

# M032 emWin Quick Start Guide

## Document Information

<b>Abstract</b>	Introduce the steps to build and launch emWin for the M032 series microcontroller (MCU).
<b>Apply to</b>	NuMicro® M032 series

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## **1 Introduction**

emWin is a graphic library with graphical user interface (GUI) designed to provide an efficient, processor and display controller-independent GUI for any application that operates with a graphical display.

Nuvoton provides emWin GUI library for free with the M032 series microcontroller (MCU) supporting up to 320x240 (16 bpp) resolution. The emWin platform can be implemented on HMI for industrial, machines, appliances, etc.

## 2 emWin BSP Directory Structure

This chapter introduces emWin related files and directories in the M032 BSP.

### 2.1 Sample Codes (SampleCode\NuMaker)

<b>emWin_GUIDemo</b>	Utilize emWin library to demonstrate widgets feature.
<b>emWin_SimpleDemo</b>	Utilize emWin library to demonstrate interactive feature.

### 2.2 Configuration Files (ThirdParty\emWin\Config)

<b>GUI_X.c</b>	Configuration and system dependent code for GUI.
<b>GUIConf.c</b>	Display controller initialization source code.
<b>GUIConf.h</b>	A header file configures emWin features, fonts, etc.
<b>LCDCConf.c</b>	Display controller configuration source code.
<b>LCDCConf.h</b>	Display driver configuration header file.

### 2.3 Documents (ThirdParty\emWin\Doc)

<b>AN03002_Custom_Widget_Type.pdf</b>	emWin custom widget type creation guide.
<b>UM03001_emWin5.pdf</b>	emWin user guide and reference manual.
<b>Release.html</b>	emWin release notes
<b>UM_Font_Architect_EN_Rev1.02.pdf</b>	Nuvoton font tool “FontArchitect.exe” user guide and reference manual in English.
<b>UM_Font_Architect_TC_Rev1.02.pdf</b>	Nuvoton font tool “FontArchitect.exe” user guide and reference manual in Chinese.
<b>Changelog.pdf</b>	Nuvoton emWin change log.

### 2.4 Include Files (ThirdParty\emWin\Include)

This directory contains header files for emWin project.

## 2.5 Library (ThirdParty\emWin\Lib)

<b>NUemWin_CM0_Keil.lib</b>	emWin library Keil for M032 series MCU.
<b>libNUemWin_CM0_GNU.a</b>	emWin library GNU for M032 series MCU.
<b>NUemWin_CM0_IAR.a</b>	emWin library IAR for M032 series MCU.

## 2.6 Tools (ThirdParty\emWin\Tool)

<b>BmpCvtNuvoton.exe</b>	The Bitmap Converter is designed for converting common image file formats like BMP, PNG or GIF into the desired emWin bitmap format.
<b>emWinPlayer.exe</b>	This tool can show the previously created emWin Movie File (EMF) on a Computer with a Windows operating system.
<b>FontArchitect.exe</b>	A Nuvoton tool for creating emWin bitmap font format.
<b>GUIBuilder.exe</b>	A tool for creating dialogs by drag and drop operation.
<b>JPEG2Movie.exe</b>	A tool to convert JPEG files to an EMF file.

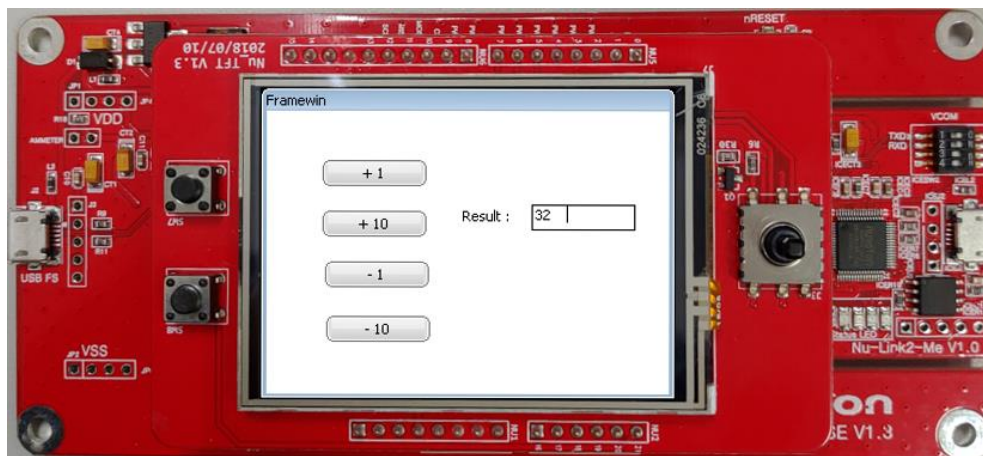
### 3 emWin Sample Code

There are two emWin sample codes in the M032 BSP SampleCode\NuMaker directory:

