LCD driver layers

This color: v1.1 extension
#define LCD_DRVTYPE_V1_1

Application

BSP_LCD... (stm32_adafruit_lcd.c)

```
uint8_t  BSP_LCD_Init(void);
uint32_t BSP_LCD_GetXSize(void);
uint32_t BSP_LCD_GetYSize(void);

uint16_t BSP_LCD_GetTextColor(void);
uint16_t BSP_LCD_GetBackColor(void);
void     BSP_LCD_SetTextColor(__IO uint16_t Color);
void     BSP_LCD_SetBackColor(__IO uint16_t Color);
void     BSP_LCD_SetFont(sFONT *fonts);
sFONT    *BSP_LCD_GetFont(void);

void     BSP_LCD_Clear(uint16_t Color);
void     BSP_LCD_ClearStringLine(uint16_t Line);
void     BSP_LCD_DisplayStringAtLine(uint16_t Line, uint8_t *ptr);
void     BSP_LCD_DisplayStringAt(uint16_t Xpos, uint16_t Ypos, uint8_t *Text, Line_ModeTypdef Mode);
void     BSP_LCD_DisplayChar(uint16_t Xpos, uint16_t Ypos, uint8_t Ascii);

void     BSP_LCD_DrawPixel(uint16_t Xpos, uint16_t Ypos, uint16_t RGB_Code);
void     BSP_LCD_DrawHLine(uint16_t Xpos, uint16_t Ypos, uint16_t Length);
void     BSP_LCD_DrawVLine(uint16_t Xpos, uint16_t Ypos, uint16_t Length);
void     BSP_LCD_DrawLine(uint16_t x1, uint16_t y1, uint16_t x2, uint16_t y2);
void     BSP_LCD_DrawRect(uint16_t Xpos, uint16_t Ypos, uint16_t Width, uint16_t Height);
void     BSP_LCD_DrawCircle(uint16_t Xpos, uint16_t Ypos, uint16_t Radius);
void     BSP_LCD_DrawPolygon(pPoint Points, uint16_t PointCount);
void     BSP_LCD_DrawEllipse(int Xpos, int Ypos, int XRadius, int YRadius);
void     BSP_LCD_DrawBitmap(uint16_t Xpos, uint16_t Ypos, uint8_t *pBmp);
void     BSP_LCD_FillRect(uint16_t Xpos, uint16_t Ypos, uint16_t Width, uint16_t Height);
void     BSP_LCD_FillCircle(uint16_t Xpos, uint16_t Ypos, uint16_t Radius);
void     BSP_LCD_FillPolygon(pPoint Points, uint16_t PointCount);
void     BSP_LCD_FillEllipse(int Xpos, int Ypos, int XRadius, int YRadius);

void     BSP_LCD_DisplayOff(void);
void     BSP_LCD_DisplayOn(void);

uint16_t BSP_LCD_ReadID(void);
uint16_t BSP_LCD_ReadPixel(uint16_t Xpos, uint16_t Ypos);
void     BSP_LCD_DrawRGB16Image(uint16_t Xpos, uint16_t Ypos, uint16_t Xsize, uint16_t Ysize, uint16_t *pData);
void     BSP_LCD_ReadRGB16Image(uint16_t Xpos, uint16_t Ypos, uint16_t Xsize, uint16_t Ysize, uint16_t *pData);
```

```
typedef struct _tFont
{
  const uint8_t *table;
  uint16_t Width;
  uint16_t Height;

} sFONT;
```

```
typedef struct
{
  uint32_t TextColor;
  uint32_t BackColor;
  sFONT    *pFont;

}LCD_DrawPropTypeDef;
```

```
typedef struct
{
  int16_t X;
  int16_t Y;
}Point, * pPoint;
```

```
typedef enum
{
  CENTER_MODE = 0x01,
  RIGHT_MODE  = 0x02,
  LEFT_MODE   = 0x03
}Line_ModeTypdef;
```

BSP_TS... (stm32_adafruit_ts.c)

```
uint8_t BSP_TS_Init(uint16_t XSize, uint16_t YSize);
void    BSP_TS_GetState(TS_StateTypeDef *TsState);
```

```
typedef struct
{
  uint16_t TouchDetected;
  uint16_t X;
  uint16_t Y;
  uint16_t Z;
}TS_StateTypeDef;
```

LCDdriver, TSdriver („ili9325.c" or „st7783.c" or „hx8347g.c" or...)

