-R, Height, Color, Color-F, Width		Set To Draw Cylinder
F4h	nn			Display Cylinder
F6h	#nn:	X, Y, Width, Height, CN, RN, C1, C2, C3, I-Width, O-Width, Mode		Set To Draw Table Window
F6h	nn			Display Table Window

4.3 UartTFT_Tool Design Flow

The following figure shows a detailed flowchart developed by the graphic integration Compiler – "UartTFT_Tool.exe". Users can download the UartTFT_Tool example from our website to learn more about the development mode. At the same time, users are advised to prepare the materials according to the required functions and TFT panel size, because these pictures, animation files, text files, sound files, etc. are stored in SPI Flash, the amount of data is big, and it takes a long time to Program the SPI Flash, Prepare in advance can avoid the "UartTFT_Flash.bin" file Programming repeatedly in SPI Flash during development. It is recommended to use the "UI_Emulator" emulator for pre-validation. The "UI_Emulator" software can be downloaded from the website of EastRising SemButtonductor.

Figure 4-23 UartTFT_Tool Design Flow



The following figure shows the structure of SPI Flash. The “UartTFT_Flash.bin” file actually includes the contents of the “UserInfo.bin” file, while the “UserInfo.bin” file stores the Command parameters, other areas are data such as pictures, animation files, text files, and sound files. If you just modify the Command parameter, when “Make Bin”, the “UartTFT_Flash.bin” file and the “UserInfo.bin” file will be generated, but you only need to update the “UserInfo.bin” file. The size of the “UserInfo.bin” file is fixed at 128KBytes, so use Uart_Debug can quickly update the “UserInfo.bin” with USB to RS232 cable. Please refer to the instructions in Chapter 5 for the usage of “UartDebug.exe”.

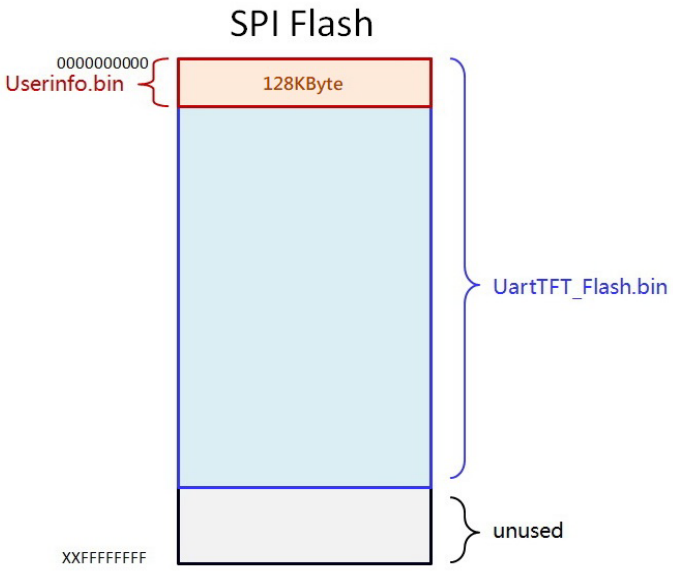


Figure 4-24A: SPI Flash Structure

Figure 4-24B: SPI Flash Programmer

4.4 Graphic Integration Compiler User Manual

This chapter will introduce how to use the "UartTFT_Tool.exe" to develop the display function of the TFT panel. The "UartTFT_Tool.exe" is based on the Bin file integration software – "LT_Image_Tool.exe)" developed by EastRising plus a special TFT panel command compiler. User can create picture Bin files, font Bin files, Bin files for GIF files, Bin files for Wav files, ER-TFT028A2-4-5465 boot programs, graphic cursor by this tool, then integrate these Bin files to generate one Bin file that can be Programmed to external SPI Flash. At the same time, the tool can compile the user's serial command to generate the command Bin file. When the host transmits Code and action No. to TFT panel, the ER-TFT028A2-4-5465 on TFT panel will parse the Code, and then read the command action in the SPI Flash to display the picture or text.

The tool has total 6 functions:

A. TFT Serial Command Compile - UartTFT

B. Communication Software - UartDebug.exe

C. Make「Picture Bin File」- InputPicture

D. Make「GIF Bin File」- GIFTool

E. Make「Font Bin File」- Font

F. Bin File Combination - BinFile

Figure 4-25: UartTFT_Tool Main Page

4.4.1 TFT Serial Command Compile

When the command file ("UartTFT.ini") is completed with the text editing software, the command compiler program in UartTools can be executed. First, insert EastRising special USB encrypt, execute "UartTFT_Tool.exe", and then click "UartTFT" to enter the TFT serial command compiler. The user can refer to the following instructions. :

1. Click【UartTools menu >UartTFT】 to open tool:

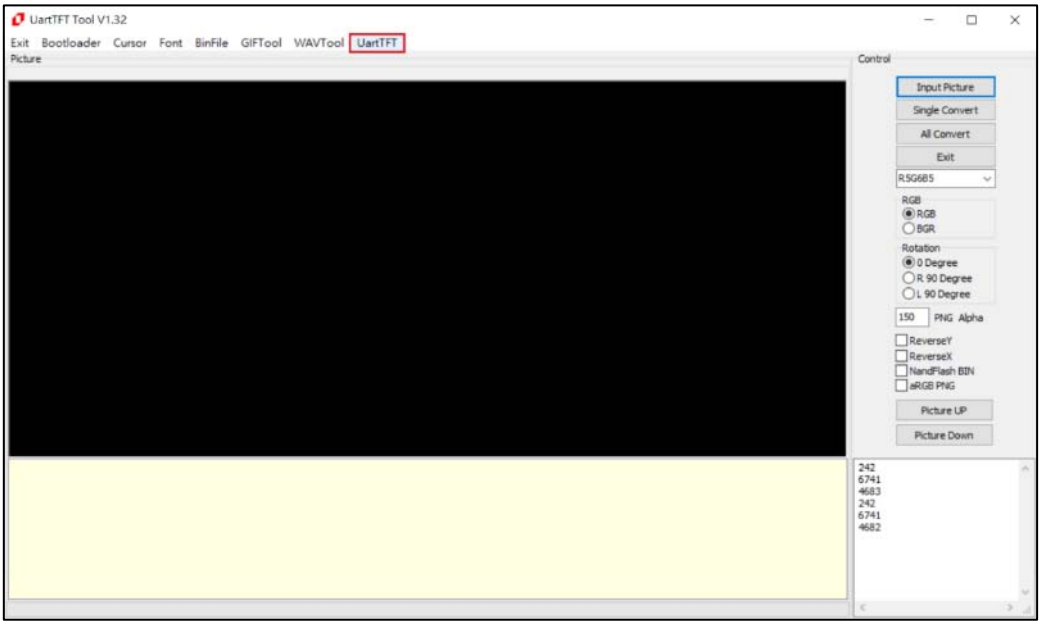


Figure 4-26: Open Tool

2、Click【Input Bin Files】to capture Bin file:

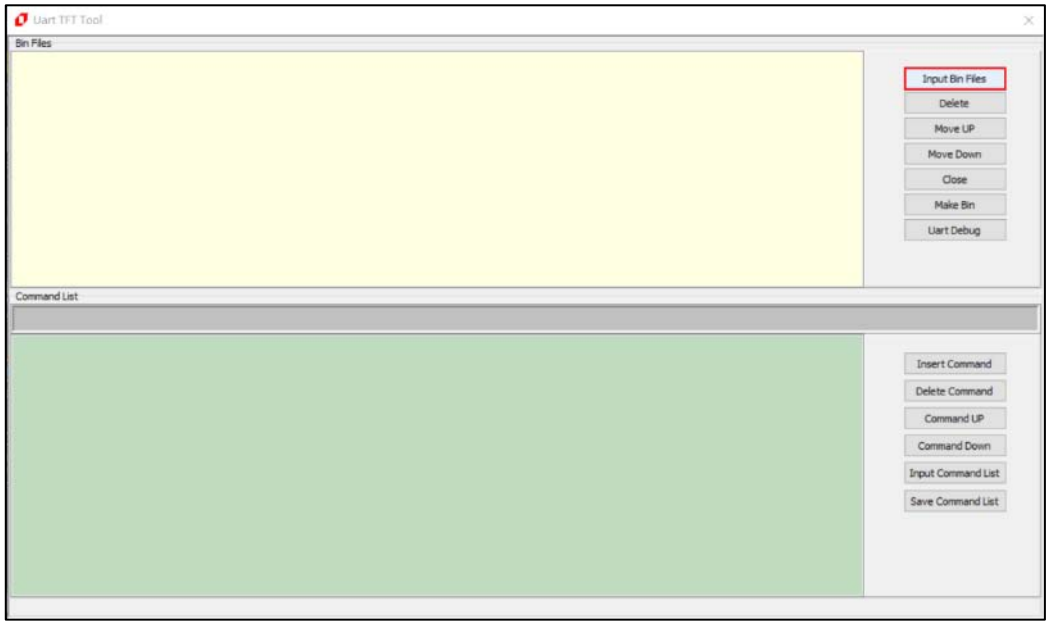


Figure 4-27: Read Bin File

3、 Select the graphic Bin, fonts bin file, etc. Users can place Bin files under the same folder, select any bin file, UartTools will automatically capture all Bin files.

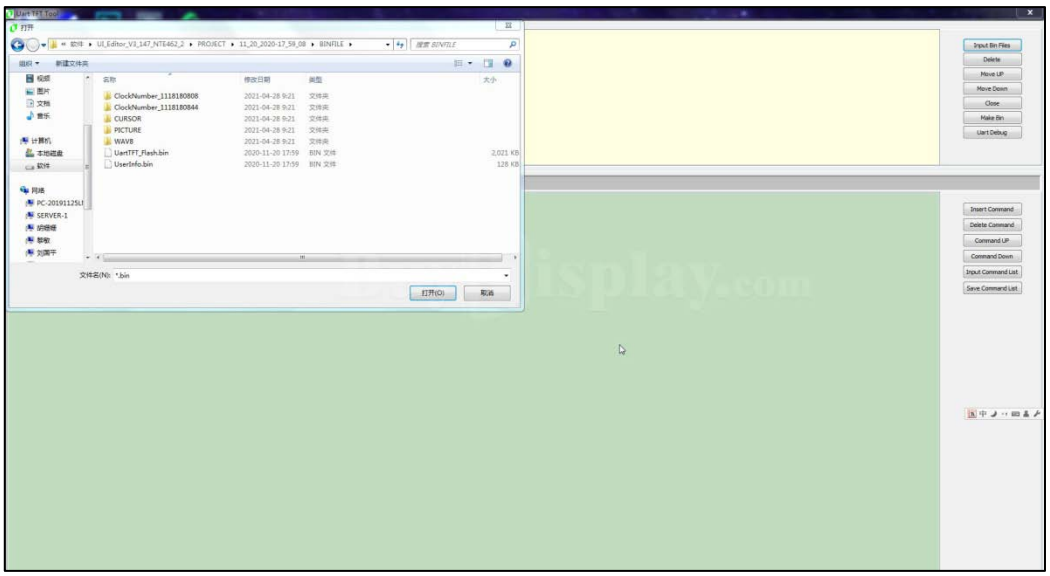


Figure 4-28: Capture All Bin File

4、UartTools will automatically ask for the input of ".ini" command setting file. There are "UartTFT.ini" examples in demo file, user may refer to the examples.

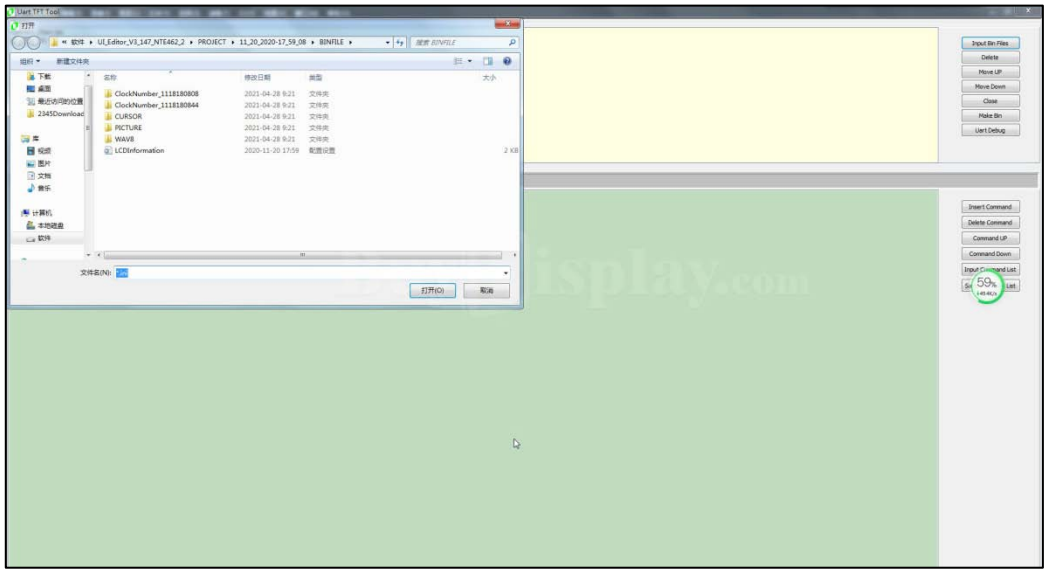


Figure 4-29: Input Command Setting File In UartTFT.Ini

ER-TFT028A2-4-5465 “UartTFT.ini” example as follow:

[INFO]

```
PCVersion: V10              // SW Version : 0x10=V1.0, 0x11=V1.1, 0x12=V1.2 .....
COMPort: UART             // COM Port: 0x00=UART, 0x01=SPI, 0x02=I2C
Baudrate: 115200          // UART Baudrate
PCBVersion: V10           // PCB Version : 0x10=V1.0, 0x11=V1.1, 0x12=V1.2 .....
MCUBit: 32                // MCU Data Bus: 0x00 = 8bit, 0x01 = 16bit, 0x02 = 32bit
MCUType: EastRising       // MCU Maker: 0x00 = EastRising, 0x01 = STM, 0x02 = STC
MCUIF: SPI                // MCU to ER-TFT028A2-4-5465 I/F: 0x00 = 8080, 0x01 = SPI, 0x02 = I2C
768Type: 268B             // 0x00: 7680A, 0x01: 7680B, 0x02: 7681, 0x03: 7683,
                          // 0x04: 7686, 0x05: 7688, 0x06: 268A, 0x07: 268B
768IF: SPI                // MCU to LT768 I/F: 0x00 = 8080-8,0x01 = 8080-16,
                          // 0x02 = SPI, 0x03 = I2C
XSIZE: 240          // TFT Panel X-Size
YSIZE: 320          // TFT Panel Y-Size
VBPD: 23            // Vsync Back-Porch
VFPD: 22            // Vsync Front-Porch
VSPW: 3             // Vsync Pulse Width
HBPD: 46            // Hsync Back-Porch
HFPD: 210           // Hsync Front-Porch
HSPW: 20            // Hsync Pulse Width
PCLKRISING: 1       // 0: Panel fetches XPDAT at XPCLK rising edge,1:falling edge
HSYNCPolarity: 0    // 0 : Low active, 1 : High active.
VSYNCPolarity: 0    // 0 : Low active, 1 : High active.
DEPolarity: 1       // 0 : Low active, 1 : High active.
RGBSequence: RGB    // 000b : RGB,001b : RBG,010b : GRB,011b : GBR,100b : BRG,101b : BGR
ColorDepth: 16      // Color Depth: 0x00 = 8bit, 0x01 = 16bit, 0x02 = 24bit
FlashType: NOR      // FlashType: 0x00 = NOR Flash, 0x01 = NAND Flash
FlashSize: 128      // Flash Size, Unit: 1MByt
```

[USERCMD]

```
9Ah #00: 0x80, 0x00, 0xD9, 0x00, 0xA0, 0x00       //Boot

A0h #00: 6, 0, 79, 150, 0x80, 0x01, 0xA0, 0x01
A0h #01: 7, 1, 82, 270, 0x80, 0x02, 0x80, 0x04, 0x80, 0x08, 0xA0, 0x02      //Home
A0h #02: 7, 1, 82, 270, 0x80, 0x02, 0x88, 0x00, 0xA0, 0x03
A0h #03: 7, 1, 82, 270, 0x80, 0x02, 0xD9, 0x01, 0xA0, 0x04
A0h #04: 7, 1, 82, 270, 0x80, 0x02, 0x80, 0x09, 0x81, 0x00, 0x81, 0x01, 0x81, 0x02, 0xA0, 0x05
A0h #05: 7, 1, 82, 270, 0x80, 0x02, 0x80, 0x0A, 0xA0, 0x06
A0h #06: 7, 1, 82, 270, 0x80, 0x03, 0x81, 0x03, 0xA0, 0x07
A0h #07: 5, 1, 82, 270, 0x9A, 0x00

80h #00: 0, 0, 0, 0         // Show Picture 1
80h #01: 1, 0, 0, 0         // Show - Fruit
80h #02: 2, 0, 0, 0         // Show Picture 2
80h #03: 3, 0, 0, 0         // Show Picture 3
80h #04: 4, 1, 23, 105      // Cmp
80h #05: 5, 0, 82, 270      // Home
80h #06: 6, 0, 90, 156      // ER-TFT028A2-4-5465 PKG
80h #07: 7, 0, 82, 270      // Next
80h #08: 8, 1, 145, 120     // Winner
80h #09: 12, 1, 31, 82      // Bar-1
80h #0A: 13, 0, 15, 85      // Font
80h #0B: 45, 0, 0, 0        // Show Picture 4
80h #0C: 46, 0, 0, 0        // Show Picture 5
80h #0D: 47, 0, 0, 0        // Show Picture 6
```

80h #0E: 48, 0, 0, 0 // Show Picture 7
80h #0F: 49, 0, 0, 0 // Show Picture 8

D8h #00: 58, 82, 3, 1, 10 // Pop-up a Picture
D9h #00: 0, 101, 2, 3, 9
D9h #01: 58, 82, 3, 2, 10, 11 // Show Rotate Pictures

81h #00: 4, 45, 119, 0, 14, 15, 16, 17, 18 // Show Bar1-Bar5
81h #01: 4, 135, 172, 0, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34 // Show 0~9
81h #02: 8, 56, 172, 0, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44 // Show 0~9
81h #03: 6, 50, 98, 0, 19, 20, 21, 22, 23, 24 // Show Fun1-6

88h #00: 1,1, 20, 80, GIF0 // Show GIF

90h #00: PT0, 10, 100, 0, 0x03, 0xe0, 1 // Show Graphics Text

C0h #00: 0, 10, 80, 200, 0xff0000, 0x00001f, 1,1,0,1 // Show Text 16*16
C0h #01: 0, 10, 100, 200, 0x0000FF, 0x00001f, 1,1,1,1
C1h #00: 1, 10, 120, 200, 0x00001f, 0x00f800, 1,1,0,1 // Show Text 24*24
C1h #01: 1, 10, 150, 200, 0xff0000, 0x00001f, 1,1,1,1
C2h #00: 2, 10, 180, 200, 0xff0000, 0x00001f, 1,1,0,1 // Show Text 32*32
C2h #01: 2, 10, 220, 200, 0x00FF00, 0x00001f, 1,1,1,1

[END]

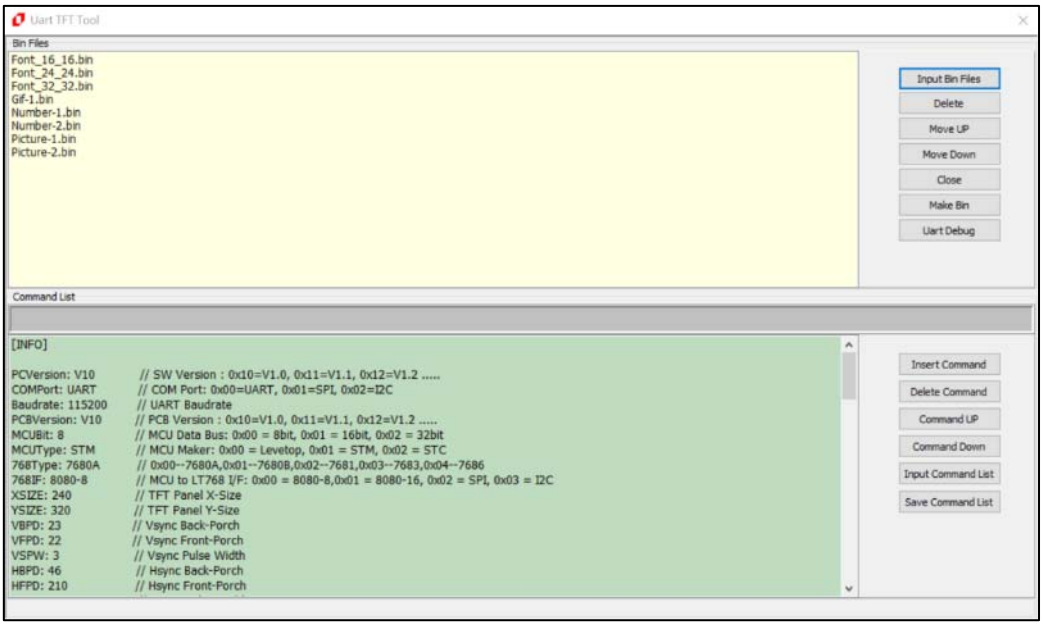


Figure 4-30: Input "UartTFT.ini"

5、Click 【Make Bin】 to compile, after compile completed, it will create two file: "UserInfo.bin" and "UartTFT_Flash.bin", user need to save it in appointed folder:

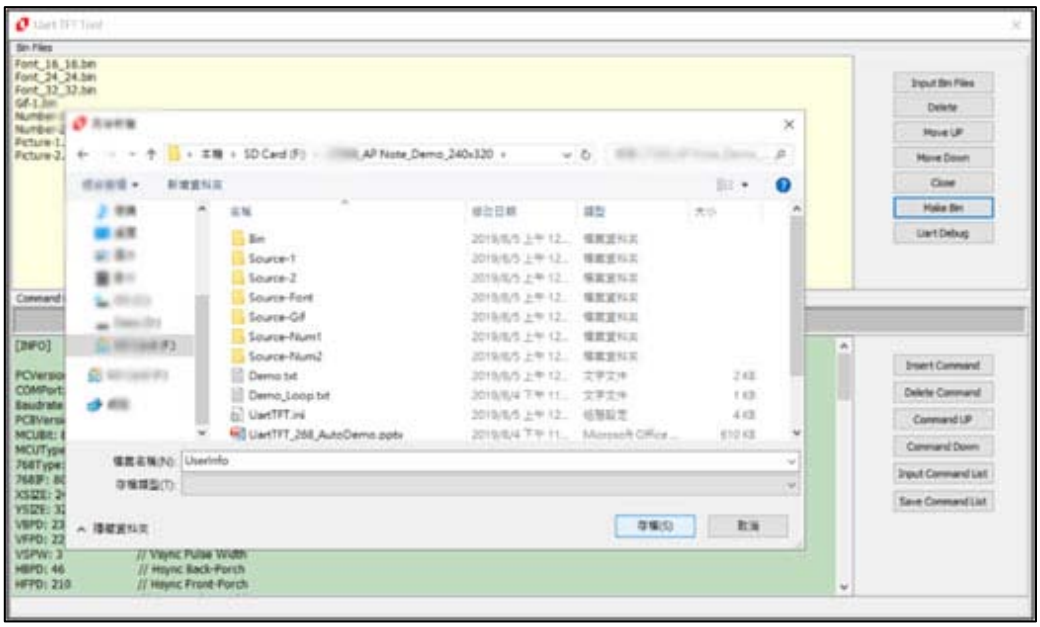


Figure 4-31: Save UserInfo.bin

6、 UartTools will automatically require to save "UartTFT_Flash.bin" in appointed directory.

