M258 LCD 面板脚位的负载和短路的检测

NuMicro® 32 位系列微控制器范例程序代码介绍

文件信息

应用简述	本范例代码利用 Charge pump timeout 来推算出当下 LCD 整体负载值，再以这个 timeout 值当作扫描检测每根 LCD pin 是否异常的基准。
BSP 版本	M251/M252/M254/M256/M258 Series CMSIS BSP V3.01.002
开发平台	NuMaker-M258KE Ver1.1

1 概述

本范例代码为”LCD_Loading_And_Short_Circuit_Detection”，主要是利用当下 Charge pump timeout 的最大时间，推论出当下 LCD 整体驱动的负载大小。再以这个 Charge pump timeout 的时间，当作扫描每根 Segment Pin 和 Common Pin 的 timeout 时间，用来测试当下 LCD 驱动的负载是否有异常、和检验是否有短路的现象。

1.1 原理

本范例主要使用 Charge pump timeout 的功能当作检验负载工具，检测 Segment Pin 和 Common Pin 是否有异常现象。首先会一直不断尝试测试，直到寻找到最大的 Charge pump timeout 时间，也就是 LCD 当下驱动电压的最小升压时间。以这个 timeout 当作 LCD 整体驱动的负载大小的基准值，再以这个基准当作测试值，有了这测试值就可以扫描所有 Segment Pin 和 Common Pin 是否有负载异常，不过为了方便测试本范例有定义”USING_TEST_CPT_THRD”阀值，这阀值是量测数个正常 LCD 所得到的平均值。

首先将所有 Segment Pin 输出先关闭。之后，一根一根开启扫描检测，确认是否有 Charge pump timeout 发生。若有，表示这个 Segment Pin 的驱动负载有异常，它的线路可能已经短路。反之，则表示目前 LCD 驱动负载是正常的，代表所有 Segment Pin 的输出线路都是正常的。同理，Common Pin 扫描检测的方式跟 Segment Pin 是一样的方式。

由于本范例目前只提供简易的异常检测方式，故只有支持 Segment Pin 和 Common Pin 一根异常的错误检查，若要继续扫描检测，需要将当下的异常现象移除后，再重复上述的检查方式。用户可以尝试调整 LCD charge pump 电压值、不同的传送 Pulse type、不同外接 pull low 电阻(10K~100K 欧姆以上)等等。会因为不一样设定，而导致有不一样的 Charge pump timeout 值，也就代表着 LCD 驱动负载大小在变化，这些变化可以让使用者作为找出更准确检测方式的依据。

1.2 执行结果

将 ”LCD_Loading_And_Short_Circuit_Detection ”的项目程序烧入到 NuMaker-M258KE Ver1.1 板子，并确认所有硬件周边是否有按图 3-1 所示的示意图安装。进入 Keil 项目 Debug 模式开启 Semihost 功能，打开 Serial Window 功能打印测试信息，并按提示发送对应的字符。

抓取当下LCD charge pump timeout值的测试信息，如图1-1所示 :

```
LCD configurations:
 * Clock source is LIRC
 * 8 COM, 40 SEG and 1/4 Bias
 * Driving waveform is Type-A
 * Target frame rate is 64Hz

Working frame rate is 64Hz on Type-A.

 * Trigger the charge pump timeout threshold is 0x3
 * ------------------------------------------
 * [1]: Get the current charge pump timeout value(using active pulse)
 * [2]: Scan all segment pins for short circuit detection
 * [3]: Scan all common pins for short circuit detection
 Fail disable all pin & test again
 If work normaly, turn segment/common pin by pin
Test Item = 1




Get max charge pump time value = 0x3
If the test data is large, it is recommended to reduce it by 25%.
Suggest -50 percent is 0x2
Suggest -25 percent is 0x3
```

图 1-1 抓取当下 LCD charge pump timeout 值执行结果，以及打印信息

LCD Segment 5 Pin 外接 pull low 电阻的测试信息如图 1- 2 所示:

```
CPU @ 48000000 Hz
+----------------------------------------+
|    LCD Loading Detector Example Code   |
+----------------------------------------+

LCD configurations:
 * Clock source is LIRC
 * 8 COM, 40 SEG and 1/4 Bias
 * Driving waveform is Type-A
 * Target frame rate is 64Hz

Working frame rate is 64Hz on Type-A.

 * Trigger the charge pump timeout threshold is 0x3
 * ----------------------------------------
 * [1]: Get the current charge pump timeout value(using active pulse)
 * [2]: Scan all segment pins for short circuit detection
 * [3]: Scan all common pins for short circuit detection
 Fail disable all pin & test again
 If work normaly, turn segment/common pin by pin
Test Item = 2
 * Scan all segment pins and check for short circuits
 * LCD segment pin status is abnormal, and check again
 * One by one detect LCD segment pin!
 * Enable LCD SEG0 - OK
 * Enable LCD SEG1 - OK
 * Enable LCD SEG2 - OK
 * Enable LCD SEG3 - OK
 * Enable LCD SEG4 - OK
 * Enable LCD SEG5 - Short circuit detected!
```

