RAiO

RA8876_77_71(M)_73(M) AP
User Guide

Version 0.3
August 20, 2017

RAiO Technology Inc.

Revise History		
Version	**Date**	**Description**
0.1	January 15, 2015	Initial Release
0.2	February 26, 2015	Add Chapter 10 PIP Function
0.3	June 29, 2017	Added information about the RA8871(M) and RA8873(M)

Contents

1. Before You Begin

1.1 Conventions Used in This Guide

Symbols

Symbols	Description
✉	Contact us information
❶ ❷	Step number
📄¹ 📄²	Note number

Text

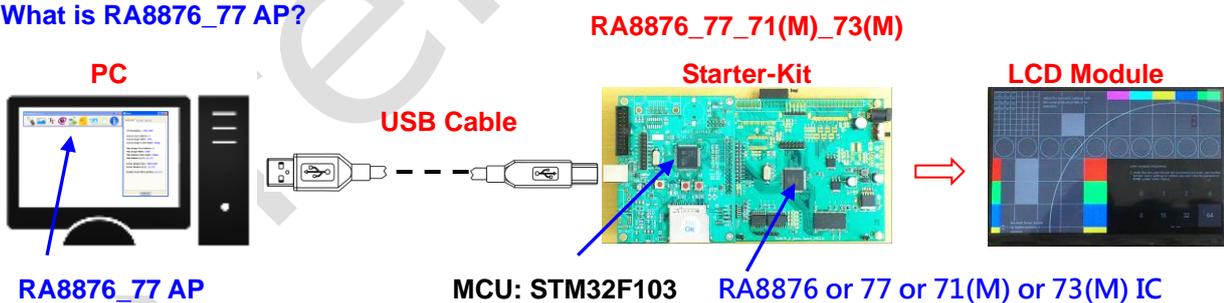| Abbreviations	Description
AP	Application Program
PC	Personal Computer
API	Application Programming Interface
DMA	Direct Memory Access
BTE	Block Transfer Engine
CE	Color Expansion
PIP	Picture in Picture
76 / 77 / 71(M) / 73(M)	RA8876、RA8877、RA8871(M)、RA8873(M)
RA8876_77 AP	RA8876、RA8877、RA8871(M)、RA8873(M) AP

1.2 What is RA8876_77 AP?

Figure 1-1 Starter-Kit connection with PC and LCD Panel

RA8876_77 AP (Application Program) was specifically developed to emulate a basic application environment for LCD controller named "RA8876"、"RA8877"、"RA8871(M)" and "RA8873(M)". This software is worked under Microsoft Windows OS (WINDOWS XP/7/8/10). With this AP and the hardware environment provided from RAiO, user can easily control RA8876 / 77 / 71(M) / 73(M) to perform graphic, font, DMA , BTE and PIP functions etc on the high resolution LCD module.

In addition, RAiO offers application-specific API and Starter-Kit which are worked with the RA8876_77 AP (F/W is edited by KEIL-C, and MCU is STMicroelectronics STM32F103). These reference data will be useable for many C language systems without additional coding effort, and it will reduce user's product development time as well.

Features and Benefits:

■Fast to realize each functionality of RA8876 / 77 / 71(M) / (73(M), user can choose the applicable functionalities for their project requirement/system. With RA8876 / 77 / 71(M) / 73(M), the performance for user's main system will be improved, and the process loading of MCU will be also reduced.

■Help user to know the operation of each function for RA8876 / 77 / 71(M) / 73(M), accelerating product fast time-to-market (TTM) and time-to-profit (TTP).

■The display result can be immediately shown on the LCD display with this AP system and the start-kit, to avoid continually modifying the parameters of RA8876 / 77 / 71(M) / 73(M) with firmware coding, so user need not to spend so much time to revise firmware for MCU.

■For the LCD module makers/producers, they can persuade customer much more easily, if they promote RA8876 / 77 / 71(M) / 73(M) with this AP system.

The goal of AP is trying to help our customers, who are unfamiliar with RA8876 / 77 / 71(M) / 73(M), let them know how to use the related parameter setting and how to apply the manipulations of RA8876 / 77 / 71(M) / 73(M). In this document, we only provide the functionality description in common use, because user can easily comprehend the usage of RA8876 / 77 / 71(M) / 73(M) and apply our controllers on their system rapidly. If user wants to use the further function of RA8876 / 77 / 71(M) / 73(M),

or have any suggestion for this AP, please contact with our FAE (✉), we will provide the solution for you as soon as possible.

✉ ──────────────────────────────────

RAiO

☒ **TEL :** +886-3-5637888   **EXT :** 178 / 188

☒ **FAX** : +886-3-5601166

☒ **Sales E-mail** : sales@raio.com.tw

☒ **FAE E-mail** : fae@raio.com.tw

☒ http://www.raio.com.tw

☒ **Office Address** :

　6F-5, No.8, Tai Yuen 1st Street, Chupei City, Hsinchu, Taiwan

1.3 Recommended System Requirements

■Need to work with the Starter-Kit of RA8876 / 77 / 71(M) / 73(M)

■Work in Windows XP / 7 / 8 / 10 OS.

■Need to install STM32F103's USB Driver before using the AP.

2. Operating the System

2.1 Installing USB Driver

2.1.1 Windows XP Driver

❶ When the first time user plugs the RA8876 / 77 / 71(M) / 73(M) Starter-Kit into a USB port of PC, The operating system (Windows) will show a message "**Found new hardware STMicroelectronics Virtual COM Port**" as shown below.
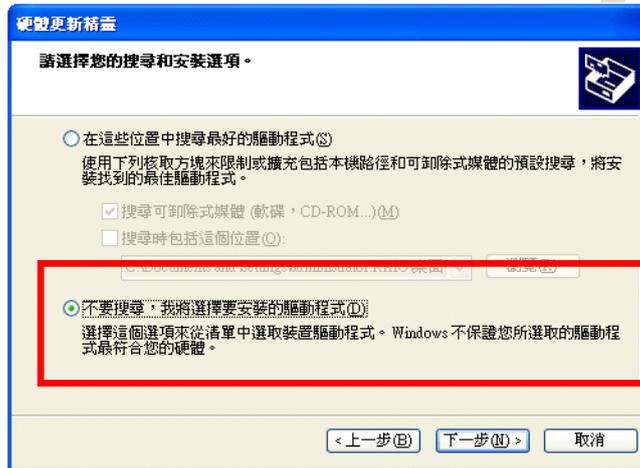

❷ Windows will ask a request "installing device driver software". And click "**Next**" button.
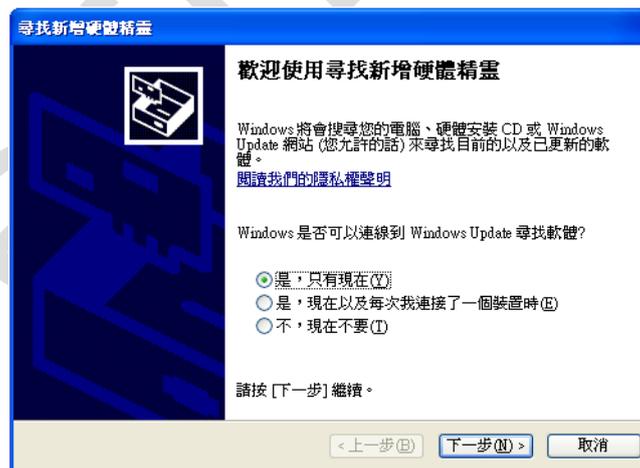
❸ To select the option titled "**Install from a list or specific location (Advanced)**" and press the Next button.

❹ To select the option titled "**Don't search. I will choose the driver to install.**" and press the Next button.
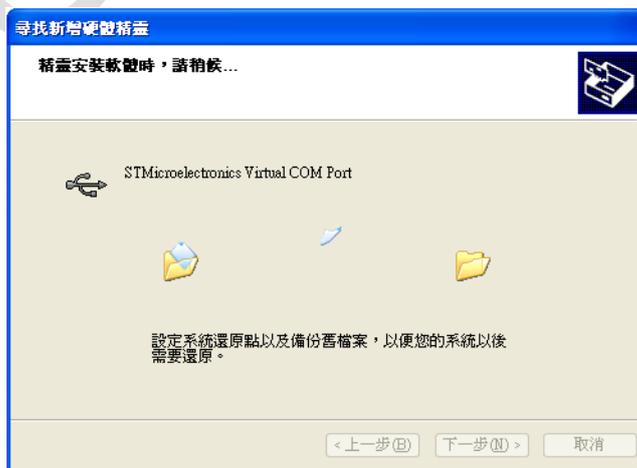

❺ Click "**Have Disk…**" button

❻ You should now see the dialog shown below. To insure that the "Include this location in the search:" checkbox is selected and hit the Browse button to navigate to the directory where the software was installed. "..\STM32F103_USB_DRIVER"

❼ Click "**Next**" button

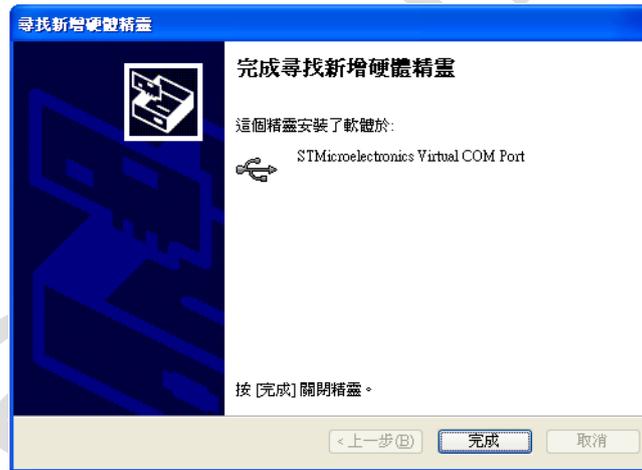

❽Start to install the driver, please wait for a while.

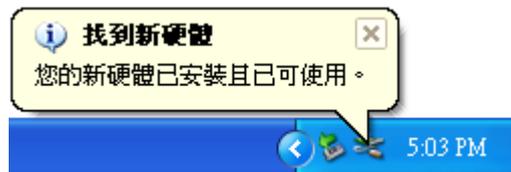❾Windows will ask a file path for "libusb0.sys". Set the path to "STM32F103_USB_DRIVER\x86", press "Enter"

⑩ The driver files have now been installed and your installation is completed.

Click [Finish] button to finish the driver install and close the dialog.

⑪ System shows the new hardware has been installed and the USB device can be used already.

⑫ To open Device Manager with the OS "Window XP", from the Windows desktop, the operating path is, click Start -> click Control Panel -> click Performance and Maintenance -> click System -> and click Device Manager. And then we can see the device is shown up in the list of Device Manager (STMicroelectronics Virtual COM Port), it means that the Windows

Machine recognizes this USB device and it has associated a specific driver to communicate with the device. Please refer to the following figure.
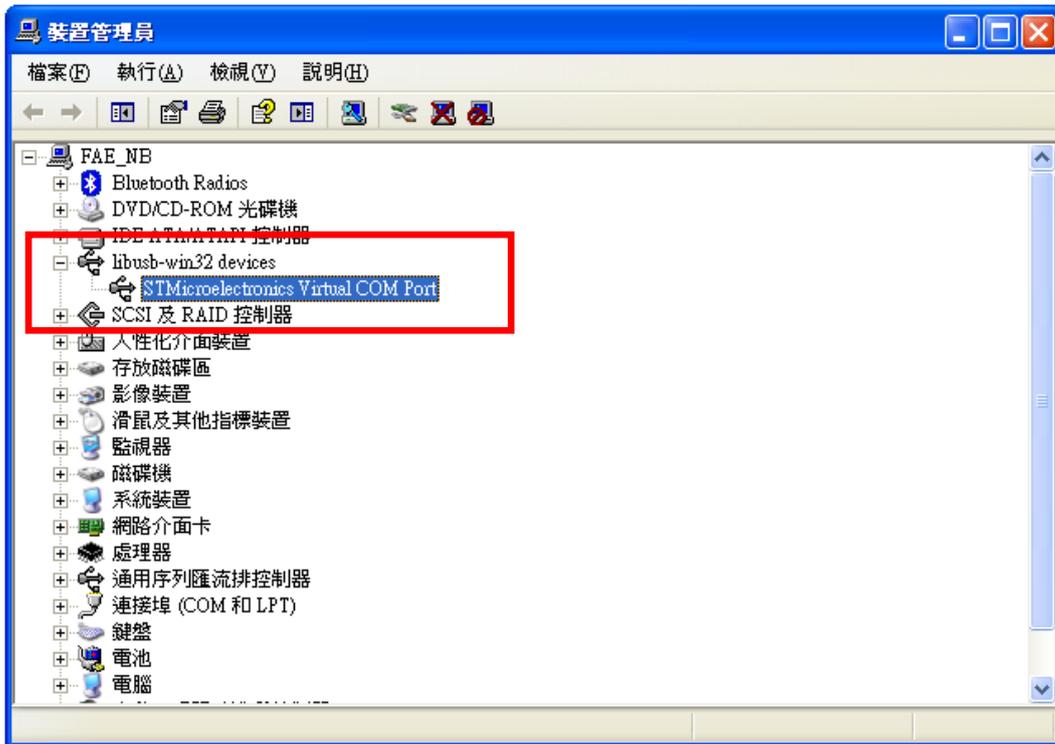

2.1.2 Windows 7/8/10 Driver

Unlike previous versions of the Windows operating system, Windows 8 imposes strict limitations on driver signing. Because of this, unsigned drivers require extra steps for installation. We can refer to this tutorial video (or this tutorial website) to disable driver signature enforcement on Windows 8 before installing this driver. If your system is running on Windows 7, you could skip that to step 1.

❶ When the first time user plugs the RA8876 / 77 / 71(M) / 73(M) Starter-Kit into a USB port of PC, The operating system (Windows) will show a message "Installing device driver software" as shown below.

❷ From the **Device Manager** window displayed, double-click on o**ther device** to display the STM32 Virtual COM Port in your computer. Click the right button on the mouse of STM32 Virtual COM Port Driver and select the **Update Driver Software item for updating the driver.**
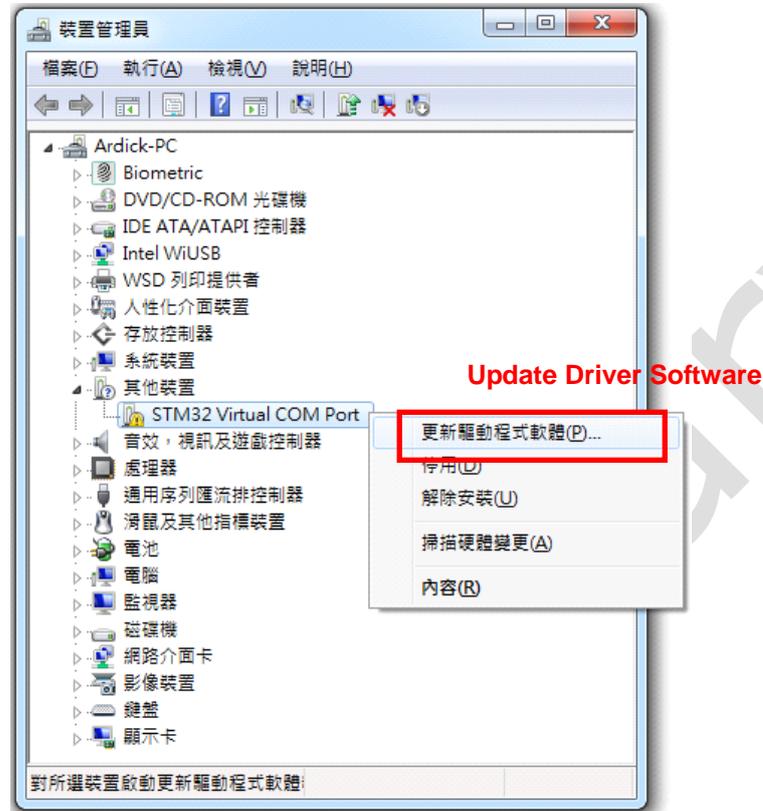
❸ To select the option titled "**Browse my computer for driver software**".
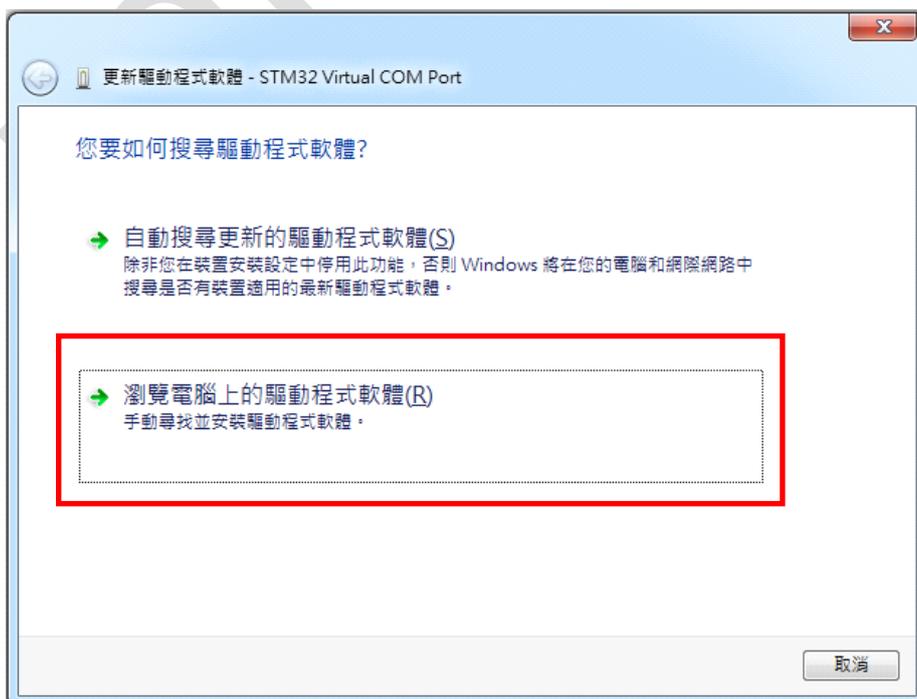
❹ To select the option titled "**Let me pick from a list of device drivers on my computer**", and click **Next**.
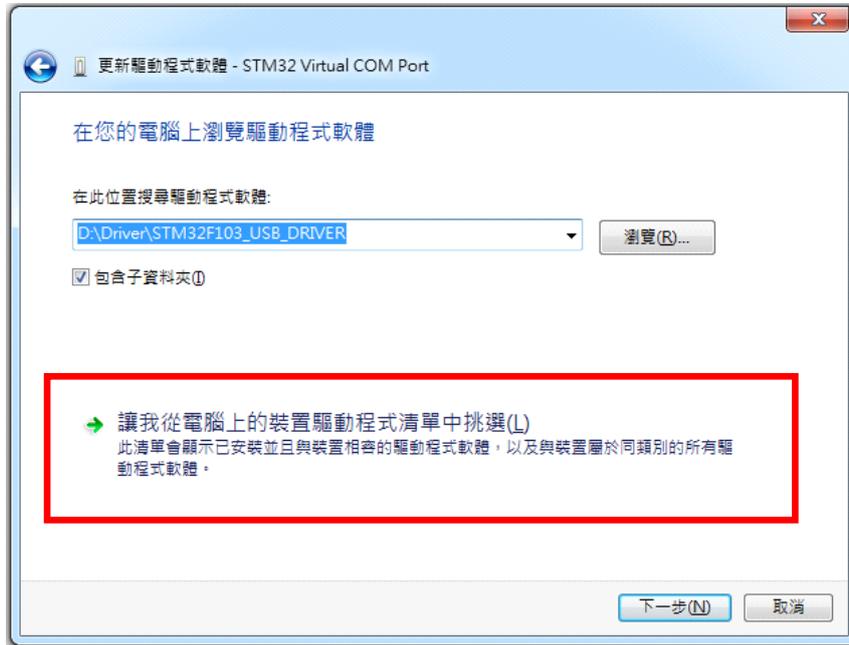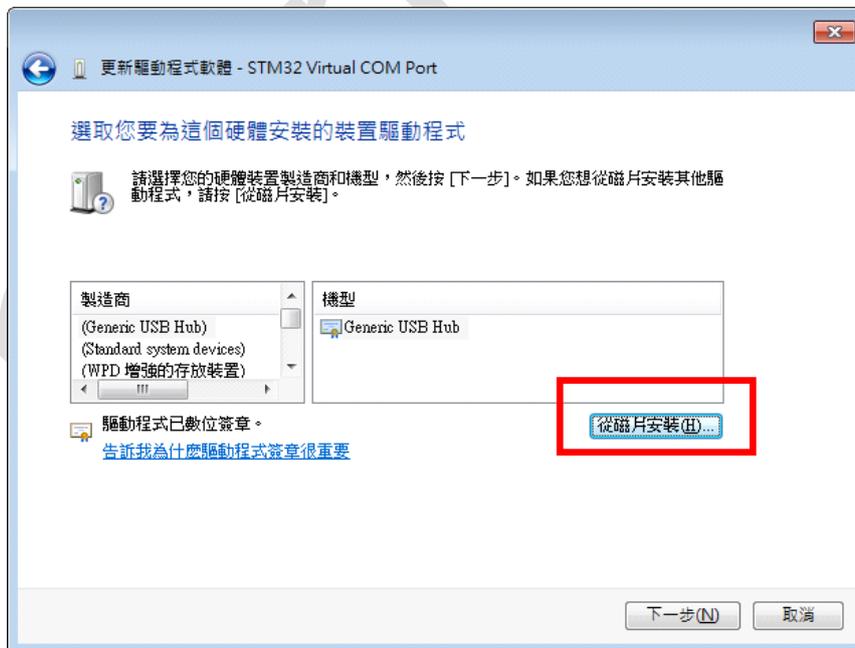
❺ Click "**Have Disk…**" button

