NUC126 emWin Quick Start Guide

Document Information

Abstract	Introduce the steps to build and launch emWin for the NUC126 series microcontroller (MCU).
Apply to	NuMicro® NUC126 series

For additional information or questions, please contact: Nuvoton Technology Corporation.

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Table of Contents

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 NUC126 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 NUC126 BSP.

2.1 Sample Codes (sampleCode\NuEdu)

emWin_GUIDemo	Utilize emWin library to demonstrate widgets feature.
emWin_SimpleDemo	Utilize emWin library to demonstrate interactive feature.

2.2 Configuration Files (ThirdParty\emWin\Config)

GUI_X.c	Configuration and system dependent code for GUI.
GUIConf.c	Display controller initialization source code.
GUIConf.h	A header file configures emWins features, fonts, etc.
LCDConf.c	Display controller configuration source code.
LCDConf.h	Display driver configuration header file.

2.3 Documents (ThirdParty\emWin\Doc)

AN03002_Custom_ Widget_Type.pdf	emWin custom widget type creation guide.
UM03001_emWin5.pdf	emWin user guide and reference manual.

2.4 Include Files (ThirdParty\emWin\Include)

This directory contains header files for emWin project.

2.5 Library (ThirdParty\emWin\Lib)

NUemWin_CM0_Keil.lib	emWin library for NUC126 series MCU.

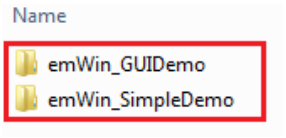
2.6 Tools (ThirdParty\emWin\Tool)

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

3 emWin Sample Code

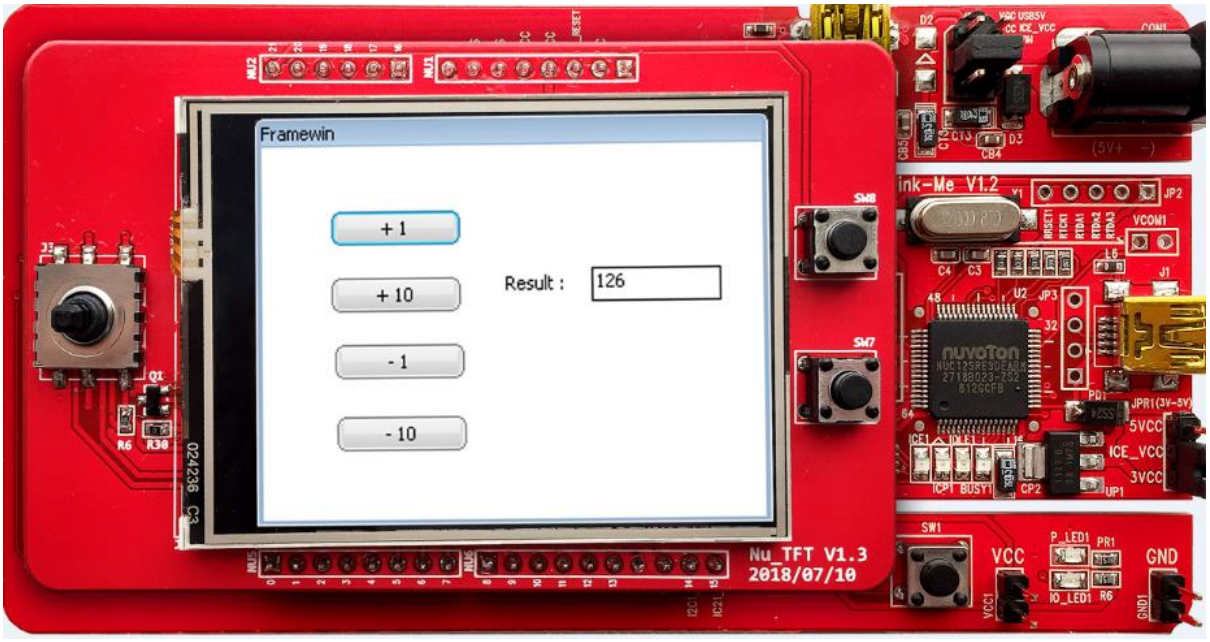
There are two emWin sample code in the NUC126 BSP SampleCode\NuEdu directory:

- **emWin_GUIDemo**: utilizes the emWin library to demonstrate widgets feature;
- **emWin_SimpleDemo**: utilizes the emWin library to demonstrate interactive feature.