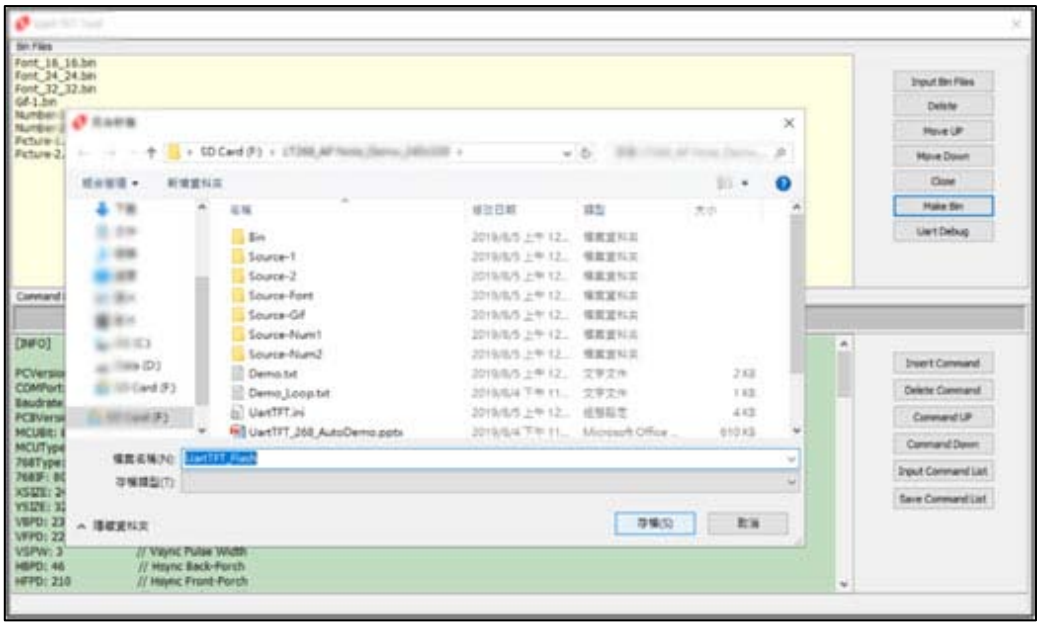


Figure 4-32: Save UartTFT_Flash.bin

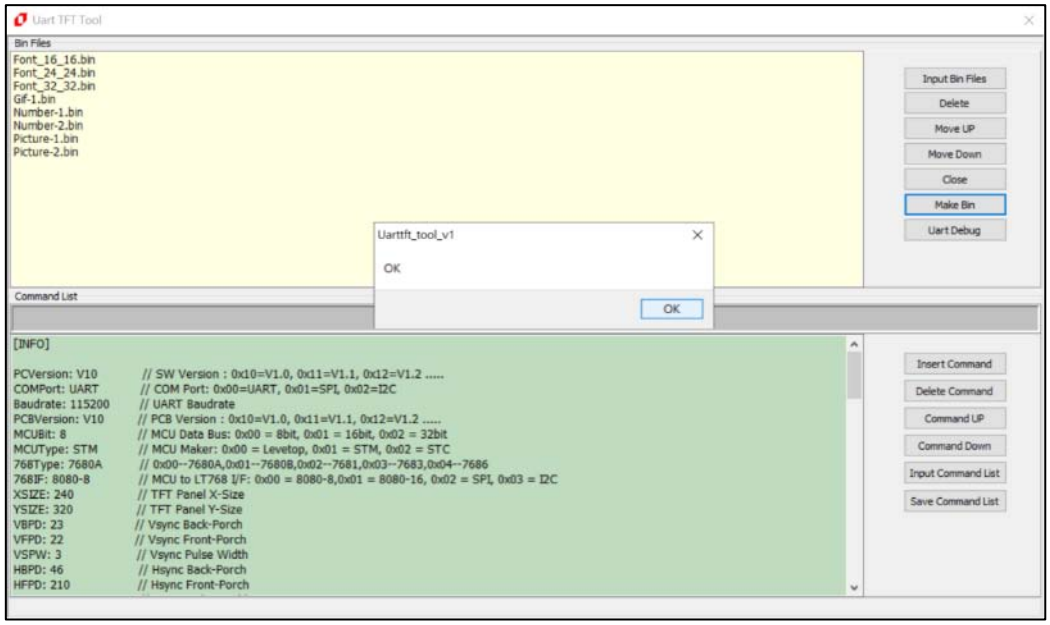


Figure 4-33: Compile Completed

7、User can use the editor window of "Command List" to modify/store the command file ("UartTFT.ini") or modify via outside file editor, after modification, click 【Input Command List】to re-read the command file, then back to step 5, execute 【Make Bin】:

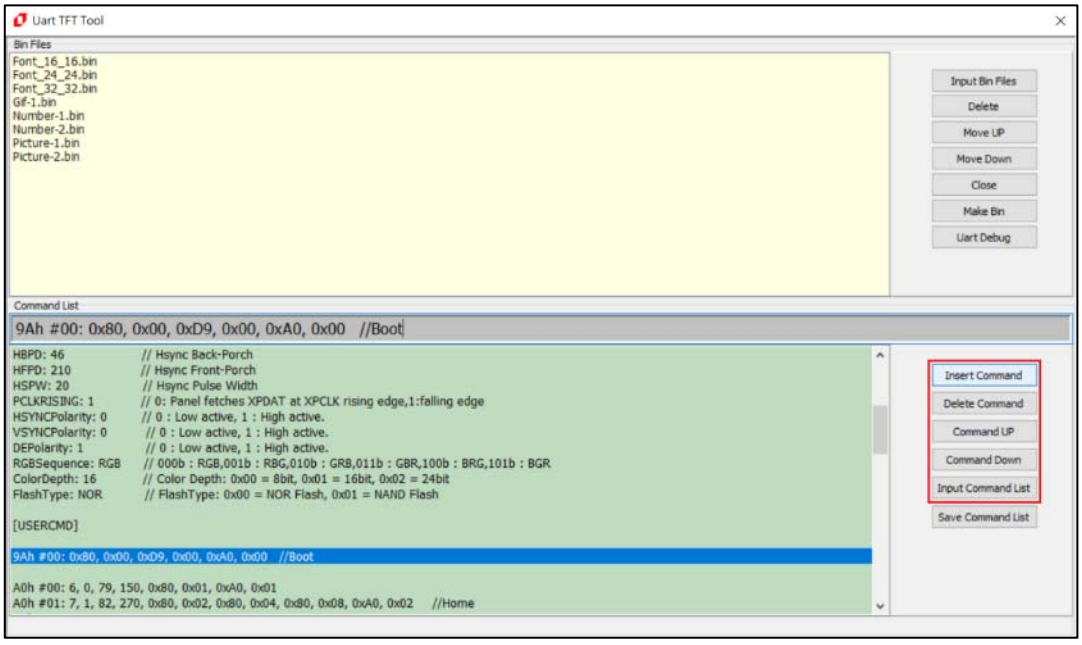


Figure 4-34: Compiler Main Page

8、 Programming the created "UartTFT_Flash.bin" into SPI Flash, which means the basic TFT panel design is finished.

9、Click 【Uart Debug】to open "UartDebug.exe" software, and run the host simulated command test.

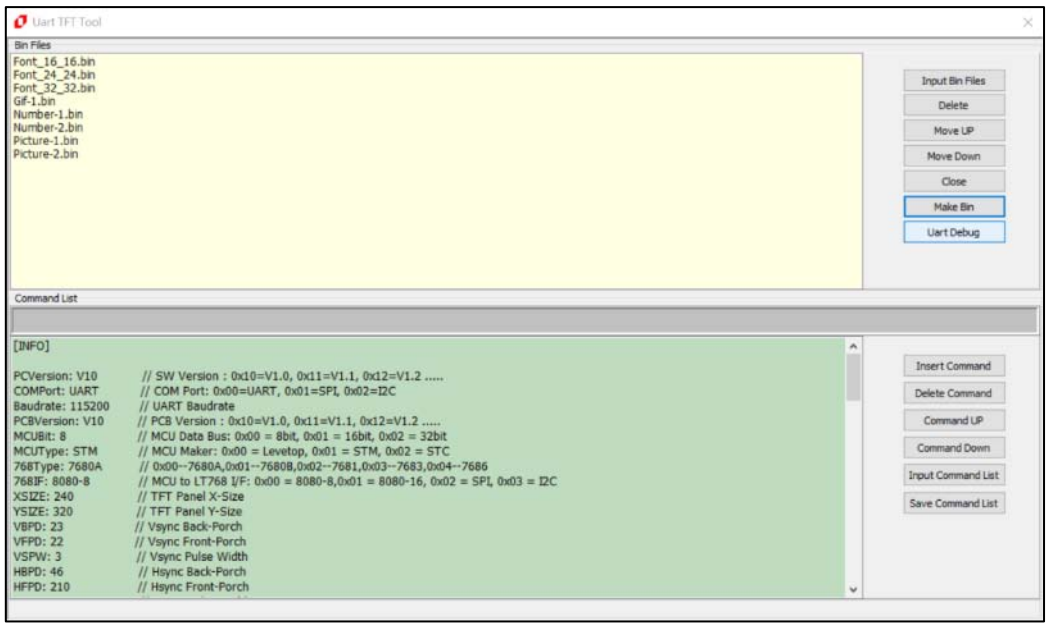


Figure 4-35: Open UartDebug

"UartDebug.exe" is a special program provided by EastRising, which is used to convert PC USB interface to UART serial port, and send commands to the TFT panel MCU Uart interface, so that the TFT panel can display different contents, in this way, user can perform pre-verification of the TFT panel. User may download ER-TFT028A2-4-5465_UartTFT_Tool Demo from our website for testing. The detail about UartDebug tool, you can refer to Chapter 5.

Remark:

- "UartTFT_Flash.bin" file is bigger, its main content is picture, font, GIF and command file action data; "UserInfo.bin" file is around 128K, which includes command file action data only. "UartTFT_Flash.bin" already included the "UserInfo.bin" file. So user just needs to Programming "UartTFT_Flash.bin" file at first time.
- Since it takes a long time to Programming the SPI Flash data, when the user's picture, font, and Gif are not changed, only the command file is modified. After the "Make Bin", only the 128K "UserInfo.bin" file needs to be Programmed, there is no need to re-Programming "UartTFT_Flash.bin" into SPI Flash, which can save a lot of time to Programming Flash and shorten development time.

4.4.2 Make Picture Bin File

The pictures that are commonly used on the application side can be stored in the built-in display memory of the ER-TFT028A2-4-5465 through DMA transfer. This can reduce the burden on the MCU to transfer image data. This function can be used to convert the picture to a Bin file first, and then pre-Programmed in the SPI Flash. UartTools provides the function of making a picture Bin file, allowing the user to import the picture on the PC side, and then generate a Bin file of the picture. User can refer to the following instructions:

1. **Open "UartTFT_Tool.exe"**:

Figure 4-37: Execute UartTFT_Tool.exe

2. Click "Input Picture" button, select the picture you need and open, then you can add all pictures under this folder:

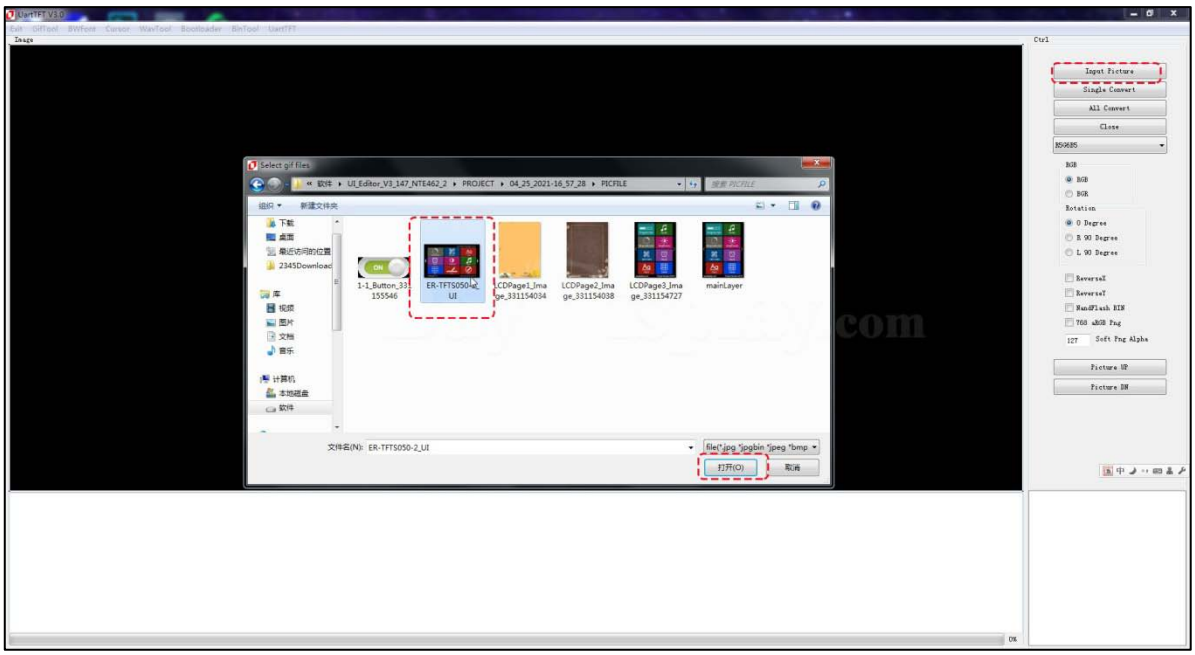


Figure 4-38: Input Picture

Figure 4-39: Input Completed

3. Export picture setting: user can select 16bpp/24bpp/Black_White/RGB/ BGR format. **Note:** if user wants to make Black_White format picture bin file, the source picture file must be only black and white.

Figure 4-40: Export Format Setting

4. Export single picture or all pictures. **Note**: the file name cannot include special character, for sample : ? * / \ < > : " |

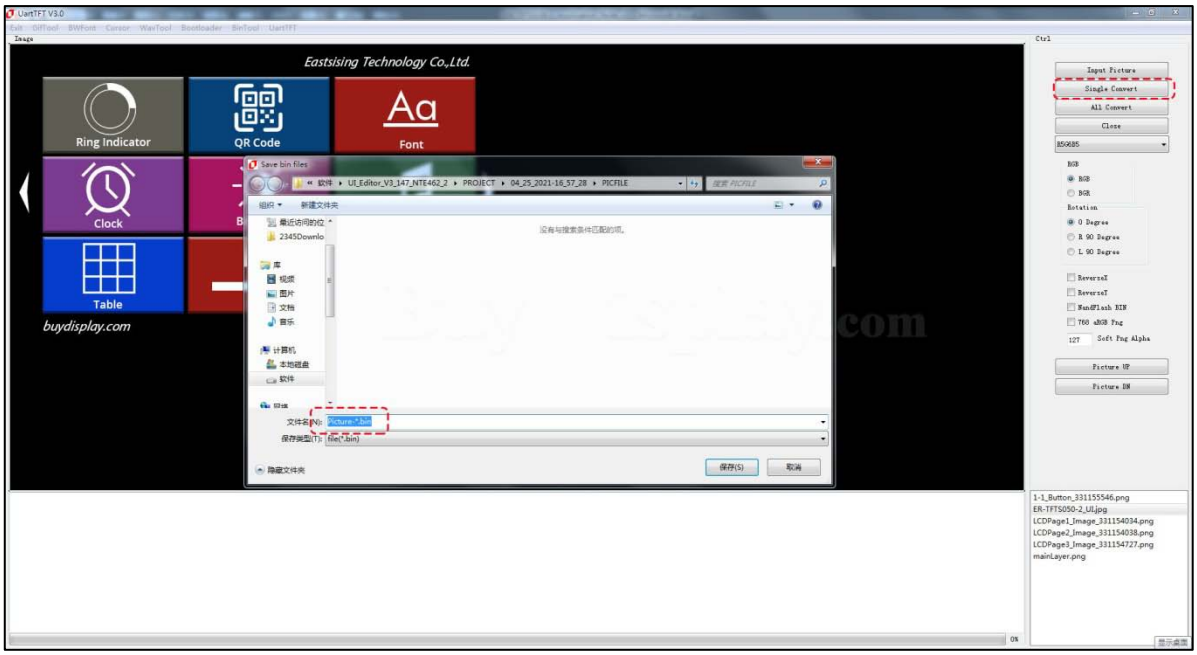


Figure 4-41: Export Picture (1/2)

5. Export picture Bin file succeed:

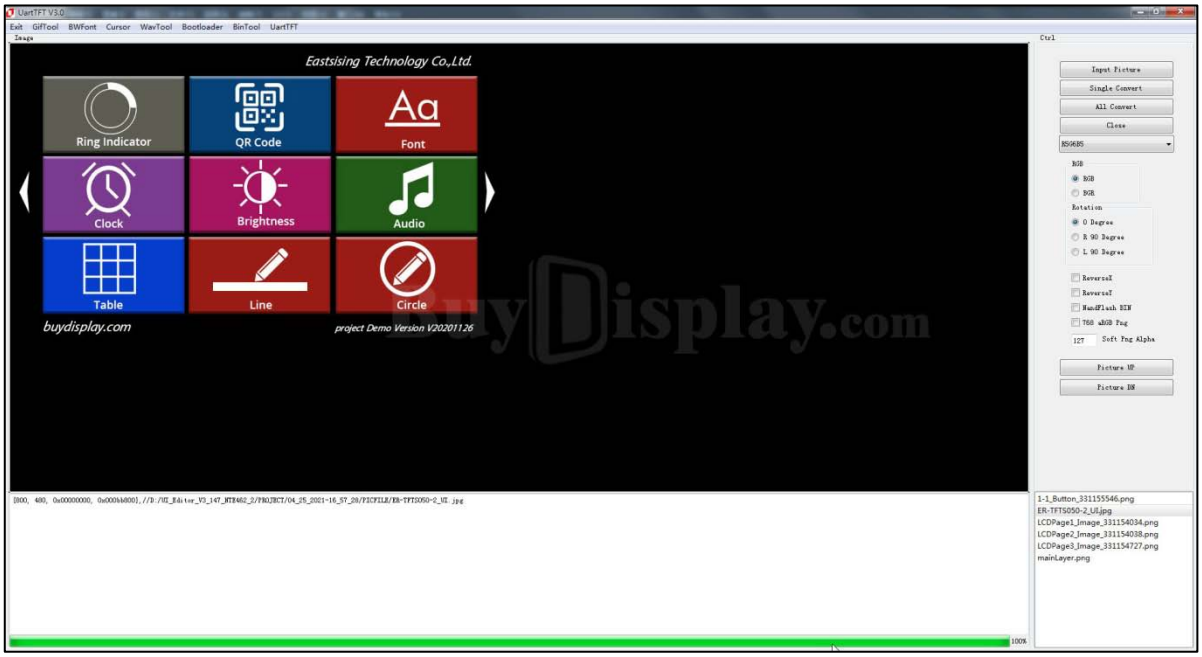


Figure 4-43: Export Succeed

6. When picture exported, you can find the Picture1.bin file in appointed folder

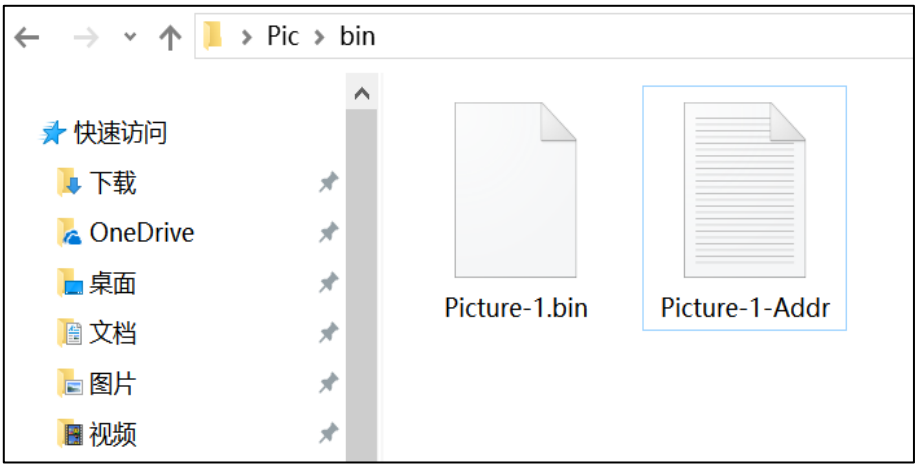


Figure 4-44: Exported Picture Bin File

4.4.3 Make GIF Bin File

If the application side wants to play the GIF animation, you can cut the GIF file into many pictures, and then store the pictures in the built-in display memory of the ER-TFT028A2-4-5465 through DMA transfer, so that the animation effect can be achieved. Users can use UartTools to input GIF animation files, and then generate a series of Bin files. For detailed steps, please refer to the following instructions:

1. Click【UartTools menu>GIFTool】to open GIF Bin file making interface:

Figure 4-45: GIF Bin File Making Interface

2. Click “Input Picture” button, select the GIF picture required and open, then you can add all GIF pictures under the folder:

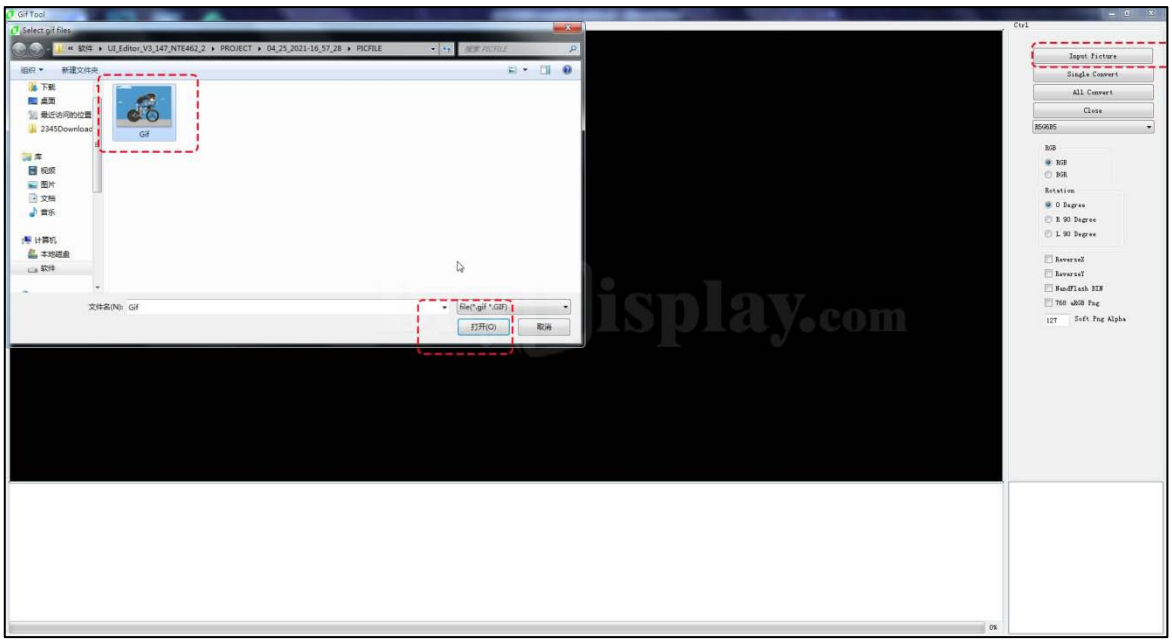


Figure 4-46: Input GIF

Figure 4-47: Input Completed

3. GIF export setting, user can select 16bpp or 24bpp, RGB or BGR:

Figure 4-48: Export Format Setting

4. Export single GIF or all GIF. **Note:** the file name cannot include special character, for sample : ? * / \ < > : " |

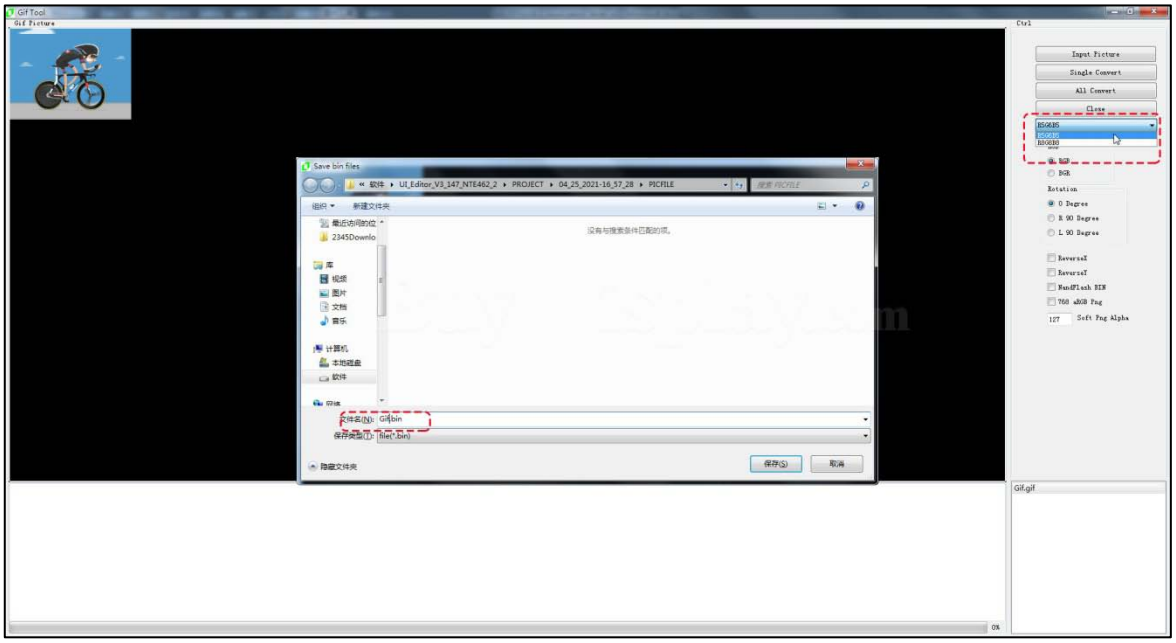


Figure 4-49: Export GIF (1/2)

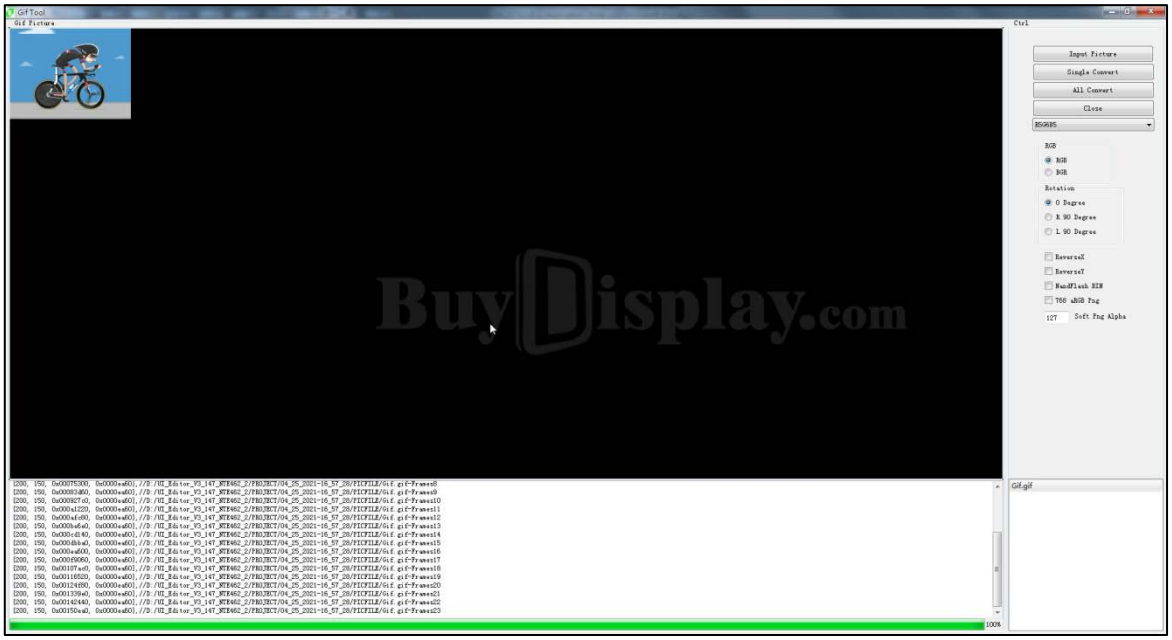


Figure 4-51: Export Succeed

7. Once GIF is exported, you can find the load.bin and txt file in appointed folder

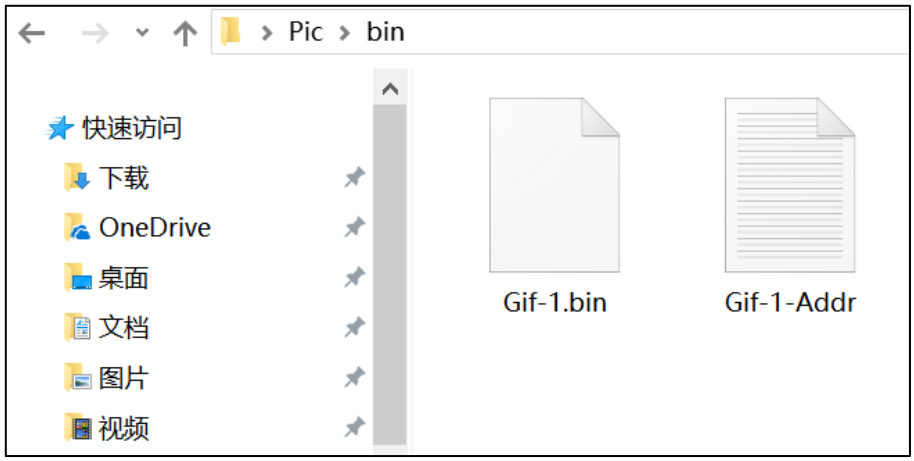


Figure 4-52: Exported GIF Bin File

In txt file, you can find the information of resolution, address, size of each GIF and total quantity

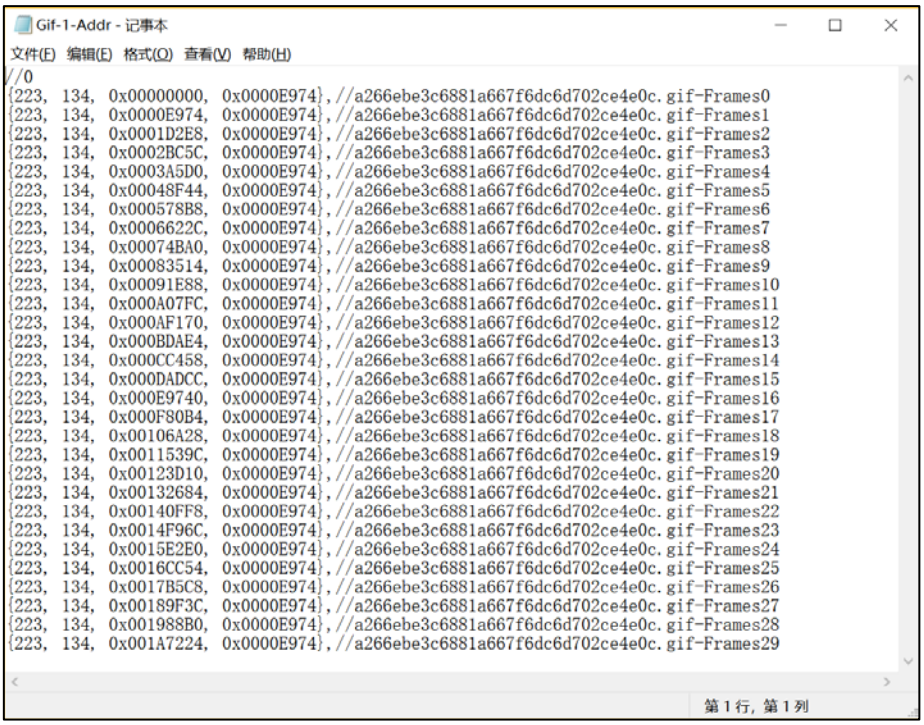


Figure 4-53: Exported GIF Information

4.4.4 Make Font Bin File

4.4.4.1 Full Font Make

If you want to use the Chinese font library on the application side, UartTools has a function to create a font Bin file, which can convert the font information into a Bin file, and then store the font data in the built-in display memory of the ER-TFT028A2-4-5465 through DMA transfer. To display Chinese on the TFT panel, the MCU only needs to send GB code (2 Bytes) to display Chinese in the appointed position, which can improve the Chinese display performance and reduce the burden of the MCU. For the creation of the font Bin file, the user can refer to the following instructions, for example, to generate a 16*16 Song style font Bin file:

1、Click【UartTools menu >Font】 to open font Bin file making interface:

Figure 4-54: Make Chinese Font

2、Click 【Select Font】 button, user can set form, style, size, press “OK” to confirm.