❻ You should now see the dialog shown below. To insure that the "Include this location in the search:" checkbox is selected and hit the Browse button to navigate to the directory where the software was installed. "..\STM32F103_USB_DRIVER"
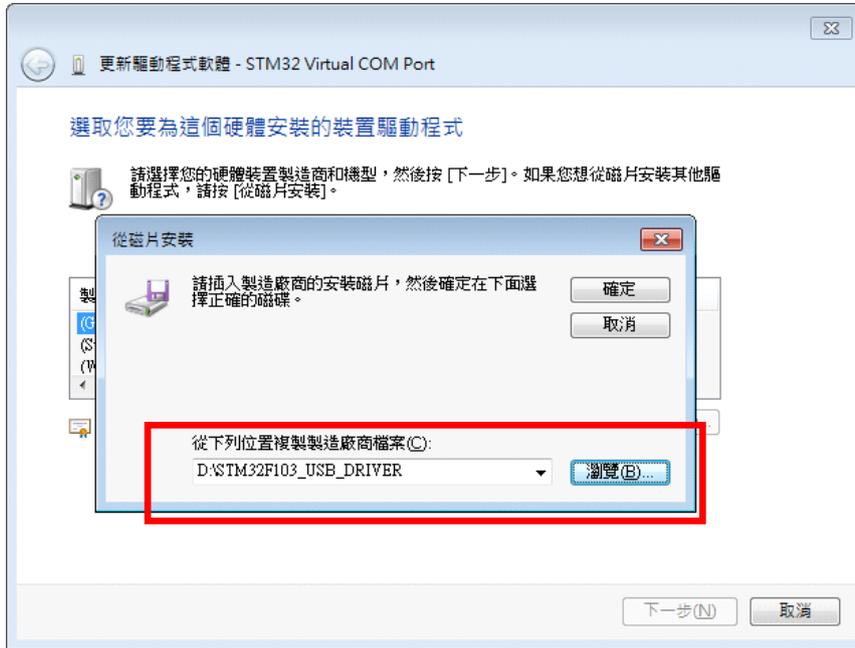
❼ Click "**Next**" button
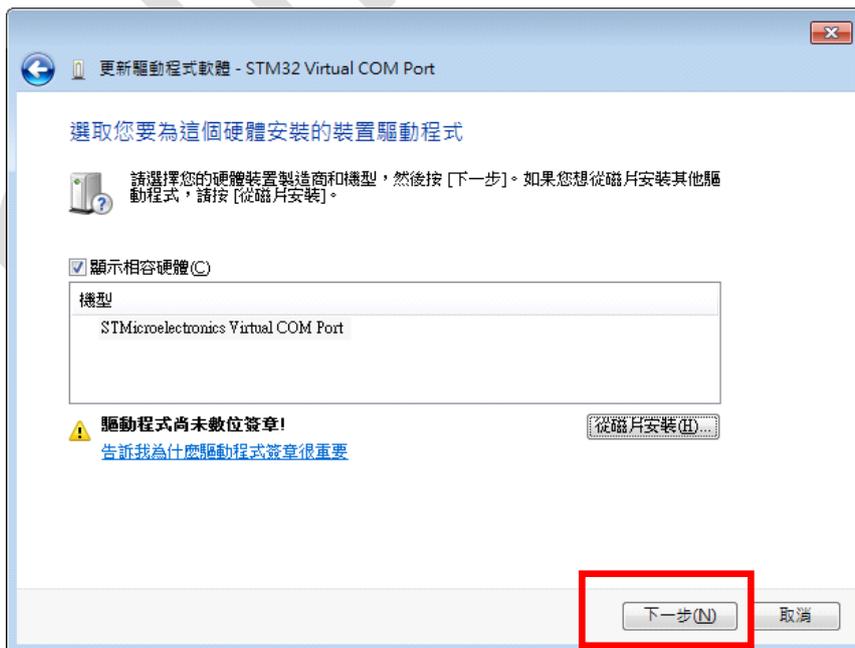
❽ Start to install the driver, please wait.
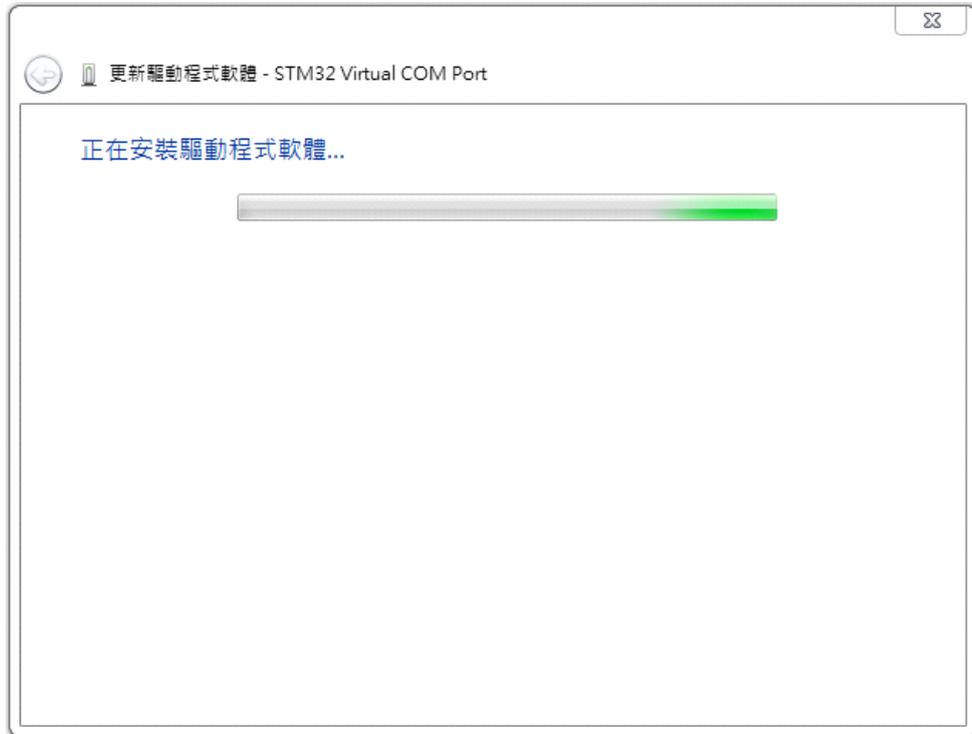
❾ Click on **Install this driver software anyway**.
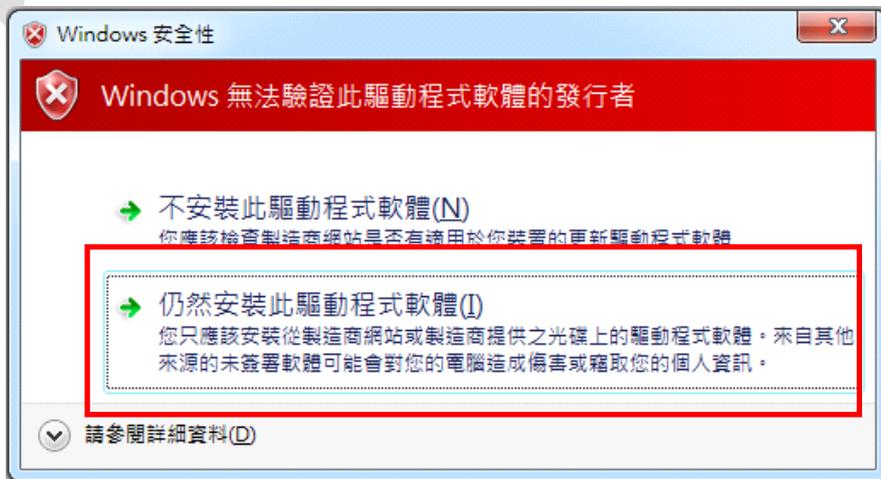
⑩ The driver files have now been installed and your installation is completed.

Click [Finish] button to finish the driver install and close the dialog.
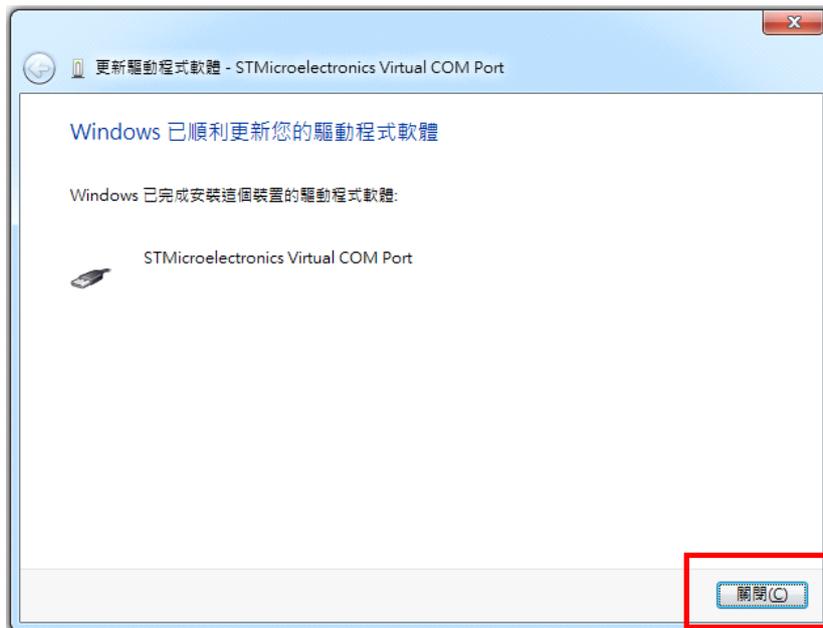
⑪We can see the device is shown up in the list of Device Manager (STMicroelectronics Virtual COM Port), it means that the Windows Machine recognizes this USB device and it has associated a specific driver to communicate with the device. Please refer to the following figure.
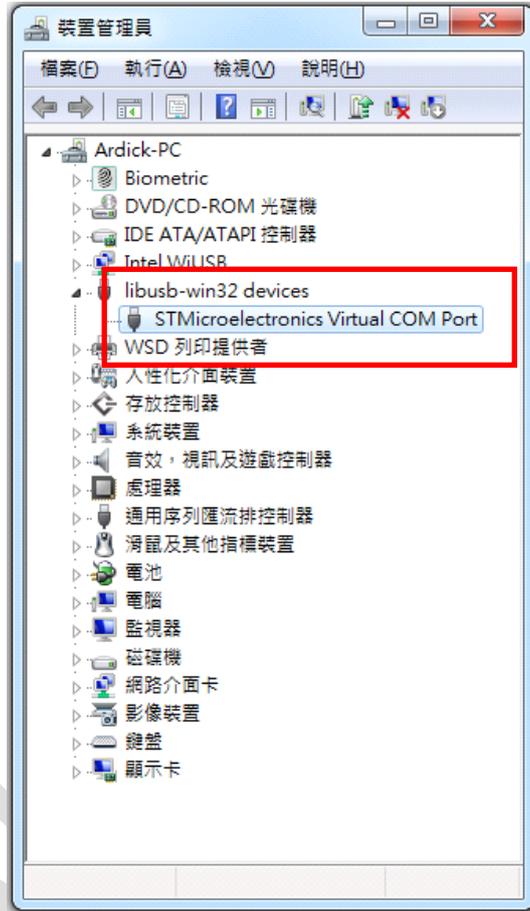
2.2 Software Main Window

The AP for RA8876 / 77 / 71(M) / 73(M) has 3 major files. "RA8876_77_AP.exe" is the main executable file, usb_off.ico and usb_on.ico are used for the icon library while the main program is executing.
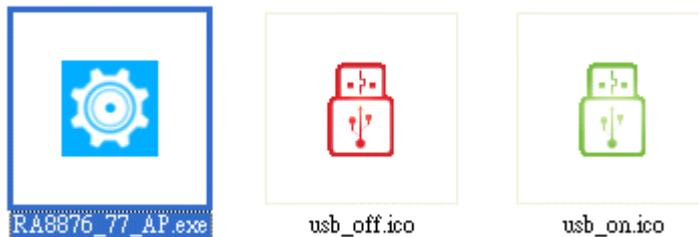
Launch "RA8876_77_AP.exe" the system status is shown as below.

When the USB port keeps disconnecting:

■Icon "USB Connection Status" is shown as the color red that represents the USB device is disconnected.

■All of the IC Functional Buttons are disabled.

■Status Window is closed.
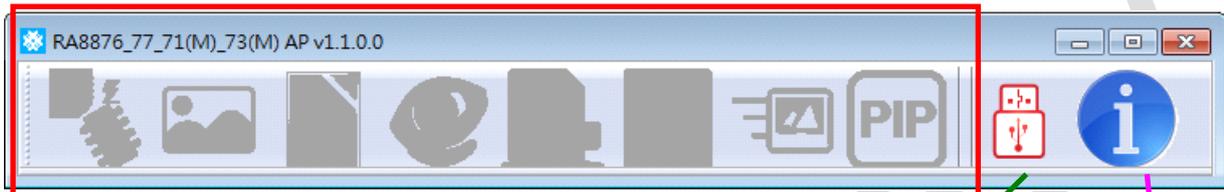
IC Function Button Disable   **USB Connection Status   Software Information**

When the USB port keeps connecting:

■Icon "USB Connection Status" is shown as the color green and represents the USB device is connected.

■All of the IC Functional Buttons are enabled, user is able to choose which function is going to use on the menu.

■Status Window is opened and showing the related parameters for system.

In the case of the RA8876 or RA8877:
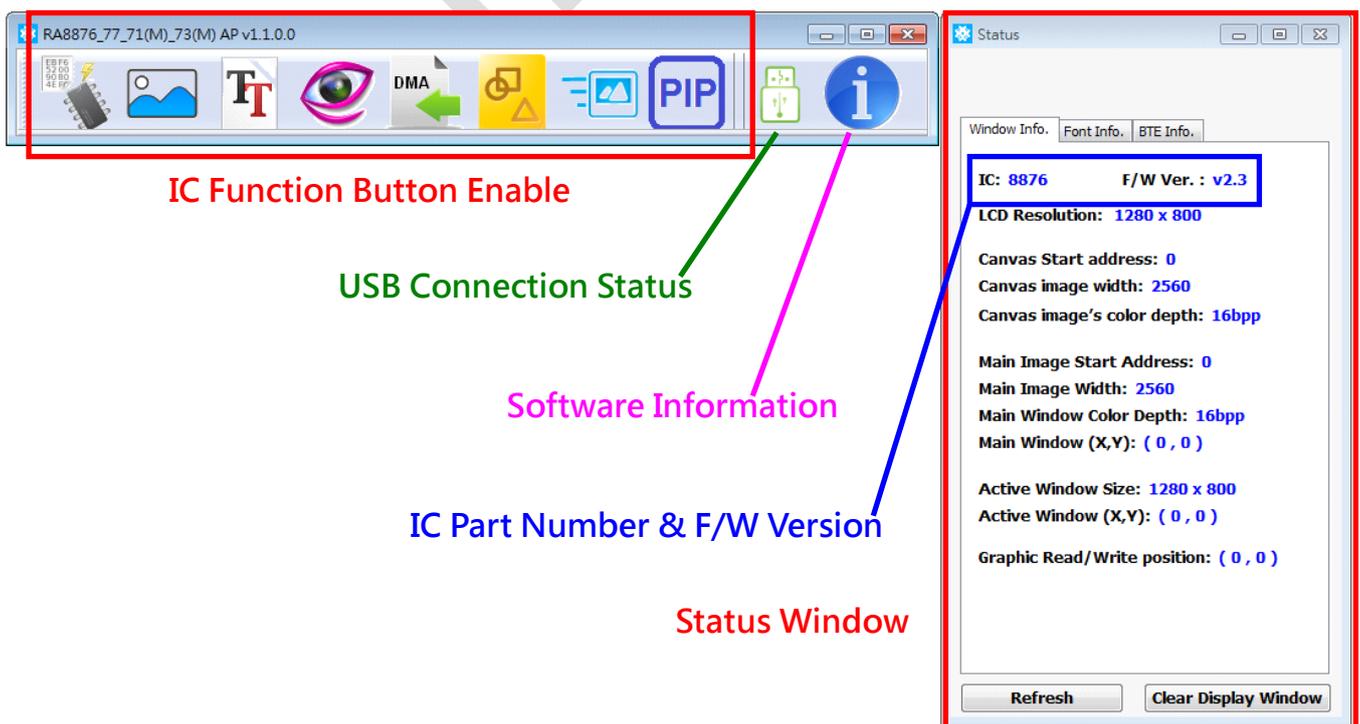
IC Function Button Enable

USB Connection Status

Software Information

IC Part Number & F/W Version

Status Window

In the case of the RA8871(M) or RA8873(M):

RAM View Function Disable

Layer Select Function Enable
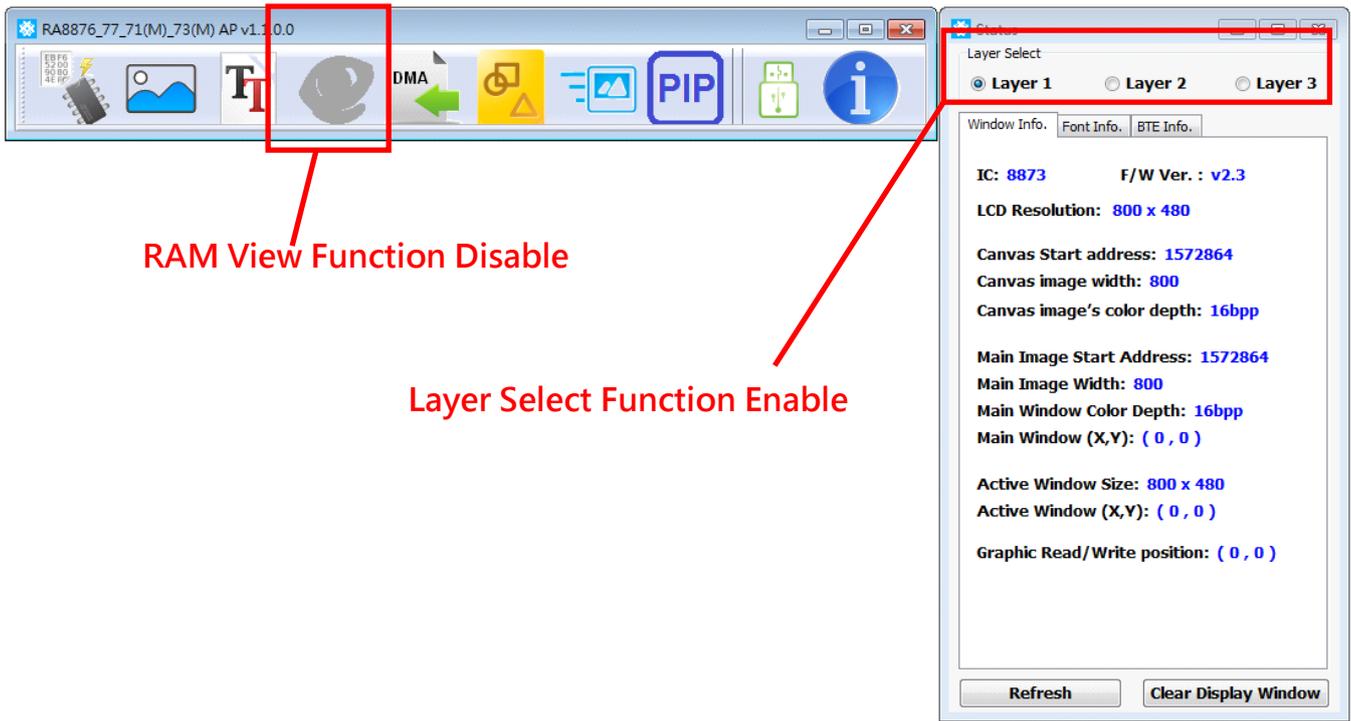
2.3 IC Function Button

There are some useful functions for RA8876 / 77 / 71(M) / 73(M) which are listed on the menu of AP tool. Including "SPI Flash Tool", "MPU Write Tool", "Text Function", "Memory View", "DMA Function", "Draw Function", "BTE Function", "PIP Function", and "Layer Select".