- **emWin\_GUIDemo**: utilizes the emWin library to demonstrate widgets feature;
- **emWin\_SimpleDemo**: utilizes the emWin library to demonstrate interactive feature.

#### 3.1 Project Structure

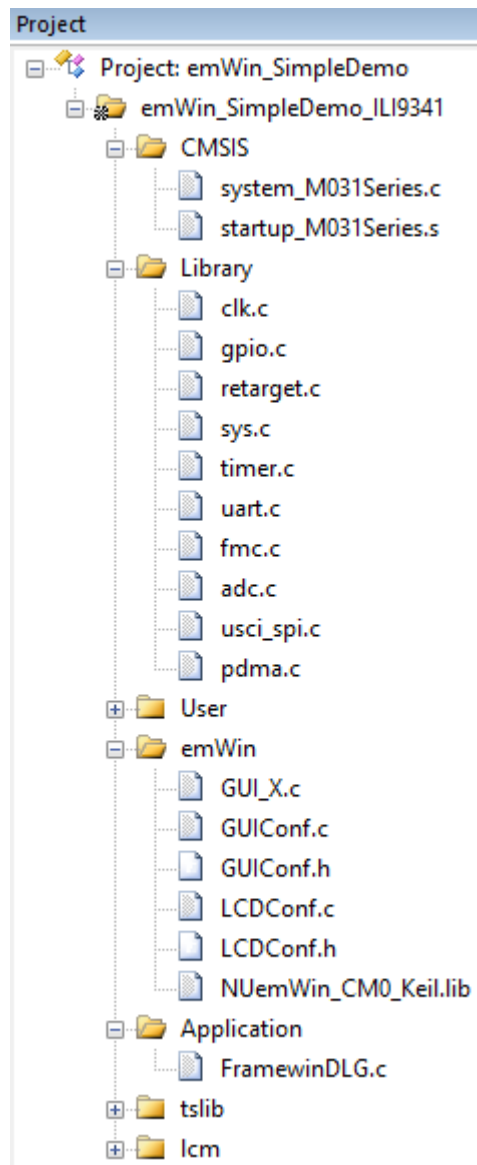
The following uses emWin\_SimpleDemo as a sample to explain the emWin project structure in BSP. This sample contains a frame window, four buttons, a text and a text editor. User can update the number shown in the text field by clicking four buttons shown on the display panel.



The project structure is shown in the following figure. The project contains two targets:

- **emWin\_SimpleDemo\_ILI9341**: utilizes 240 x 320 LCD;
- **emWin\_SimpleDemo\_ST7735**: utilizes 128 x 160 LCD.

The Libraries group contains low level driver and system startup code. The emWin group contains emWin library and panel configuration for the NuMicro® family. The Application group contains the C code generated by emWin GUIBuilder. The tslib group is the touch screen library. The lcm group is the display driver. The User group contains the main file.



## 3.2 System Initialization

The system initialization code is located in main function, including peripheral clock preparation, multi-function pin configuration, and UART debug port setting. Also, a 1000Hz timer is configured to keep track of time elapsed.

```
int main(void)
{
    // Init System, IP clock and multi-function I/O
    _SYS_Init();
    //
    // Init UART to 115200-8n1 for print message
    //
```

```

UART_Open(UART0, 115200);

// Enable Timer0 clock and select Timer0 clock source
//
CLK_EnableModuleClock(TMR0_MODULE);
CLK_SetModuleClock(TMR0_MODULE, CLK_CLKSEL1_TMR0SEL_HXT, 0);
//
// Initial Timer0 to periodic mode with 1000Hz
//
TIMER_Open(TIMER0, TIMER_PERIODIC_MODE, 1000);
//
// Enable Timer0 interrupt
//
TIMER_EnableInt(TIMER0);
NVIC_EnableIRQ(TMR0_IRQn);

//
// Start Timer0
//
TIMER_Start(TIMER0);

printf("\n\nCPU @ %d Hz\n", SystemCoreClock);

MainTask();
while(1);
}