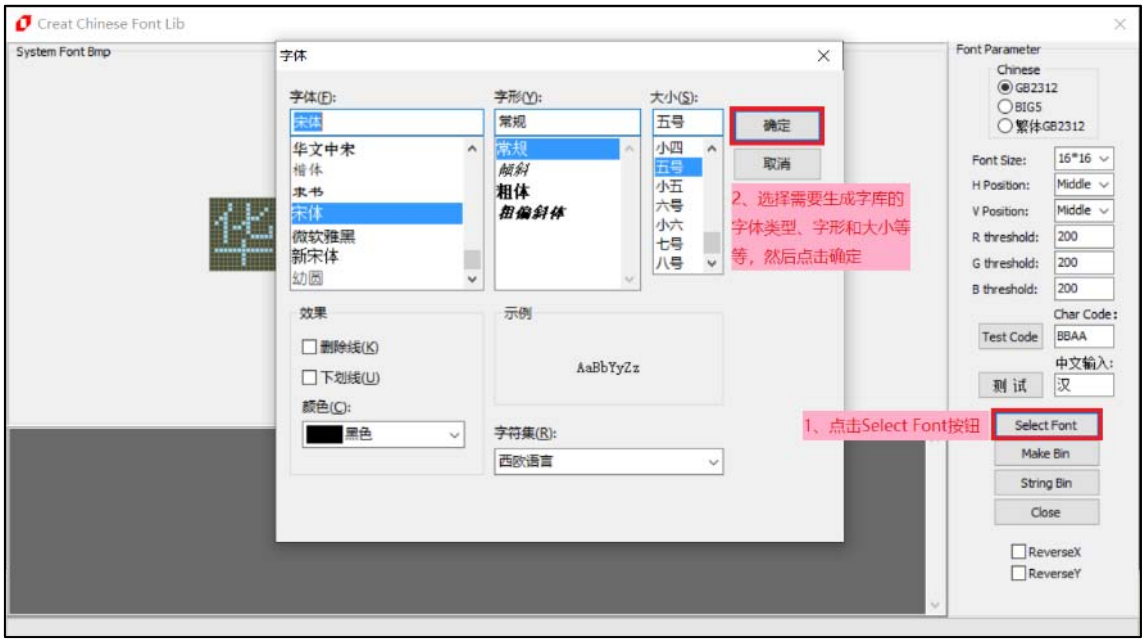


Figure 4-55: Select Font

3、 There are five font size: 16*16, 24*24, 32*32, 48*48, 72*72, and user can set font horizontal (left, center, right) and vertical (upper, center, lower) positions, color threshold (0~254), and preview text, click the [Test Code] button to view the data for this character

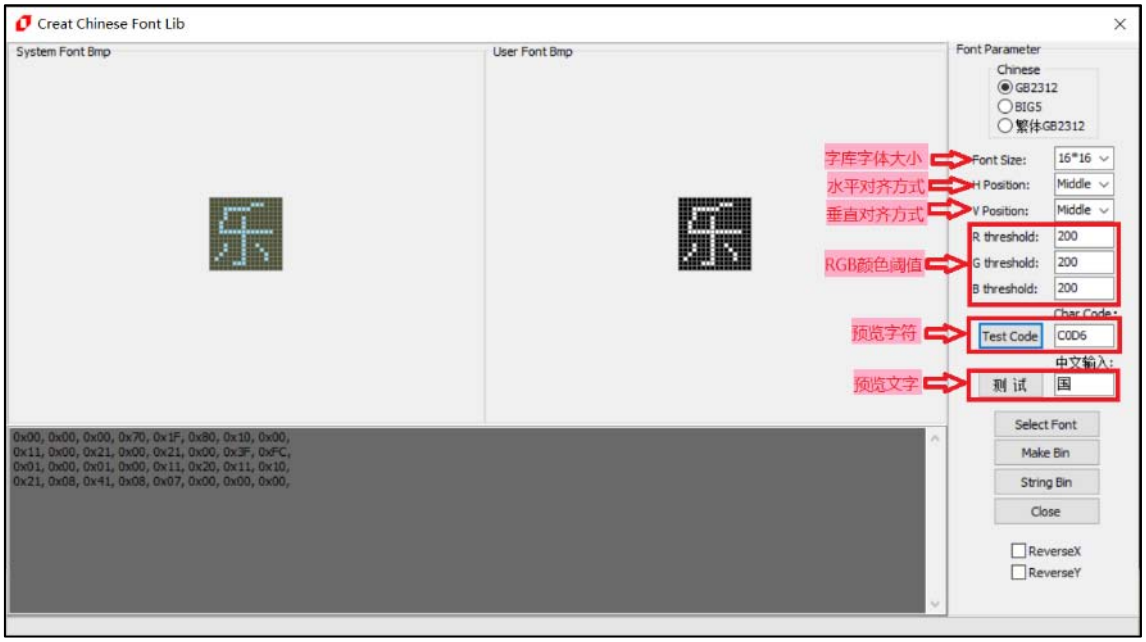


Figure 4-56: Font Setting

4、Click【Make Bin】 to export Bin file of font. Note: the file name cannot include special character, for example: ? * / \ < > : " |

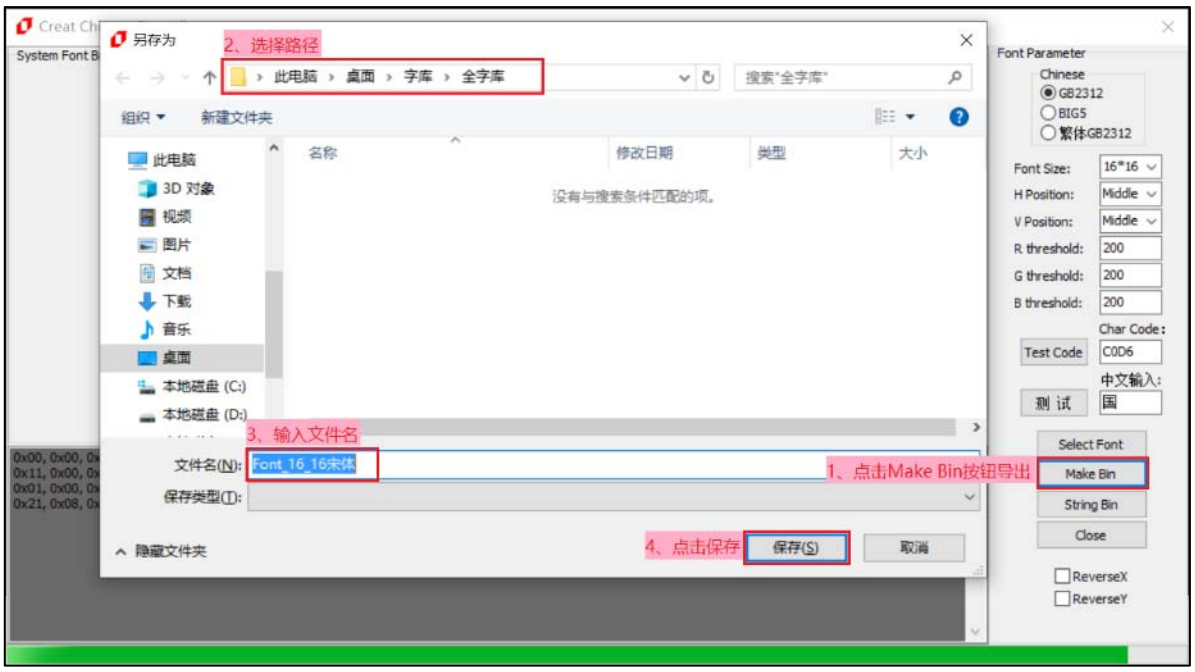


Figure 4-57: Save Font

When shows font name +Font Lib ok, means the font make succeed:

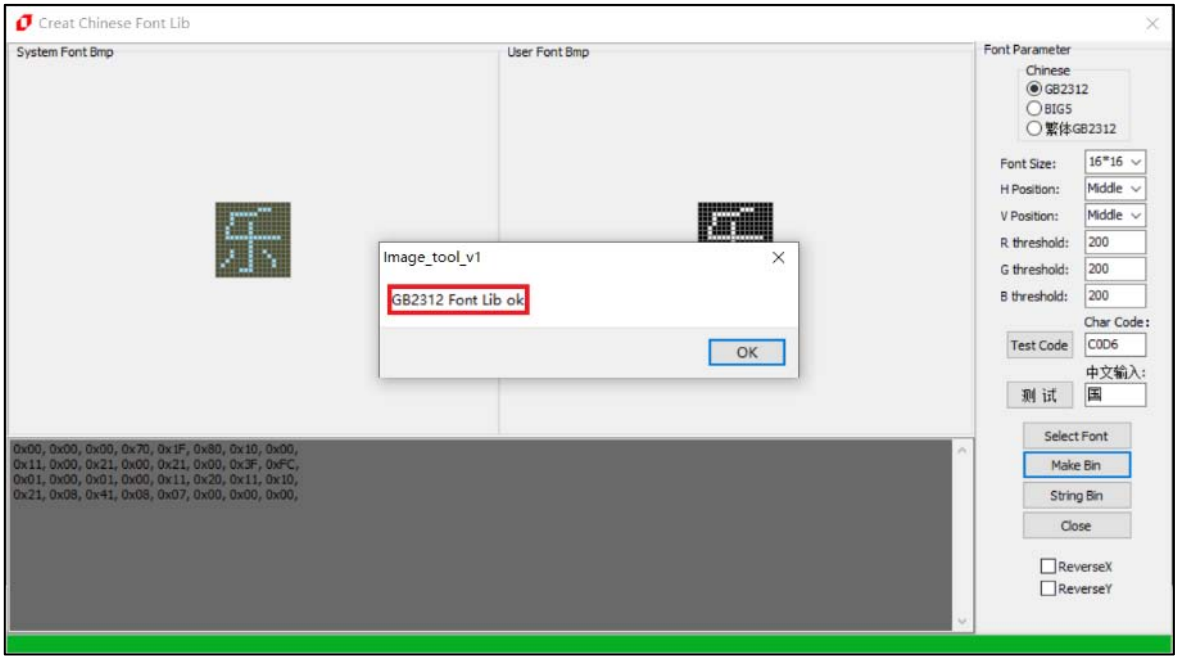


Figure 4-58: Font Make Succeed

5、After completed, you can find the exported "简体 16_16 宋体.bin" file in appointed folder.

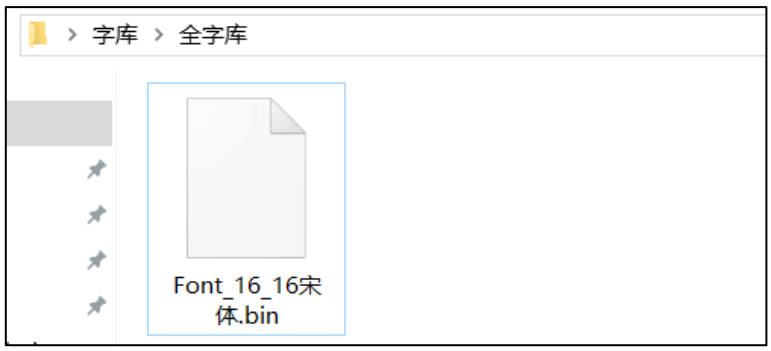


Figure 4-59: Exported Font Bin File

4.4.4.2 User-Define Font Make

Since the capacity of the font library is relatively large, and occupy much space of Flash, the PC software provides the function of custom font library, so user can prepare the texts to be called in advance as per demand, and packed these texts into one font library. For the creation of the custom font Bin file, the user can refer to the following instructions, for example, to generate a 48*48 Song custom font Bin file:

1. Select font size and type, follow the instruction as 4.4.4.1 mentioned, then click 【String Bin】, select a notebook document to store the text.

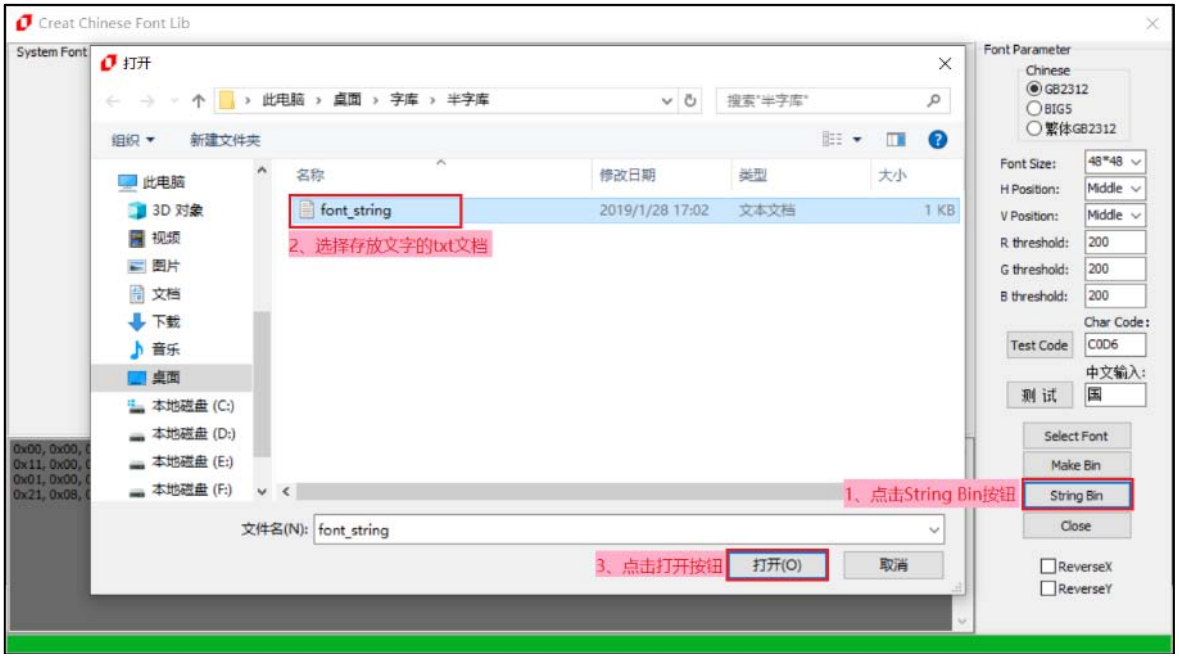


Figure 4-60: Select Txt File

2. Store the text to be called in a notebook in advance:

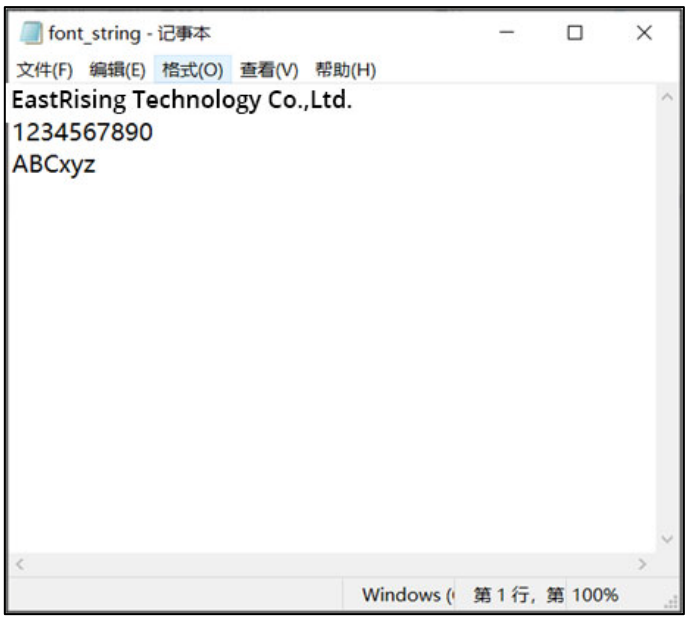


Figure 4-61: Store Text

3. Select a folder to save the user-define font, name the font and save:

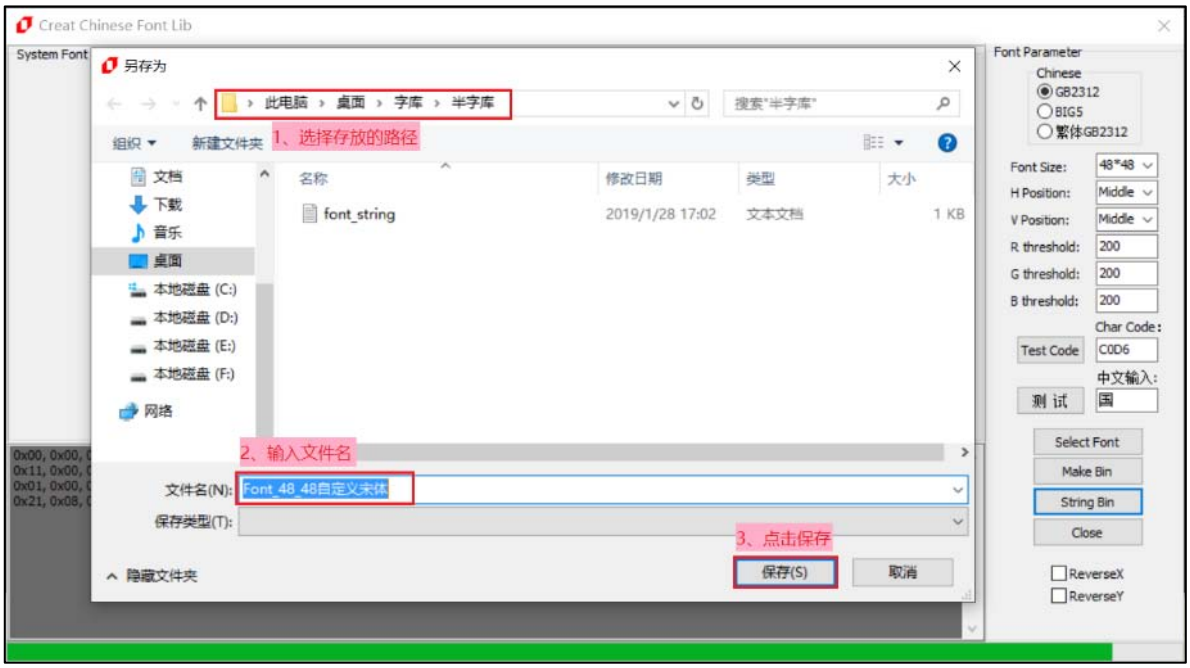


Figure 4-62: Save Font

When shows “String Font Lib ok”, it means user-define font making succeed:

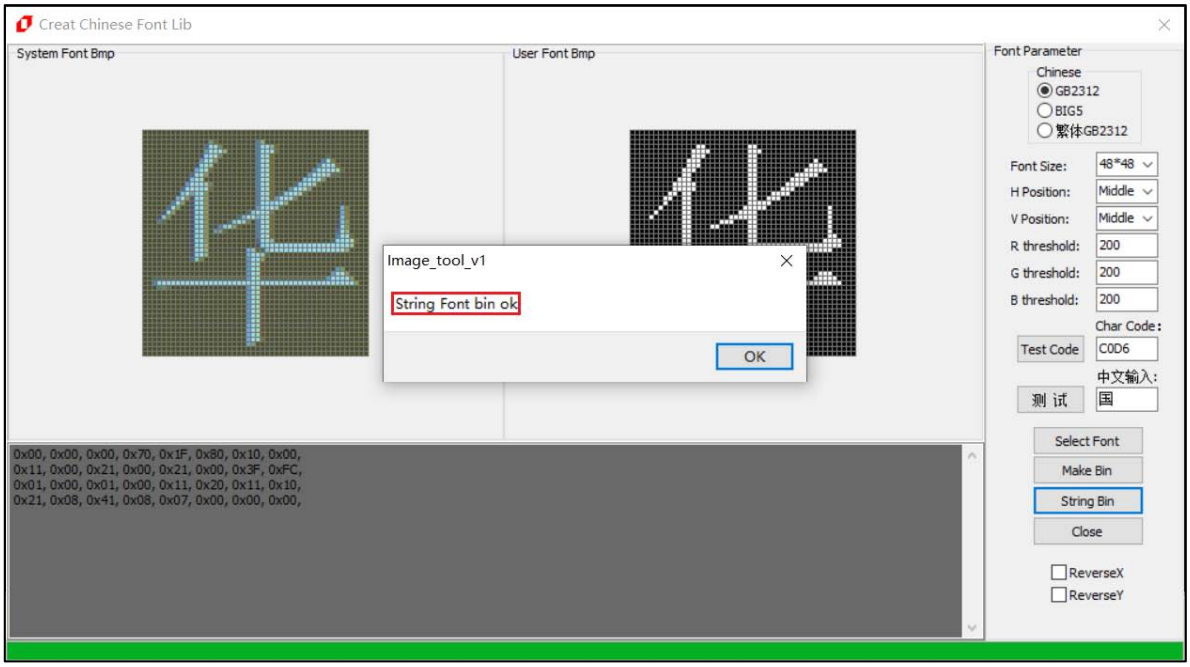


Figure 4-63: Font Making Succeed

4. After completed, you can find the exported "Font_48_48 自定义宋体.bin" file in appointed folder:

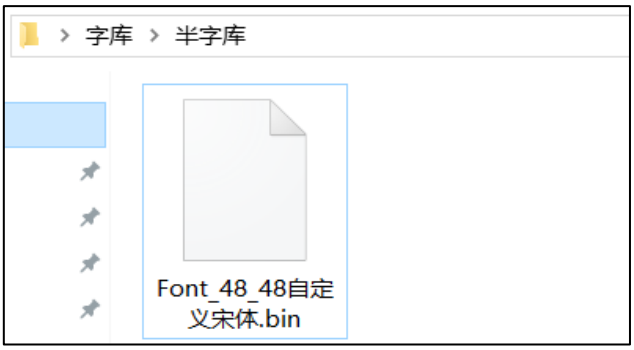


Figure 4-64: Exported Bin File

4.4.5 Make Wav Bin File

4.4.5.1 Audio File Convert to WAV

1.If the audio material format is not the WAV format, you need to obtain the WAV format file by format conversion. The following is the operation of the "Format Factory" free version for the conversion platform. First open the software, select the audio, select "-> WAV", enter the add file interface.