SPI Flash Tool

Text Function

DMA Function

BTE Function

MPU Write Tool

Memory View

(76 、 77 only)

Draw Function

PIP Function

Layer Select

(71(M) 、 73(M) only)

---
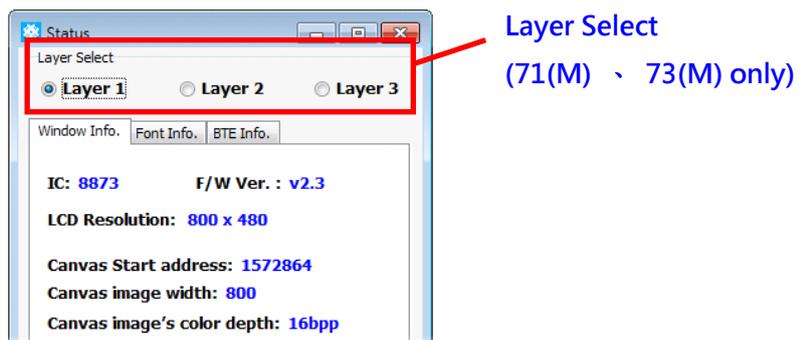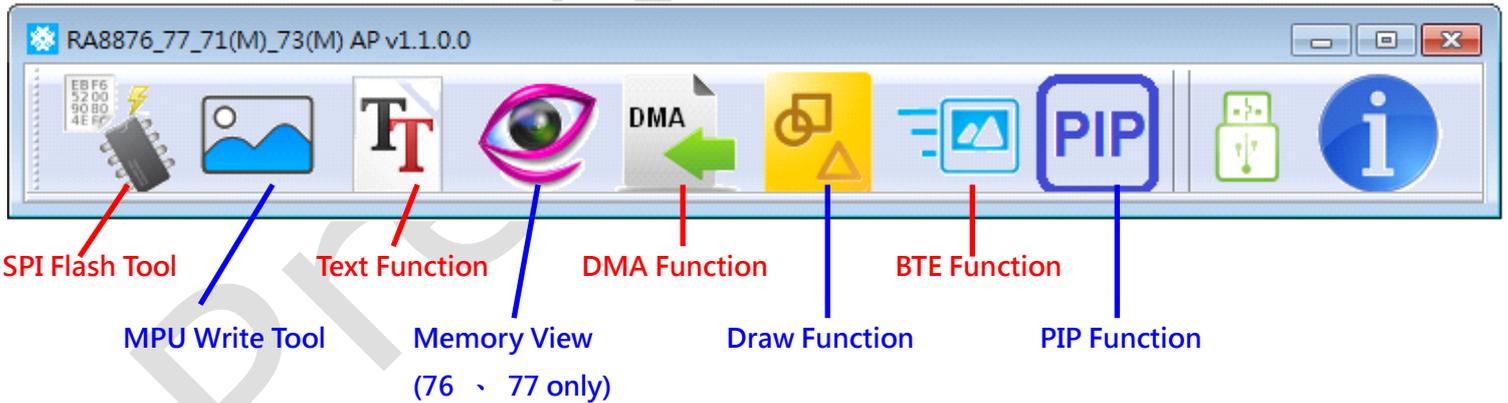
3. SPI Flash Tool

RA8876 / 77 / 71(M) / 73(M) provides a SPI master interface for accessing the external Serial Flash ROM. Serial Flash ROM function of RA8876 / 77 / 71(M) / 73(M) can be used for the FONT mode and the DMA mode. FONT mode means that the external serial Flash ROM is treated as a source of characters bitmap. To support the most useful characters, RA8876 / 77 / 71(M) / 73(M) is compatible with the character ROM of professional font vendor—Genitop Inc. in Shanghai. DMA mode means that the external Flash ROM is treated as data source for DMA function (Direct Memory Access). User can speed up the data transfer rate to display memory and need not too much MPU intervene by this mode.

Generally, if users want to apply the DMA function of RA8876 / 77 / 71(M) / 73(M) for their system, they have to store the image data into the serial flash memory in advance, so they need a universal IC programmer for programming the serial flash memory (e.g. ALL-100A). But during new product development, the image data is undetermined or is needed to modify frequently, so if the serial flash memory is soldered on the PCB, users should implement so many fussy works, such as de-solder, solder and program the serial flash memory etc. until the image data is fixed. It is so inefficient for development job.

To use SPI Flash Tool in this AP, it can reduce the above fussy works. User can implement erase/program/verify operations to the serial flash memory directly, through using the SPI Master function of RA8876/RA8877.

Click ![icon] button to enable the SPI Flash Tool functionality.

Your display window might then look like this：

The programming procedures for Serial Flash memory are this:

1 Select SPI Flash on CS0 or CS1.

2 Select the memory size for the SPI Flash Memory.

3 Open and Select a binary file (*.bin)

4 Check the programming manipulation with "Verify" or not.

5 Click the "Auto" button to start the programming operation.

6 Wait for the programming is completed or not which means that Erase, Program and Verify procedures are finished.

---

1 If the selected binary file is over the memory size which was chosen in the step 1, the tool will appear a dialogue "Data exceeds ROM size" and then the procedure is stopped.

```
Warning!!                    [x]

   Data exceeds ROM size!!


              [ 確定 ]
```
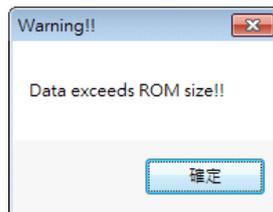
2 RAiO provides another image converter which can transfer the file format from "*.bmp/*.jpg" to "*.bin". It is recommended to use the tool to get the binary file what we wanted.

3 If the tool shows the dialogue "**Time-out !!**" or "**Fail !!**" during the flash memory programming, please check the peripheral H/W, firmware setting or software setting is correct or not. Such as the CS0/CS1 setting for SPI flash memory, the protocol setting for SPI flash memory or the ROM size setting.

Your Form should now look something like this without "Verify" operation

Your Form should now look something like this with "Verify" operation
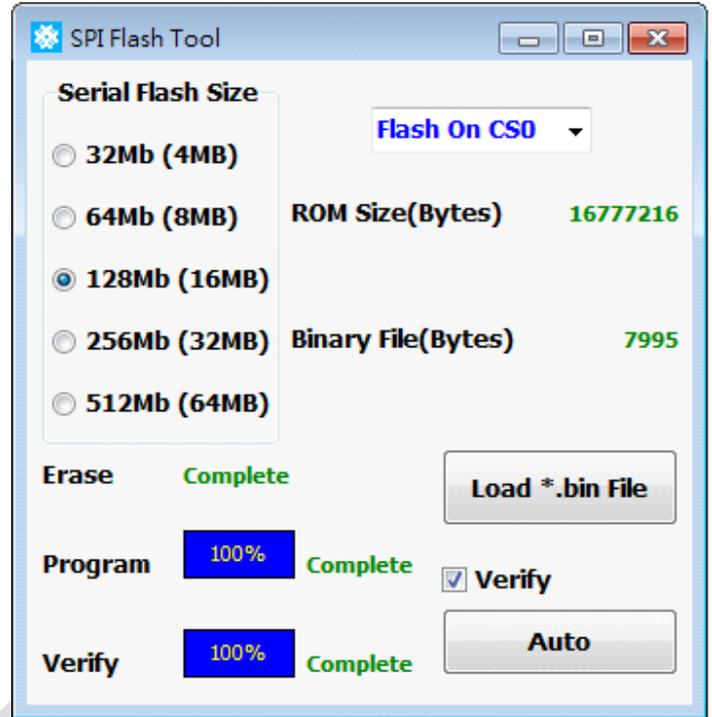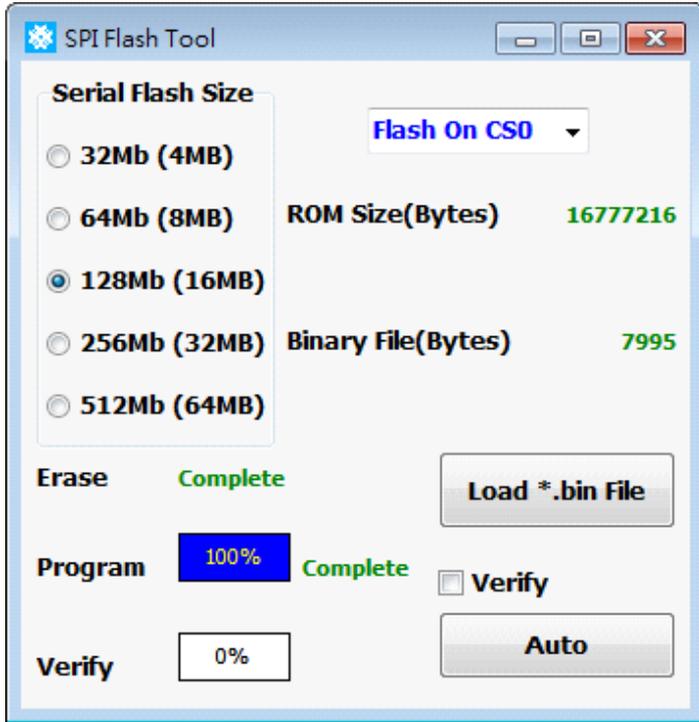
RAiO has already tested some of the flash memories. The part number are listed as below please have a look. If you/user can not get the correct programming result when using the different serial flash memory from the other IC vender, please contact with us(✉), we will try to find out a solution for you.

MXIC: MX25L6406E, MX25L12835E, MX25L25635E.
Winbond: W25Q256FVFG.

Demo Video:

YouTube

https://www.youtube.com/watch?v=rjlcnGb84PE

youku

http://v.youku.com/v_show/id_XODk4NzUyNTc2.html

4. MPU Write Tool

In this section, we'll take a look at "MPU Write Tool". With the Starter-Kit of RA8876 / 77 / 71(M) /73(M) and this AP tool, user is able to use USB port for dumping image data from PC to the external SDRAM of RA8876 / 77 / 71(M) /73(M), and show the image data on the LCD panel directly (Please refer to Figure 1-1).This manipulation will base on the user's setting to generate a program paragraph coded in C-Language, the C code can be easily migrated to user's own firmware. Besides, for applying RA8876/RA8877, user might need more subroutines when using the generated C codes, thus RAiO also provides so many

F/W APIs for the convenience of our customers, please contact with our FAE (✉)or visiting our official website for getting the related information.

This function supports two kind of digital image format, Bitmap and JPEG. When we choose to use Bitmap format, RA8876 / 77 / 71(M) /73(M) supports 2 color depths, 1bpp and 24bpp. On the other hand, JPEG format only supports 24bpp. The color depth 1bpp is used for the function "BTE Color Expansion of RA8876 / 77 / 71(M) /73(M)", so the 1bpp function should be assorted with the BTE function of the AP. For 24bpp RGB image, the AP will detect which color depth setting was selected for RA8876 / 77 / 71(M) /73(M) (8/16/24bpp), and transfer the image format to accord with the selected color depth, therefore deliver the image data for RA8876 / 77 / 71(M) /73(M). This is a common way for refreshing the display.

Click "MPU Write Tool " Button on the main menu. You should see the item you selected as below:

Rotate Right

Mirror horizontally

Rotate Left

Mirror vertically

Active Window Width

Load Picture File
(*.bmp or *.jpg)

Load Picture

Write Picture To LCD

Write Picture to LCD

Active Window
Upper-Left corner
coordination

Active Window

X: 100

Y: 200

Width

320

Active Window Height

Height

240

Show Selected

Image

BMP image or JPEG image

Show API C code

C code:

```
MPU8_16bpp_Memory_Write(100,200,320,240,*data);
//*data : image 8bit 16bpp data
```

The operating procedures for MPU Write Tool are described as following:

❶ Set the start address for active window in accordance with the allocated memory area.

❷ Load an image file, supported 1/24bpp data format. The color depth 1bpp is used for the function "BTE Color Expansion of RA8876 / 77 / 71(M) / 73(M)", so the 1bpp function should be assorted with the BTE function.

❸ After loading the image file, the form will show a cut down picture and the height/width information for the image.

❹ Click the button "Write Picture To LCD", you should see data transferred to the allocated memory area of RA8876 / 77 / 71(M) / 73(M) by USB port, and then the image will be displayed on LCD panel.

❺ If we have done the above procedures, we can get a paragraph of API program from C code dialog box. Users can migrate the related API code to their own firmware code.

📑 **1** RA8876 / 77 / 71(M) / 73(M) supports many useful functions, so user might take a little bit time to create the firmware program without any open resource. For the convenience of our customers, RAiO also provides plenty of API codes, our customers' just need to migrate these subroutines to their firmware and set a few parameters, and then they are able to use RA8876 / 77 / 71(M) / 73(M) for displaying on their system instantly.

📑 **2** The rotate and mirror functions are only supported at 24bpp color depth image.

Virtual display on LCD panel (Resolution is 1280x800, the display color seems a bit different between visual effect, it attributes to photograph)

Demo Video:

YouTube

https://www.youtube.com/watch?v=Ly-8XRgCNyY

youku

http://v.youku.com/v_show/id_XOTAwMTA5ODUy.html

5. Text Function

5.1 Internal CGROM

RA8876 / 77 / 71(M) / 73(M) supports the text display function. The RA8876 / 77 / 71(M) / 73(M) is built-in 8x16, 12 x 24, 16 x 32 dots ASCII Characters ROM that provides user a convenient way to show the characters on LCD display. Furthermore, RA8876 / 77 / 71(M) / 73(M) can use the external serial ROM interface to provide more characters set for different applications. It is compatible with Character ROM of Genitop Inc., which is a professional Character sets ROM vendor. Users can base on their display requirement, select a font ROM from the seven available product numbers. The supported product numbers are GT21L16T1W, GT30L16U2W, GT30L24T3Y, GT30L24M1Z, GT30L32S4W, GT30L24F6Y and GT30L24S1W. When user wants to show characters on LCD screen, just need to set RA8876 / 77 / 71(M) / 73(M) is worked in the text mode, select using internal or external font ROM and deliver the font code to RA8876 / 77 / 71(M) / 73(M). After RA8876 / 77 / 71(M) / 73(M) decodes the font codes, the core of RA8876 / 77 / 71(M) / 73(M) will transfer the font display data from font ROM to display RAM. Then the font will be shown on the LCD panel.

Click "Text Function   " Button on the main menu. You should see the item you selected displayed:
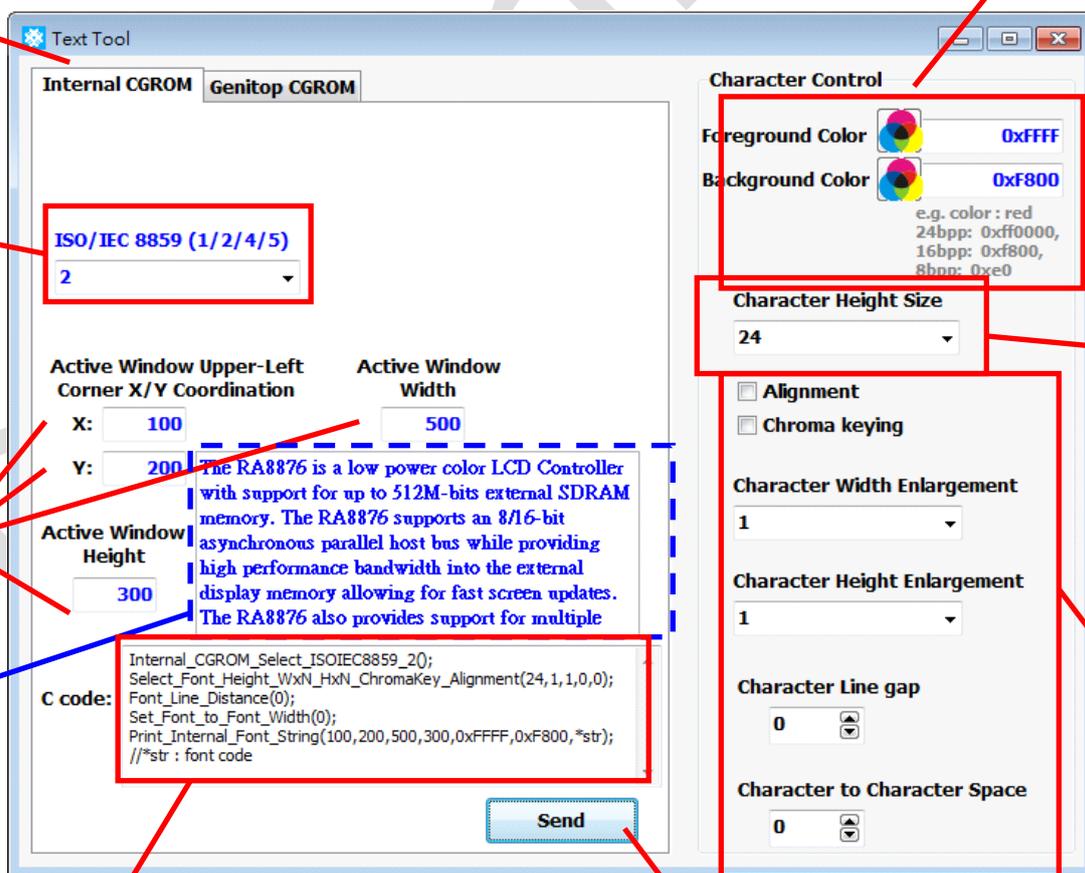
The operating procedures for the Internal CGROM Text Function are described as following:

❶ Select the internal CGROM

❷ Select which part will be used for ISO/IEC 8859 (1/2/4/5)

❸ Set the foreground color and the background color for the displayed characters. For the data format of the input color, it is based the canvas color depth setting of RA8876 / 77 / 71(M) / 73(M) (8/16/24bpp), it can be three kinds of type, we use the pure red to be an example here.