LCD_DrvTypeDef (from lcd.h), TS_DrvTypeDef (from ts.h), BITMAPSTRUCT (from bmp.h)

```
typedef struct
{
  void     (*Init)(void);
  uint16_t (*ReadID)(void);
  void     (*DisplayOn)(void);
  void     (*DisplayOff)(void);
  void     (*SetCursor)(uint16_t, uint16_t);
  void     (*WritePixel)(uint16_t, uint16_t, uint16_t);
  uint16_t (*ReadPixel)(uint16_t, uint16_t);

   /* Optimized operation */
  void     (*SetDisplayWindow)(uint16_t, uint16_t, uint16_t, uint16_t);
  void     (*DrawHLine)(uint16_t, uint16_t, uint16_t, uint16_t);
  void     (*DrawVLine)(uint16_t, uint16_t, uint16_t, uint16_t);

  uint16_t (*GetLcdPixelWidth)(void);
  uint16_t (*GetLcdPixelHeight)(void);
  void     (*DrawBitmap)(uint16_t, uint16_t, uint8_t*);
  void     (*DrawRGBImage)(uint16_t, uint16_t, uint16_t, uint16_t, uint8_t*);
  void     (*ReadRGBImage)(uint16_t, uint16_t, uint16_t, uint16_t, uint8_t*);
  void     (*FillRect)(uint16_t, uint16_t, uint16_t, uint16_t, uint16_t);
}LCD_DrvTypeDef;

typedef struct
{
  void       (*Init)(uint16_t);
  uint16_t  (*ReadID)(uint16_t);
  void       (*Reset)(uint16_t);
  void       (*Start)(uint16_t);
  uint8_t    (*DetectTouch)(uint16_t);
  void       (*GetXY)(uint16_t, uint16_t*, uint16_t*);
  void       (*EnableIT)(uint16_t);
  void       (*ClearIT)(uint16_t);
  uint8_t    (*GetITStatus)(uint16_t);
  void       (*DisableIT)(uint16_t);
}TS_DrvTypeDef;
```

IO driver („lcdts_io_gpio8.c" or „lcd_io_spi.c" or „lcdts_io_fsmc8.c" or lcd[ts]...)

```
void     LCD_Delay (uint32_t delay);
void     LCD_IO_Init(void);
void     LCD_IO_Bl_OnOff(uint8_t Bl);

void     LCD_IO_WriteCmd8(uint8_t Cmd);
void     LCD_IO_WriteCmd16(uint16_t Cmd);
void     LCD_IO_WriteData8(uint8_t Data);
void     LCD_IO_WriteData16(uint16_t Data);

void     LCD_IO_WriteCmd8DataFill16(uint8_t Cmd, uint16_t Data, uint32_t Size);
void     LCD_IO_WriteCmd8MultipleData8(uint8_t Cmd, uint8_t *pData, uint32_t Size);
void     LCD_IO_WriteCmd8MultipleData16(uint8_t Cmd, uint16_t *pData, uint32_t Size);
void     LCD_IO_WriteCmd16DataFill16(uint16_t Cmd, uint16_t Data, uint32_t Size);
void     LCD_IO_WriteCmd16MultipleData8(uint16_t Cmd, uint8_t *pData, uint32_t Size);
void     LCD_IO_WriteCmd16MultipleData16(uint16_t Cmd, uint16_t *pData, uint32_t Size);

void     LCD_IO_ReadCmd8MultipleData8(uint8_t Cmd, uint8_t *pData, uint32_t Size, uint32_t DummySize);
void     LCD_IO_ReadCmd8MultipleData16(uint8_t Cmd, uint16_t *pData, uint32_t Size, uint32_t DummySize);
void     LCD_IO_ReadCmd8MultipleData24to16(uint8_t Cmd, uint16_t *pData, uint32_t Size, uint32_t DummySize);
void     LCD_IO_ReadCmd16MultipleData8(uint16_t Cmd, uint8_t *pData, uint32_t Size, uint32_t DummySize);
void     LCD_IO_ReadCmd16MultipleData16(uint16_t Cmd, uint16_t *pData, uint32_t Size, uint32_t DummySize);
void     LCD_IO_ReadCmd16MultipleData24to16(uint16_t Cmd, uint16_t *pData, uint32_t Size, uint32_t DummySize);

uint8_t  TS_IO_DetectToch(void);
uint16_t TS_IO_GetX(void);
uint16_t TS_IO_GetY(void);
uint16_t TS_IO_GetZ1(void);
uint16_t TS_IO_GetZ2(void);
```

(only lcdts...)

Hardware

GPIO, SPI, FSMC, LTDC...