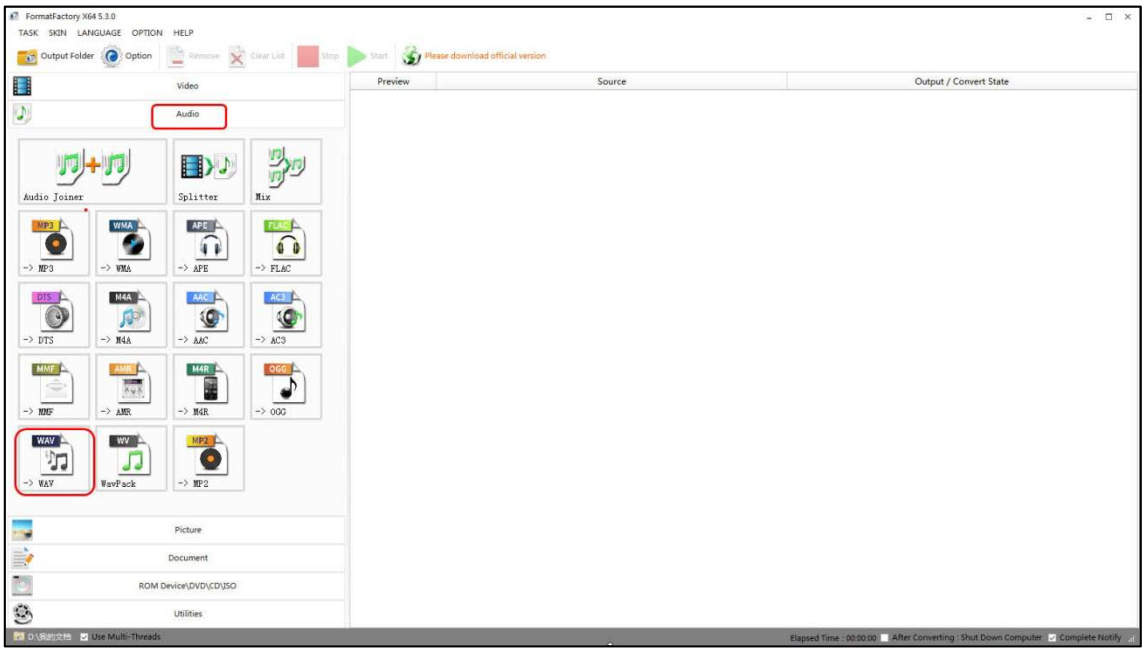


Figure 4-65: Select "WAV"

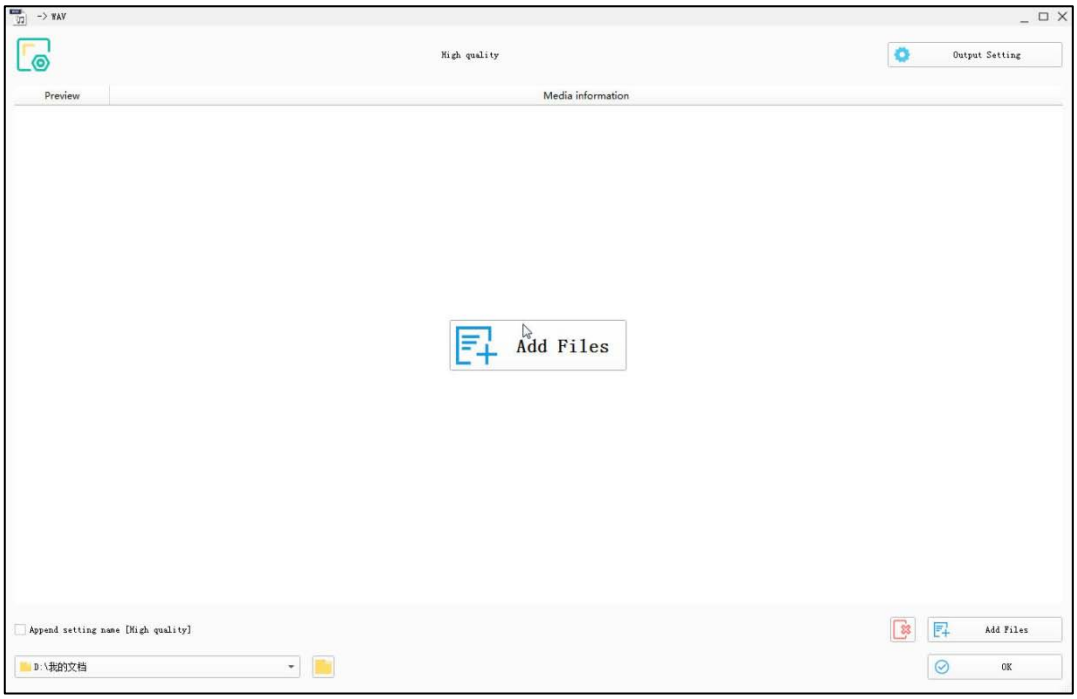


Figure 4-66: Wav Function Interface

2.Click" add file" button, select the converting file

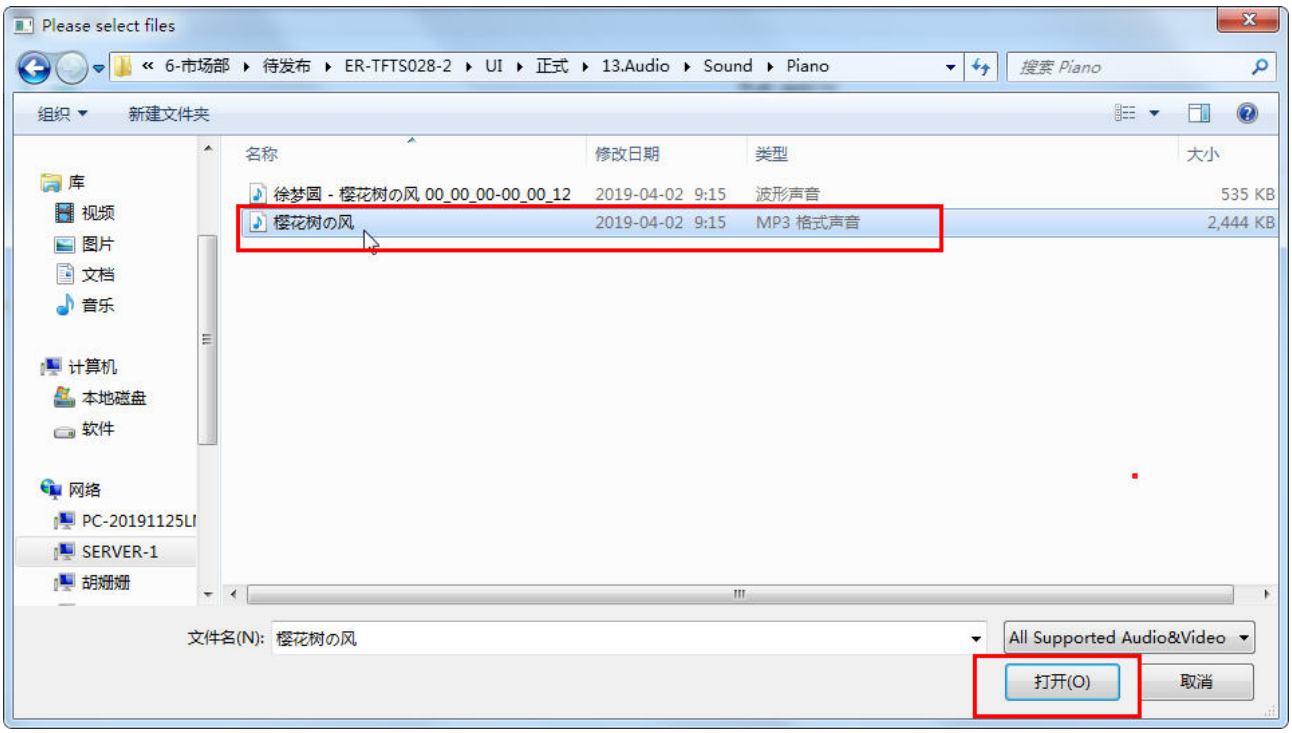


Figure 4-67: Add Wav File

3. Click the export Configuration button to set the audio. The sampling rate can be 11025 or 22050. Due to the low-cost power amplifier solution and in order to save storage space, it is recommended to select sampling rate of 11025.

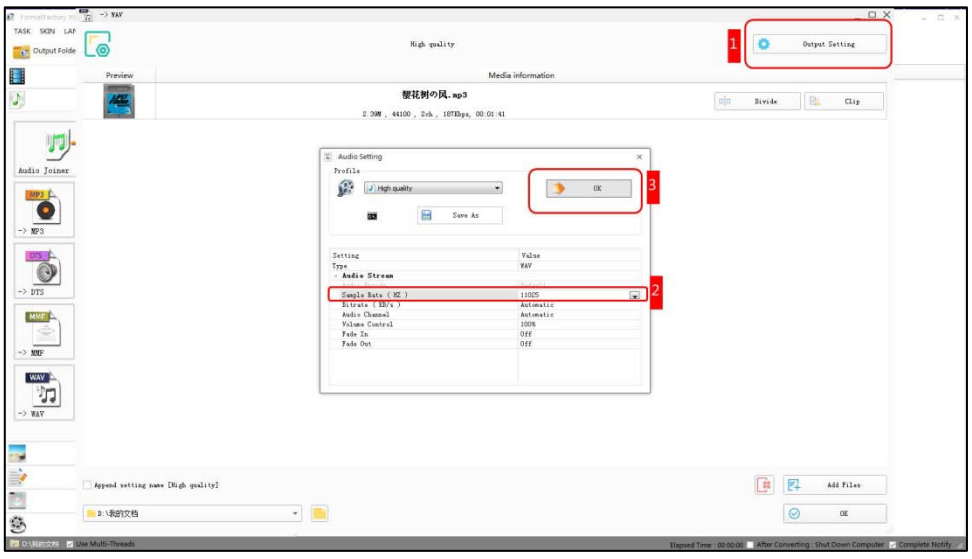


Figure 4-68: Export Configuration

4.Select the file, click the Edit button, enter the audio clip interface, and select the desired audio segment. If you don't need to edit, go directly to step 5.

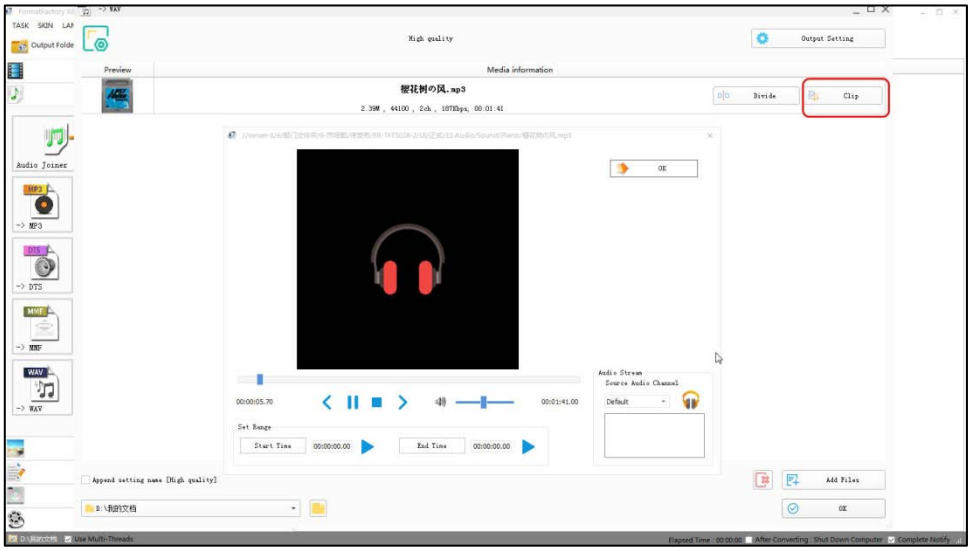


Figure 4-69: Enter Edit Function

Edit the audio, user can adjust the volume, and capture the clips. After the edit is complete, click the OK button to save:

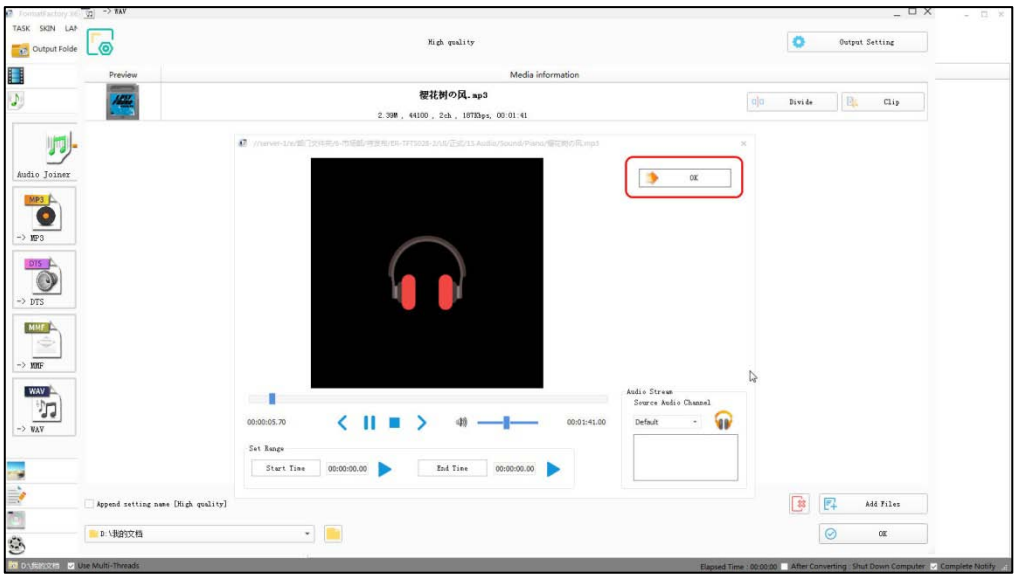


Figure 4-70: Edit Interface

5.Click the “Change” button in the lower right corner to reselect the export destination folder and click the OK button to add the task.

Figure 4-71: Select Export Folder

6.Click the Start button to start the conversion. After the conversion is complete, you can view the exported WAV file in the appointed folder

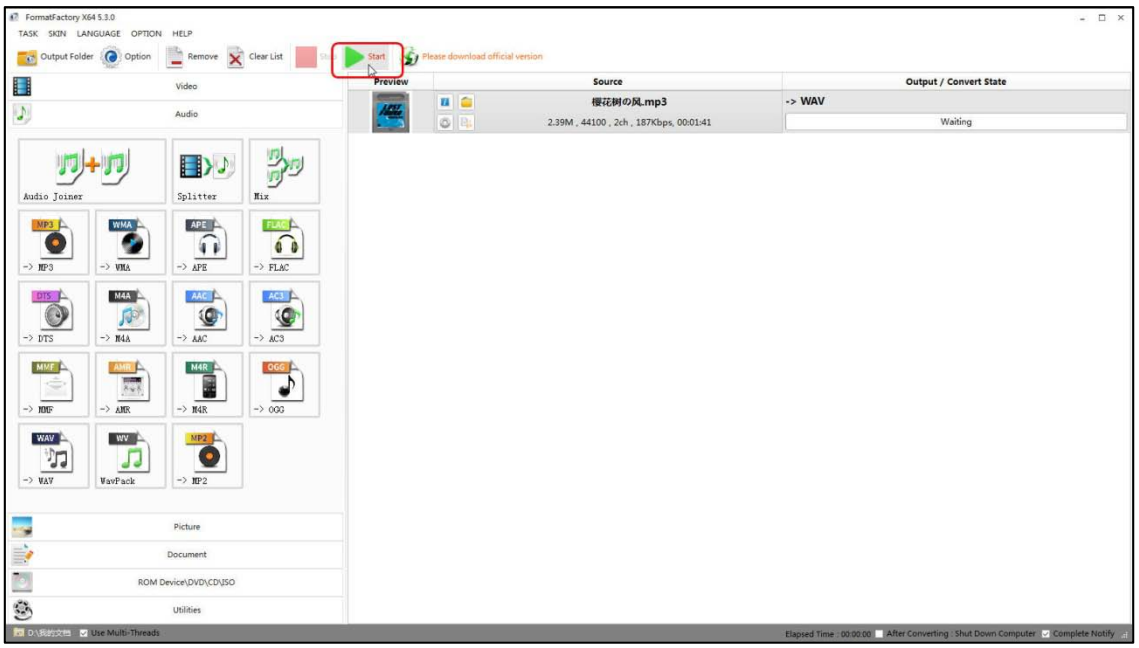


Figure 4-72: Start Conversion

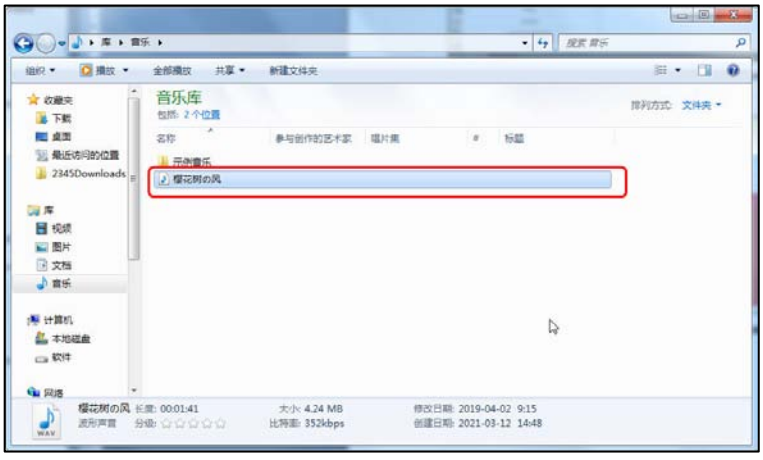


Figure 4-73: Exported Wav File

4.4.5.2 Make WAV Bin File

1. Click【UartTFT_Tool menu>WAVTool】to open WAV Bin make interface :

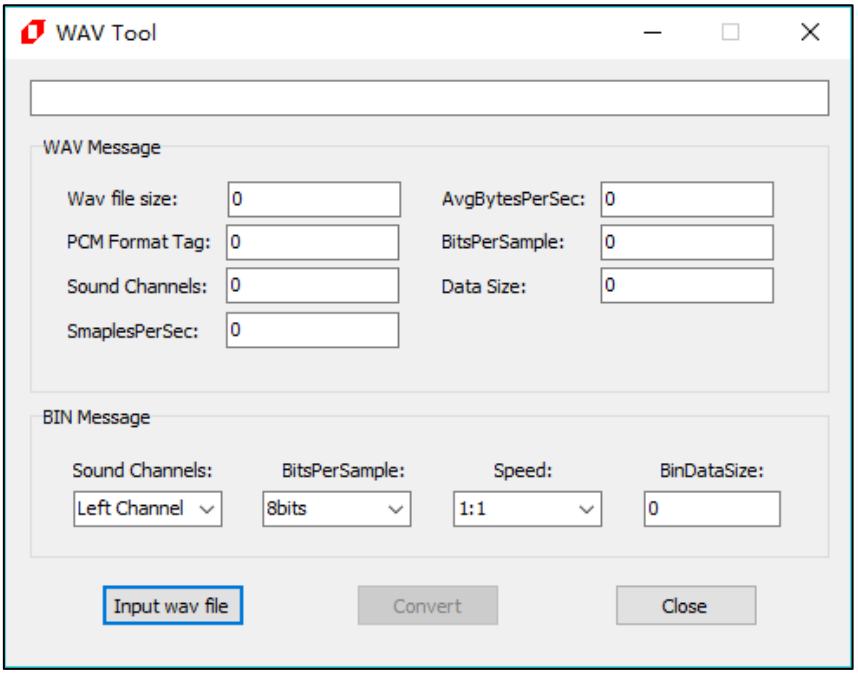


Figure 4-74: WAV Bin File Make Interface

2.Click “Input wav file” button, select the WAV file to be converted, click open to add:

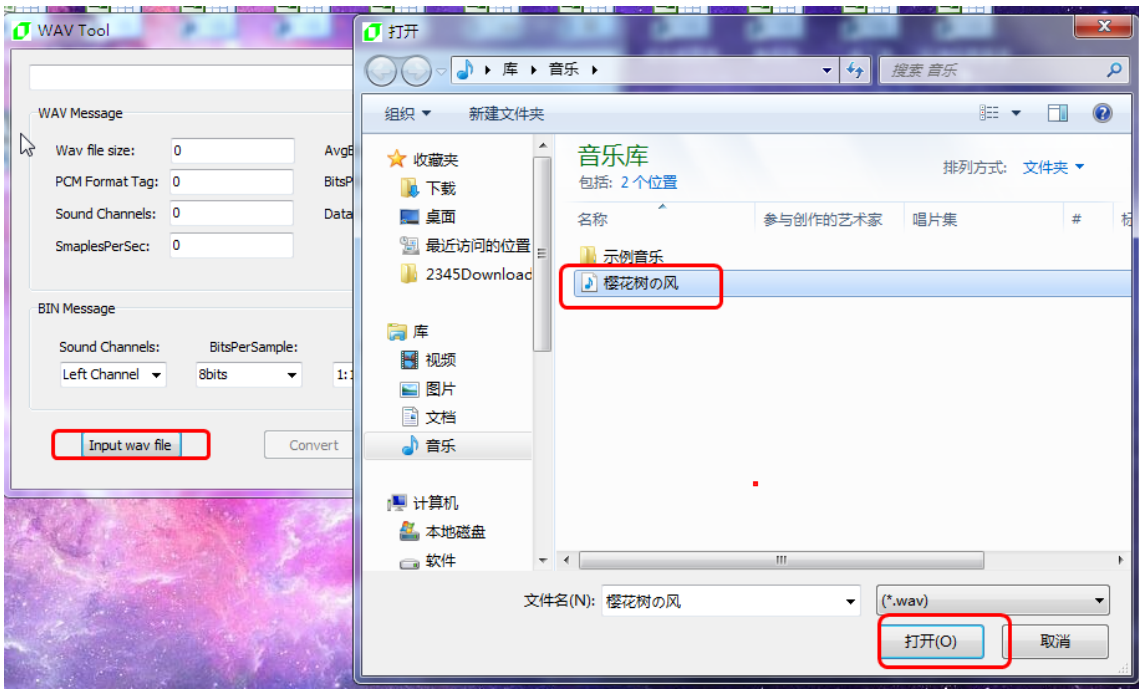


Figure4-75: Add Wav File

After added, at the top of the interface, user can find the path of the file and the related data of the wav file (as shown below). If the sampling rate (SamplesPerSec) is not 11025 or 22050, it is recommended to change the speed ratio or first use other audio software to change the sampling rate to 11025 or 22050.

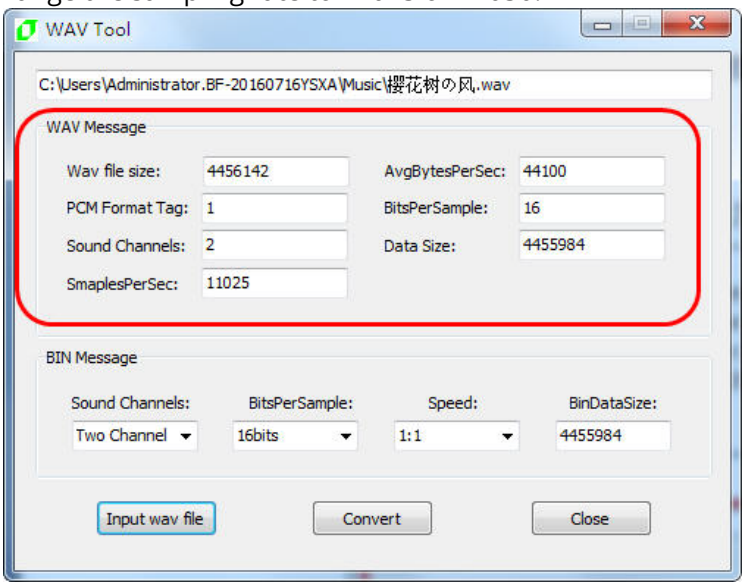


Figure 4-76: Add Succeed

3. Set the parameters of the bin file. The Sound Channels option can be left channel, right channel or dual stereo channel. The BitsPerSample can be 8bits or 16bits. Generally, mono and 8bits are enough, and the bin file is small to store. The Speed option is used to select the sampling speed when the bin file is generated. The higher the speed, the lower the sound quality, and the time required to change the program's timer update data.

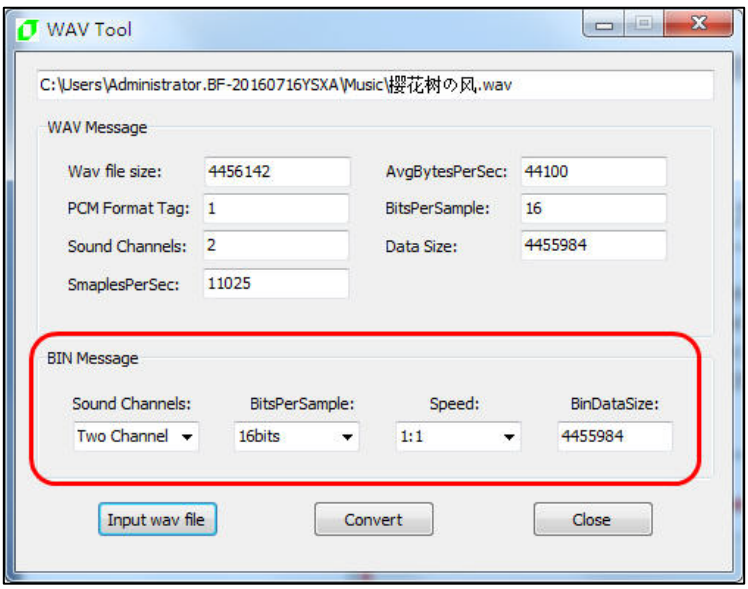


Figure 4-77: WAV Bin File Make Interface

4.Export Bin file. Note that the file name cannot include special character, for sample : ? * / \ < > : " |

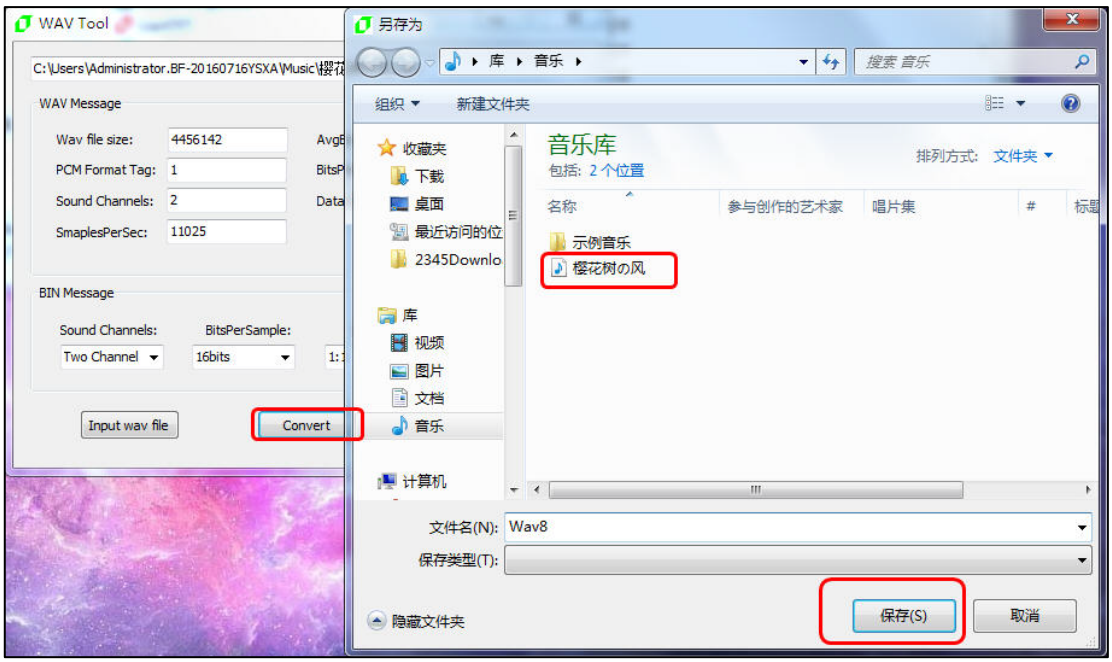


Figure 4-78: Export Bin File

If the audio file does not match the bin setting parameters, it will prompt “Can't support this bits”, please follow step 3 to reset:

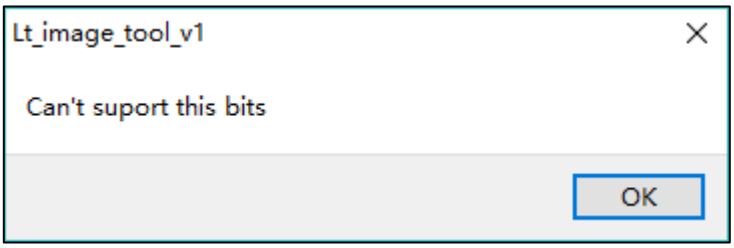


Figure 4-79: Error Message

If matched, press “OK” to export**:**

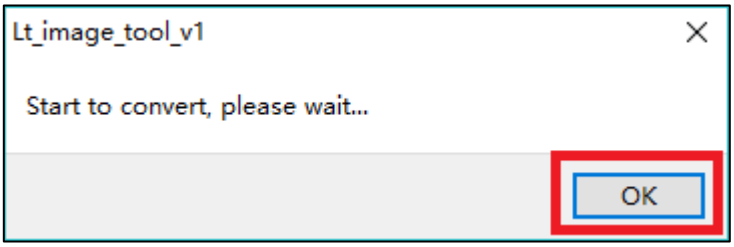


Figure 4-80: Press OK

5.Export WAV's bin file succeed, now user can find Bin file in appointed folder.