```

### 3.3 emWin Initialization

To initialize emWin GUI, the application needs to call GUI\_Init() and CreatFramewin() function. The code is in MainTask() in main.c.

```

void MainTask(void)
{
    WM_HWIN hWin;
    Char acVersion[40] = "Framewin: Version of emWin: ";

    printf("Main Task -> \n");
    GUI_Init();
    strcat(acVersion, GUI_GetVersionString());
    hWin = CreateFramewin();
    FRAMEWIN_SetText(hWin, acVersion);
}

```



```
while (1)
{
    GUI_Delay(1000);
}
}
```

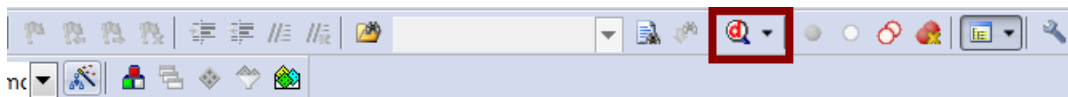
### 3.4 Build emWin Project

To build the emWin project in Keil MDK, click the rebuild icon as shown below or press F7 function key.



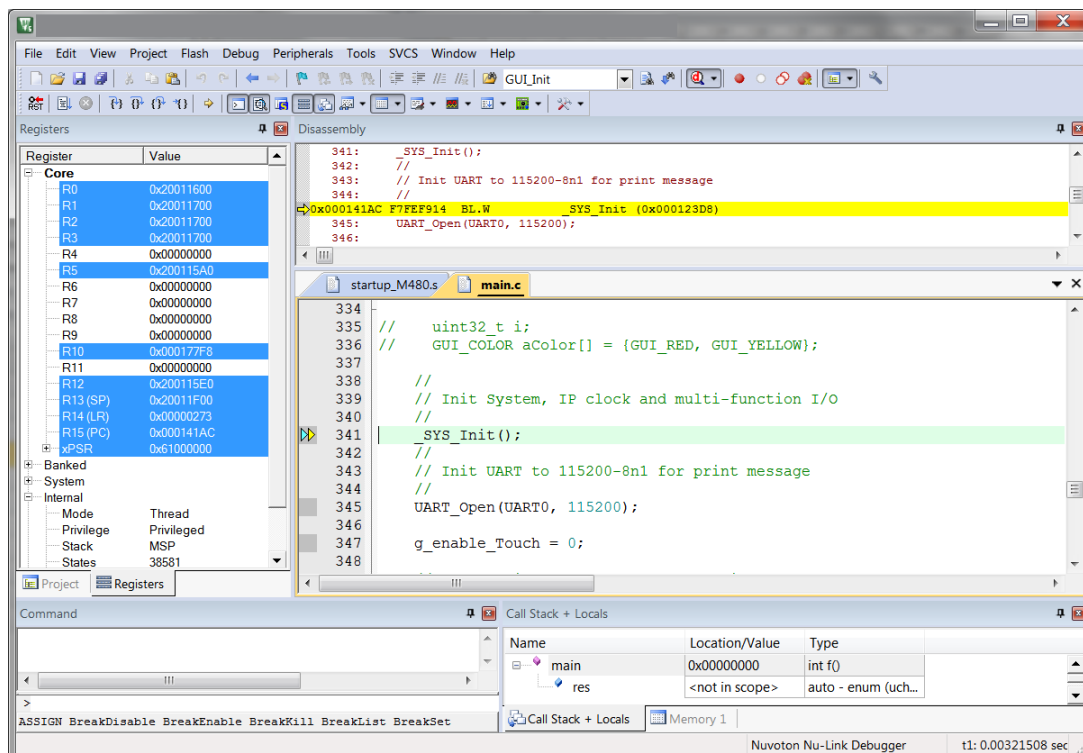
### 3.5 Download and Run

Press Ctrl + F5 to download the application and start a debug session or click start/stop debug session icon as shown below.



After entering debug session, press F5 to start code execution.

The following figure shows the application halts in main() function after starting a debug session.



### 3.6 Touch Screen

To support resistive touch screen, use ADC to convert the voltage of X axis and Y axis, and then use the open source tslib to map the ADC conversion result into the coordination. The conversion result can be affected by power noise, mechanical misalignment, etc. To overcome this issue, the tslib supports calibration function, and the calibration parameter is stored ether in APROM.

emWin\_SimpleDemo uses the calibration parameter in the APROM offset 0x00030000.