图 1- 2 Segment 5 Pin 外接 pull low 电阻执行结果，以及打印信息

LCD Common 1 Pin 外接 pull low 电阻的测试信息如图 1- 3 所示:

```
LCD configurations:
 * Clock source is LIRC
 * 8 COM, 40 SEG and 1/4 Bias
 * Driving waveform is Type-A
 * Target frame rate is 64Hz

Working frame rate is 64Hz on Type-A.

 * Trigger the charge pump timeout threshold is 0x3
 * ------------------------------------------
 * [1]: Get the current charge pump timeout value(using active pulse)
 * [2]: Scan all segment pins for short circuit detection
 * [3]: Scan all common pins for short circuit detection
 Fail disable all pin & test again
 If work normaly, turn segment/common pin by pin
Test Item = 3
 * Scan all common pins and check for short circuits
 * LCD common pin status is abnormal, and check again
 * One by one detect LCD common pin!
 * Enable LCD COM0 - OK
 * Enable LCD COM1 - Short circuit detected!
```

图 1- 3 LCD Common 1 Pin 外接 pull low 电阻执行结果，以及打印信息

LCD Segment 10 Pin 短路到 ICE 的 UART Tx pin 的测试信息如图 1- 4 所示:

```
LCD configurations:
 * Clock source is LIRC
 * 8 COM, 40 SEG and 1/4 Bias
 * Driving waveform is Type-A
 * Target frame rate is 64Hz

Working frame rate is 64Hz on Type-A.

 * Trigger the charge pump timeout threshold is 0x3
 * ------------------------------------------
 * [1]: Get the current charge pump timeout value(using active pulse)
 * [2]: Scan all segment pins for short circuit detection
 * [3]: Scan all common pins for short circuit detection
 Fail disable all pin & test again
 If work normaly, turn segment/common pin by pin
Test Item = 2
 * Scan all segment pins and check for short circuits
 * LCD segment pin status is abnormal, and check again
 * One by one detect LCD segment pin!
 * Enable LCD SEG0 - OK
 * Enable LCD SEG1 - OK
 * Enable LCD SEG2 - OK
 * Enable LCD SEG3 - OK
 * Enable LCD SEG4 - OK
 * Enable LCD SEG5 - OK
 * Enable LCD SEG6 - OK
 * Enable LCD SEG7 - OK
 * Enable LCD SEG8 - OK
 * Enable LCD SEG9 - OK
 * Enable LCD SEG10 - Short circuit detected!
```

图 1- 4 LCD Segment 10 Pin 短路到 ICE 的 UART Tx pin 执行结果，以及打印信息

2 程序代码介绍

下面编码是在介绍 ”LCD_Loading_And_Short_Circuit_Detection ”范例的主要程序：

LCD 驱动负载的 Pulse 的模式和 charge pump timeout 阀值设定:

```
#define INACTIVE_PULSE                0
#define ACTIVE_PULSE                  1
#define USING_TEST_PULSE              ACTIVE_PULSE
#define USING_TEST_CPT_THRD           3     //Charge pump timeout threshold
```

计算目前最大 LCD 驱动负载的时间：

```
uint32_t LCD_GetMaxChargePumpTimeOutValue(void)
{
    uint32_t u32MaxCTOVal=0;
    uint32_t u32Loop;
    uint32_t u32CTVal;
    for( u32Loop = 0; u32Loop < 5 ; u32Loop++)
    {
        for(u32CTVal = 1; u32CTVal < 0xFFE; u32CTVal++)
        {
            //Send the 5 frame pulse
            LCD_SET_FRAME_COUNTING_VALUE(5);
            LCD_CLEAR_FRAME_COUNTING_END_FLAG();
            LCD_CLEAR_CHARGE_TIMEOUT_FLAG();
            LCD_SET_CHARGE_TIMEOUT_TIME(u32CTVal);
            while(LCD_GET_FRAME_COUNTING_END_FLAG()==0) {};
           //Check the charge pump timeout flag
            if(LCD_GET_CHARGE_TIMEOUT_FLAG()==0)
            {
                break;
            }
            if(u32CTVal%10 == 0)
                printf(">");
        }
        //Get the maximum charge pump time value
        if(u32CTVal > u32MaxCTOVal)
            u32MaxCTOVal = u32CTVal;
        printf("\n");
    }
    return u32MaxCTOVal;
}
```