Figure 4-81: Export Succeed

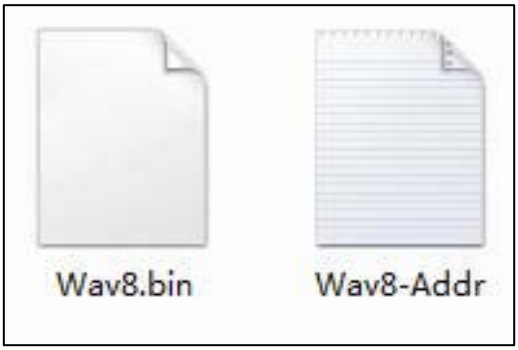


Figure 4-82: Generated Bin File

4.4.5.3 Typical PWM Audio Drive Circuit

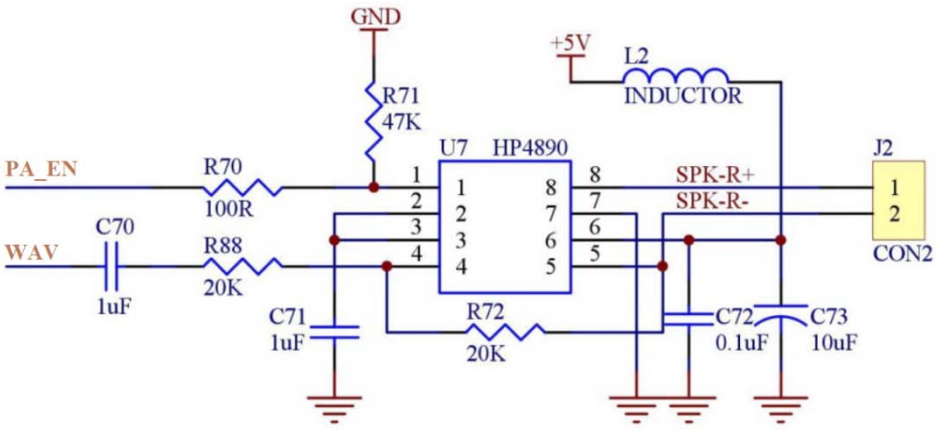


Figure 4-83: Typical PWM Audio Drive Circuit

4.4.6 Bin File Combination

After generating many different Bin files, they are finally Programming into the SPI Flash. Therefore, UartTools provides a Bin file combination function that allows users to combine different Bin files into one Bin file on the PC side. For detailed steps, please refer to the following instructions:

1、Click【UartTFT_Tool menu >Binfile】to open file combination interface, up to 6 Bin file can be combined. Click【File 1~6】to add file in order. Note: Bootloader.bin file must be put in 0 position, which is file 1.

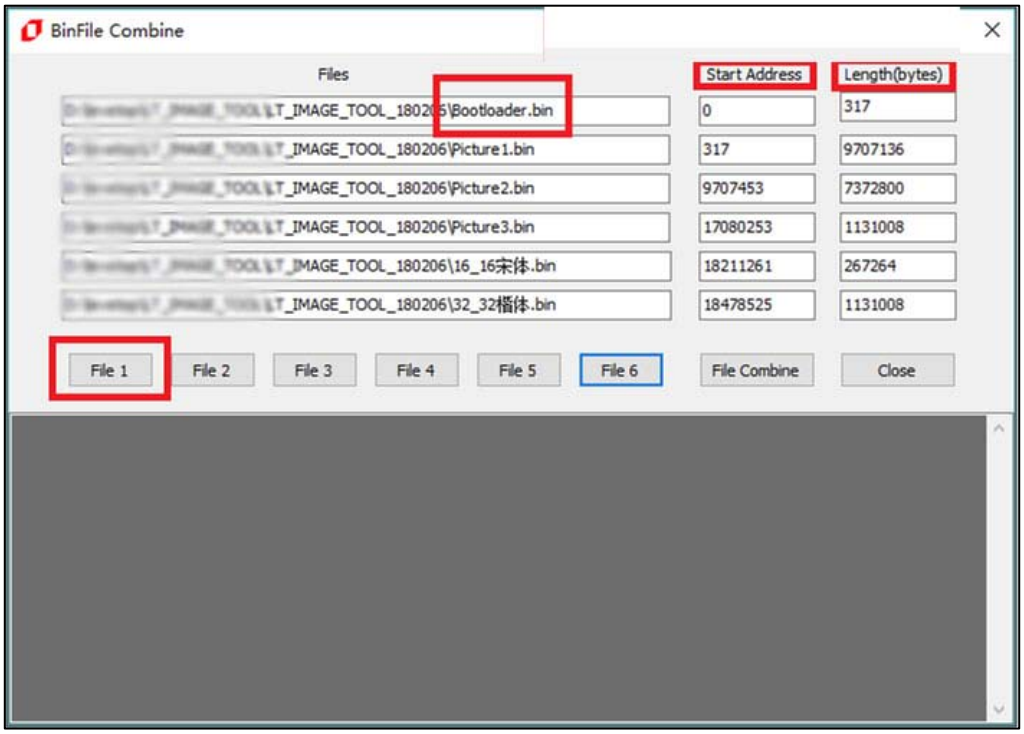


Figure 4-84 : Bin File Combination

Click【File Combine】button to save combined file, **note** that the file name cannot includes special character, for example: ? * / \ < > : " |

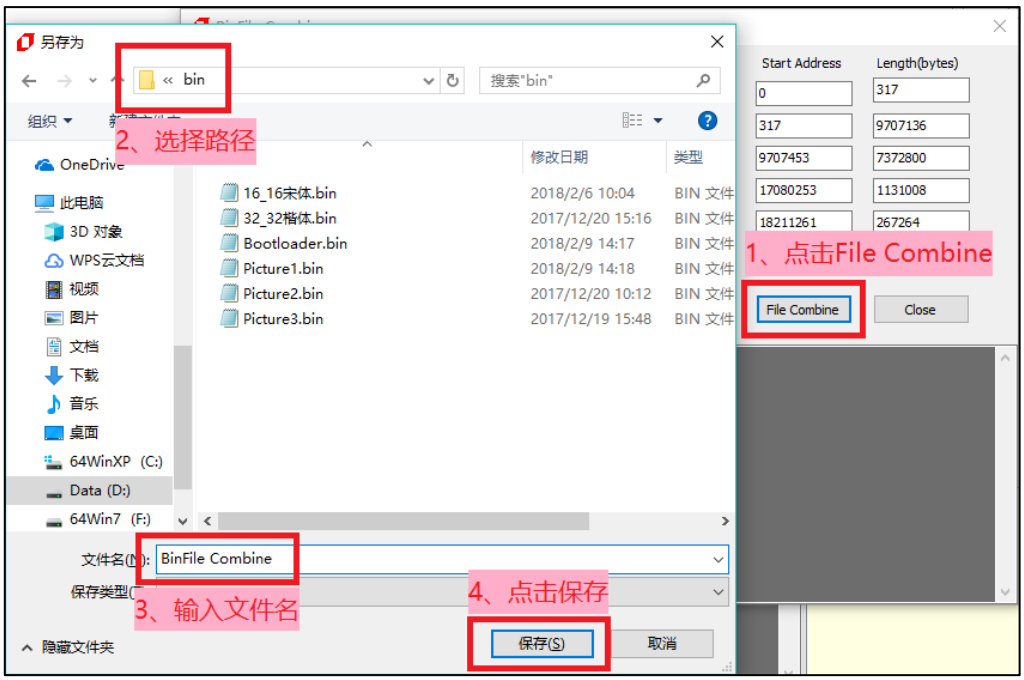


Figure 4-85: Save Combined File

When shows "Combine over", the combination is successful, and the address and size of each source file are displayed. At the same time, "BinFile Combine-Addr.txt" file is generated, which is convenient for checking the address, size and other details of each source file.

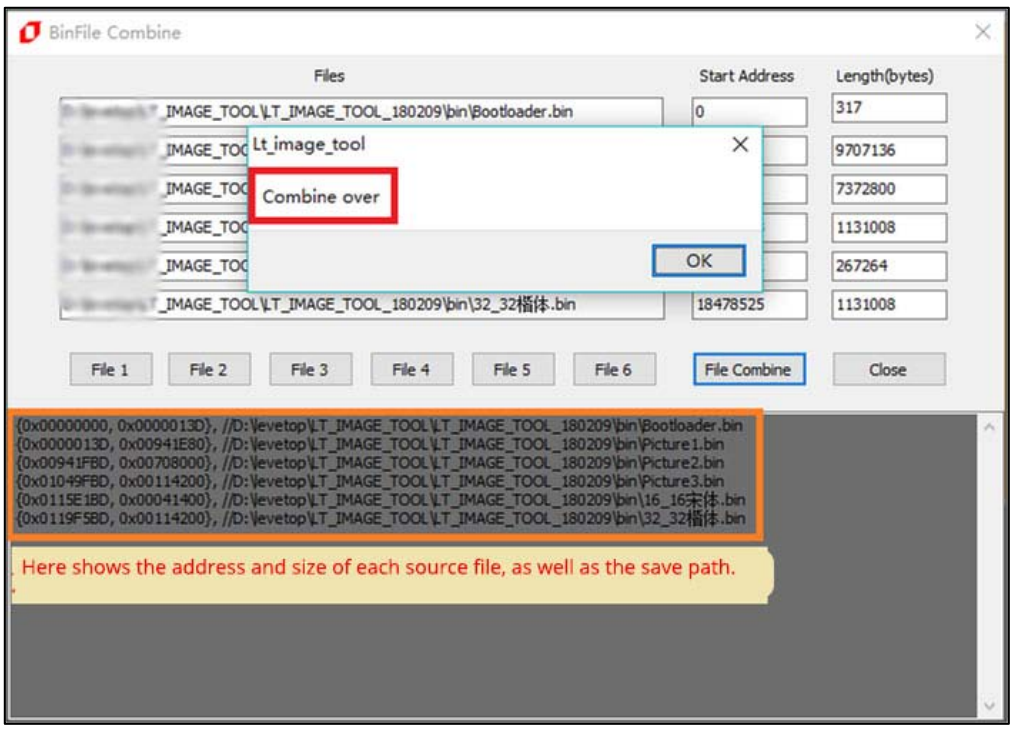


Figure 4-86: Combine Succeed

2、Generated BinFile Combine-Addr.txt:

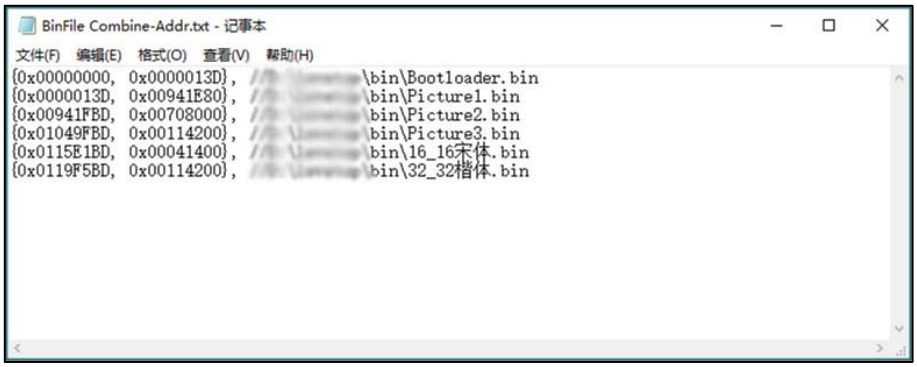


Figure 4-87: Save File

After combine completed, user can find the exported BinFile Combine.bin file in appointed folder, and user can use Programming the file in ER-TFT028A2-4-5465 external flash via SPI Flash Programmer.

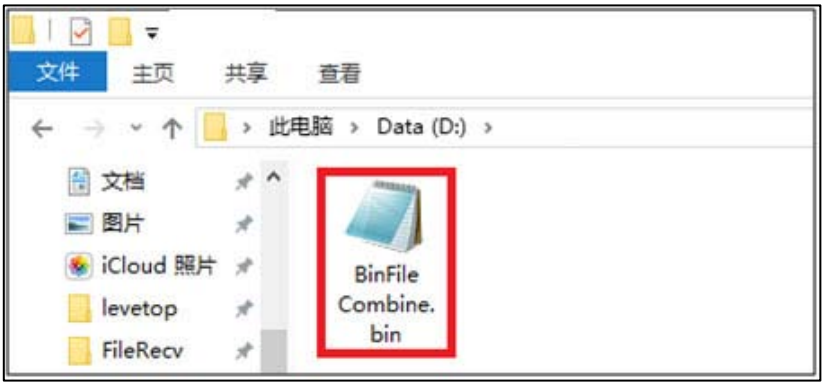


Figure 4-88: Exported Bin Combination File

5. Serial Communication Software (UartDebug.exe)

"UartDebug.exe" is a special software developed by EastRising, which is used to convert USB interface on PC to UART signal, and send command to ER-TFT028A2-4-5465 TFT panel Uart port to display different contents. Click 【Uart Debug】in "UartTFT_Tool", then user can open this software, it includes below section:

A. UartDebug Precaution

B. UartDebug Introduction

C. Load Simulation Command

D. Send Simulation Command

E. Send Simulation Command in Loop

F. Modify and Save Command List

G. Clear Command Box and Receiving Data

H. Load and Update "UserInfo.bin"

5.1 UartDebug Precaution

When using the UartDebug software, it is best to run as an administrator, otherwise the UartDebug software may receive errors in sending and receiving data. There are two ways to running as an administrator:

1) Right click on the “UartDebug”, and then click on the option “run as an administrator” in the pops up area. .If you choose this method, you need to perform the above operations every time you use the software. :

2) Right click on the “UartDebug” and click on the property in the area that pops up. (as Figure 5–2), click on the property and a new window will pop up. Chose “compatibility”, under the privilege level, select the option of “running this program as an administrator” and press “OK” (as Figure 5–3). After configuring it, use the software and double-click it to open it

3) Execute “UartDebug.exe” or open the software via “UartTFT_Tool.exe”. At first, double-click “UartTFT_Tool”, and click 【UartTFT】, pop-up a “Uart TFT Tool” window, click【Uart Debug】to open the software, as step 9 in previous Chapter 4.4.1 .

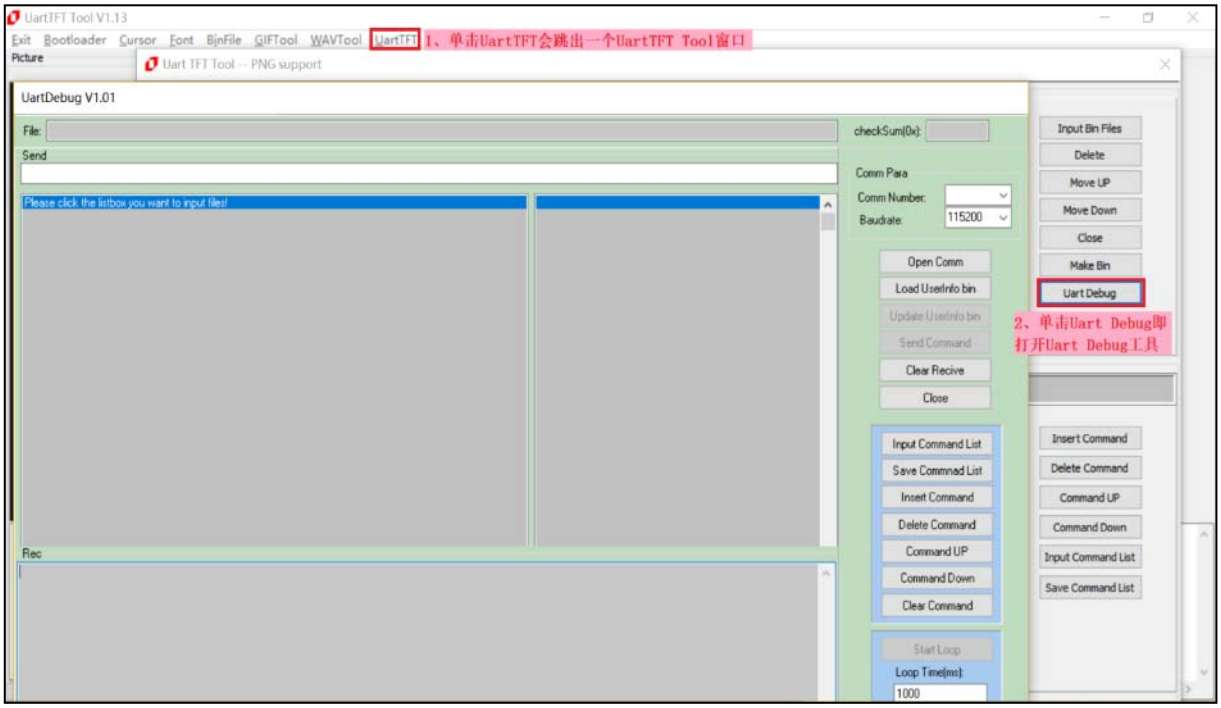


Figure 5-4 Open UartDebug on UartTFT_Tool

5.2 UartDebug Introduction

The UartDebug software interface as follow:

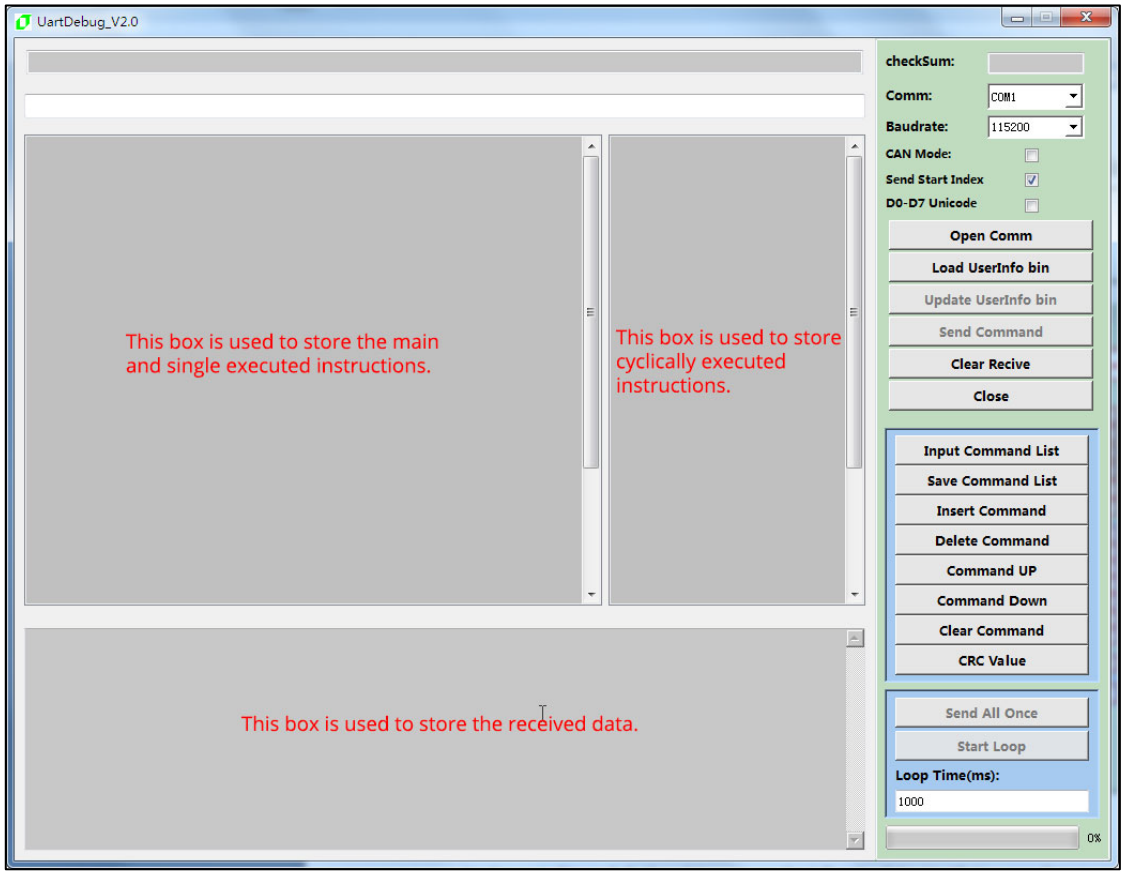


Figure 5-5: UartDebug Interface

As shown in Figure 5–5, the white area on the left side of the UartDebug interface is used to store single execution command, the white area on the right is used to store the loop execution command, and the lower gray area is used to store the received data. The small area is on the right from top to bottom. Are: select port, configure baud rate, open or close COM port, load “UserInfo.bin” file, update “UserInfo.bin” document, send command, clear receiving data, add command list, save command list, insert command, delete command, move up command, move down command, clear command, start or stop loop, time interval of two loop commands.

5.3 Load Simulation Command

1. At first, make sure PC (USB convert Uart) connect with the UART of ER-TFT028A2-4-5465 TFT panel, then click, 【Comm Number】and select correct Com Port, then click【Open Comm】:

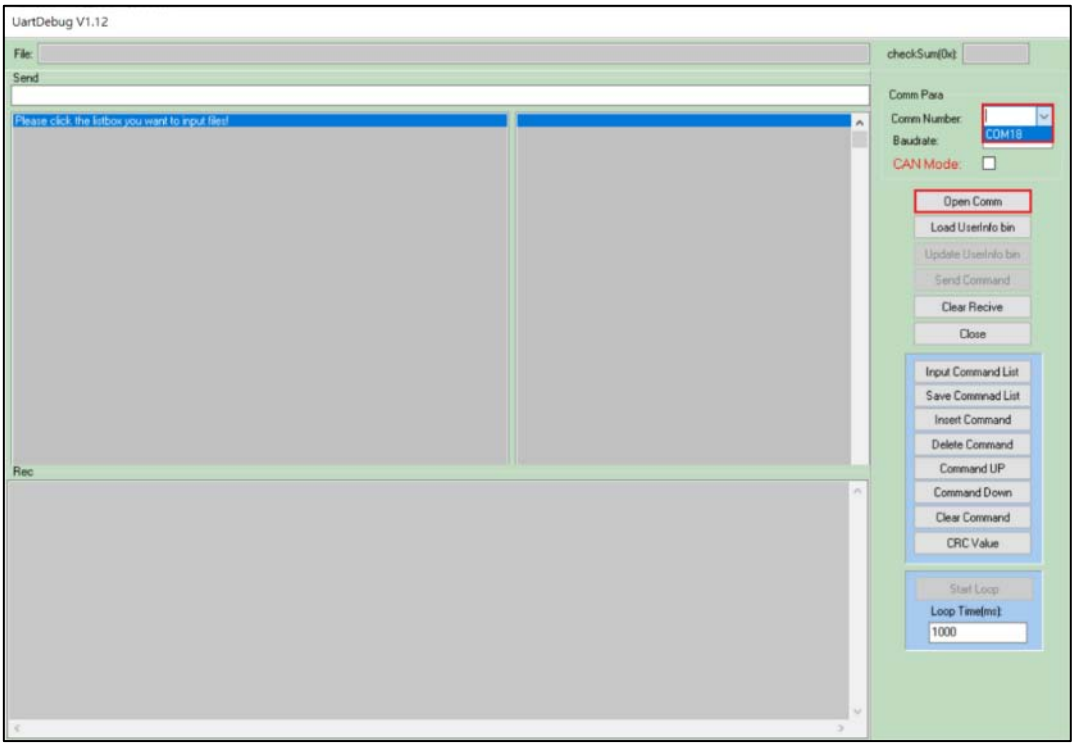


Figure 5-6: Select Com Port

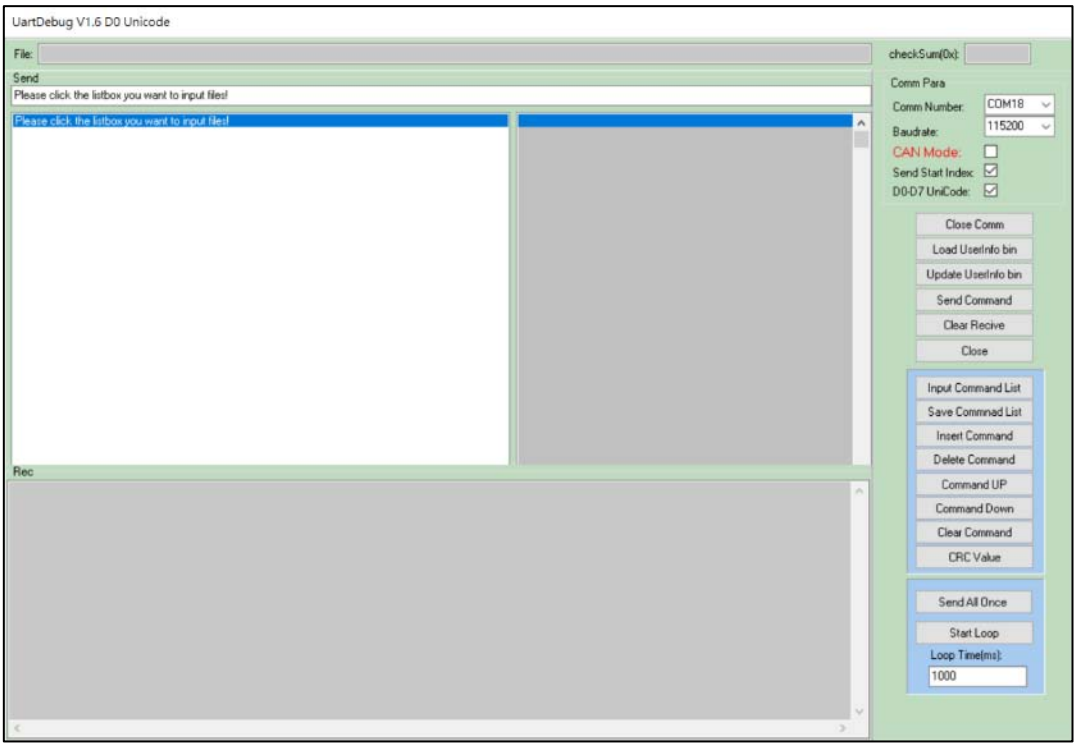


Figure 5-7: Click 【Open Comm】

2. Click the single command storage box on the left white area, and then click [Input Command List] to select the simulation command (.txt) that user written in advance, and click Open:

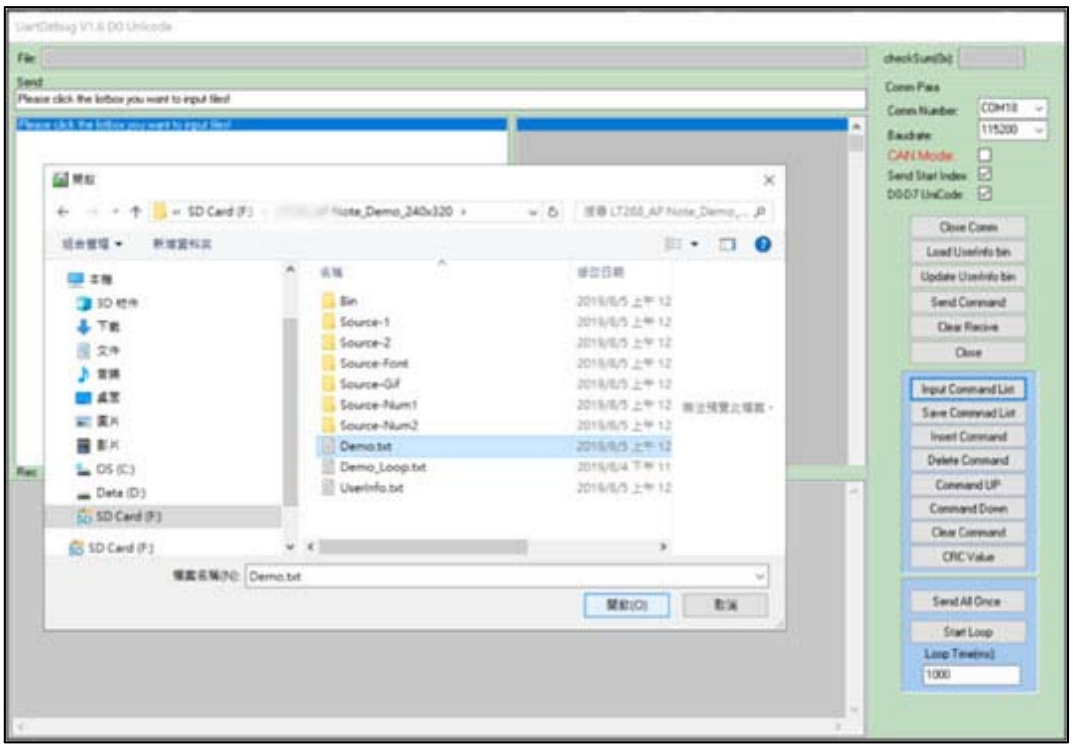


Figure 5-8: Select Command File

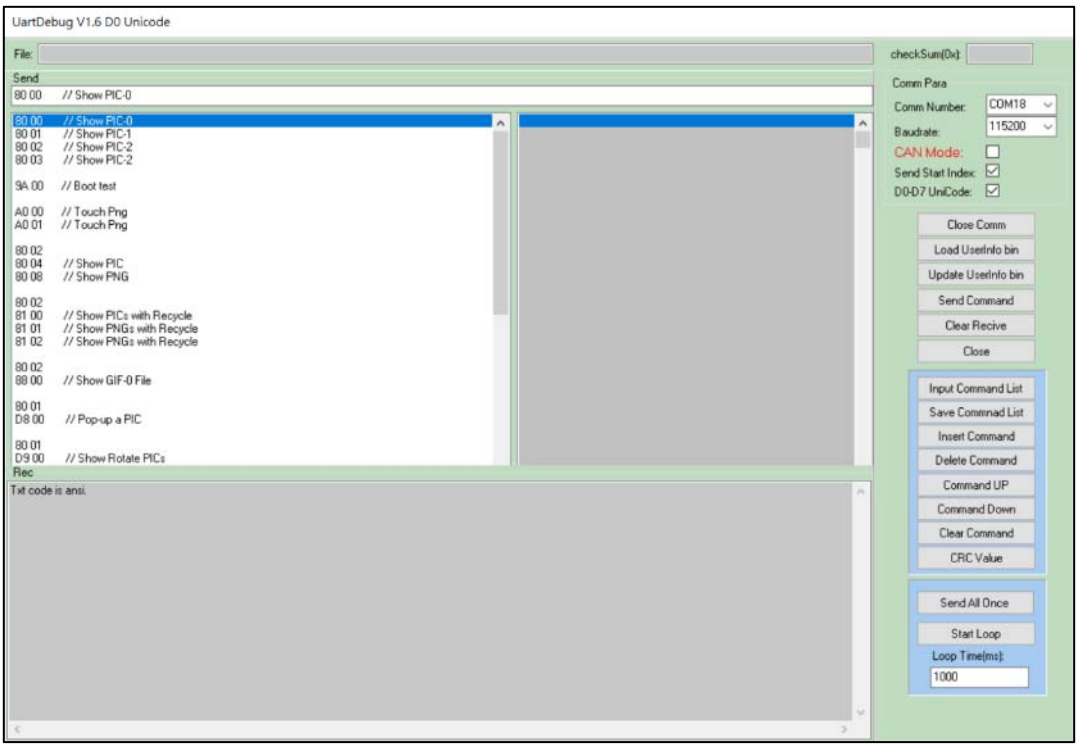


Figure 5-9: Load Command File

If user clicks “Input Command List:” without click the command storage area at first, it will pop up a notification: Please select a list box for input file, see Figure 5-10:

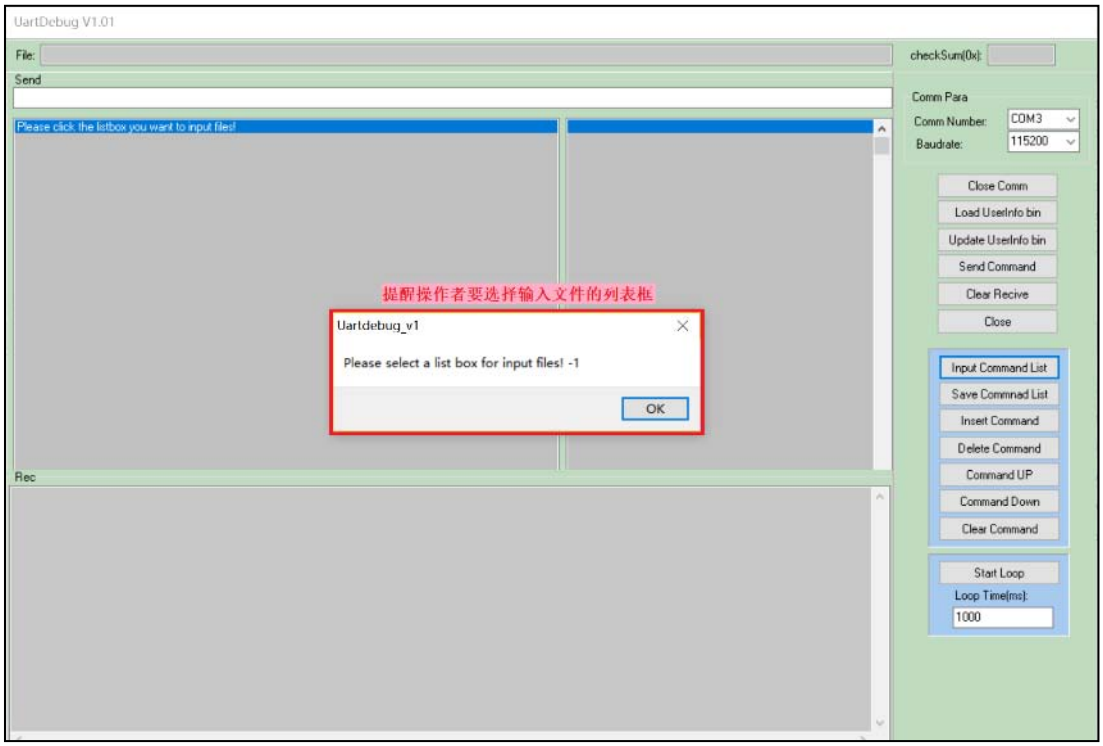


Figure 5-10: Select Input Command List

5.4 Send Simulation Command

User can double-click the simulation command, or click to select the command to be sent, and then click [Send Command] to send the command, then PC will send the simulation command to TFT panel. For example, double-click 80 01 on line 2 (Figure 5 -12), the TFT panel will display another picture (Figure 5-13A). Double click 88 00, the TFT panel will display an animated GIF (Figure 5-13B), and a feedback information will appear in the "Rec" window. Users can verify if the "UartTFT.ini" command file is correct.

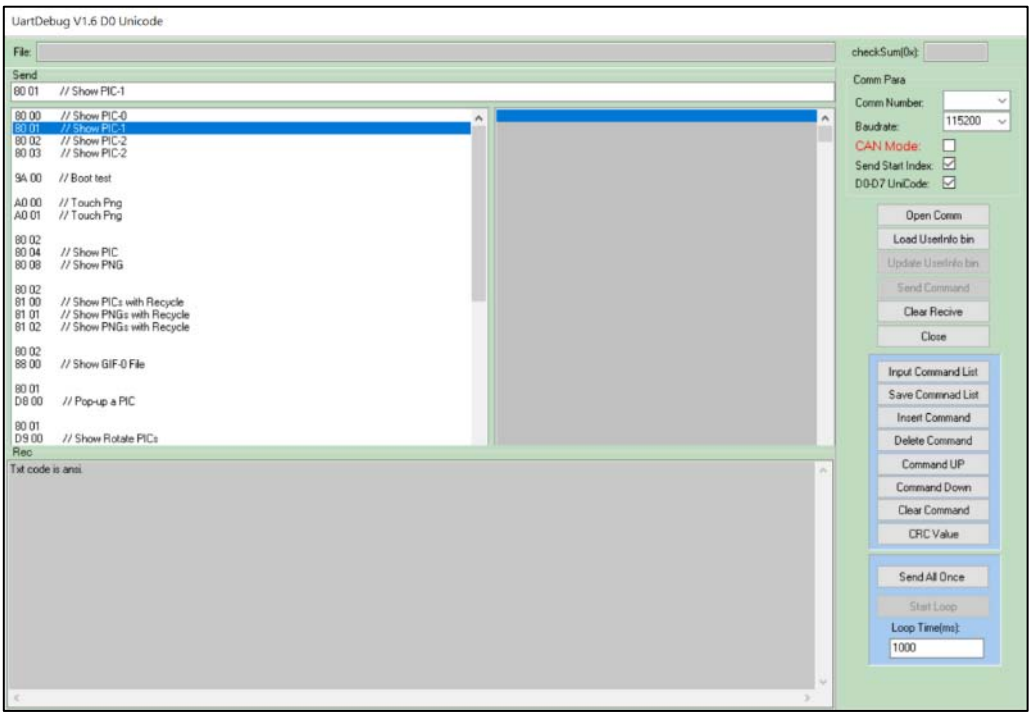


Figure 5-12: Send Simulation Command To TFT Panel

Figure 5-13A: Display Picture

Figure 5-13B: Display GIF

For the simulation command, the user can use the editing window on the right to modify and save the simulation command file (Demo.txt), or modify the simulation command file by the outside editor and click [Input Command List] to re-read the file.

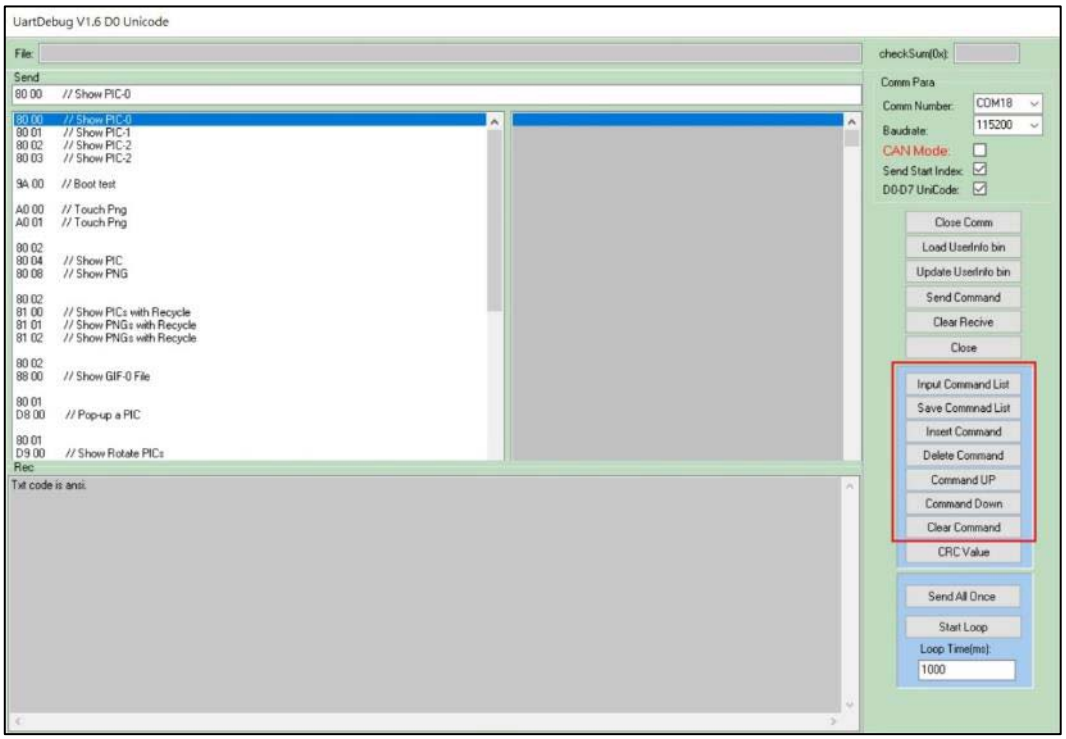


Figure 5-14: Revise Simulation Command File

According to Table 2-2 in Chapter 2, when the host transmits the display command to the ER-TFT028A2-4-5465 TFT panel through UART port, in addition to the command code, serial number, and command parameters, user still need to add 1 byte start code (fixed to 0xAA), 2 Byte CRC code, 4 Byte end code (fixed to 0xE4, 0x1B, 0x11, 0xEE), but there is no need to add the start code, CRC, and the end code of 4 Bytes in UartDebug simulation command, because UartDebug will automatically add these code in the program. For example, the above 88 00 example, in fact, the information that UartDebug passes to TFT panel is 0xAA + 88 + 00 + CRC(1) + CRC(2) + 0xE4 + 0x1B + 0x11 + 0xEE, which simplifies the complexity of command file

5.5 Send Simulation Command in Loop

1) Click the loop command store box on the right, click【Input Command List】, a new window will pop up, select the loop command and click open:

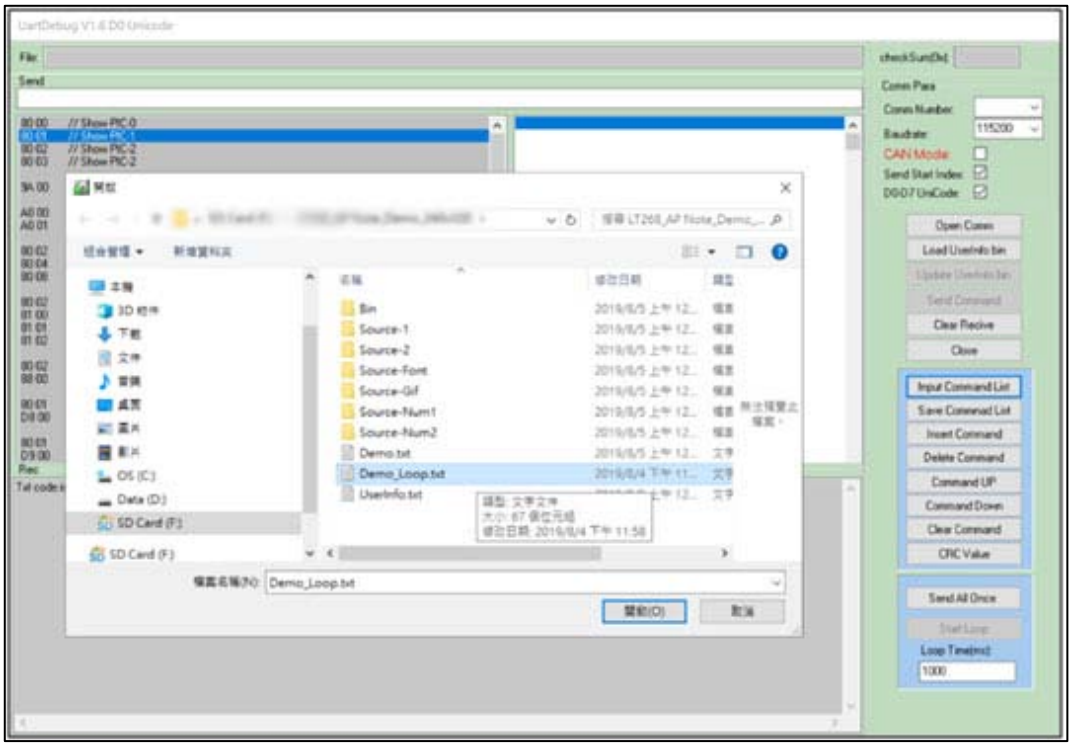


Figure 5-15: Select Loop Command

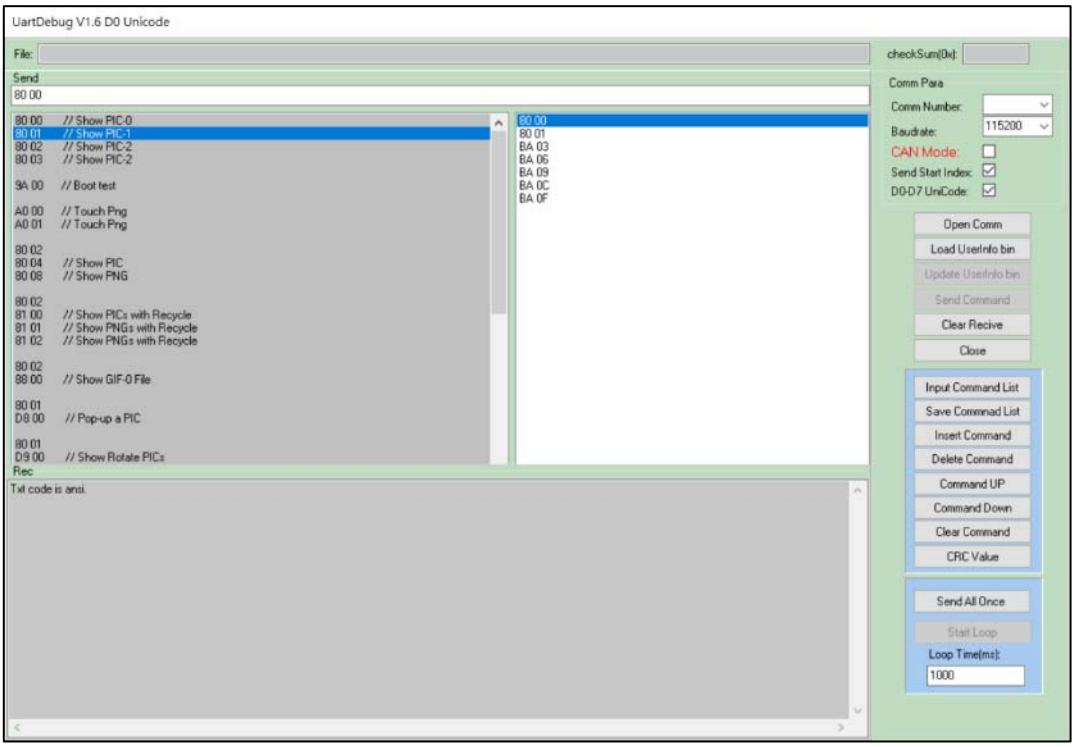


Figure 5-16: Loop Command Is Selected

2) Another way to select the simulation loop command is to click the command on the left, and select the loop command, then an “Add to Loop” box pop up, Click it to add the loop command.

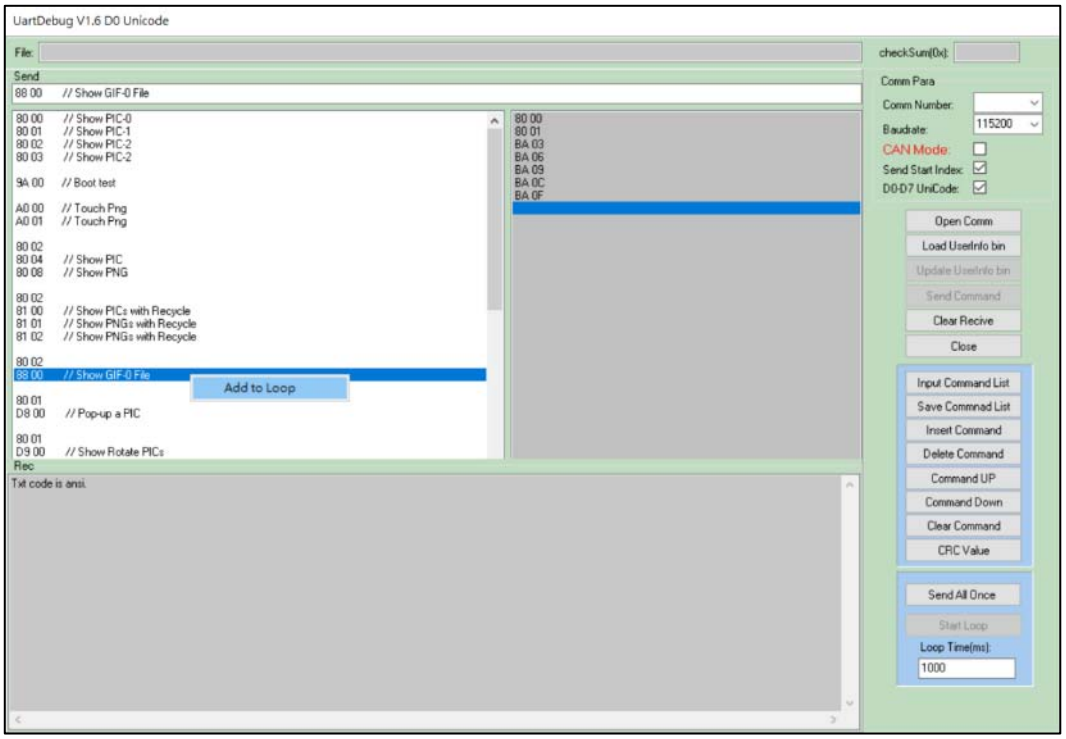


Figure 5-17: Add Simulation Loop Command

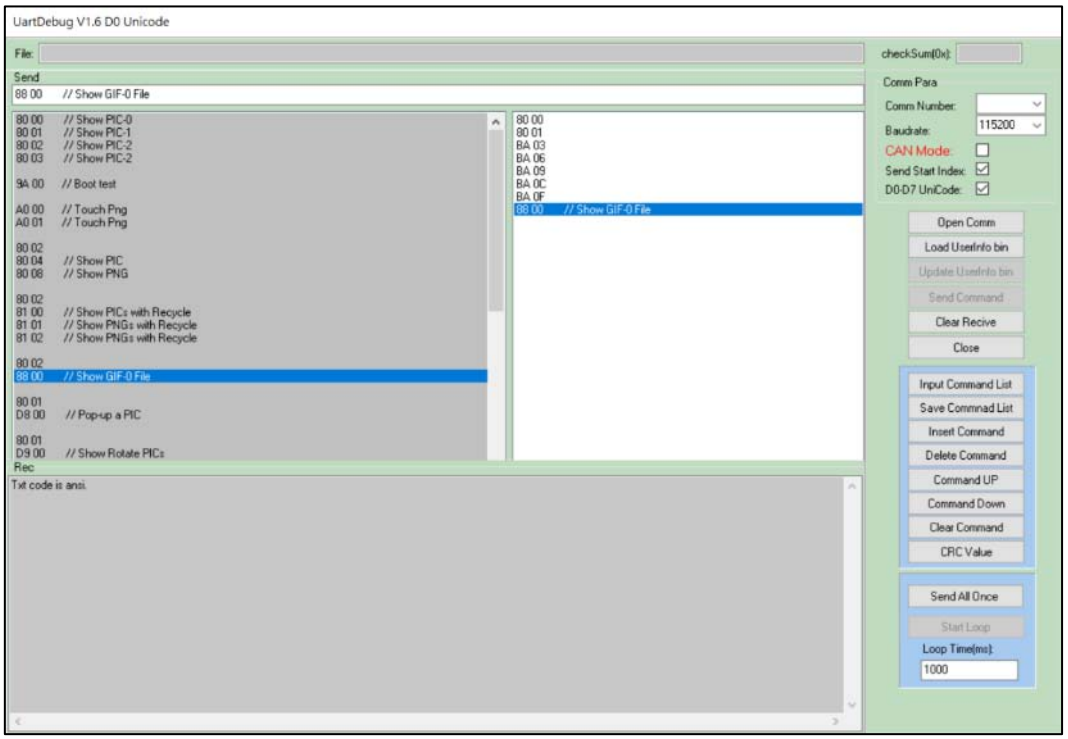


Figure 5-18: Simulation Loop Command Added

3) Click【Start Loop】, then user can send simulation command in loop, detail operation as below figure:

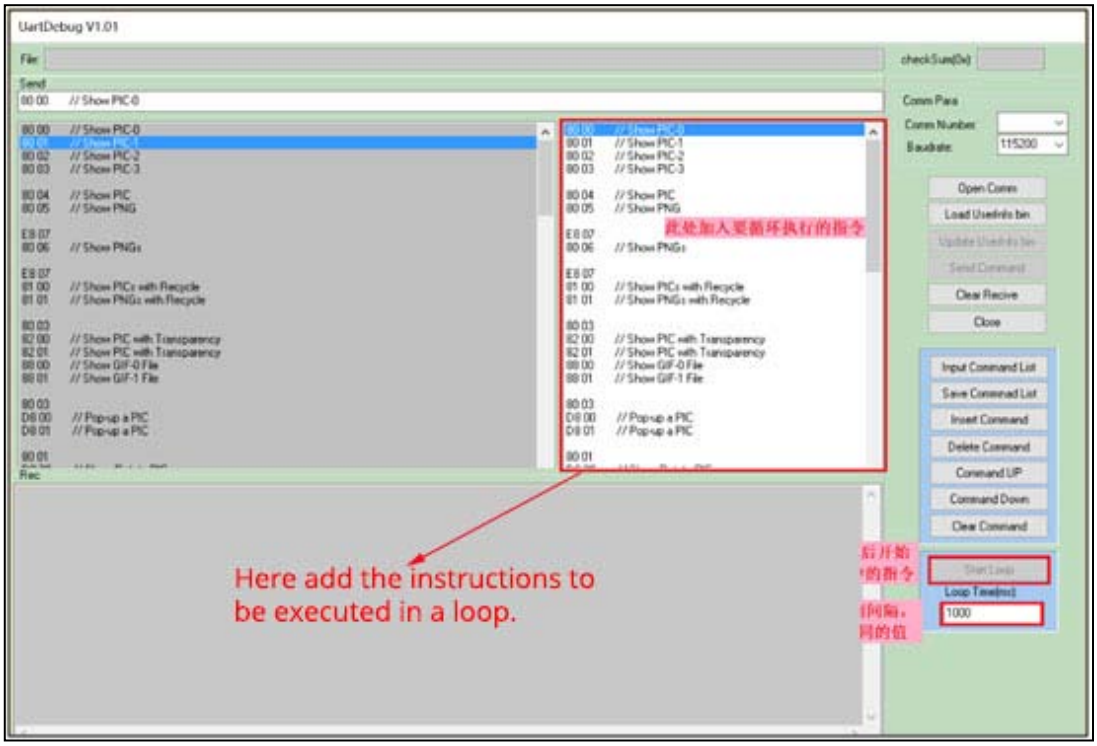


Figure 5-19: Send Simulation Command In Loop

4) During the process of sending command in loop, “Start Loop” will change to “Stop Loop”, user can click “ Stop Loop” to stop sending.