   8bpp, data format is set to 0xe0

  16bpp, data format is set to 0xf800

  24bpp, data format is set to 0xff0000

❹ Select character height (16/24/32)

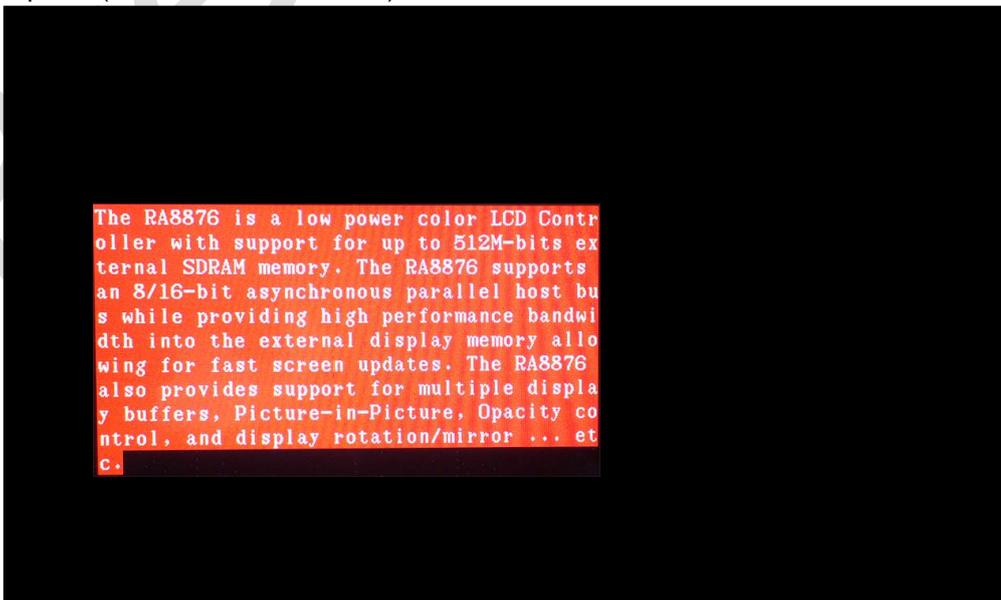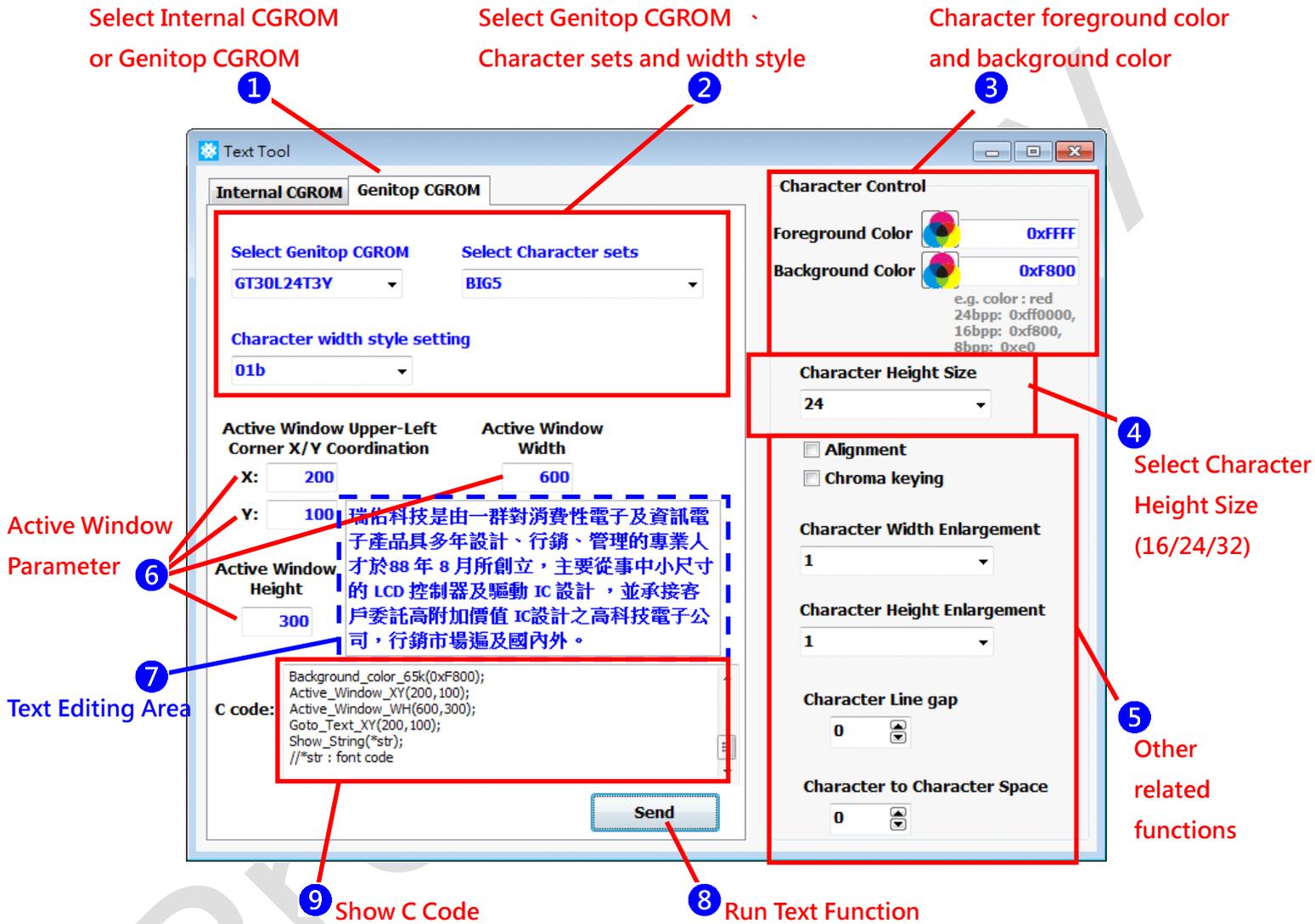❺ Set the related functions for displaying character, such as "Alignment", "Chroma Keying", "Enlargement", "Character-to-character space" and "Character line gap".

❻ Set the related parameters for active window, e.g. the start address, width and height for active window. AP will automatically set the text cursor to the same address with the start address of active window. The text cursor has automatic movement function; the cursor address will be added one automatically, after a new character is stored in the display RAM and shown on the panel.

❼ Type the supported characters or symbol within the "Text Editing Area".

❽ Click the button "Send". AP will store the font data from font ROM to the display RAM and the characters will be shown on the LCD panel.

❾ If we have done the above procedures, we can get a paragraph of C program from C code dialog box. Users can migrate the related API code to their firmware code for internal CGROM text function.

Virtual display on LCD panel (Resolution is 1280x800):

5.2 External CGROM

When using the external font ROM from Genitop for RA8876 / 77 / 71(M) / 73(M), with some simple AP's settings and the font typing, user can easily show fonts on the LCD screen with different encoding standard, such as GB2312, GB12345, BIG5, JIS and Unicode etc...

❶ Select the external CGROM (Genitop CGROM)

❷ Select which supported product number will be used, select the font style and font width.

❸ Set the foreground color and the background color for the displayed characters. The data format for the foreground/background color, it is based the canvas color depth setting of RA8876 / 77 / 71(M) / 73(M) (8/16/24bpp), it can be three kinds of type; we use the pure red to be an example here.

    8bpp, data format is set to 0xe0

   16bpp, data format is set to 0xf800

   24bpp, data format is set to 0xff0000

④ Select character height (16/24/32)

⑤ Set the related functions for displaying character, such as "Alignment", "Chroma Keying", "Enlargement", "Character-to-character space" and "Character line gap".

⑥ Set the related parameters for active window, e.g. the start address, width and height for active window. AP will automatically set the text cursor to the same address with the start address of active window. The text cursor has automatic movement function; the cursor address will be added one automatically, after a new character is stored in the display RAM and shown on the panel.

⑦ Type the supported characters or symbol within the "Text Editing Area"

⑧ Click the button "Send". AP will store the font data from font ROM to the display RAM and RA8876 / 77 / 71(M) / 73(M) will show the fonts on the LCD panel.

⑨ If we have done the above procedures, we can get a paragraph of C program from C code dialog box. Users can migrate the related API code to their firmware code for external CGROM text function.

Virtual display on LCD panel (Resolution is 1280x800, the display color seems a bit different between visual effect, it attributes to photograph)

Demo Video:

YouTube

https://youtu.be/QV2ARVI4iAE
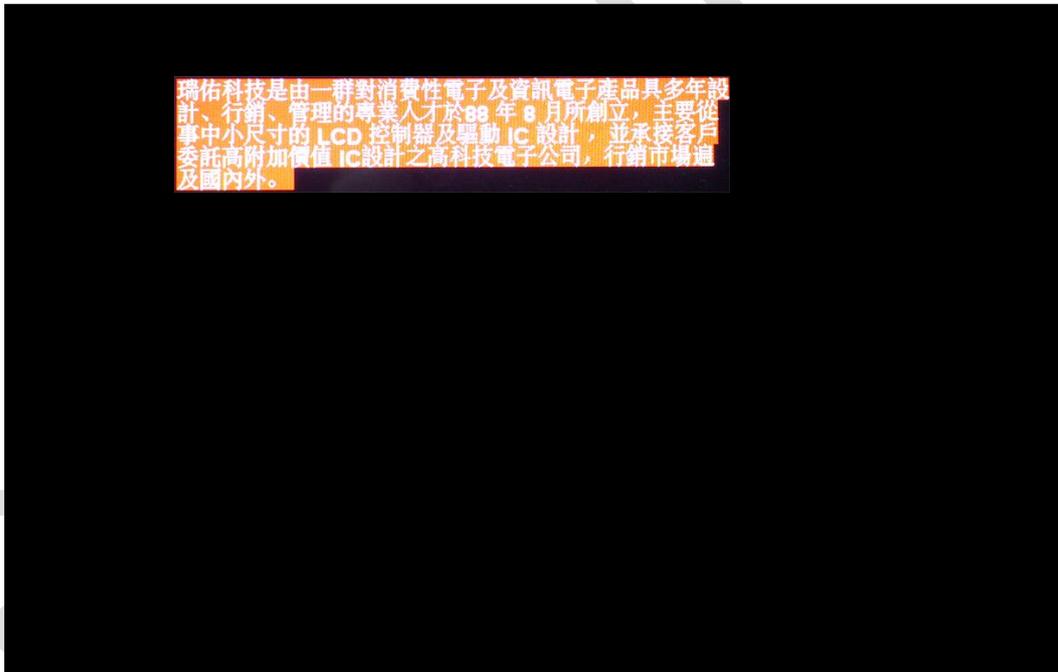
youku

http://v.youku.com/v_show/id_XMTQyMzgyNTgzMg==.html

6. DMA Function

RA8876 / 77 / 71(M) / 73(M) supports a SPI master interface for accessing Serial Flash/ROM, Serial Flash function can be used for DMA mode. DMA mode means that the external flash memory is treated as the data source of DMA function (Direct Memory Access). User can speed up the data transfer to display memory without MPU intervene. Besides, before using DMA function, users have to store the image data into the serial flash memory previously.

RAiO provides another image transfer tool named "Image Tool"; users can exploit the tool for transferring the image format and get the binary file. After we have done the transferring of the image files, we will get a "*.bin" file and a "*.xls" files. The "*.bin" file is a data source and it is used to store into the serial flash memory by the SPI Flash tool. The "*.xls" file is used for recording the related information of each transferred image file, for example, the file name, width, height, data format, size and start address, etc…

For the manipulation of Image Tool, please refer to the user guide of Image Tool. Let's take a look at an example, there are six 128 x 128 icons below (RAiO also provide so many useful 64*64/128*128 icons; please refer to our official website http://www.raio.com.tw/E%20version/e_product.tech3_pic.htm, and we can provide the custom – made icon service for our clients when needed). After the transferring of the image files, AP will generate two files "All_Pic_65K .bin" and "All_Pic_65K .xls".

S1_24.bmp	S1_16.bmp	S0_24.bmp	S0_16.bmp
DES_24.bmp	DES_16.bmp	All_Pic_65K.xls	All_Pic_65K.bin

"All_Pic_65K .xls" contains some image information as following:

	A	B	C	D	E	F	G
1	No.	File Name	Width	Height	Data Format	Size (Bytes)	Start Address
2	1	DES_16.bmp	128	128	16bpp mode (RG	32768	0
3	2	DES_24.bmp	128	128	16bpp mode (RG	32768	32768
4	3	S0_16.bmp	128	128	16bpp mode (RG	32768	65536
5	4	S0_24.bmp	128	128	16bpp mode (RG	32768	98304
6	5	S1_16.bmp	128	128	16bpp mode (RG	32768	131072
7	6	S1_24.bmp	128	128	16bpp mode (RG	32768	163840
8						196608	

Program "All_Pic_65K .bin" into the serial flash memory, and then starting the DMA operations.

Click "DMA Function [DMA icon]" Button on the main menu. You should see the item you selected displayed:

① Select Flash on CS0 or CS1

Set Destination Upper-Left corner coordination

② Select ROM Size >128Mbits

⑤

Set DMA Block Width and Height

③ Set the image start address in the SPI flash memory

⑥

④ Set the image width

Show API C code

⑧

⑦ Run DMA Function

DMA Tool — DMA Function

Destination (Memory)

Destination Upper-Left corner coordination   X: 100   Y: 200

ROM Size > 128Mb

Source (SPI Flash)

Source Start Address: 0

Destination Block Width W: 128
Destination Block Height H: 128

Source Width: 128

Run

C code:
```
switch_24bits_to_32bits(1);
DMA_32bit(1,0,100,200,128,128,128,0);
```

Flash On CS1

① Select SPI Flash on CS0 or CS1.

② If the capacity of serial flash memory is more than 128Mbit, then this item should be checked. In this case, we use 256Mbits serial flash memory here, so the item "ROM Size > 128Mb" needs to be checked.

③ Set the source start address for the displayed image. As the example here, the source start address for "DES_16.bmp" is "0".

④ Set the width for the original image, the image width is 128 here.

⑤ Set the destination address for canvas. x=100, Y=200.

⑥ Set the width and height for the destination block. We set the completed size to 128x128 in this example.

⑦ Click the button "Run" to execute the DMA function.

⑧ If we have done the above procedures, we can get a paragraph of API program from C code dialog box. Users can migrate the related API code to their own firmware code for their application. [icon]¹

If the capacity of serial flash memory is more than 128Mbit, then the serial flash memory should be addressed in 32-bit mode. Generally, serial flash memory is addressed in 24-bit when the memory capacity is less than or equal to 128Mbits. So, if the memory size is more than 128Mbit and user wants to use a serial flash memory for RA8876 / 77 / 71(M) / 73(M), it is needed to set the memory is worked in 32-bit mode before implementing any read/write data command to RA8876 / 77 / 71(M) / 73(M) and serial flash memory.

When the step 1 "ROM Size>128Mb" is checked, run DMA function, RA8876 / 77 / 71(M) / 73(M) and the serial flash memory will be worked in the 32-bit mode. After executing the DMA function, we can get a paragraph of API program from C code dialog box. There is an extra code subroutine named "switch_24bits_to_32bits API", Users have to migrate the related API code from API library to their own firmware code for 32-bit application. If the step 1 "ROM Size>128Mb" is not checked, then RA8876/RA8877 and the serial flash memory will be worked in the 24-bit mode, you should see the item you selected displayed as below:
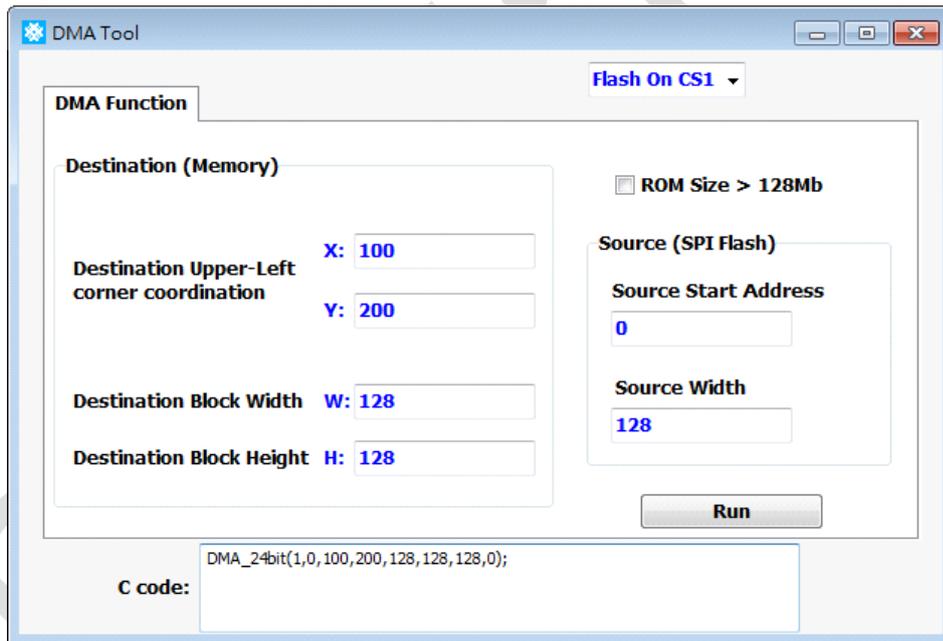
Virtual display on LCD panel:

DMA function can be used to show the partial block of the original pattern. The example here is going to show the half pattern of "S1_24.bmp".
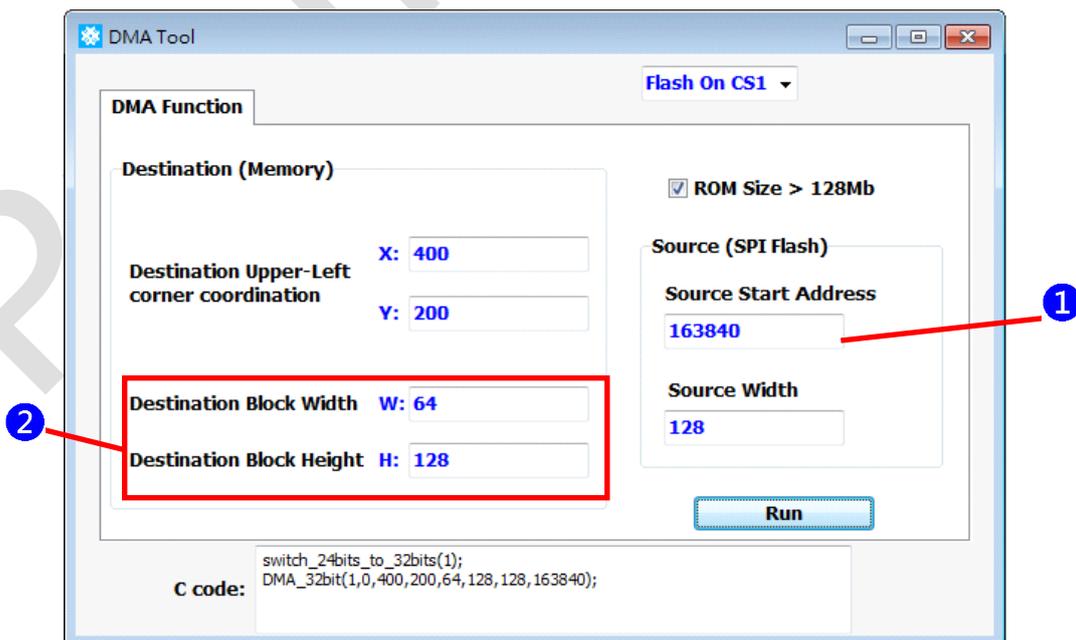
Most of the operating procedures are the same as the preceding above. The different operations are listed as below.

❶ The image data of S1_24.bmp is stored in the SPI Flash Memory; its start address is "163840" which is exposed at the file "All_Pic_65K .xls".

❷ In this case, we just want to show half width of image data from SPI Flash Memory (64x128), so the destination block width should be set to 64.

Virtual display on LCD panel:
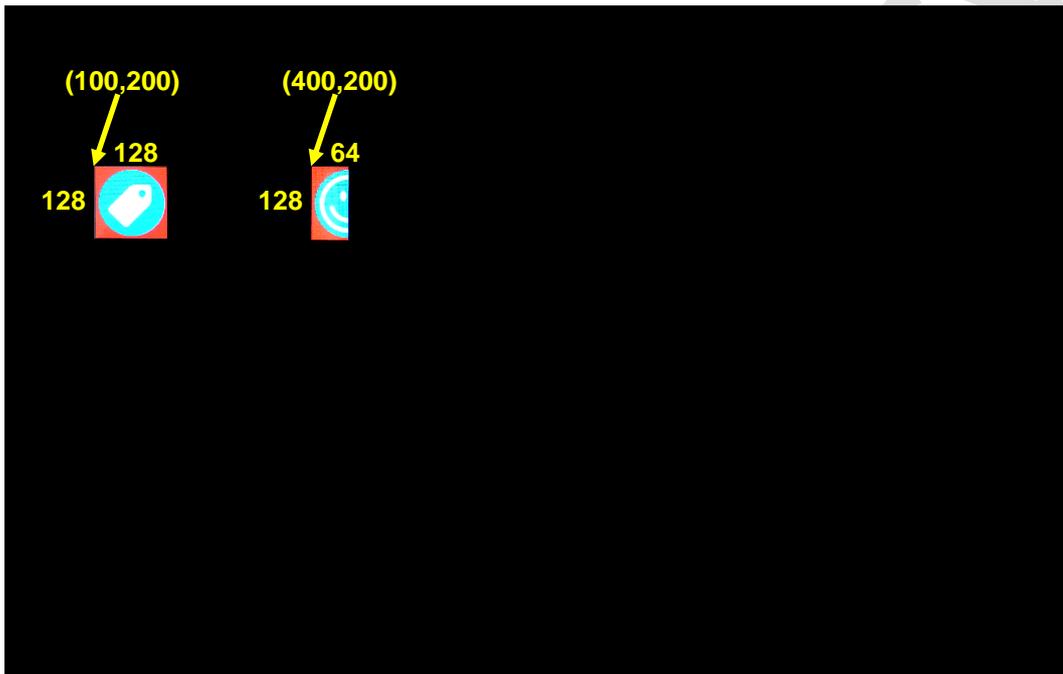
Demo Video:

YouTube

https://www.youtube.com/watch?v=PJ-6_h9sFMk

youku

http://v.youku.com/v_show/id_XOTAwMjAwNDY4.html

7. Draw Function

RA8876 / 77 / 71(M) / 73(M) provides a Geometric Engine which can be used for drawing geometric figures on the display, e.g. Ellipse, Circle, Curve, Square, Line, Triangle and Square Of Circle Corner etc. User just need to set a few program setting and will be able to show the patterns on the display. These geometric figures can be applied for the control button, the dialogue box and so on.

Click "Draw Function   " Button on the main menu. You should see the item as below:

Active Window Upper-Left corner coordination (X,Y)、Active Window Width and Height

Select Geometric Shape ❶

❷

Drawing Function Parameters

❸

Color ❹

Color Fill or not Fill ❺

❻

❼

The operating procedures for Draw Function are described as following:

❶ Select a geometric shape what you needed, we use square for an example here, and we are going to fill up the 1280x800 display with the color black. Please note that the operation is normally used for cleaning display.

❷ Set the related parameters for active window. Please note that the drawing function is only worked within the active window area. In this case, we set X=0 and Y=0 for the coordinates of active window, and set the Width=1280, Height=800 for active window area.