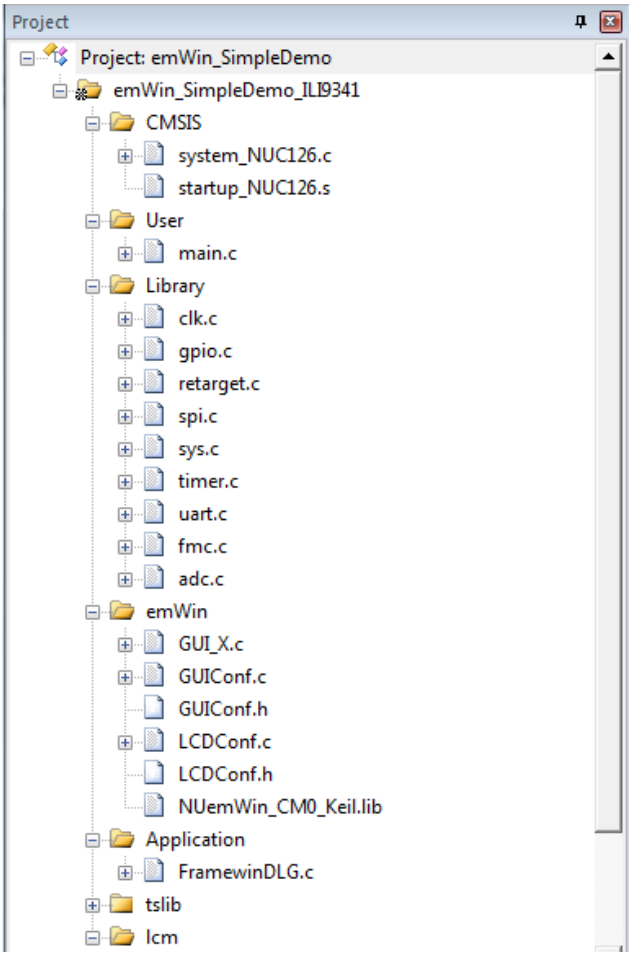


3.1 Project Structure

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.



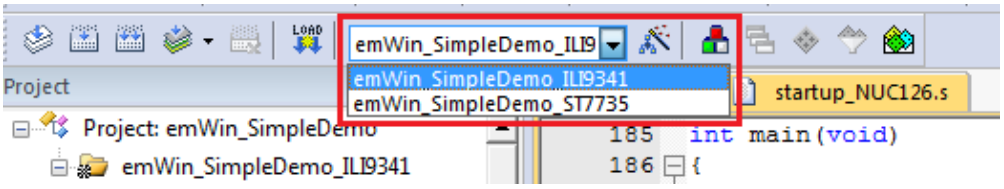
The project structure is shown in the following figure. The CMSIS group contains system startup code. The user group contains the main file. The Libraries group contains low level driver. The emWin group contains emWin library and panel configuration for the NuMicro® family. The Application group contains the C code generated by emWin GUIBuilder. The tslib group is the touch screen library.



The project contains two targets:

- **emWin_SimpleDemo_ILI9341**: use ILI9341 touch panel;
- **emWin_SimpleDemo_ST7735**: use ST7735 touch panel.

User can switch between different targets using the pull down menu marked in the red rectangle shown below.



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);
    //
    // multi- function pin configuration
    //
    GPIO_SetMode(PB, BIT13, GPIO_MODE_INPUT);
    GPIO_SetMode(PB, BIT14, GPIO_MODE_INPUT);
    GPIO_SetMode(PC, BIT9, GPIO_MODE_INPUT);
    GPIO_SetMode(PC, BIT12, GPIO_MODE_INPUT);
    GPIO_SetMode(PC, BIT10, GPIO_MODE_INPUT);
    GPIO_SetMode(PC, BIT11, GPIO_MODE_INPUT);
    GPIO_SetMode(PC, BIT13, GPIO_MODE_INPUT);

   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)
{
    extern GUI_CONST_STORAGE GUI_BITMAP bmnuvoton_logo;

    WM_HWIN hWin;
    char     acVersion[40] = "Nuvoton NUC126";

    GUI_Init();

    GUI_SetBkColor(GUI_WHITE);
    GUI_Clear();
#ifdef __DEMO_160x128__
    GUI_DrawBitmap(&bmnuvoton_logo, 1, 55);
#else
    GUI_DrawBitmap(&bmnuvoton_logo, (320 - bmnuvoton_logo.XSize) >> 1, (240 -
bmnuvoton_logo.YSize) >> 1);
#endif
    GUI_Delay(3000);
    GUI_SetBkColor(GUI_BLACK);
    GUI_Clear();

    hWin = CreateFramewin();
    FRAMEWIN_SetText(hWin, acVersion);
    while(1)
    {
        GUI_Delay(1000);
    }