The touch resolution and the APROM offset store calibration parameters in the TouchPanel.h.

```
#ifndef __M032TOUCHPANEL_H__
#define __M032TOUCHPANEL_H__

#define __DEMO_TSFILE_ADDR__    0x00030000 /* SPI flash 192KB address */

#ifdef __DEMO_160x128__
#define __DEMO_TS_WIDTH__      160
#define __DEMO_TS_HEIGHT__     128
#else
#define __DEMO_TS_WIDTH__      320
#define __DEMO_TS_HEIGHT__     240
#endif

#endif
```

If APROM is used to store the calibration parameter, main function will load the parameter from APROM. If the parameter doesn't exist, main function will call ts\_calibrate() to generate a copy.

```
/* Unlock protected registers */
SYS_UnlockReg();

/* Enable FMC ISP function */
FMC_Open();

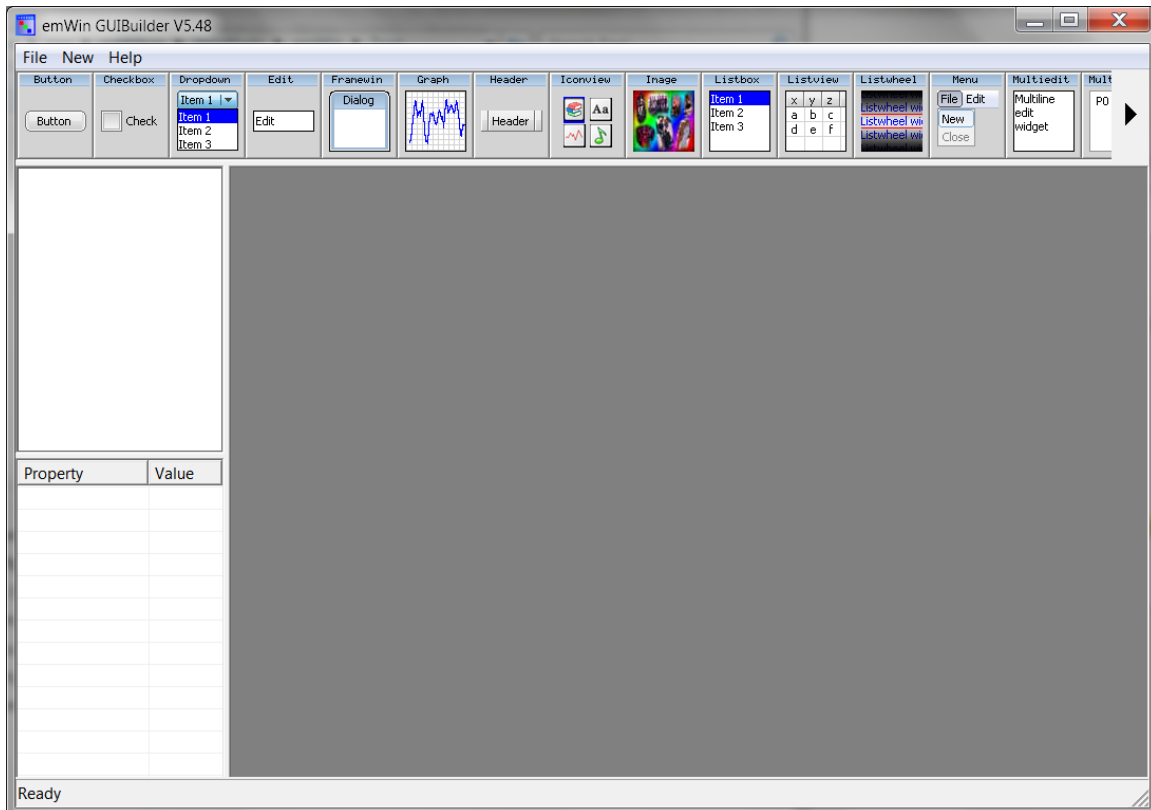
/* If calibration parameter exists, call ts_calibrate to generate a copy */
if (FMC_Read(__DEMO_TSFILE_ADDR__ + 0x1C) != 0x55AAA55A)
{
    FMC_ENABLE_AP_UPDATE();
    ts_calibrate(__DEMO_TS_WIDTH__, __DEMO_TS_HEIGHT__);
    // Erase page
    FMC_Erase(__DEMO_TSFILE_ADDR__);
    ts_writefile();
}
```

```
FMC_DISABLE_AP_UPDATE();  
}  
else  
{  
    ts_readfile();  
}  
  
/* Disable FMC ISP function */  
FMC_Close();  
  
/* Lock protected registers */  
SYS_LockReg();
```