检查 Charge Pump Timeout 是否有发生：

```
uint8_t LCD_CheckChargePumpTimeOut(uint32_t u32CTOVal)
{
    uint32_t u32Loop;
    for( u32Loop=0; u32Loop < 5 ; u32Loop++)
    {
        //Send the 5 frame pulse
        LCD_SET_FRAME_COUNTING_VALUE(5);
        LCD_CLEAR_FRAME_COUNTING_END_FLAG();
        LCD_CLEAR_CHARGE_TIMEOUT_FLAG();
        LCD_SET_CHARGE_TIMEOUT_TIME(u32CTOVal);
        while(LCD_GET_FRAME_COUNTING_END_FLAG()==0) {};
       //Check the charge pump timeout flag
        if(LCD_GET_CHARGE_TIMEOUT_FLAG())
        {
            return 1;
        }
    }
    return 0;
}
```

扫描每根 Segment pin 是否有 LCD 驱动负载时间超过，来判断是否有短路的现象：

```
void LCD_SegmentPinShortCircuitScan(uint8_t u8PulseLeve,uint32_t u32CTval)
{
    printf(" * Scan all segment pins and check for short circuits \n");
    LCD_AllDataSet(u8PulseLeve);
    LCD_MultiFunctionPinSet();
    LCD_Segment_MultiFunctionPinOutputMode();
    LCD_Common_MultiFunctionPinOutputMode();

    printf(" * LCD segment pin status is abnormal, and check again \n");
    LCD_MultiFunctionPinClear();
    printf(" * One by one detect LCD segment pin!\n");
    uint8_t Pin_Cnt;
    sMFP_LCD *psPtr = (sMFP_LCD *) g_sLCD_SEG_PIN;

    for(Pin_Cnt=0; Pin_Cnt<sizeof(g_sLCD_SEG_PIN)/sizeof(sMFP_LCD); Pin_Cnt++)
    {
      printf(" * Enable LCD SEG%d -", Pin_Cnt);
       //Segment Pin Set
```

```
      Set_MFP((psPtr+Pin_Cnt)->u8PinID,1, (psPtr+Pin_Cnt)->u8FunVal );
      if(LCD_CheckChargePumpTimeOut(u32CTval))
      {
        printf(" Short circuit detected!\n");
        break;
      }
      else
        printf(" OK\n");
      //Segment Pin Clear
      Set_MFP((psPtr+Pin_Cnt)->u8PinID,0, (psPtr+Pin_Cnt)->u8FunVal );
    }
    printf("\n");
    LCD_Segment_MultiFunctionPinInputMode();
    LCD_Common_MultiFunctionPinInputMode();
}
```

扫描每根 Common pin 是否有 LCD 驱动负载时间超过，来判断是否有短路的现象：

```
void LCD_CommonPinShortCircuitScan(uint8_t u8PulseLeve,uint32_t u32CTval)
{
    printf(" * Scan all common pins and check for short circuits \n");
    LCD_AllDataSet(u8PulseLeve);
    LCD_MultiFunctionPinSet();
    LCD_Segment_MultiFunctionPinOutputMode();
    LCD_Common_MultiFunctionPinOutputMode();
    printf(" * LCD common pin status is abnormal, and check again \n");
    LCD_MultiFunctionPinClear();
    printf(" * One by one detect LCD common pin!\n");
    uint8_t Pin_Cnt;
    sMFP_LCD *Ptr = (sMFP_LCD *) g_sLCD_COM_PIN;

    for(Pin_Cnt=0; Pin_Cnt<sizeof(g_sLCD_COM_PIN)/sizeof(sMFP_LCD); Pin_Cnt++)
    {
      printf(" * Enable LCD COM%d -", Pin_Cnt);
      // Common Pin Set
      Set_MFP((Ptr+Pin_Cnt)->u8PinID,1, (Ptr+Pin_Cnt)->u8FunVal);

      if(LCD_CheckChargePumpTimeOut(u32CTval))
      {
        printf(" Short circuit detected!\n");
        break;
      }
      else
        printf(" OK\n");
    // Common Pin Clear
    Set_MFP((Ptr+Pin_Cnt)->u8PinID,0, (Ptr+Pin_Cnt)->u8FunVal);

    }
    printf("\n");
    LCD_Segment_MultiFunctionPinInputMode();
    LCD_Common_MultiFunctionPinInputMode();
}
```

3 软件与硬件需求

3.1 软件需求

- BSP 版本
  - M251/M252/M254/M256/M258 Series CMSIS BSP V3.01.002
- IDE 版本
  - Keil uVersion 5.26