}
```

3.4 Build emWin Project

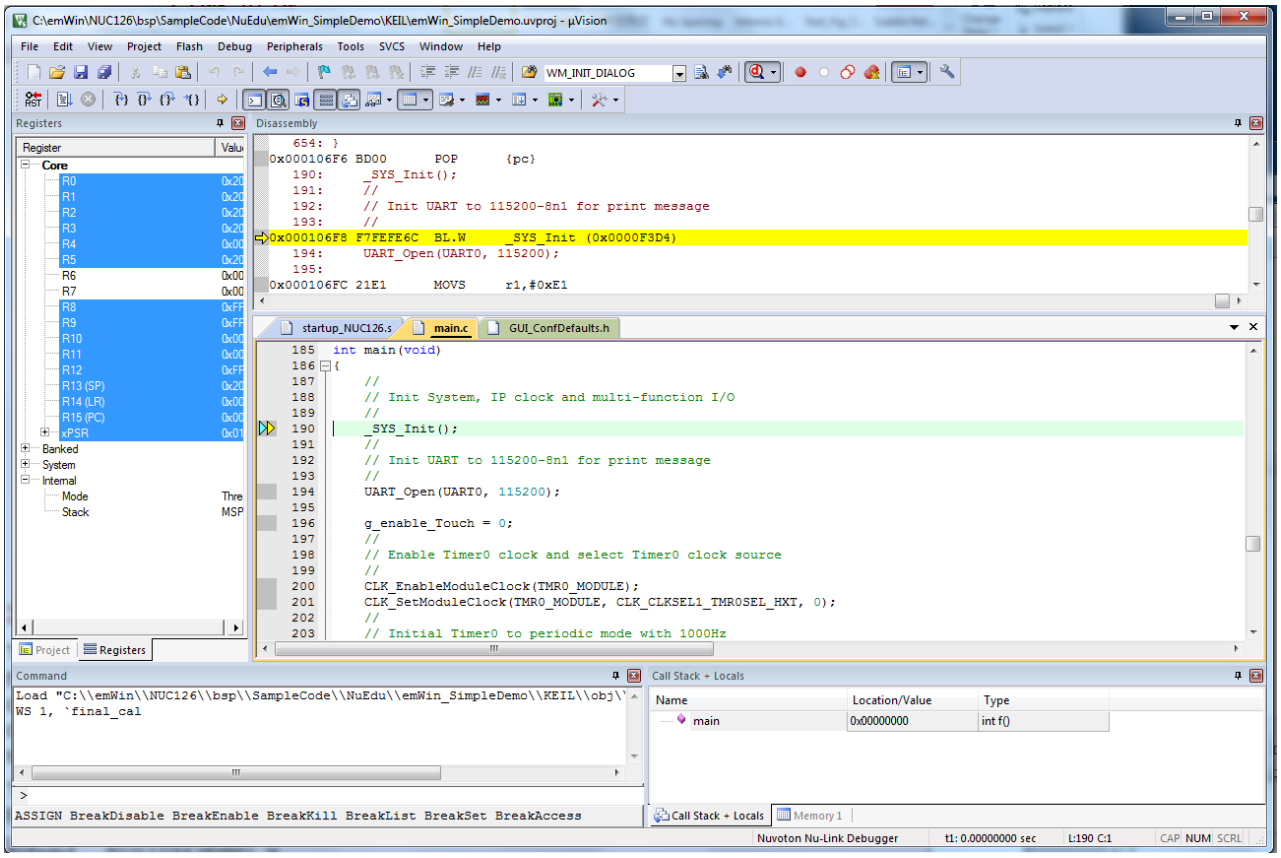
To build the emWin project in Keil MDK, click the rebuild icon as shown below or press F7 function key.

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 in APROM offset 0x00030000.

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

```
#ifndef __NUC126TOUCHPANEL_H__
#define __NUC126TOUCHPANEL_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

int Init_TouchPanel(void);
int Read_TouchPanel(int *x, int *y);
int Uninit_TouchPanel(void);
int Check_TouchPanel(void);