❸ Set the start point and the end point coordinates for the square what we wanted. And then RA8876 / 77 / 71(M) / 73(M) will draw a corresponding square on the display. So for different size of the square, we should set different parameters.

Here, the coordinate of start point are X=0 and Y=0, the coordinate of end point are X=1279 and Y=799.

❹ According to the description in the chapter 5 "Text Function", the setting of color black is equal to 0x0000h when the color depth is set to16bpp.

❺ Set the square is filled up or not.

❻ Click the button "Run" to execute the DMA function.

❼ If we have done the above procedures, we can get a paragraph of API program from C code dialog box. Users can migrate the related API code to their firmware code for displaying geometric figures.

Virtual display on LCD panel:

Here, we have another example for "Circle Square":

❶ Click the button "Circle Square".

❷ Set the start point and the end point coordinates for the circle square. Here, the coordinate of start point are X=200 and Y=200, the coordinate of end point are X=450 and Y=400. Besides, we need to set the X and Y radius to 25 for the four circular - arc – shapes. In order to force user to get the correct display with circle square, there are some restrictions for the X and Y radius. If the wrong parameters are used by user, then this tool will show an error dialogue box. The restrictions and the error message are followed as below.
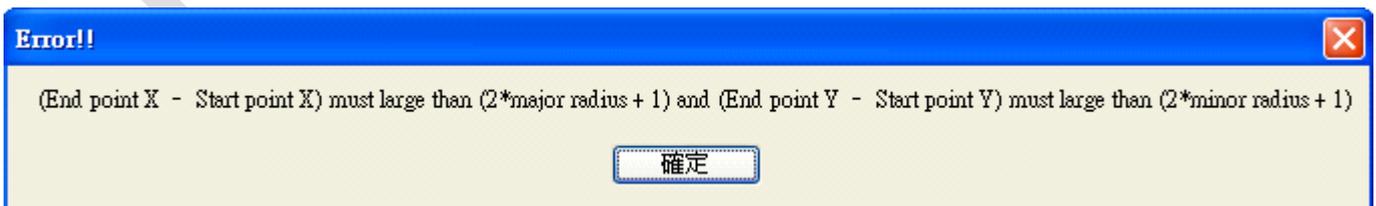
❸ Click the button "Run" to execute the DMA function.

Virtual display on LCD panel:
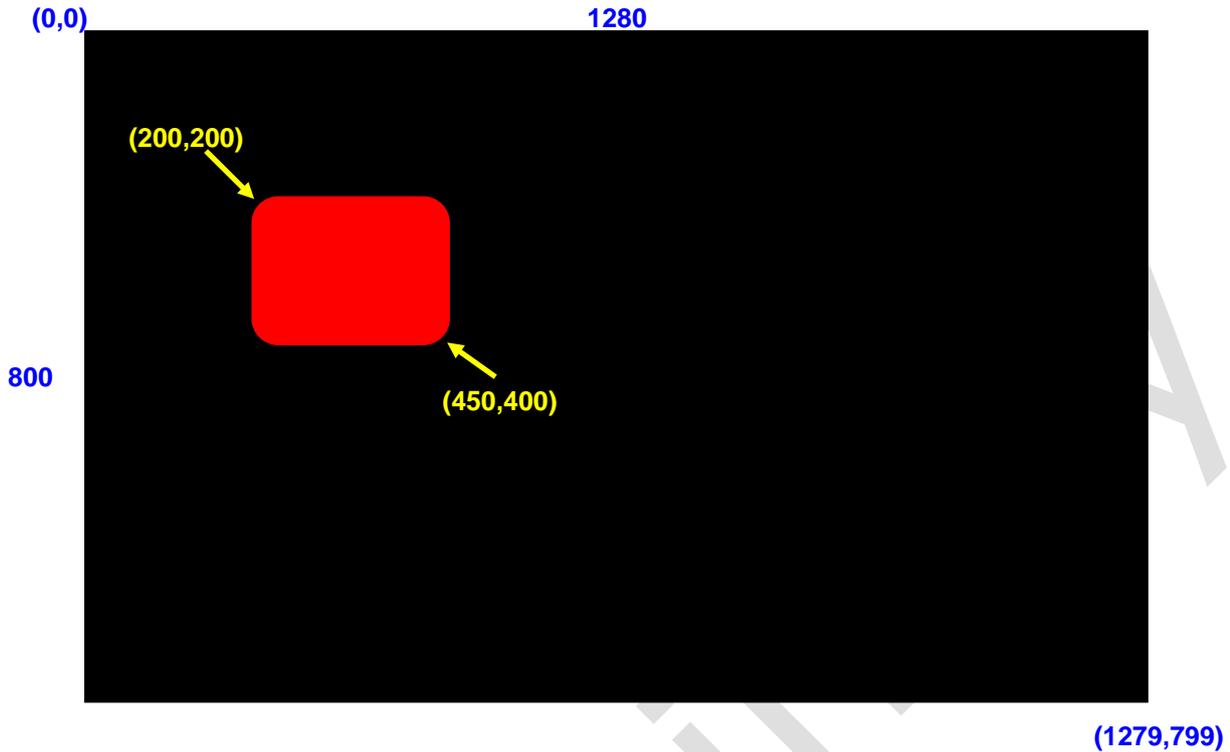
If we want to make a simple control button on the display, user just needs to combine text and drawing circle square function. Firstly, we can draw a circle square by using the above function, secondly place texts with Chroma key function on the shape of circle square, and then we will get a simple button on the display. If we need more the same kinds of button for the application, it is recommended to use the BTE function; the BTE function can duplicate the same display data to the different memory address for showing many buttons.

Demo Video:

YouTube

https://www.youtube.com/watch?v=5JLdPng51fs

youku

http://v.youku.com/v_show/id_XODk5OTE0NzQ0.html

8. Memory View Tool (RA8876 / RA8877 only)

8.1 Ping-pong Buffer

RA8876/RA8877 provides an external SDRAM interface; its memory capacity is supported up to 512Mbits. In the normally application, RA8876/RA8877 is needed to work with an external SDRAM for storing the processed data and LCD display requirement. Ordinarily the capacity of SDRAM should be more than the sum of displayed data. Therefore we can use the main window function of RA8876/RA8877 to switch the display area. And then the non-display area can be used as an image data buffer for storing the processed data. So if we want to implement the analogous scrolling function, we can periodically switch the display area and the image buffer to reach the scrolling effect.

In the case here, the LCD resolution is 1280x800, the canvas image width is set to 2560, and the active window size is set to 2560x1600. So we can perceive that the canvas image is four times as big as LCD's resolution for SDRAM programming.

Firstly, clear the 2560x1600 memory area and fill the pattern up as the following figure by using the drawing and DMA function. The memory area can be divided to 4 blocks; the resolution for each of block is 1280x800. The block 1 is the default display area, so the block 2, 3 and 4 are the non-display areas. But how to switch the display area to block 2, block 3 or block 4? It can be reached by adjusting the Main Window Upper-Left corner X-coordination and the Main Window Upper-Left corner Y-coordination.
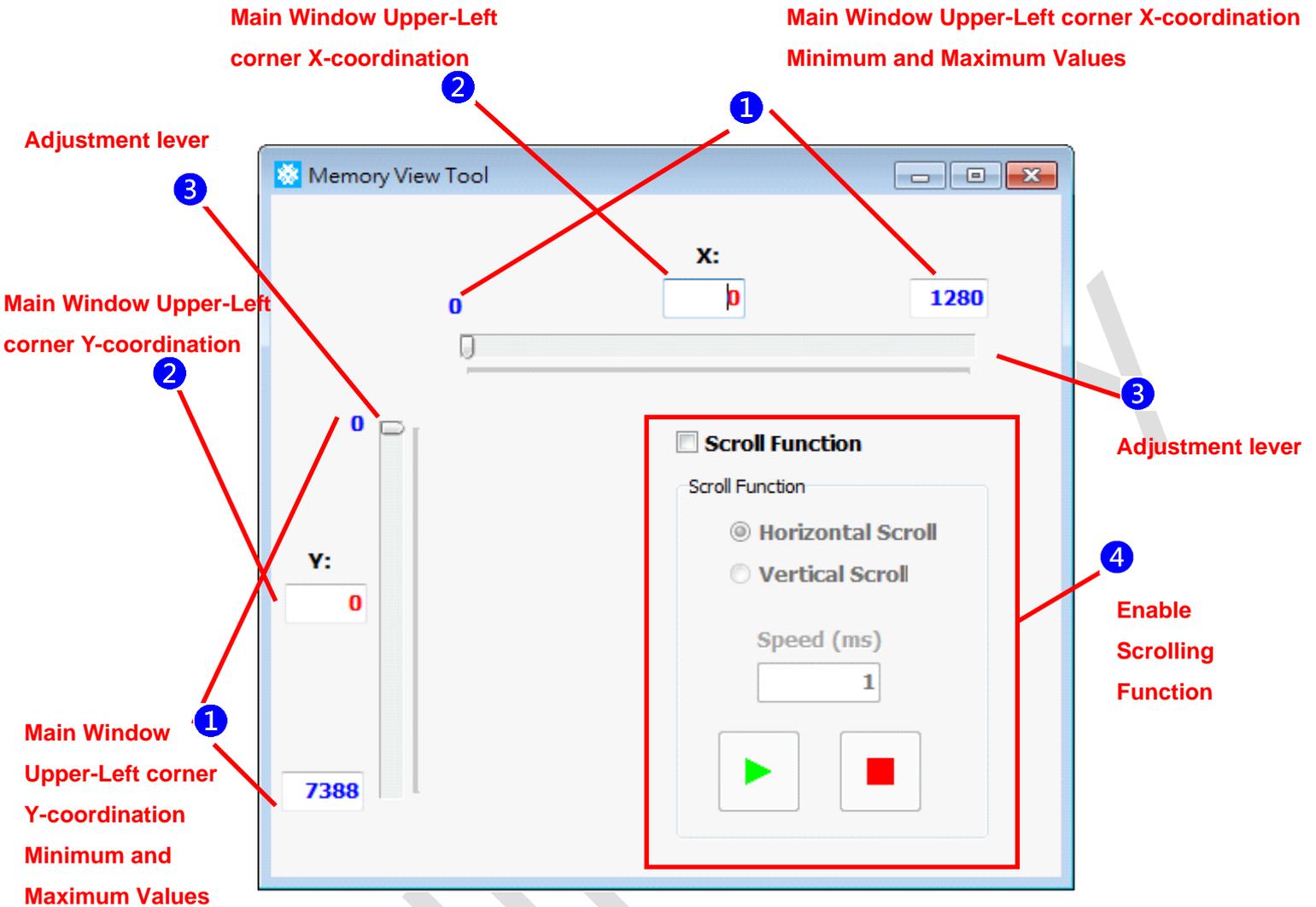
In the functional description above, it can be used to implement so many applications. For example, as we can see in the figure below, user can use the 1st memory block to be as the display area, meanwhile, we can refresh the image data in the 2nd memory block. After finishing the data refresh in the 2nd memory block, user can switch the main window to the 2nd memory block. This application is a little bit like "Ping-pong Buffer", and it can help user to solve the insufficient refresh speed of MCU. User won't perceive the strange display as well during the data refresh operation in any memory block.
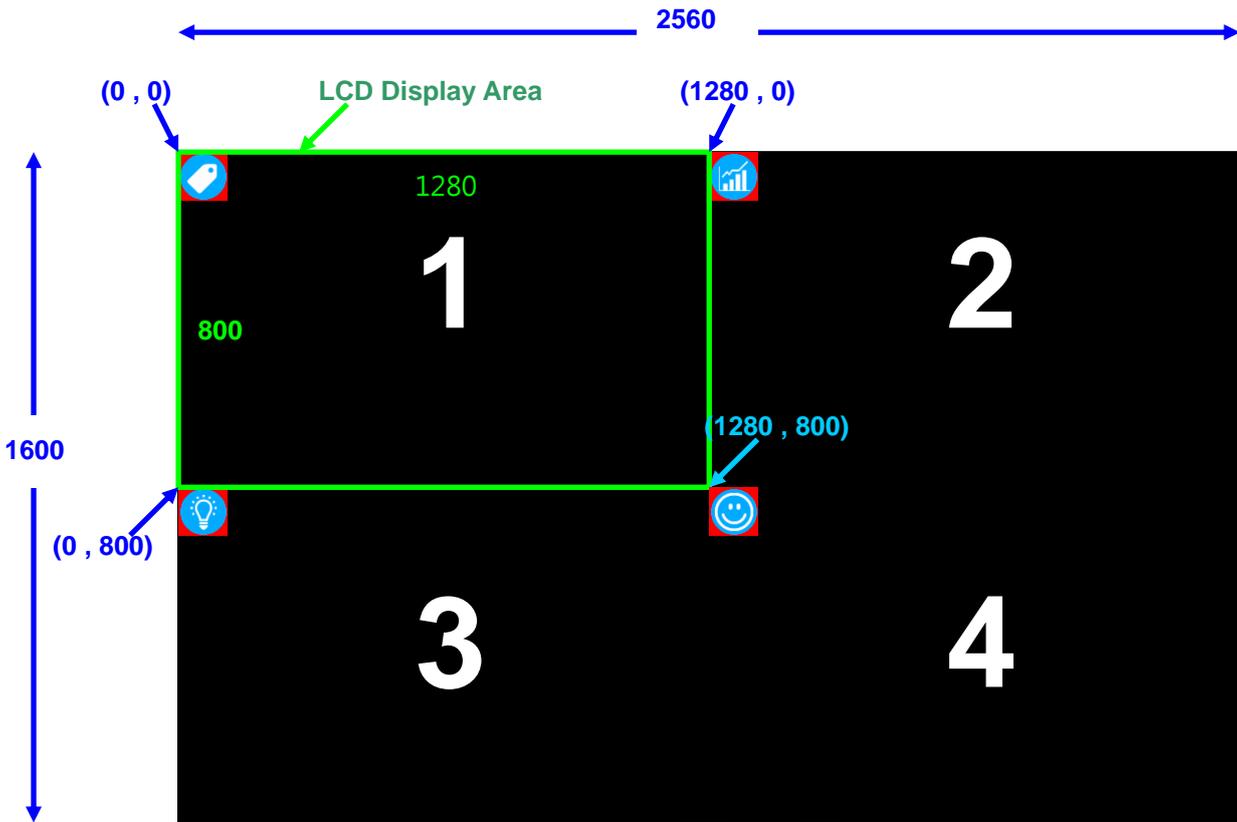
This AP provides a simple function for switching the coordinates of main window. Click "Memory View Tool Function

" Button on the main menu. You should see the item as below:

Main Window Upper-Left corner X-coordination

Main Window Upper-Left corner X-coordination Minimum and Maximum Values

Adjustment lever

Main Window Upper-Left corner Y-coordination

Main Window Upper-Left corner Y-coordination Minimum and Maximum Values

Adjustment lever

Enable Scrolling Function

❶ The coordinates for main window can be set the minimum or maximum value in this case; the coordinate ranges will be automatically calculated by the AP. The canvas width minus the LCD display width is equal to the maximum coordinate value of main window. For example the LCD display width is 1280, so the maximum value of X coordinate for this case is 2560-1280=1280. Moreover, the maximum value of Y coordinate is 8188-800=7388. Please note that although the coordinate can be set up to 7388, but it still has to depend on the actual memory size. If the memory size is not enough, then the unpredictable display will be appeared on the LCD. Regarding the canvas image, main window and the memory size calculating, please refer to the datasheet.

❷ Set the coordinates for the main window. For example, if the memory block 2nd is displayed, then X=1280 and Y=0. The coordinate X should be divisible by 4 due to IC designing restriction. But, the coordinate Y is without this restriction.

❸ There is another fast way to set up the coordinate for X or Y, is using your mouse to drag the scrollbar except assigning a coordinate value in the X/Y field.

❹ Scroll Function, tick "Scroll Function" item for enabling the scroll manipulation.

Virtual display on LCD panel:
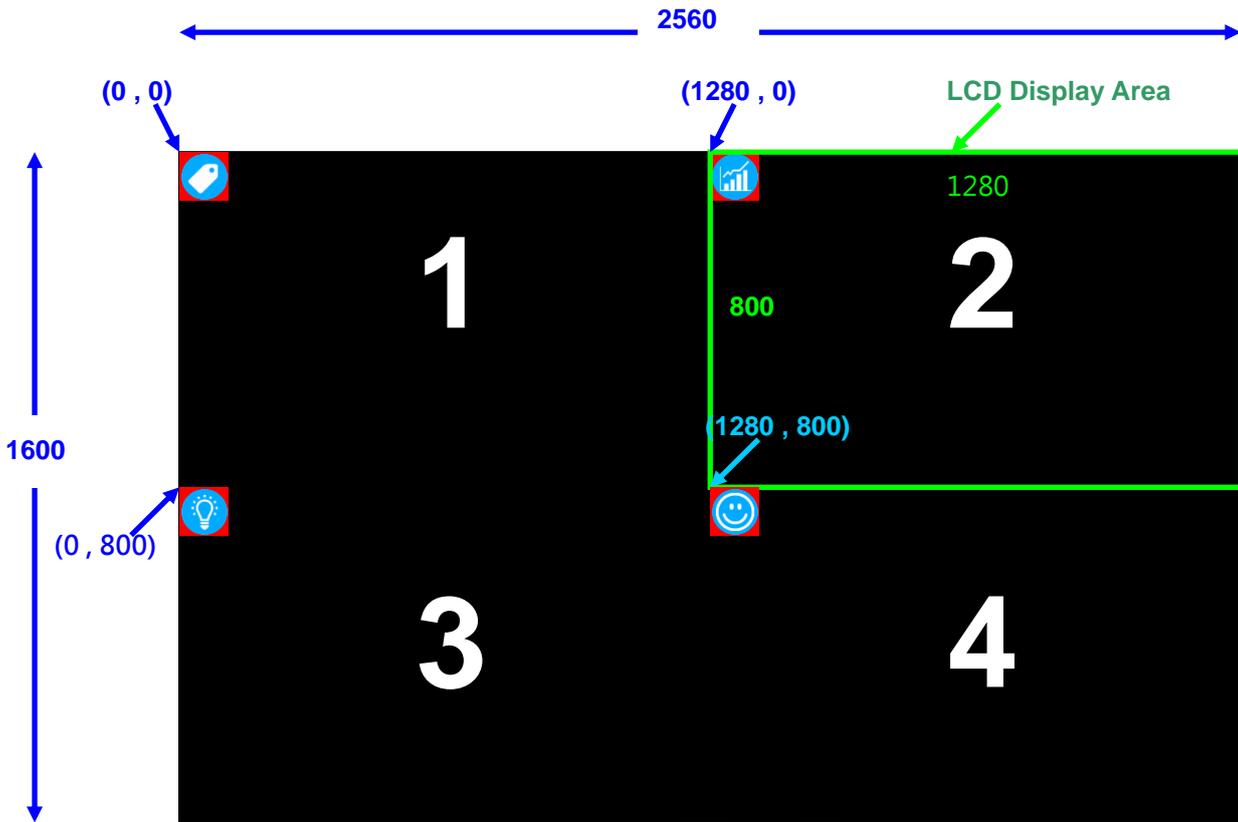
8.2 Scrolling

Scroll application for main window.

❶ Check the item "Scroll Function" to enable the scroll operation.

❷ Set the start address of main window (X and Y) for the scroll function. Scroll function will depend on these start addresses to carry out the scroll operation up to the maximum coordinate X/Y value.

❸ Set the scroll operation is worked with the horizontal scroll or the vertical scroll. Each of horizontal scroll can be moved 4-bit X coordinates (As the above description, it is the design restriction for RA8876/RA8877). And each of vertical scroll operation can be moved 1-bit Y coordinate.

❹ It is the time interval which is required for the scroll function to shift location.

❺ Start and Stop keys are used for starting or stopping the scroll function.