5.6 Modify and Save Command List

1) Modify Command: first click the command to be modified, then the command will be displayed in the blank area below “Send”. Now user can modify the command in bank area. After modifying it, press “Enter” to save the modification. The specific operation as below:

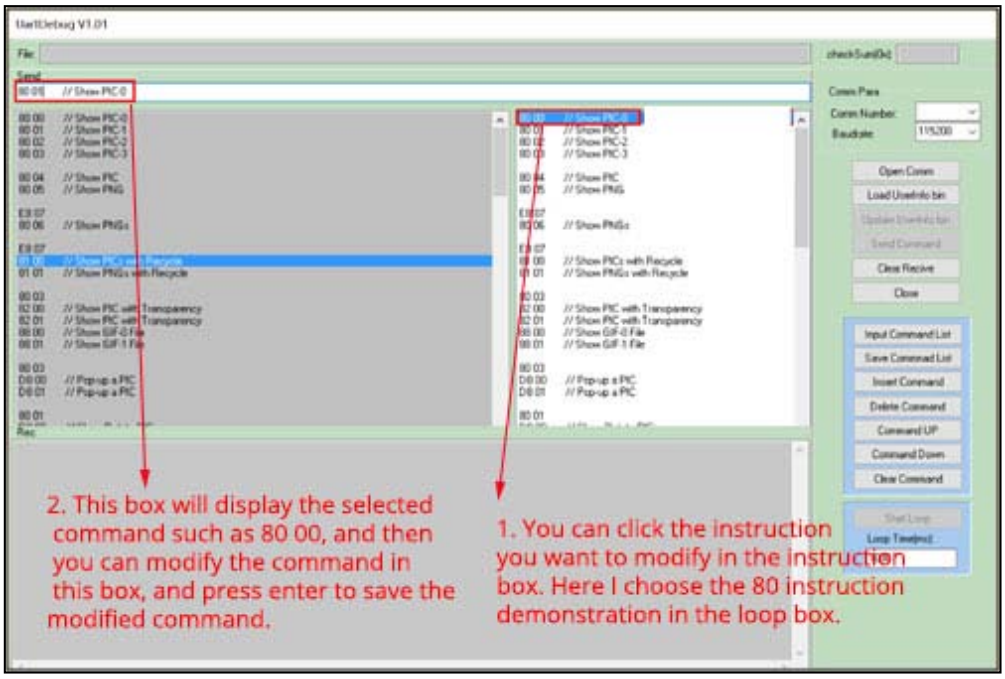


Figure 5-20: Modify Command

2) Insert Command: First select the location where you want to insert the command, then click “Insert Command”, and modify the command in the blank area below “send” to the command you want to insert, press “Enter” to save the command, the specific operation as follows:

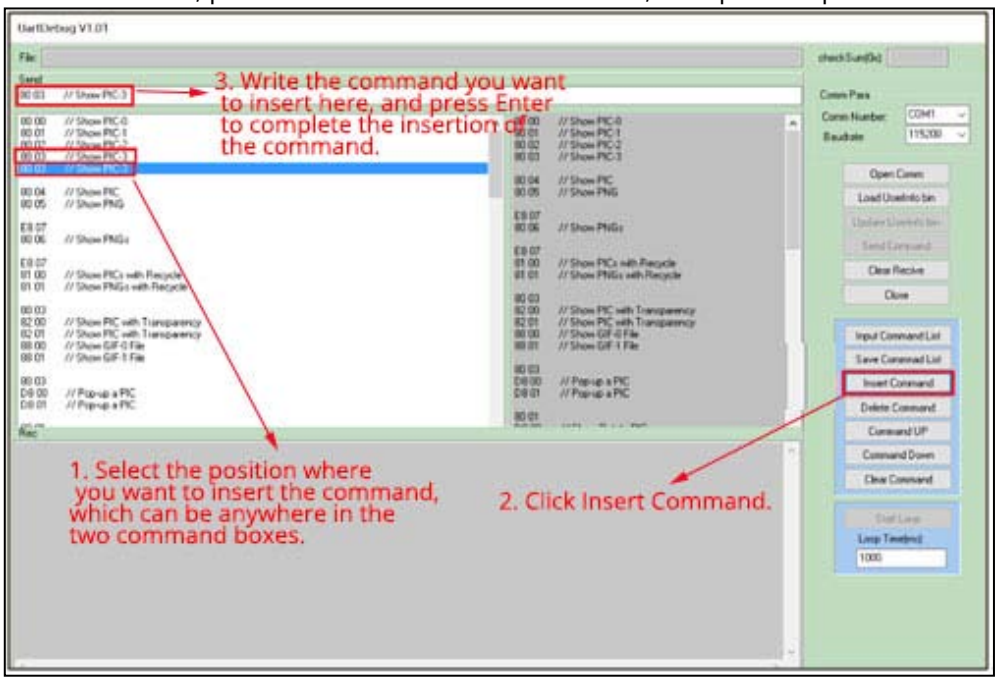


Figure 5-21: Insert Command

3) Select the command you want to delete, then click “Delete Command”, now the command is deleted. The specific operation as below:

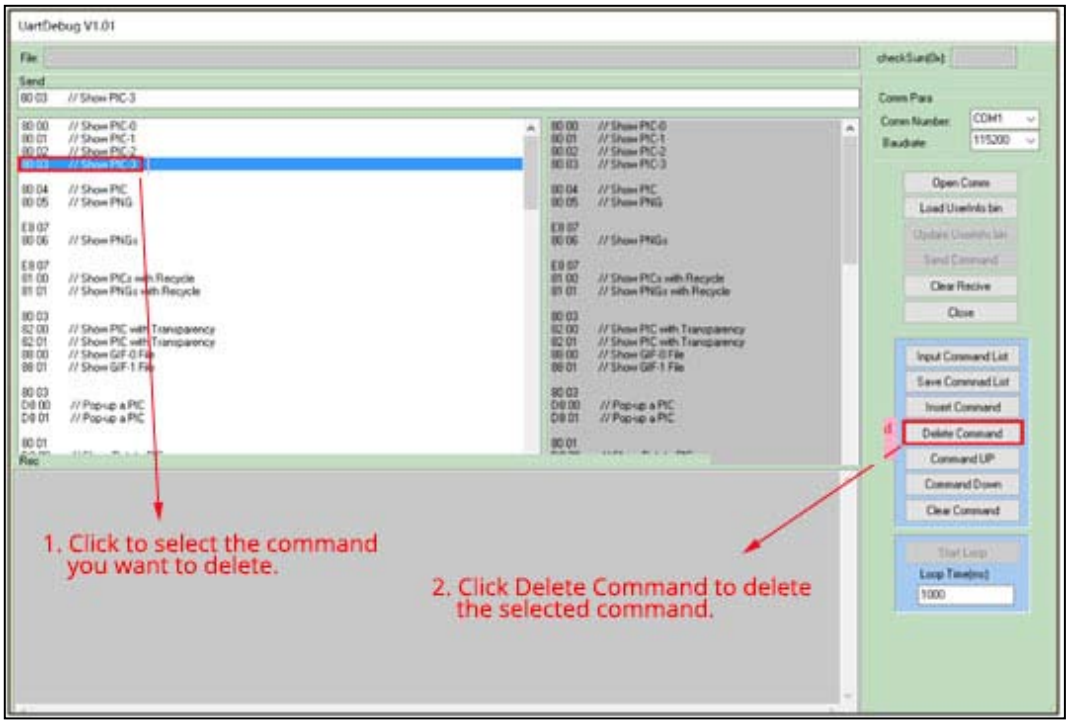


Figure 5-22: Delete Command

4) Move Up/Down Command: select the command you want to move, click “Command UP” to move up the command; click “Command Down” to move down. Specific operation as below::

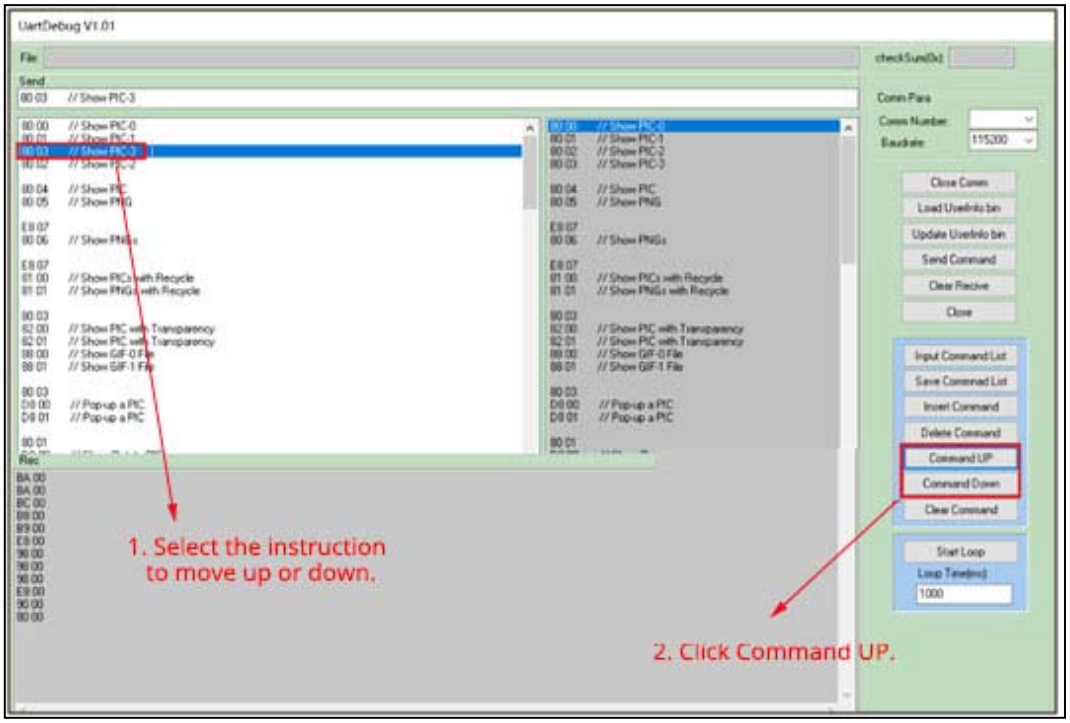


Figure 5-23: Move Up/Down Command

5) Save Command: First click on command area to save the command in the area as a document, then click “Save Command List”, a window will pop up. Select the folder to save, name the document you want to save, and click “Save” button to save the commands in the command areas as a document. Note: that user cannot directly save the commands in two areas at once; user can only save one area at a time. The specific operation as below:

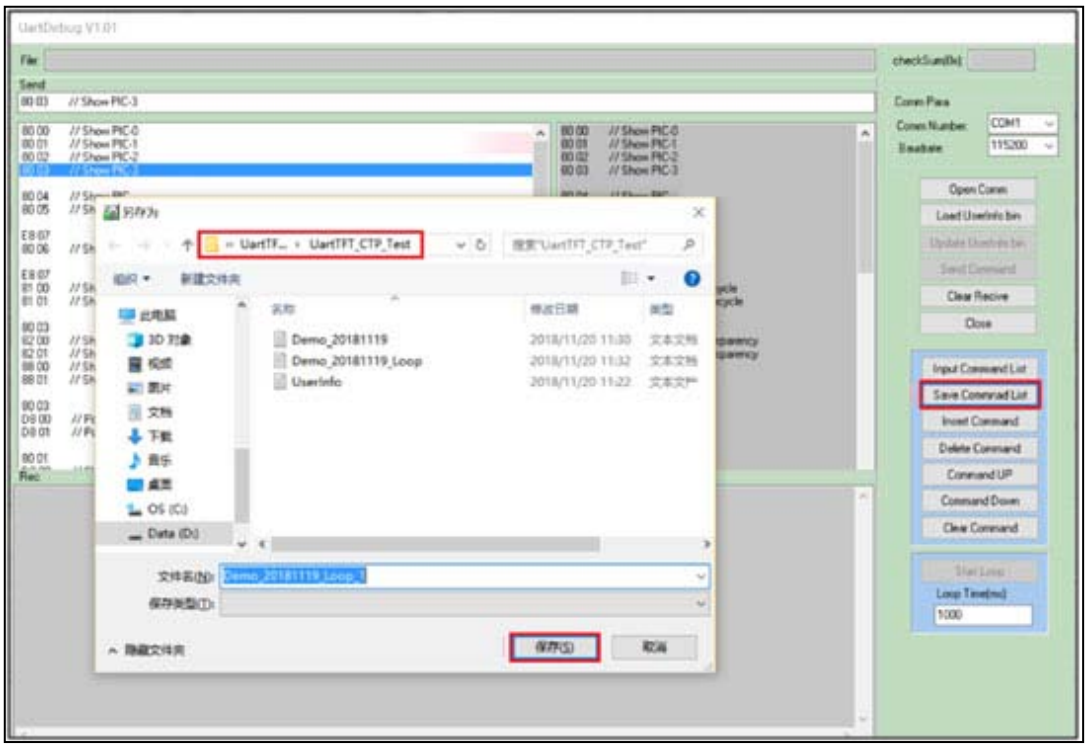


Figure 5-24: Save Command

5.7 Clear Command Box and Receiving Data

1) Clear command in command box: select the command area you want to clear, then click “Clear Command”, it will pop up a double confirm notice, press “OK” to delete, press “Cancel” to cancel the action.

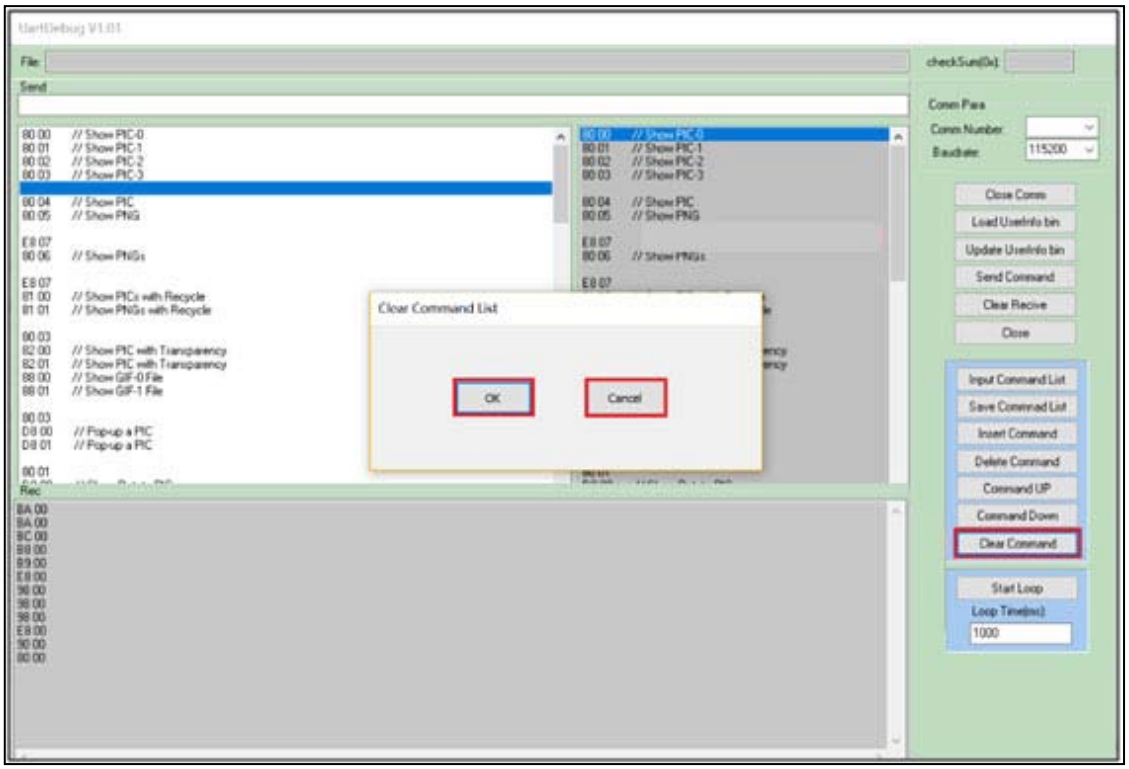


Figure 5-25: Clear Command

2) Clear receiving date: user just need to click “Clear Receive” to clear all date, specific operation as below:

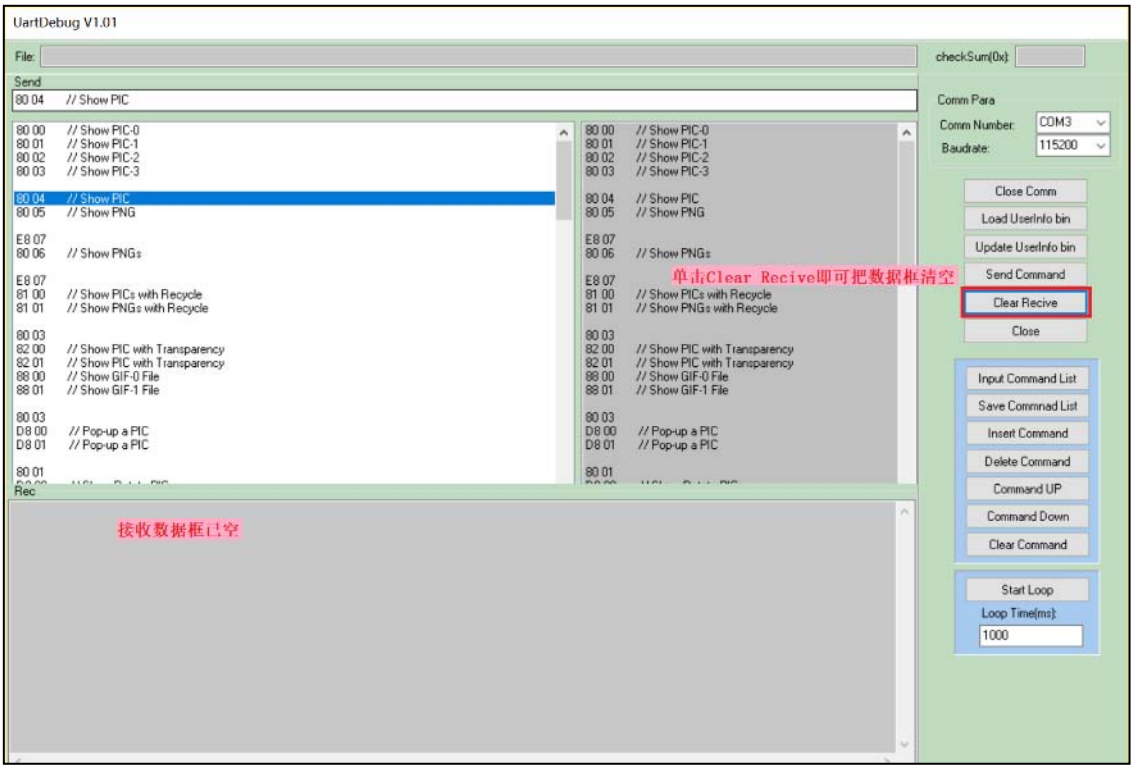


Figure 5-26: Clear Receiving Data

5.8 Load and Update UserInfo.bin

1) after COM port is opened, click “Load UserInfo Bin”, a window will pop-up, select the to be loaded “UserInfo.bin” file in the folder, see as below:

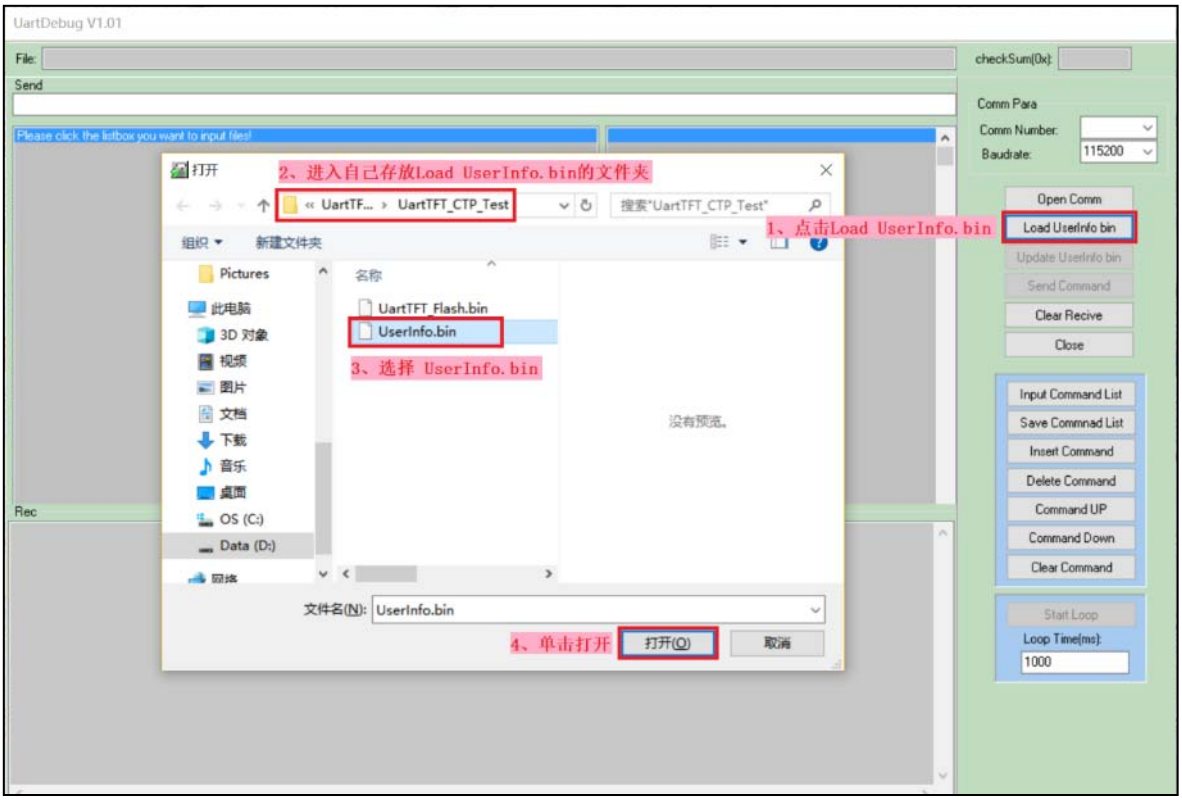


Figure 5-27: Load “Userinfo.Bin” File

2) Once load completed, click "Update UserInfo.bin" to update the "UserInfo.bin", as Figure 5-28 shown; TFT panel will show as Figure 5-29 shown.

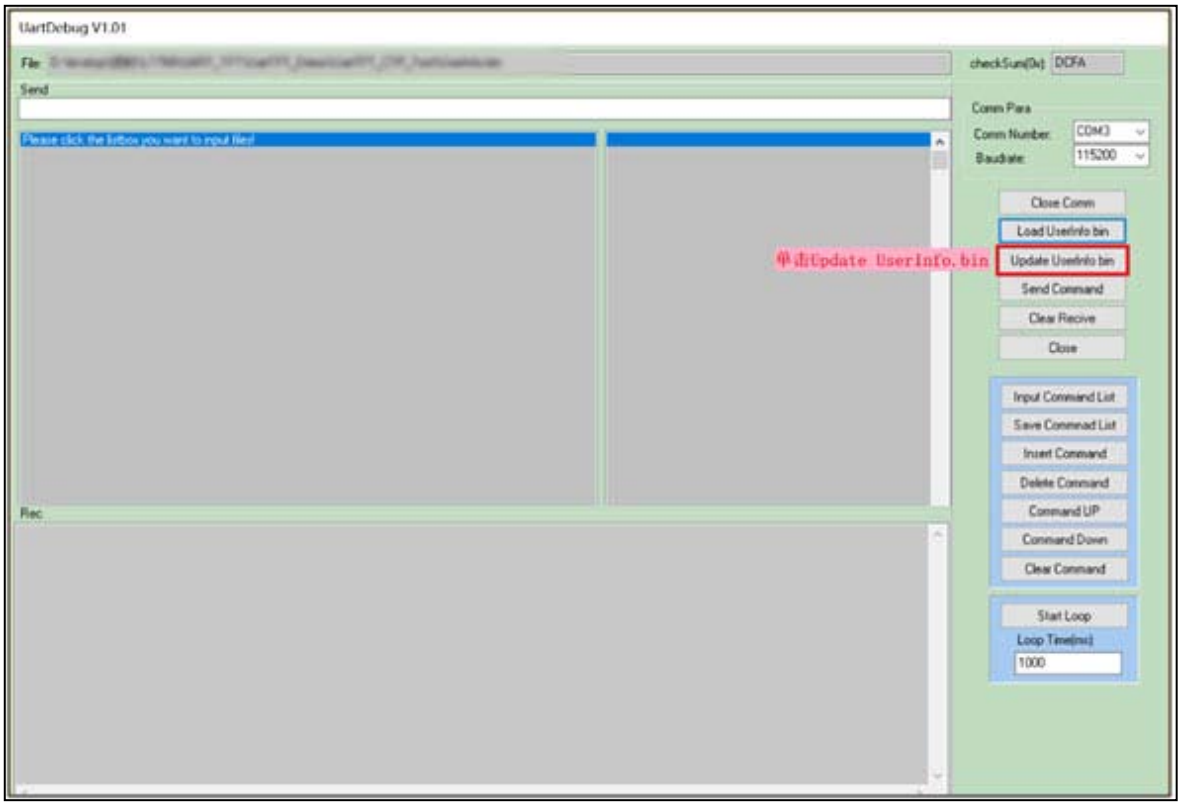


Figure 5-28: Update "Userinfo.Bin" File

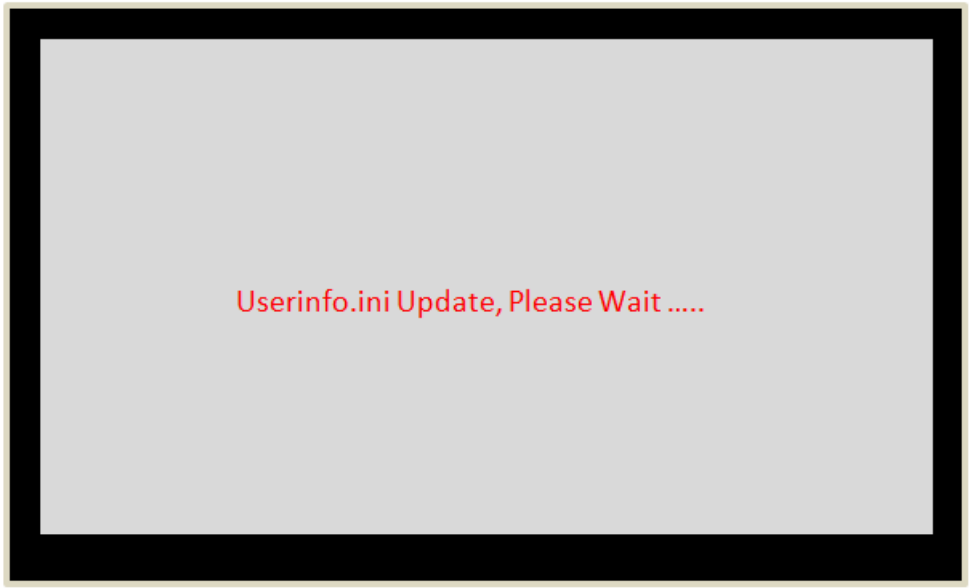


Figure 5-29: "Userinfo.Bin" Updating

3) Once update completed, TFT panel will display “Update Complete”

Figure 5-30: “Userinfo.Bin” Update Complete

Note: “UserInfo.bin” is generated by “UartTFT_Tool.exe”. Detail steps please refer to Section 4.4.1.