## 4 emWin GUIBuilder

### 4.1 Create Widget

Segger provides a Windows tool GUIBuilder to create application with drag and drop interface. The tool is located under the ThirdParty\emWin\Tool\ directory. This tool can generate a file named FramewinDLG.c for the widget of target application. Please refer to chapter 20 of UM03001\_emWin5.pdf for the usage of GUIBuilder.



### 4.2 Handle Widget Event

FramewinDLG.c is only the framework of widget and programmers still need to add their desired widget event handler in this file after copying the FramewinDLG.c file into the project directory. Below is the event handling code of emWin\_SimpleDemo.

```
.....
switch (pMsg->MsgId)
{
case WM_INIT_DIALOG:
    //
    // Initialization of 'Edit'
    //
    value = 32;
```

```

    sprintf(sBuf,"%d  ", value);
    hItem = WM_GetDialogItem(pMsg->hWin, ID_EDIT_0);
    EDIT_SetText(hItem, sBuf);

    // USER START (Optionally insert additional code for further widget initialization)
    // USER END
    break;
case WM_NOTIFY_PARENT:
    Id      = WM_GetId(pMsg->hWinSrc);
    NCode = pMsg->Data.v;
    switch(Id)
    {
    case ID_BUTTON_0: // Notifications sent by '+ 1'
        switch(NCode)
        {
        case WM_NOTIFICATION_CLICKED:
            // USER START (Optionally insert code for reacting on notification message)
            // USER END
            value += 1;
            sprintf(sBuf,"%d  ", value);
            hItem = WM_GetDialogItem(pMsg->hWin, ID_EDIT_0);
            EDIT_SetText(hItem, sBuf);
            break;
        case WM_NOTIFICATION_RELEASED:
            // USER START (Optionally insert code for reacting on notification message)
            // USER END
            break;
            // USER START (Optionally insert additional code for further notification
handling)
            // USER END
            break;
        .....

```

## 5 Change Display Panel

### 5.1 emWin Display Configuration

emWin declares its display panel resolution in LCDConf.c under the ThirdParty\emWin\Config\ directory. The resolution is different from the touch panel resolution defined in the TouchPanel.h. This is because the panel is a portrait display and data is swapped before output for a landscape view by LCD driver IC.

```
.....
// Physical display size
#define XSIZE_PHYS 240
#define YSIZE_PHYS 320
```

In the LCDConf.c file, the panel orientation and control functions are also defined. These settings need to be modified according to the display panel attached to the system.

```
.....

void LCD_X_Config(void)
{
    .....
    // Orientation
    Config.Orientation = GUI_MIRROR_Y | GUI_SWAP_XY;
    GUIDRV_FlexColor_Config(pDevice, &Config);

    // Set controller and operation mode
    PortAPI.pfWrite8_A0 = _Write0;
    PortAPI.pfWrite8_A1 = _Write1;
    PortAPI.pfWriteM8_A1 = _WriteM1;
    PortAPI.pfReadM8_A1 = _ReadM1; /* FIXME if panel supports read back feature */
    GUIDRV_FlexColor_SetFunc(pDevice,
                             &PortAPI,
                             GUIDRV_FLEXCOLOR_F66709,
    GUIDRV_FLEXCOLOR_M16C0B8);
    .....
}
```

### 5.2 Display Driver

The project file includes the usci\_spi.c driver since demo system is connected to a MPU display using the SPI interface. For systems connecting display with the SPI interface, usci\_spi.c needs to be added to the project.

## **6 Supporting Resources**

Segger provides an emWin supporting forum. Questions regarding emWin usage are discussed at: <https://forum.segger.com/index.php/Board/12-emWin-related/>.

The M032 system related issues can be posted in Nuvoton's HMI/GUI forum at: <http://forum.nuvoton.com/viewforum.php?f=31>.

**Revision History**

Date	Revision	Description
2019.10.03	1.00	1. Initially issued.



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