3.2 硬件需求

- 电路组件
  - NuMaker-M258KE Ver1.1
  - NuMaker – TNLCDSub_M258K_4.8V_V1.0
- 示意图

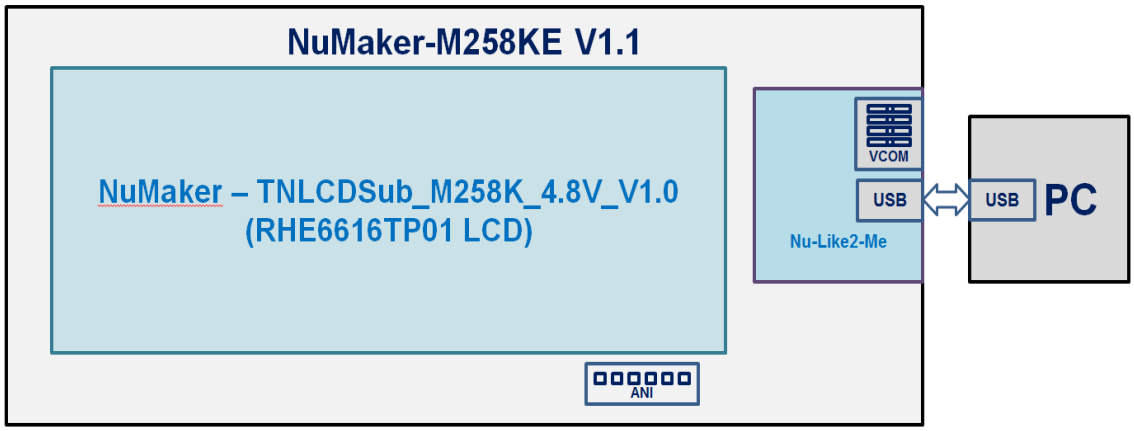

图 3-1 硬件线路连接示意图

本范例测试一，需要外接 pull down 电阻来增加整体驱动负载，模拟 LCD 脚位短路的情况，User 可以选择下面 5 个接口外接 pull down 电阻脚位，如图 3-2 所示。

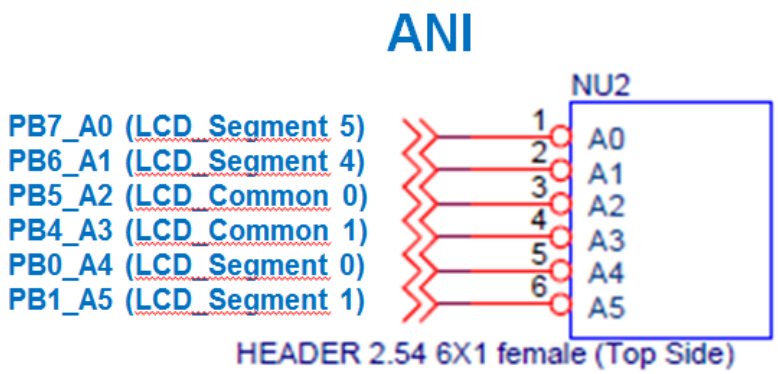

图 3-2 外接 pull low 电阻的接口示意图

本范例测试二时需将 Switch 切换到跟 ICE_TX 连接在一起，透过 ICE_TX 来增加整体驱动负载，模拟 LCD 脚位短路的情况，如图 3-3 所示。

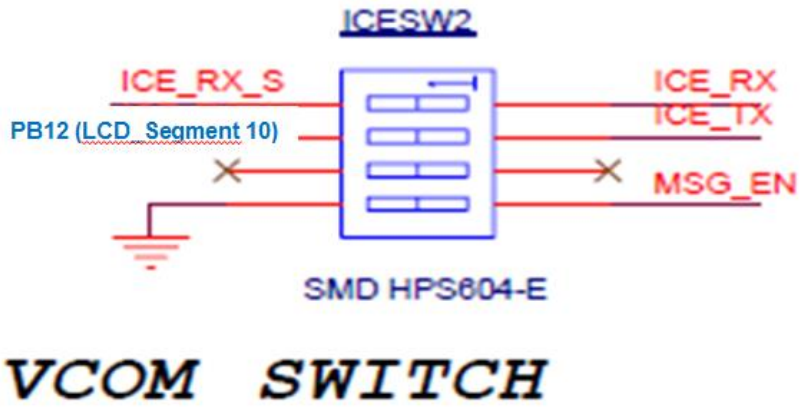

图 3-3 外接 ICE_TX 线路示意图

4 目录信息

EC_M258_Loading_And_Short_Circuit_Detection_V1.00	
Library	Sample code header and source files
CMSIS	Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
Device	CMSIS compliant device header file
StdDriver	All peripheral driver header and source files
SampleCode	
ExampleCode	Source file of example code

图 4-1 目录信息

5 范例程序执行

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 M258_Loading_And_Short_Circuit_Detection.uvprojx。
2. 进入编译模式接口
   a. 编译
   b. 下载代码至内存
   c. 进入 / 离开除错模式
3. 进入除错模式接口
   a. 执行代码

6 修订纪录

Date	Revision	Description
2021.10.28	1.00	1. 初始发布.

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