6. MCU Code and Flash Update

6.1 ER-TFT028A2-4-5465 Program Update

At first, download “LT Vcom GUI” from our website (www.buydisplay.com), and then extract and generate the “LT Vcom GUI” file. Before updating the SPI Flash or MCU program of ER-TFT028A2-4-5465 TFT Panel, the "BUSY" pin on the ER-TFT028A2-4-5465 board needs to be pulled low to enter the “USB_Update” mode. Then use the USB cable to connect the board to the computer, shown as below:

Figure 6-1: USB Connection

Execute update program “LT Vcom GUI.exe”, the software will automatically select ER-TFT028A2-4-5465 port number by clicking “Open Port”, shown as below:

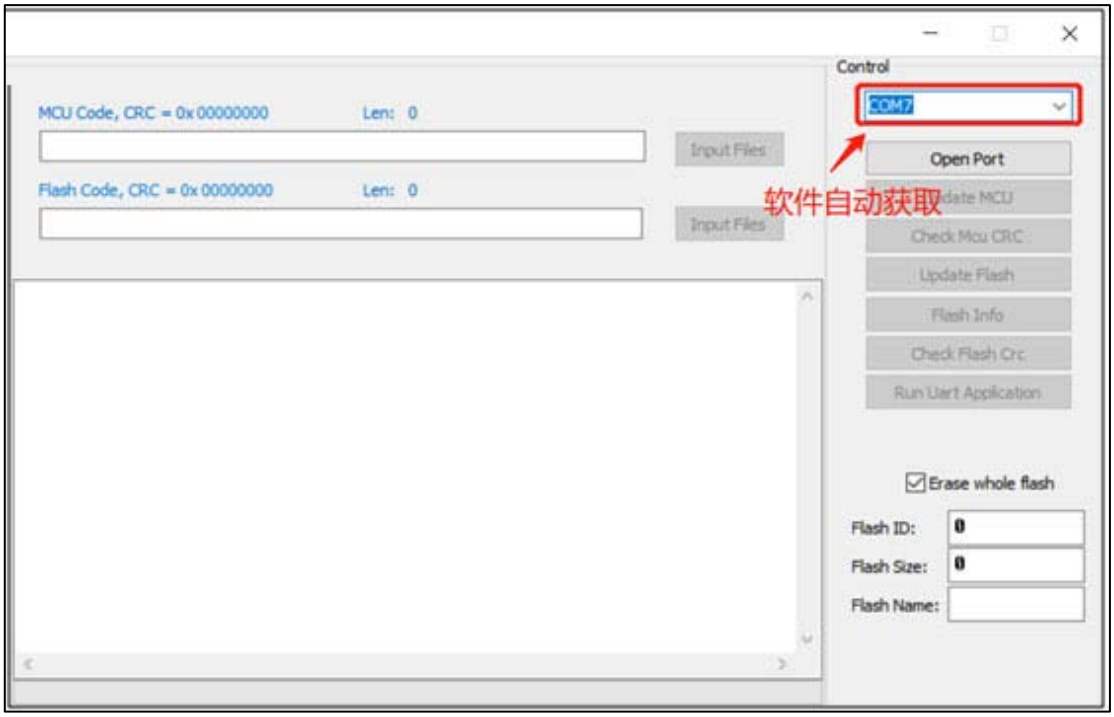


Figure 6-2: Execute LT Vcom GUI.exe E

The software interface as below after open COM port:

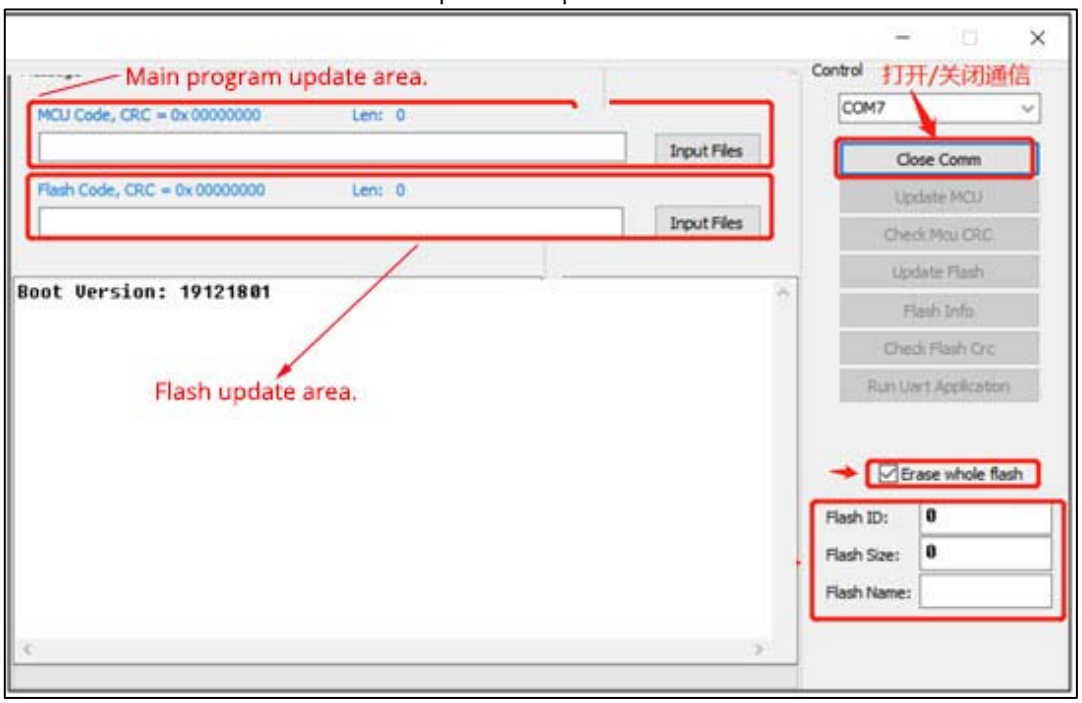


Figure 6-3: Main Interface

If you want to update the main program of ER-TFT028A2-4-5465's internal Flash, at first select the program update (the area in red circle), click "Input Files", open the program file of ER-TFT028A2-4-5465's MCU Code:

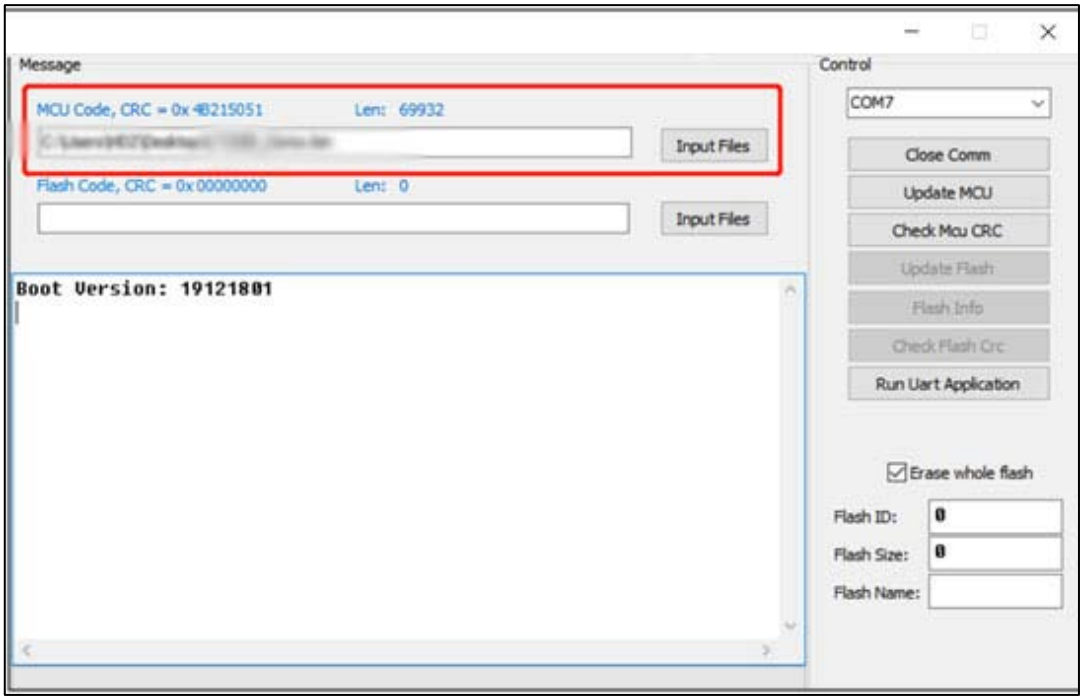


Figure 6-4: Select ER-TFT028A2-4-5465 Internal MCU Program

Click “Update MCU”, then it will update MCU.

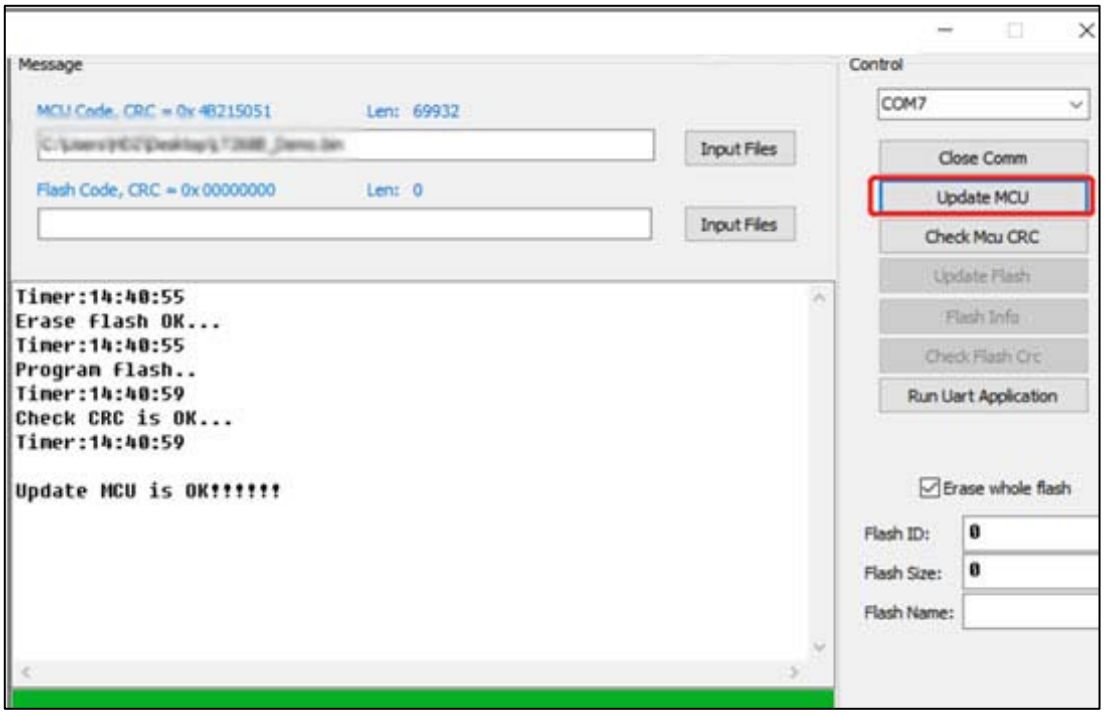


Figure 6-5: ER-TFT028A2-4-5465 Internal MCU Update

The button “Check MCU CRC” allows you to check whether the imported file is consistent with the current MCU settings, making it easy to verify the version. (The Update MCU already includes Check, no need to check the MCU CRC):

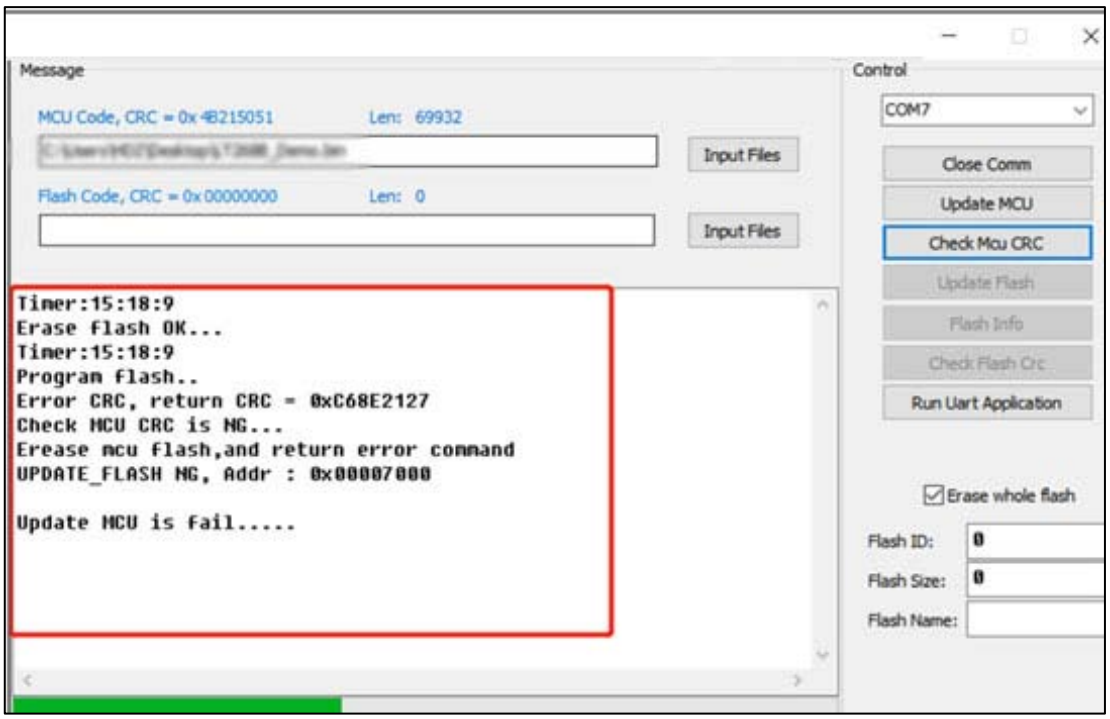


Figure 6-6: Check If Import File Consistence With Current MCU

After the programming is completed, you can click “Run Uart Application” to reset and run the program, or you can power on again to reset and run the program.

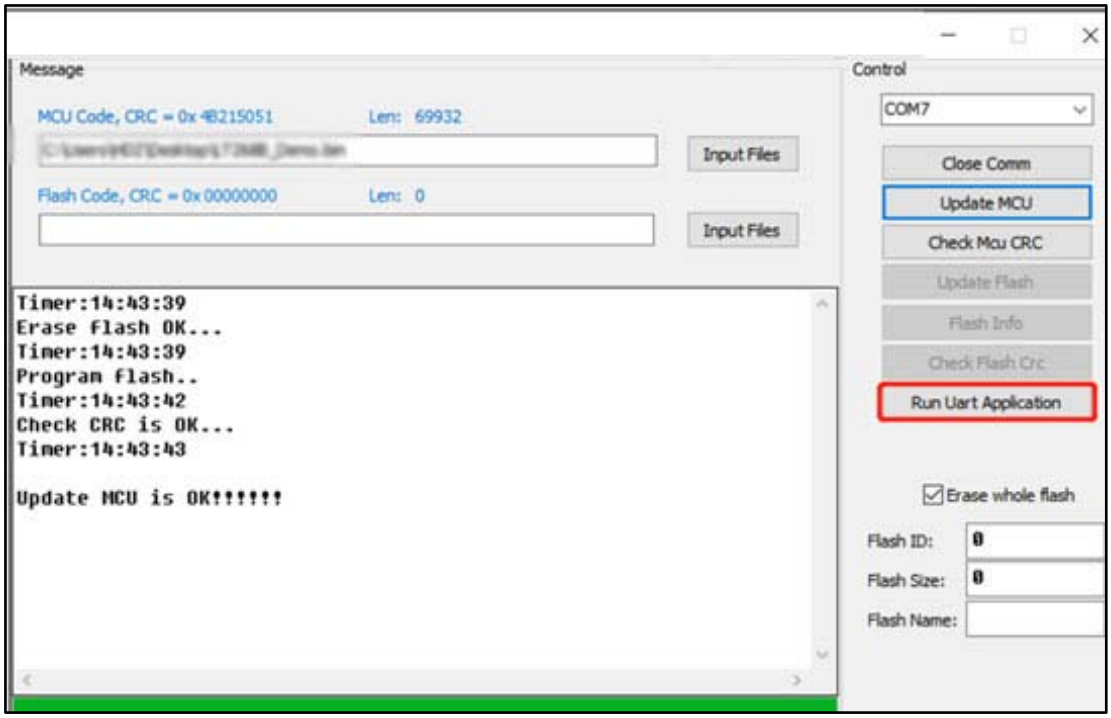


Figure 6-7: Reset And Run Program After Updating

6.2 ER-TFT028A2-4-5465 External Flash Update

The SPI Flash update method is similar to the update MCU program. Select the Flash file with the .bin suffix in the Flash Programming area(the area in red circle), and then click “Update Flash” to update. As shown below:

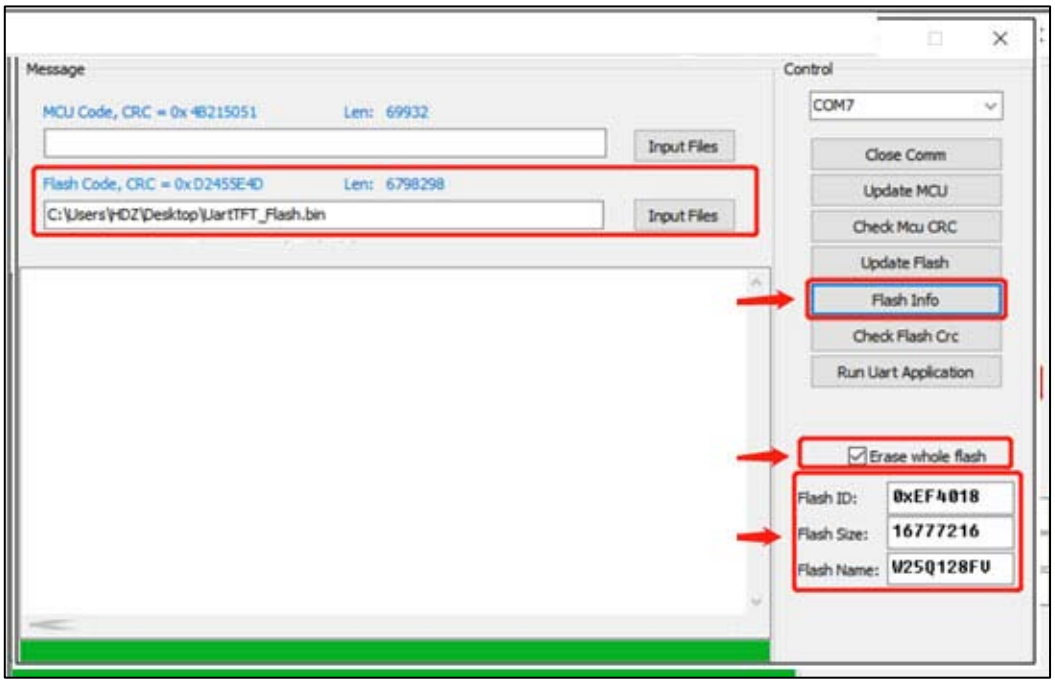


Figure 6-8: SPI Flash Update

Click "Update Flash" to update Flash. When updating large file, choosing “Erase whole flash” to reduce programming time. For example, erasing 16Mbit Flash will take about 30 seconds, and 32Mbit about 60 seconds. Flash CRC (Check Nor CRC checked) is automatically detected when the update is complete. When all is done, the following figure is shown:

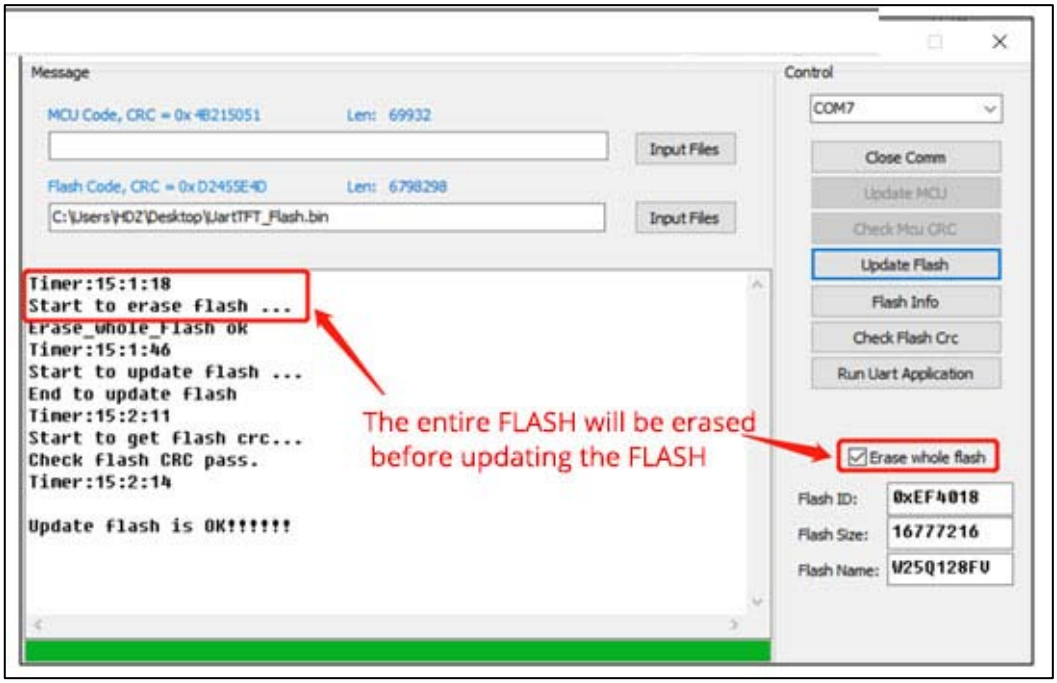


Figure 6-9: Update Flash Done

If updating small file, do not choosing “Erase whole flash” to reduce programming time. When update is done, the following figure is shown:

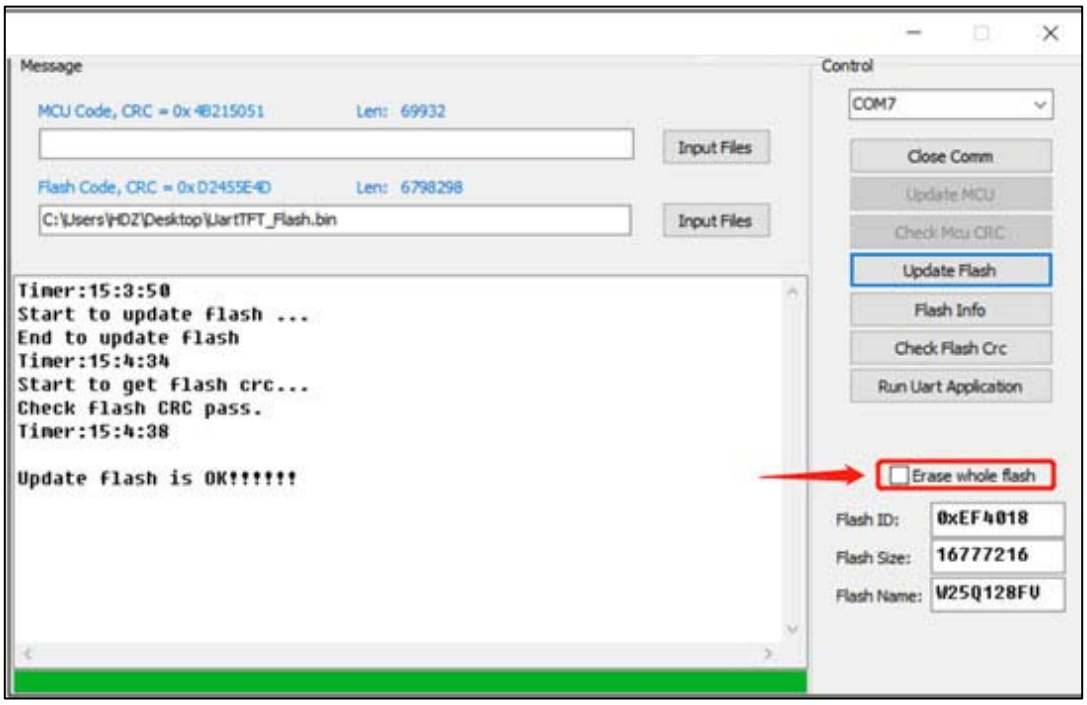


Figure 6-10: Update Flash Done

Currently this tool is compatible with most Winbond's NOR Flash. You can add your own Flash information and modify the "Flash.ini" file in the folder. At first, open the "Flash.ini" file in the same directory of this tool using notepad.

You can base on the format add the new Flash ID in "Flash.ini" file, as following figure:

Figure 6-12: Add New Flash ID Information on the "Flash.ini"

6.3 Use SD Card Update SPI Flash

ER-TFT028A2-4-5465 can also update External SPI Flash with an SD card. First store the update file "UartTFT_Flash.bin" on the root of an SD card. Note that the "BUSY" pin on the ER-TFT028A2-4-5465 module does not need to pull low. After the TFT module is power on, insert the SD card into the SD card socket on the module. The ER-TFT028A2-4-5465 will automatically detect and then enter the update image, as following:

Figure 6-13: Flash Update Image

After the countdown is 3 seconds, ER-TFT028A2-4-5465 will start to read the "UartTFT_Flash.bin" data on the SD card, and begin to program the SPI Flash, as shown in the figure below, after the program is completed, ER-TFT028A2-4-5465 It will restart automatically. Note: SD card does not support updating ER-TFT028A2-4-5465 serial port main program.

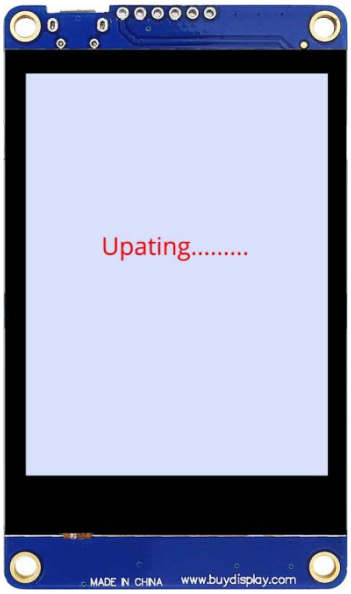


Figure 6-14: SPI Flash Updating