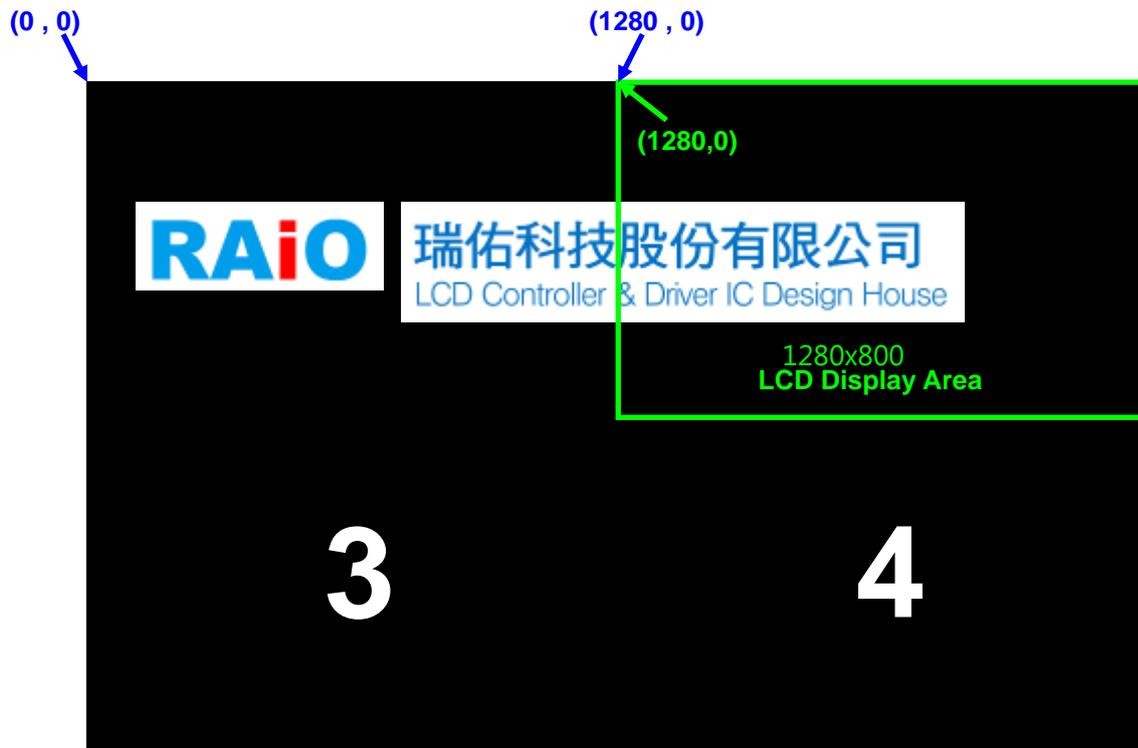Horizontal scroll illustration:

Before Horizontal Scrolling.

Horizontal Scrolling

Horizontal Scrolling

After Horizontal Scrolling:

The visual effects for the above illustrations are looked like the scrolling text marquee on the LCD display. For the further application, RA8876/RA8877 can be used to execute the scroll function and refresh the display data synchronously. So this function can perk up the still image for many high resolution displays.

Demo Video:

YouTube

https://www.youtube.com/watch?v=bliJiKRqhd4

youku

http://v.youku.com/v_show/id_XODk4NzQ0MDQw.html

9. BTE Function

9.1 Memory Copy with ROP

The detailed introduction for BTE function, please refer to the related description of datasheet of RA8876 / 77 / 71(M) / 73(M). This AP provides several most common usages for BTE function; help our user to realize what the BTE function is and how to use it.

Click "BTE Function   " Button on the main menu. You should see the items as below:

The memory arrangement is shown as the figure below. The 1st memory block is set to be the destination, the 2nd memory block is set to be the data source zero (S0), the 3rd memory block is set to be the data source one (S1), and the 4th memory block is the unused area:
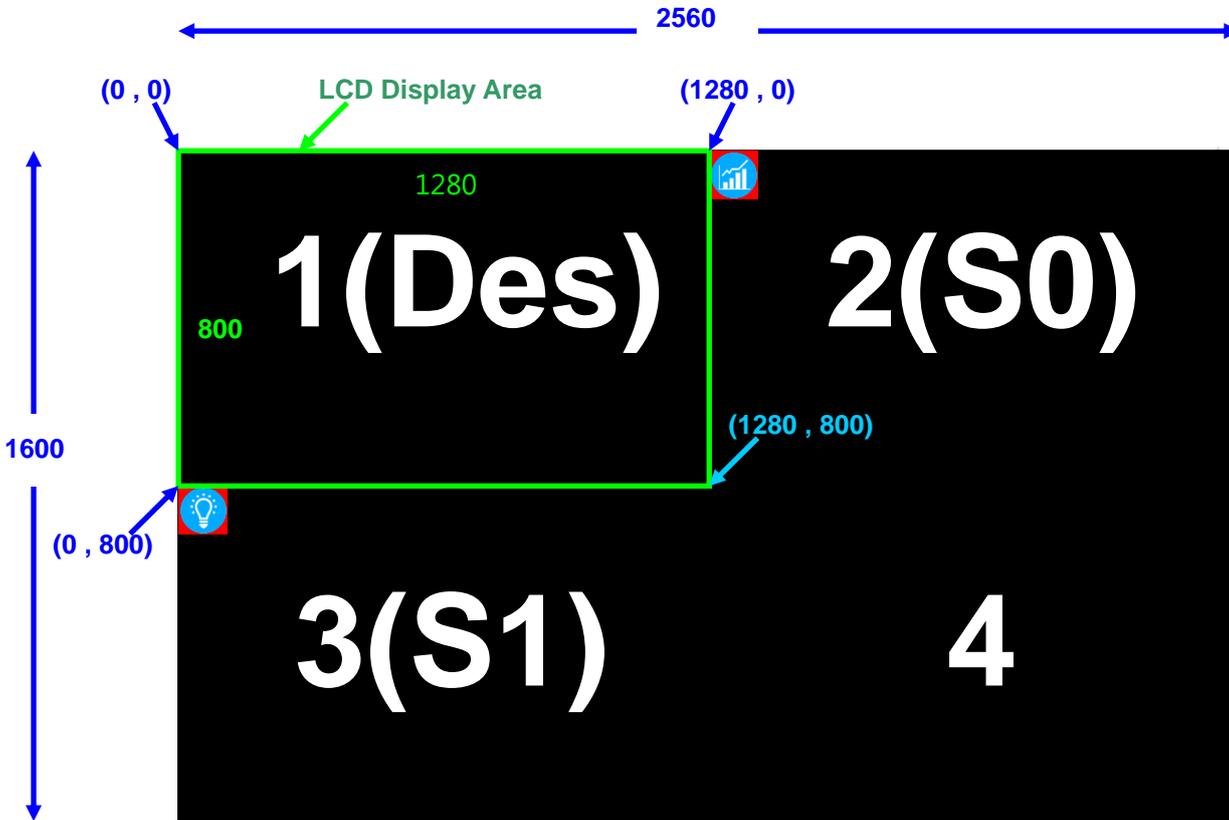
❶ Click the function "Copy ROP(Memory Copy with ROP)".

❷ Set the related parameters for S0, S1 and Des, the start address is the default value "0"; the image width is same as the canvas image width "2560". The coordinate for S0 is set as (1280, 0), the coordinate for S1 is set as (0, 800) and the coordinate for Des is set as (0, 0)

❸ Set the logical operation for S0 and S1, we set ROP=S0 for this example.

❹ Run the Copy ROP operation.

❺ If we have done the above procedures for Copy ROP, and then we can get a paragraph of API program from the C code dialog box. Users can migrate the generated C code to their firmware code for using "Memory Copy with ROP" function in their system.

The executed result is shown as the figure below. When ROP = S0, it means that the S0 is set to be the source data, and after executing BTE function, the display data in the 2nd memory (S0) will be copied to the 1st memory block (Destination).
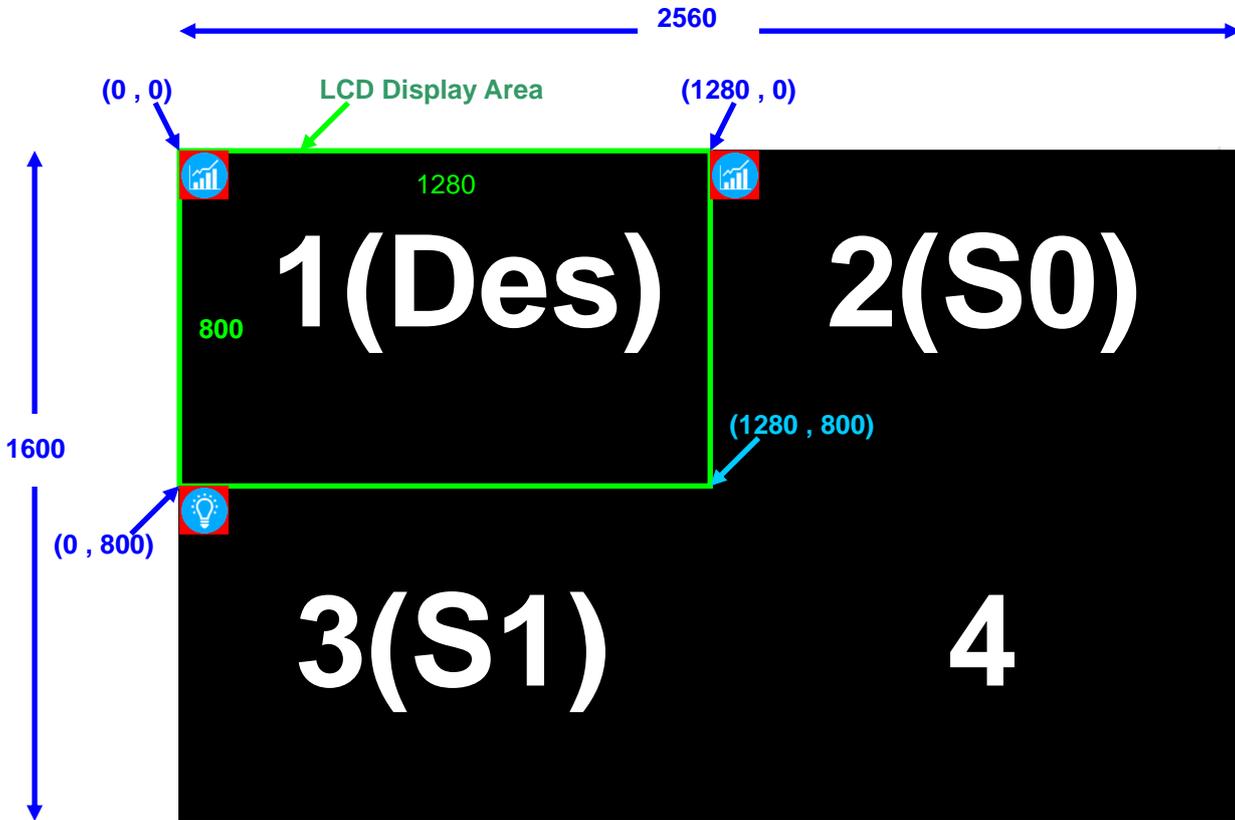
Demo Video:

YouTube

https://www.youtube.com/watch?v=srbvwcZ_w_U

youku

http://v.youku.com/v_show/id_XODk4Njc1NzA4.html

9.2 Memory Copy with Chroma Keying

This function is something like Memory Copy with ROP function, but it is without ROP logical operation. The color of chroma keying can be set for this function which is used for filtering one of S0 color.

The memory arrangement is shown as the following figure. The 1st memory block is set to be as the destination and the LCD Display Area, the 2nd memory block is set as the source data zero (S0), the 3rd memory block is set as the source data one (S1), and the 4th memory block is the unused area:
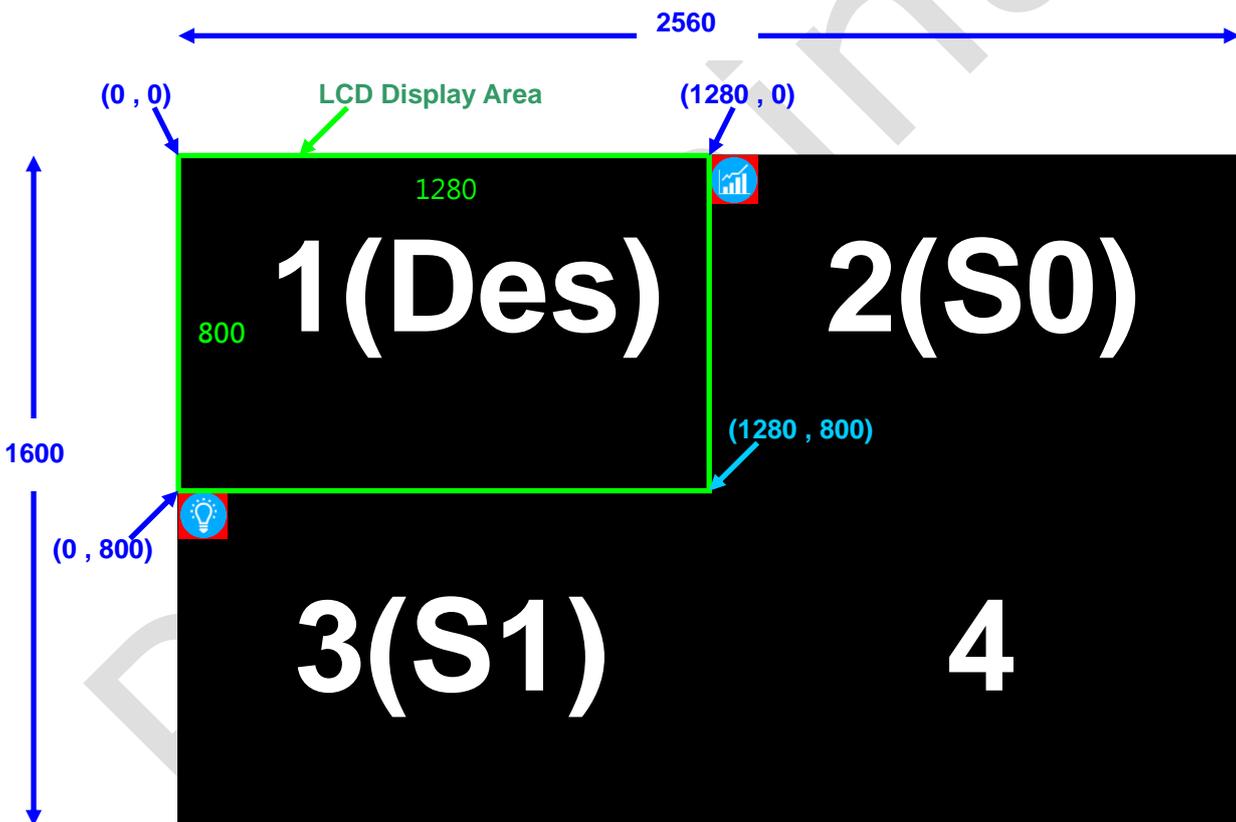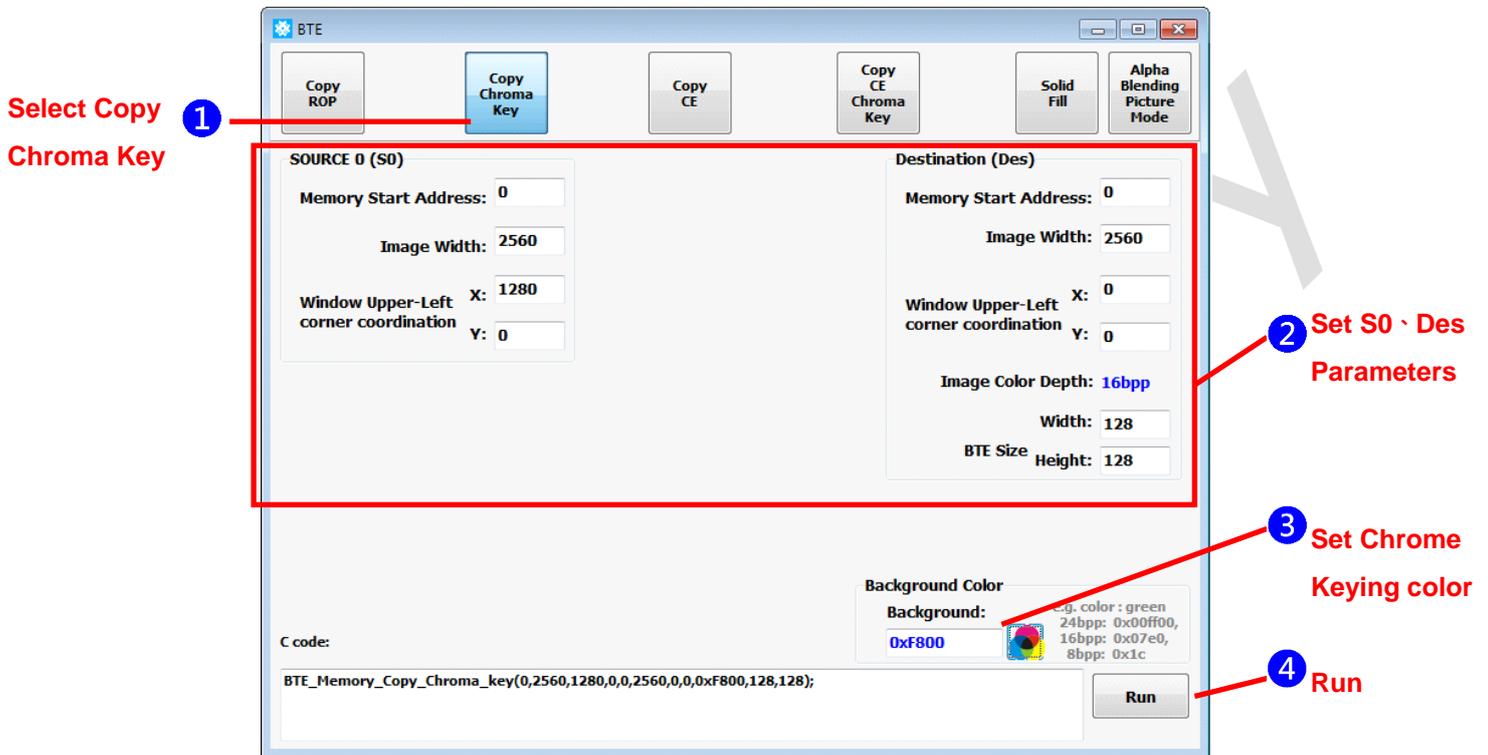
❶ Click to select the function "Copy Chroma Key (Memory Copy with Chroma Keying)".

❷ Set the related parameters for S0 and Des. The S1 is not used for this example, so we do not have to set the parameters for source1.

❸ Set which color of S0 should be filtered out.

❹ Run the BTE function.

The executed result is shown as the figure below. As we can see, the red color of S0 is filtered by chroma keying setting and the BTE engine will copy the processed S0 data to the destination area.