#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 1 // Use default touch screen parameters
    ts_init();
#else // Get touch screen parameters
    /* SPI flash 192KB + 0x1C marker address */
    if (FMC_Read(__DEMO_TSFILE_ADDR__ + 0x1C) != 0x55AAA55A)
    {
        FMC_EnableAPUpdate();
        ts_calibrate(__DEMO_TS_WIDTH__, __DEMO_TS_HEIGHT__);
        // Erase page
        FMC_Erase(__DEMO_TSFILE_ADDR__);
        ts_writefile();
        FMC_DisableAPUpdate();
    }
    else
```

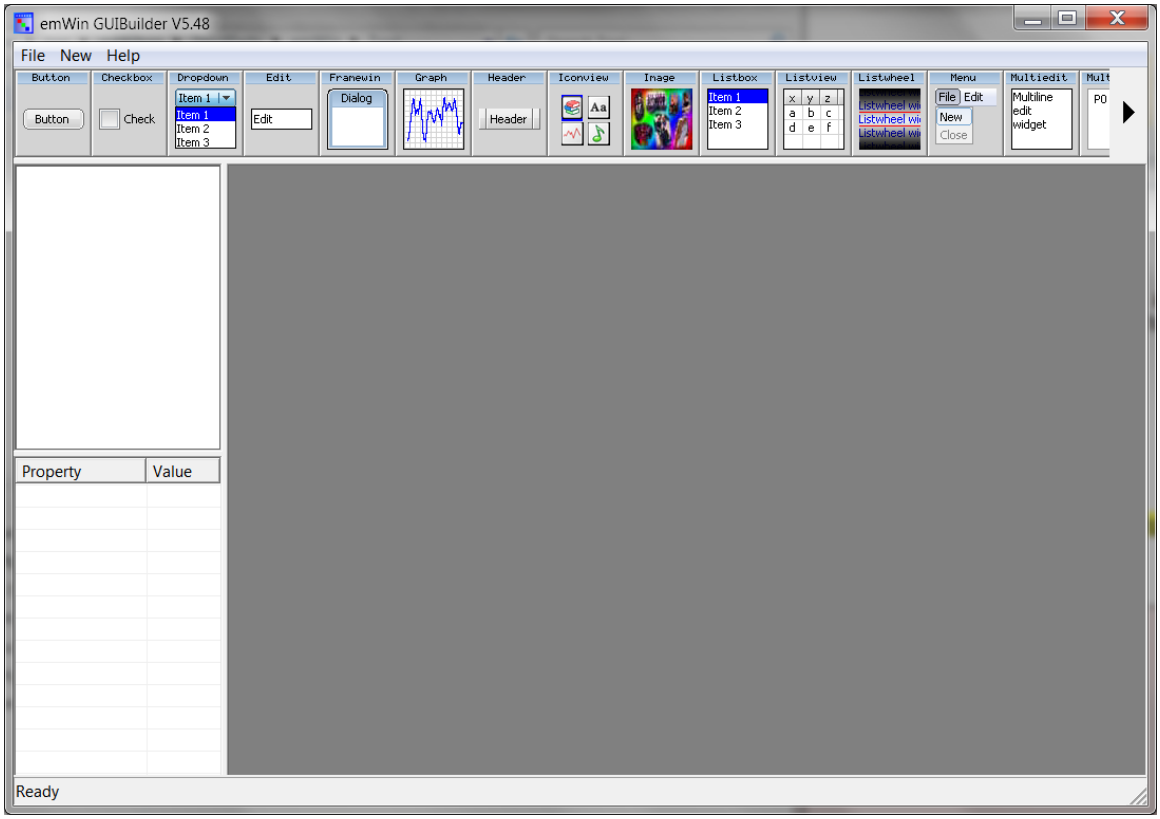
```
    {
        ts_readfile();
    }
#endif
    /* Disable FMC ISP function */
    FMC_Close();

    /* 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'
    //
    sprintf(sBuf,"%d    ", value);
```

```
      hItem = WM_GetDialogItem(pMsg->hWin, ID_EDIT_0);
      EDIT_SetText(hItem, "126");
      value = 126;
    // 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 = DISPLAY_ORIENTATION;
    GUIDRV_FlexColor_Config(pDevice, &Config);

    // Set controller and operation mode
    PortAPI.pfWrite8_A0  = _Write0;
    PortAPI.pfWrite8_A1  = _Write1;
    PortAPI.pfWriteM8_A0 = _WriteM1;
    PortAPI.pfWriteM8_A1 = _WriteM1;
    PortAPI.pfRead8_A0   = _Read1;    /* FIXME if panel supports read back feature */
    PortAPI.pfRead8_A1   = _Read1;    /* FIXME if panel supports read back feature */
    PortAPI.pfReadM8_A0  = _ReadM1;   /* FIXME if panel supports read back feature */
    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 ebi.c driver since demo system is connected to a MPU display

using the EBI interface. For systems connecting display with the SPI or I^2C interface, spi.c or i2c.c needs to be added to the project.

Revision History

Date	Revision	Description
2018.10.18	1.00	1. Initially issued.

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