Demo Video:

YouTube

http://youtu.be/hmidywKHm0Q
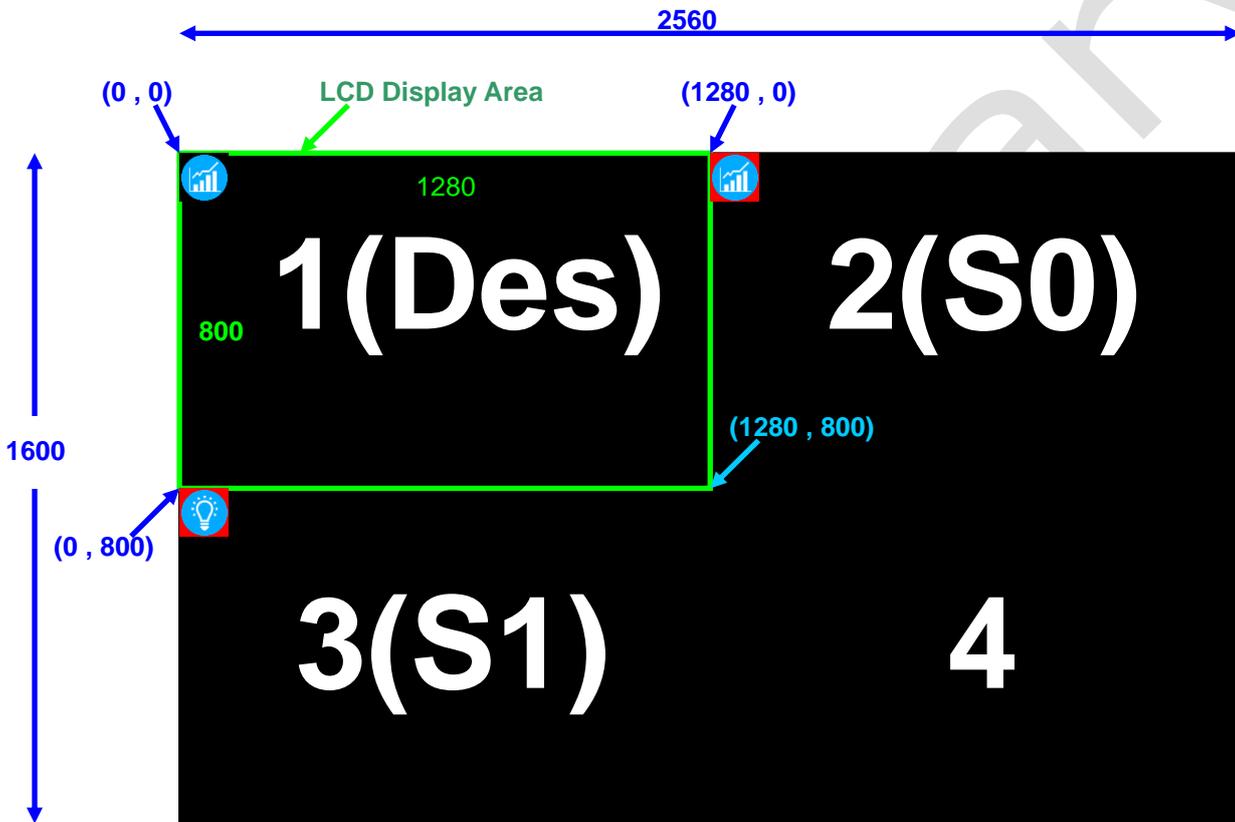
youku

http://v.youku.com/v_show/id_XOTEwODM0NzQ4.html

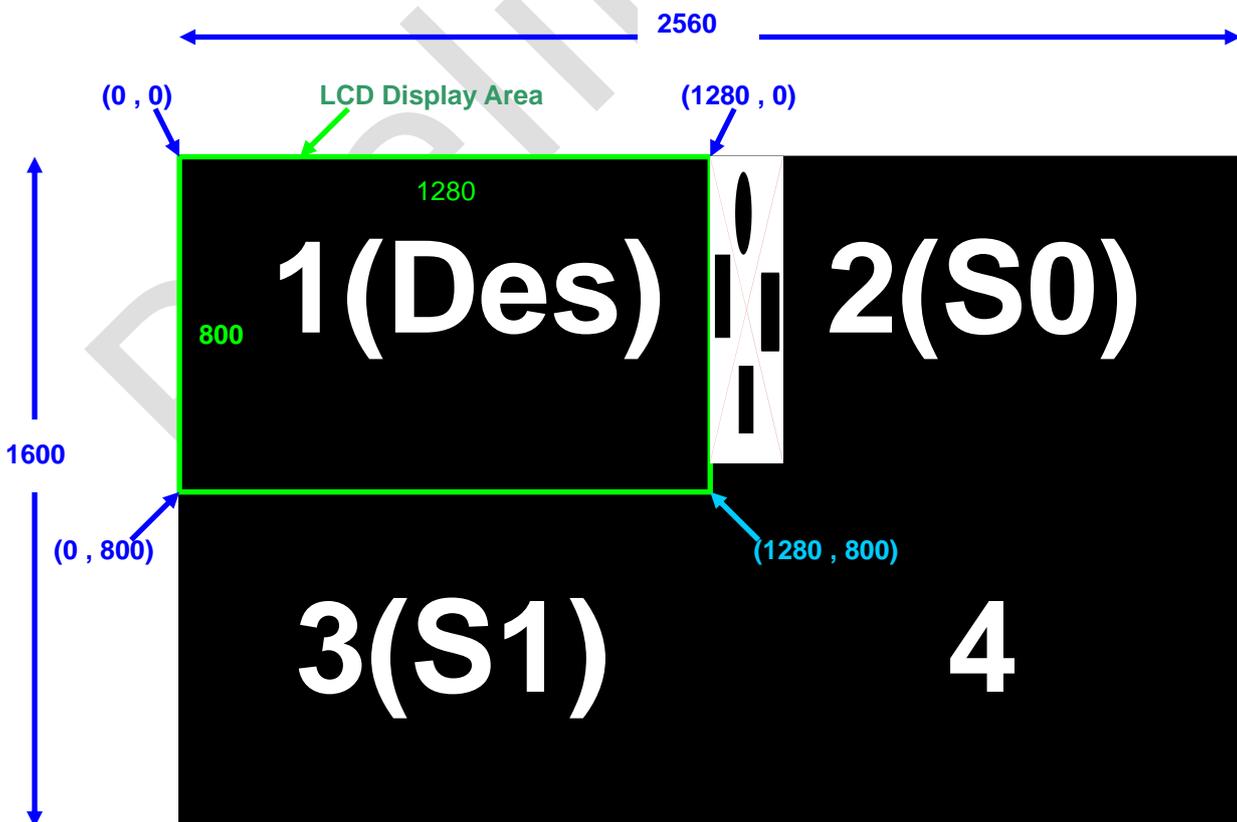## 9.3 Memory Copy with Color Expansion

The Memory Copy with Color Expansion is used for expanding the source's monochrome data to 8/16/24 bpp color format. And the expanded colors are defined in the BTE Foreground Color Register and the BTE Background Color Register.

As the following picture which is shown on the LCD panel, we use MCU write function to write 1024x768 image data into the 2nd memory block (S0). The monochrome image data which is stored in source 0 area seems to be zipped, that's because the image data is 1bpp format, so the illustration is the correct display effect.

Original 1bpp monochrome image:
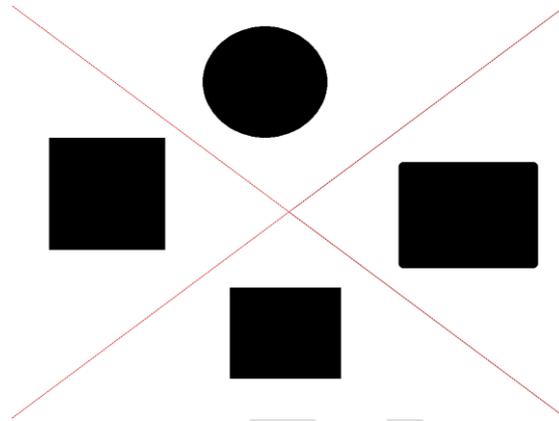
The memory arrangement is shown as the following figure. The 1st memory block is set to be as the destination and the LCD Display Area, the 2nd memory block is set to be the source data zero (S0), the 3rd memory block is set to be the source data one (S1), and the 4th memory block is the unused area:

Select Copy CE ❶

❷ Set S0、Des parameters

❸ Set Foreground and Background color

❹ Run
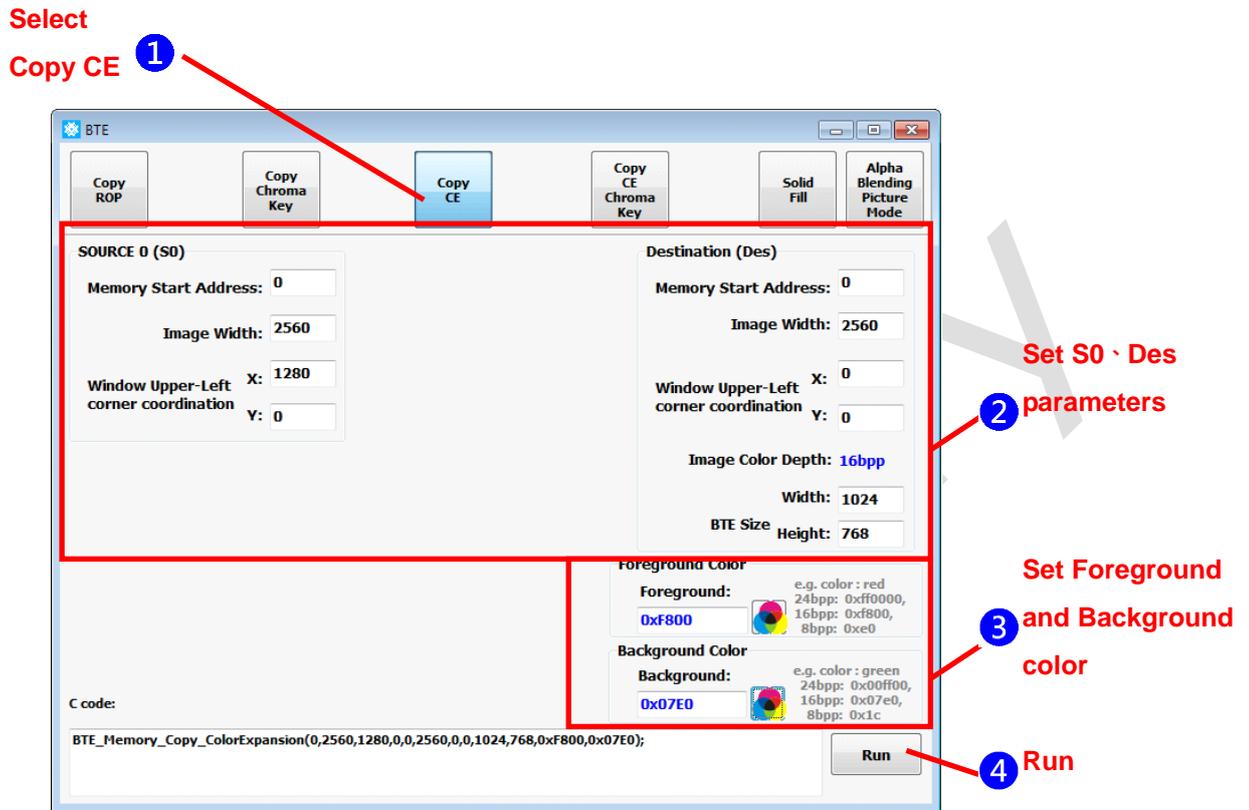
❶ Click to select the function "Copy CE(Memory Copy with Color Expansion)".

❷ Set the related parameters for S0 and Des. The S1 is not used for this case, so we do not have to set the parameters of S1.

❸ Define the BTE Foreground Color and define the BTE Background Color. The monochrome data "1" will be expanded to the colorful data and it is defined by the setting of BTE Foreground Color Register. The monochrome data "0" will be expanded to the colorful data and it is defined by the setting of BTE Background Color Register.

❹ Run the BTE function.

The executed result is shown as the figure below.

Demo Video:

YouTube

https://www.youtube.com/watch?v=MRV7CrANIA0
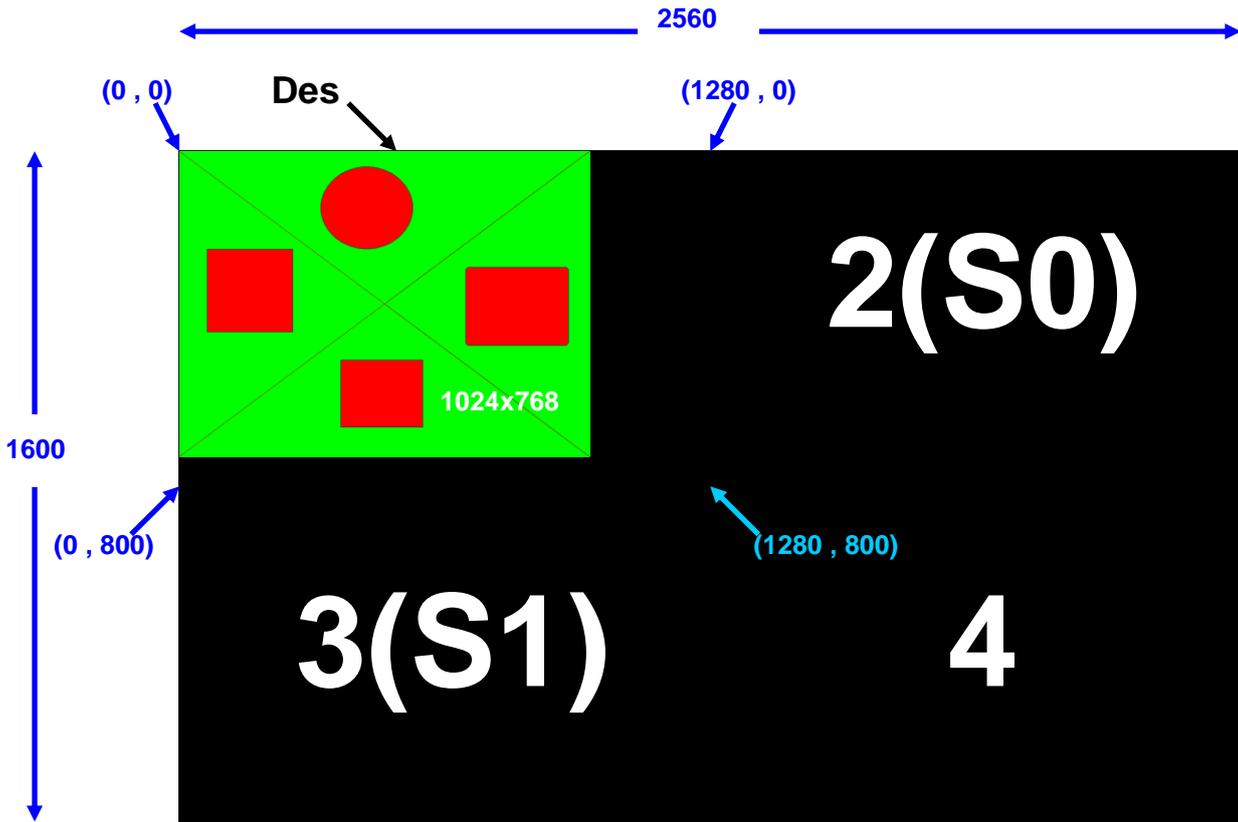
youku

http://v.youku.com/v_show/id_XODk4NjYwOTI0.html

9.4 Memory Copy with Color Expansion and Chroma Keying

This function is something like Memory Copy with Color Expansion function, without the monochrome data "0, therefore the original data in the destination will not be changed. Without the BTE Background Color setting, the other operations are same as Memory Copy with Color Expansion function, so we are not going to explain the detailed manipulations again. The executing result is shown as the figure below.
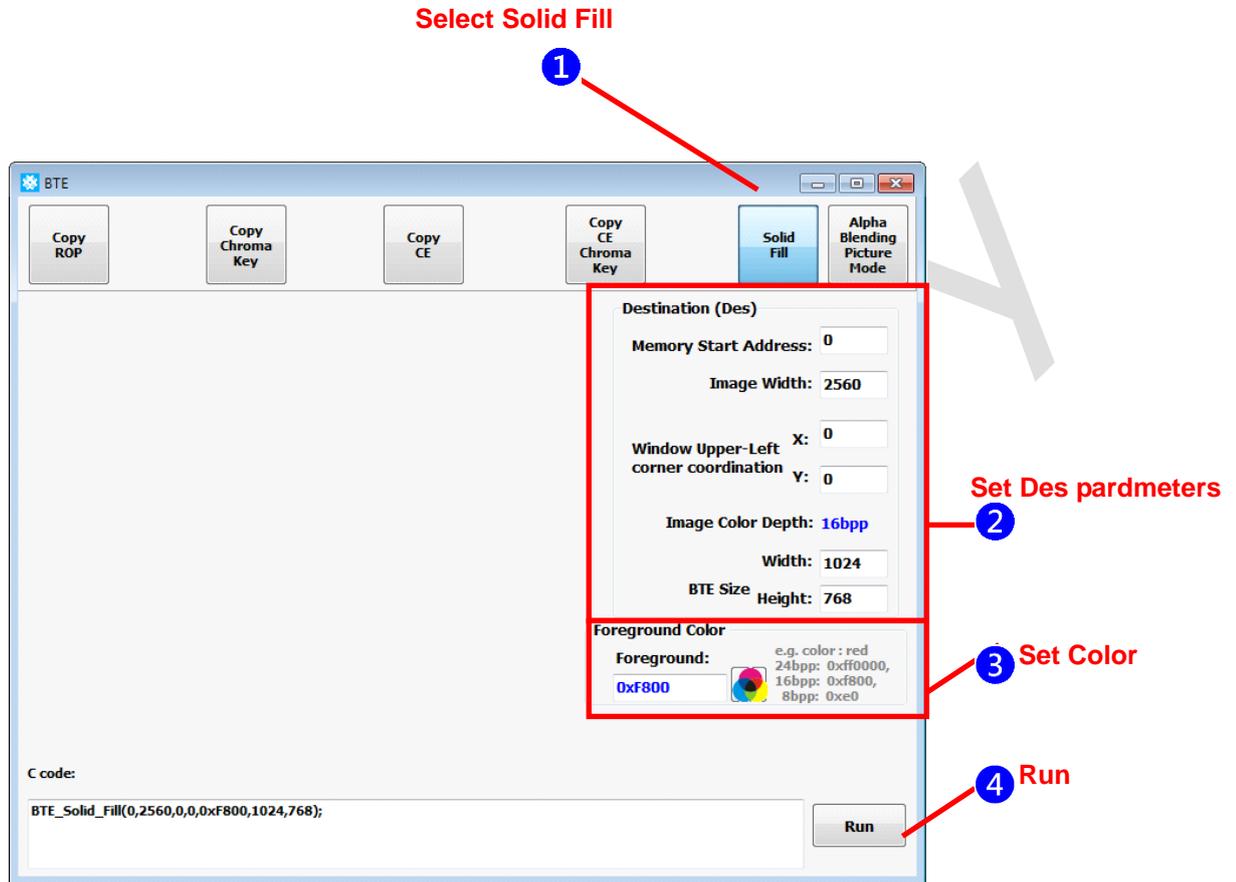

Demo Video:

YouTube

http://youtu.be/cbwKnBfinPQ
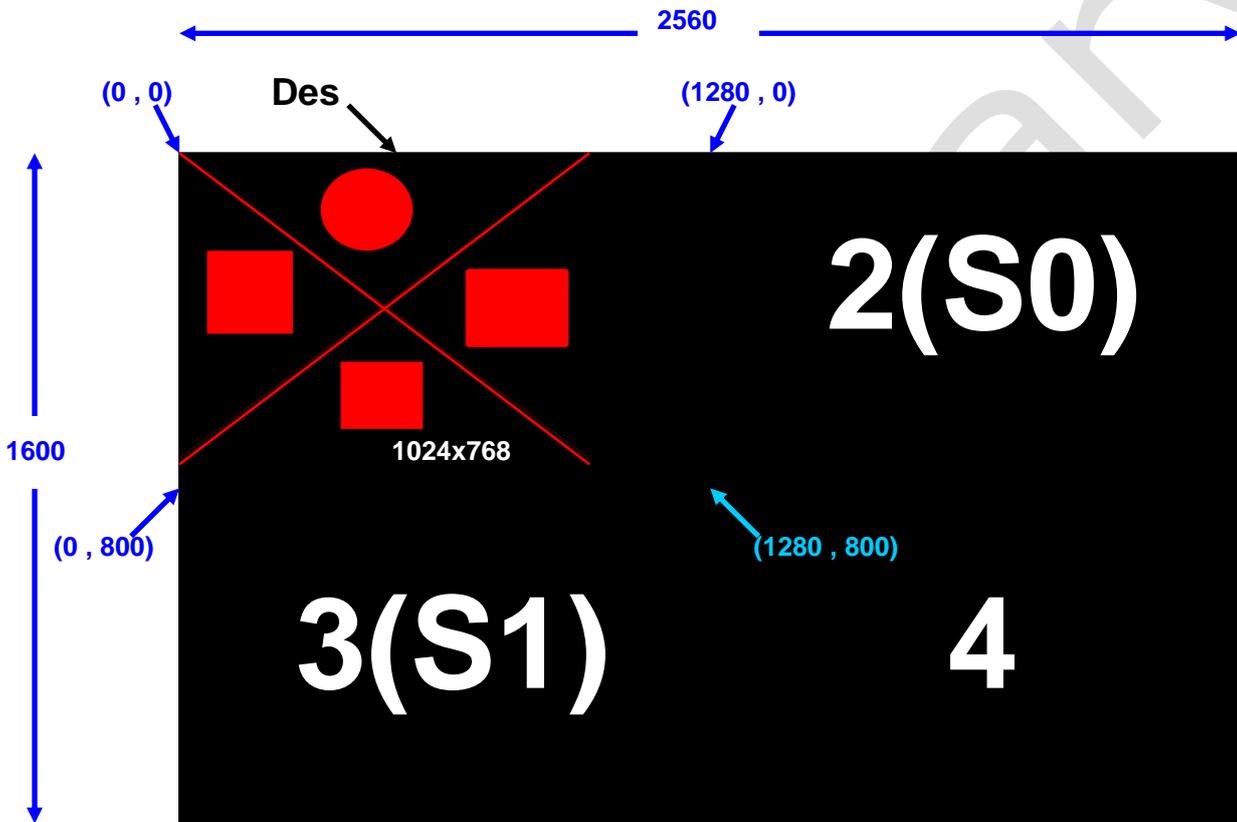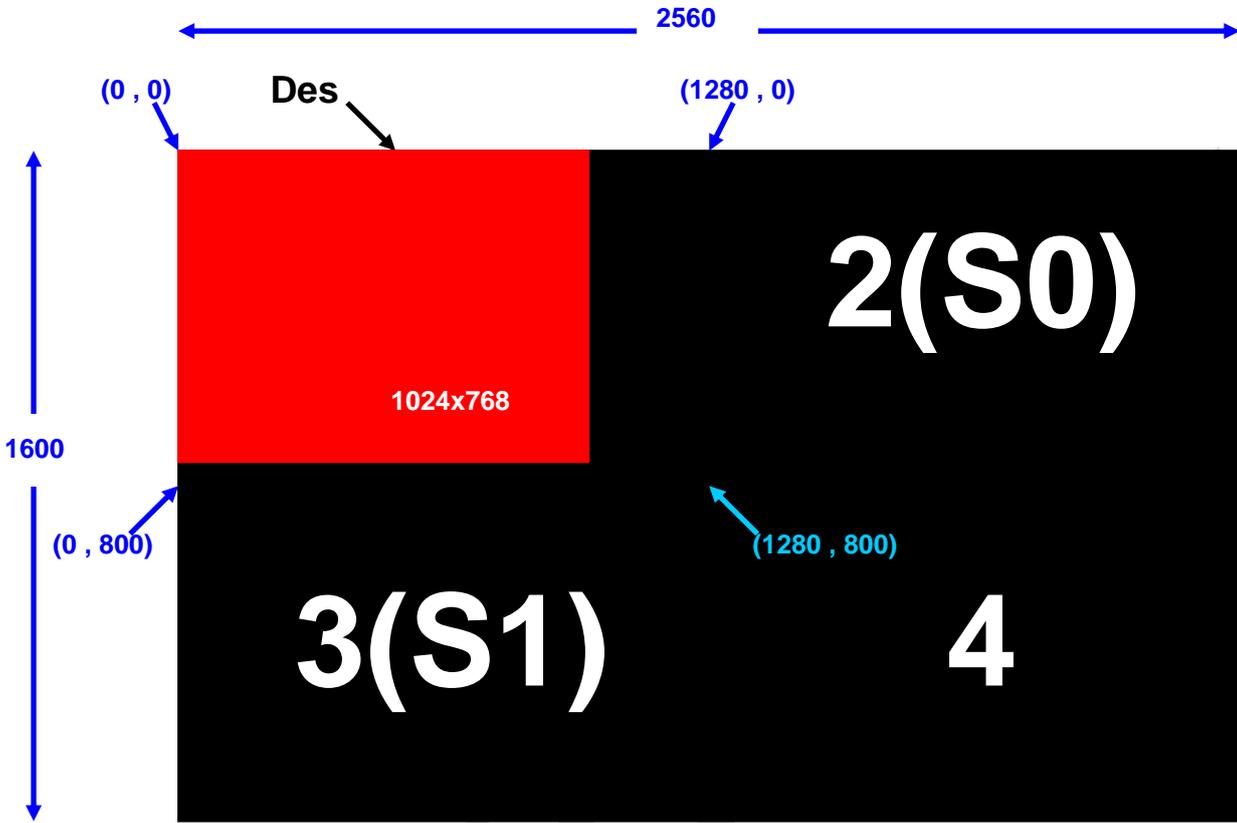
youku

http://v.youku.com/v_show/id_XOTEwNDYxODMy.html

9.5 Solid Fill

The Solid Fill function fills a specified BTE area (destination) with a solid color as defined in the BTE Foreground Color Register. This function is a little like the Drawing Function.

Select Solid Fill

❶

❷ Set Des pardmeters

❸ Set Color

❹ Run

❶ Click to select the function "Solid Fill".

❷ Set the operated area and the solid fill area.

❸ Set the required color for Solid fill.

❹ Run the BTE function.

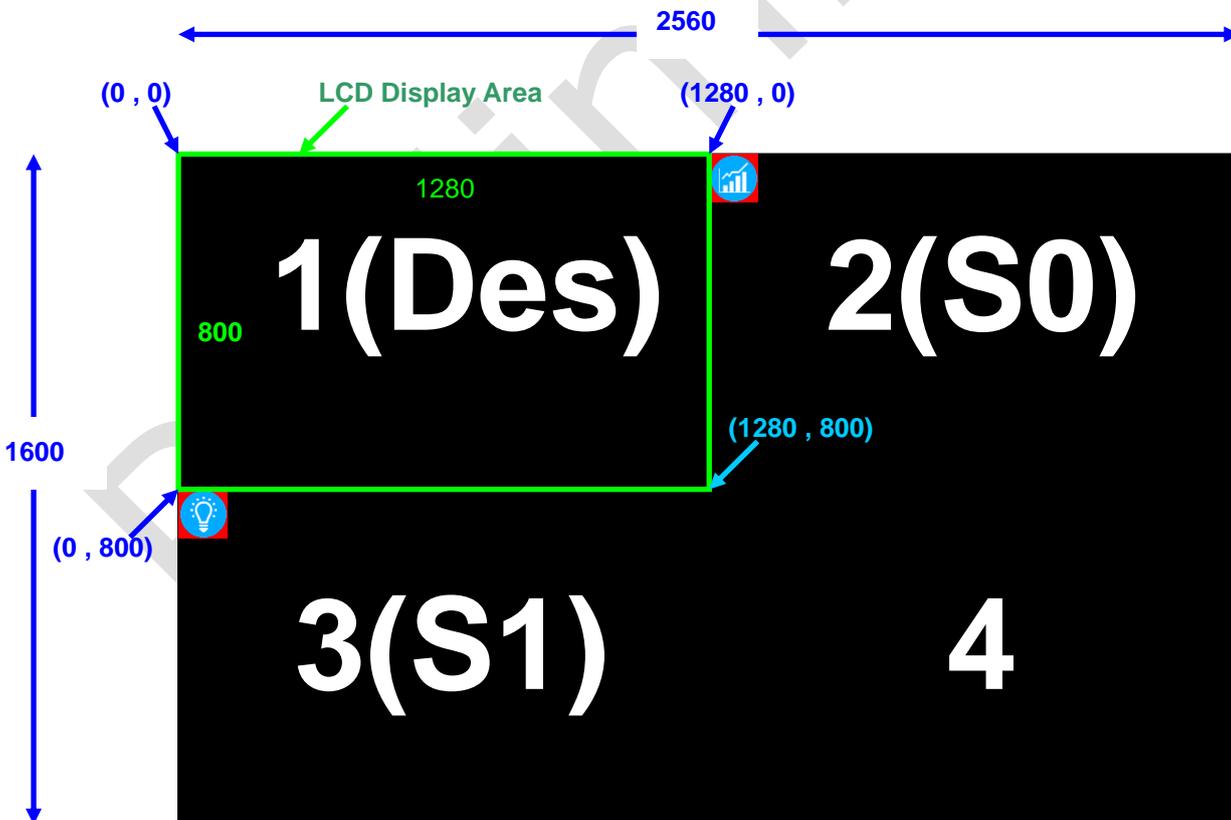The executed result is shown as the figure below.

Demo Video:

YouTube

https://www.youtube.com/watch?v=bbFBLHCvoUE

youku

http://v.youku.com/v_show/id_XODk4NjkwNjU2.html

9.6 Alpha Blending in Picture Mode

This function is the process of combining an image (S1) with a background (S0) to create the appearance of partial, and then move the calculated image to the destination. This function is a bit like the Memory Copy with ROP function, only the ROP operation is changed to Alpha Level. In the picture mode, each pixel in the selected area will get the same level calculation for the alpha compositing. Besides, RA8876 / 77 / 71(M) / 73(M) also supports 16-bit pixel mode for the alpha blending function, it is not discussed here, please refer to the datasheet of RA8876 / 77 / 71(M) / 73(M) about the 16-bit pixel mode. But RAiO's image tool supports converting image for this 16bpp pixel mode. If user has the requirement for this application, please

contact with our FAE (✉) department.

The memory arrangement is shown as the following figure. The 1st memory block is set to be as the destination and the LCD Display Area, the 2nd memory block is set to be the source data zero (S0), the 3rd memory block is set to be the source data one (S1), and the 4th memory block is the unused area:

Select Alpha Blending Picture Mode

Set S0、S1、Des parameters

Set Alpha Level

Run

❶ Click to select the function "Alpha Blending Picture Mode (Alpha Blending in Picture Mode)"

❷ Set the related parameters for S0, S1 and Des.

❸ Set the Alpha Level (0~32), it is set to 16 here, so it has the translucent effect on the display.

❹ Run the BTE function.

The executed result is shown as the figure below.

Demo Video:

YouTube

https://www.youtube.com/watch?v=GGo5FbaeARg
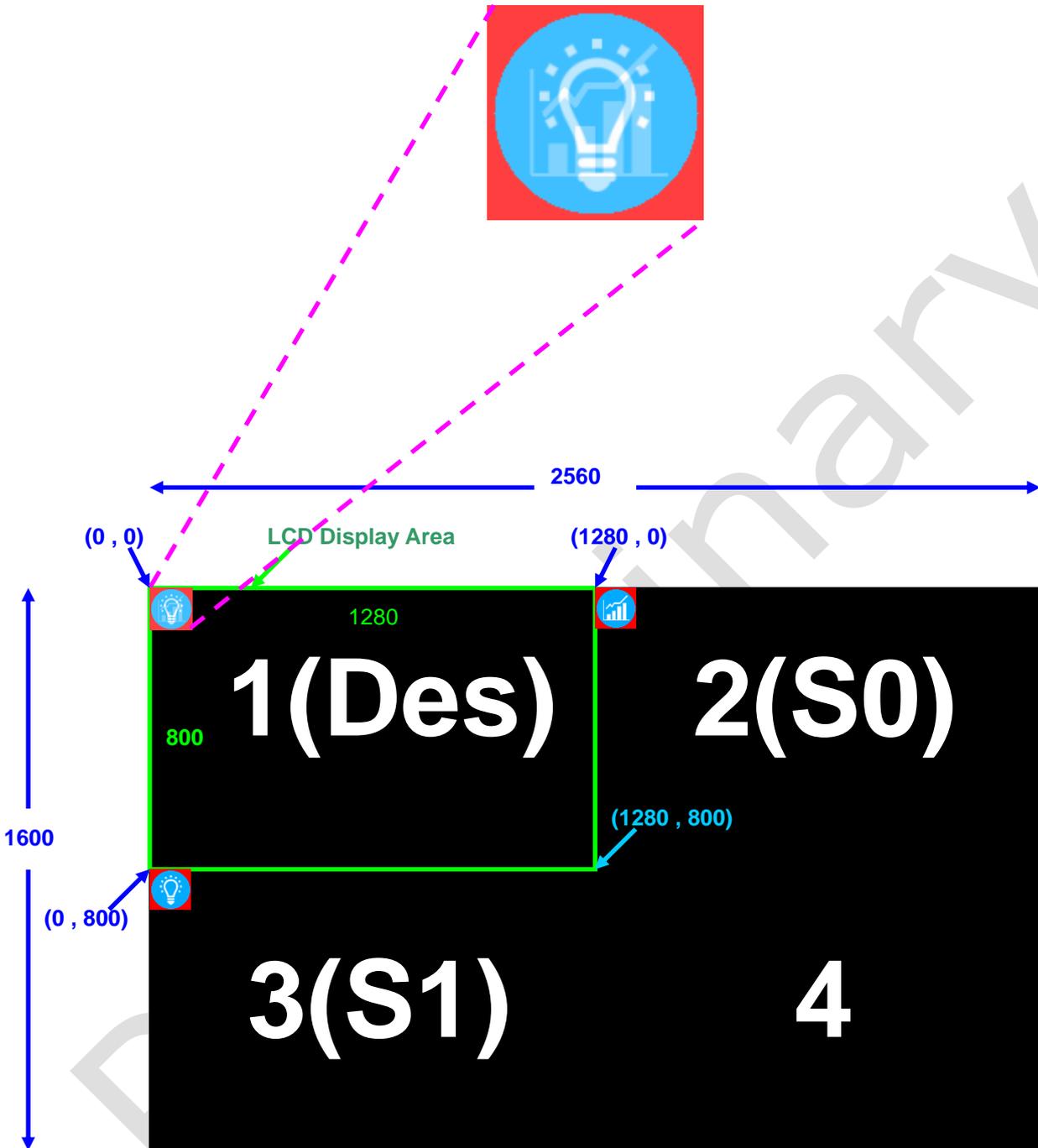
youku

http://v.youku.com/v_show/id_XOTQwMTI2OTMy.html

10. PIP Function

RA8876 / 77 / 71(M) / 73(M) supports two PIP windows that can be used with main display window. PIP windows do not support transparent overlay, it just provides users that can enable or disable without overwriting the main display window image data. If the PIP1 and PIP2 windows are overlapped, the PIP1 window is displayed over PIP2 window.

Click "PIP Function [PIP]" Button on the main menu. You should see the items as below:
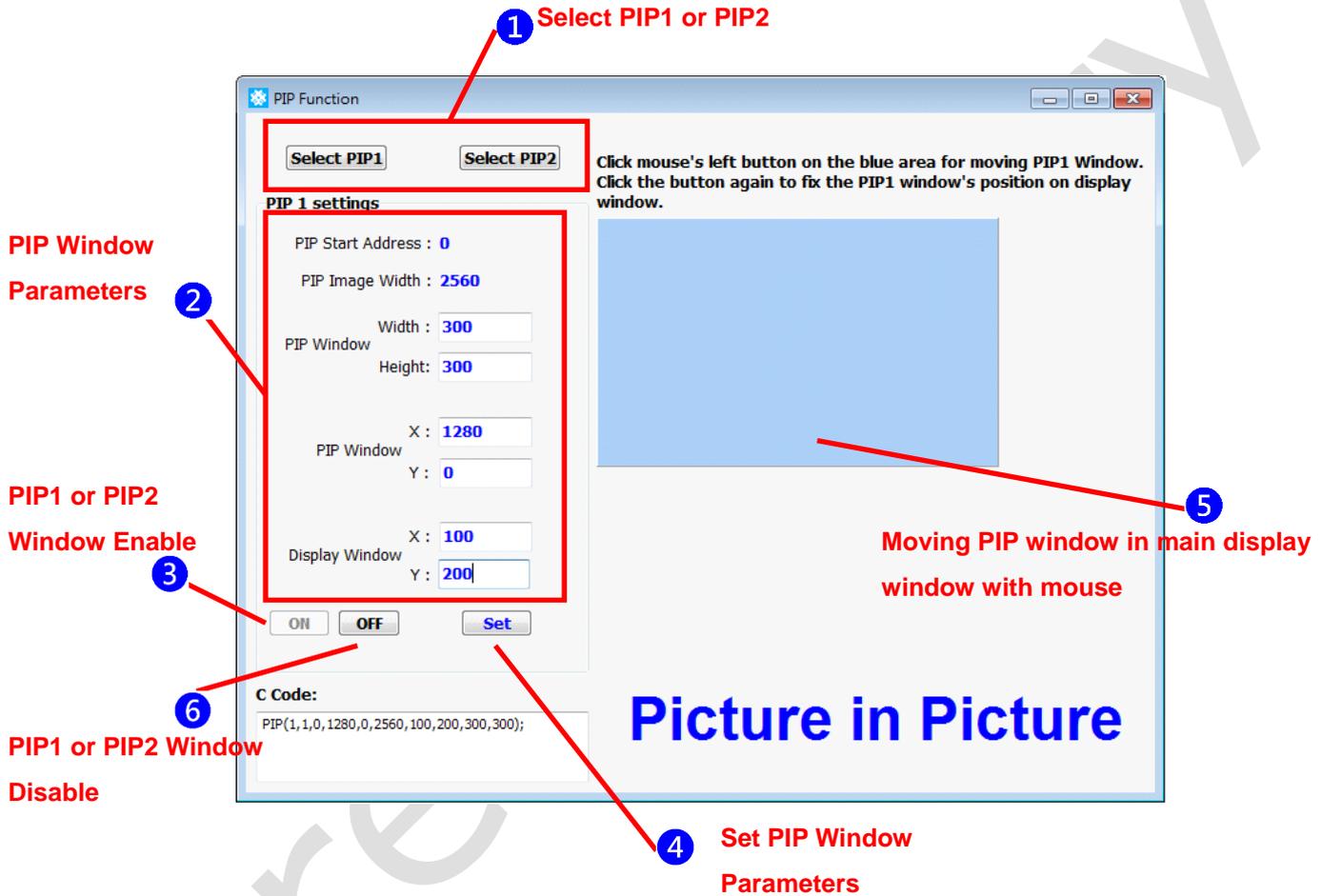
❶ Click "Select PIP1" or "Select PIP2" button to choose PIP1 window or PIP2 window.

❷ Set the related parameters for selected PIP window. In this case, the coordinate for PIP1 window is set to (1280, 0), the size for PIP1 window is set to 300x300 and the coordinate for display window is set to (100,200).

❸ Click "ON" button to enable selected PIP window.

❹ If it is needed to modify the PIP window's parameters, after finishing the related settings, click "Set" button to execute the PIP window function.

❺ Except for the method of step 4, we can also use the mouse to move the position of PIP window on the display window. First, click the mouse's left button on the blue area, we will see the mouse cursor be changed from the arrow shape to the crosshair shape ┼ . And then move the mouse cursor on the blue area. The position of PIP window will be moved on the display window simultaneously with the mouse moving. If we click mouse's left button again, it can fix PIP window's positions on the display window.

❻ To enable PIP2 window, repeat the manipulations from step 1 to step 5. In this example, the coordinate for PIP2 window is set as (1280, 300), the size for PIP2 window is set as 320x240 and the coordinate for display window is set as (360,460).

❼ Click "OFF" button to disable selected PIP window.

Virtual display on LCD panel:

Demo Video:

YouTube

https://www.youtube.com/watch?v=psNso5ZkLrY
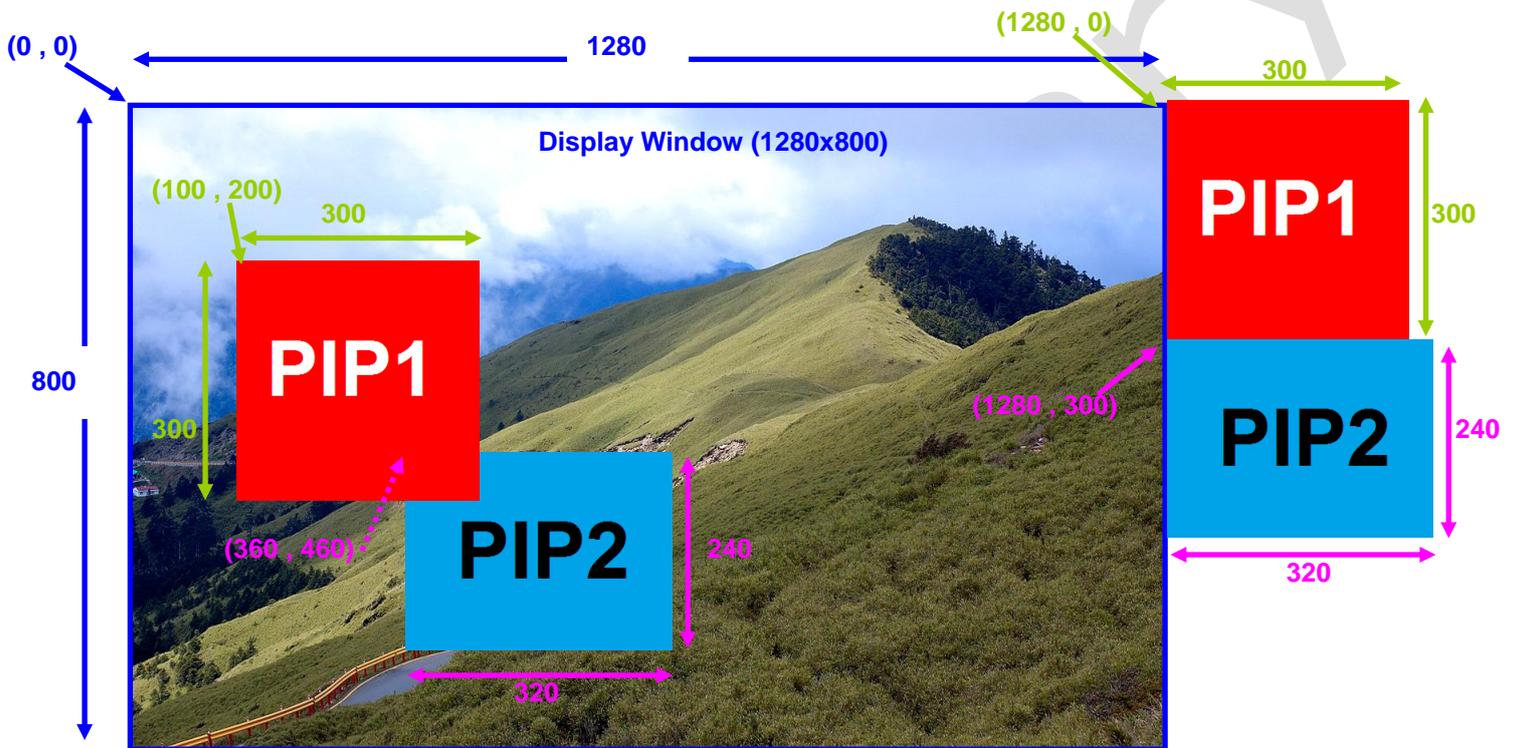
youku

http://v.youku.com/v_show/id_XODk4NzM2ODUy.html