Stm32f103 bluepill – st7735 spi setting

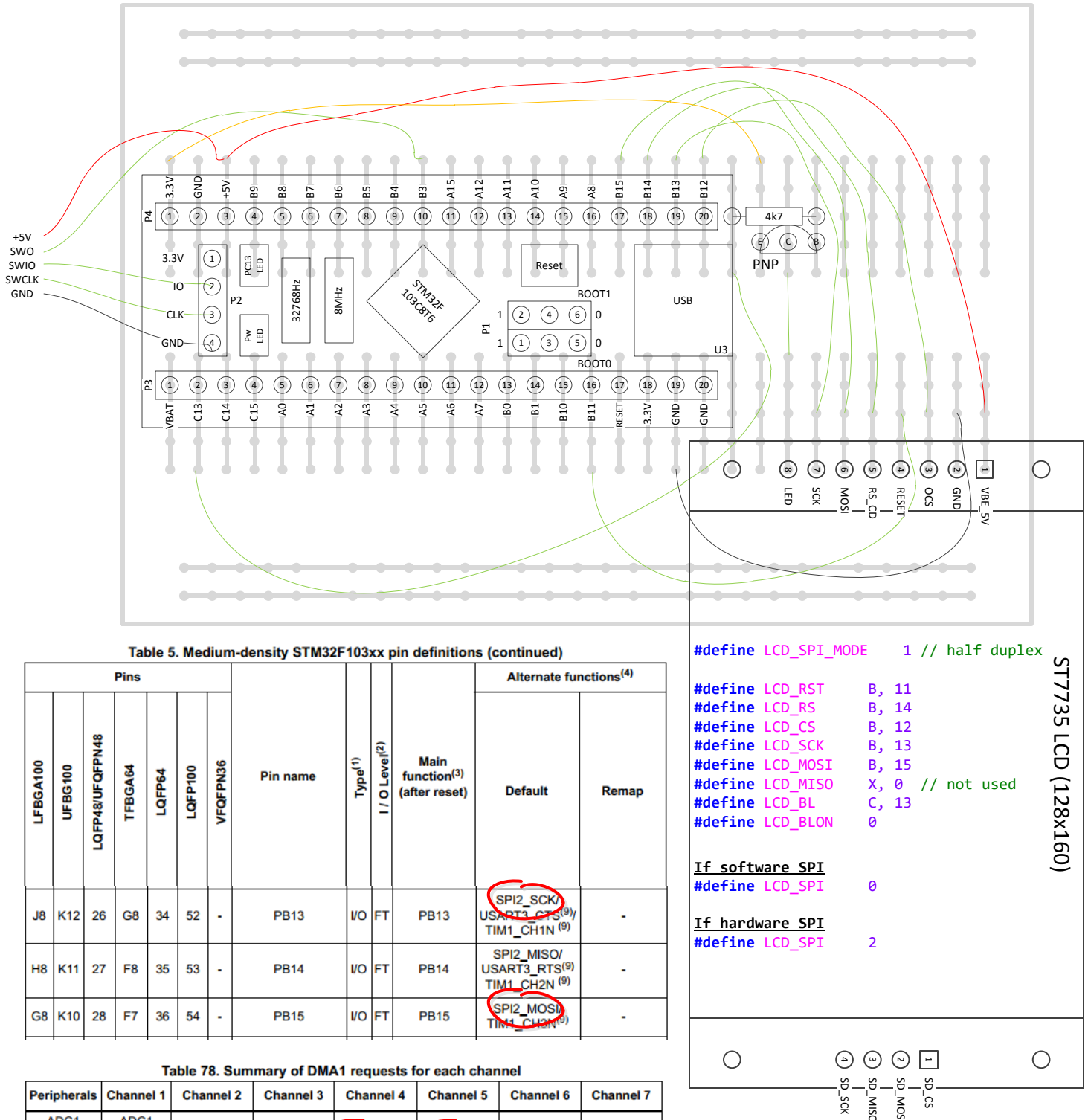


Table 5. Medium-density STM32F103xx pin definitions (continued)

Pins							Pin name	Type(1)	I / O Level(2)	Main function(3) (after reset)	Alternate functions(4)	
LFBGA100	UFBG100	LQFP48/UFQFPN48	TFBGA64	LQFP64	LQFP100	VFQFPN36					Default	Remap
J8	K12	26	G8	34	52	-	PB13	I/O	FT	PB13	SPI2_SCK/ USART3_CTS(9)/ TIM1_CH1N (9)	-
H8	K11	27	F8	35	53	-	PB14	I/O	FT	PB14	SPI2_MISO/ USART3_RTS(9) TIM1_CH2N (9)	-
G8	K10	28	F7	36	54	-	PB15	I/O	FT	PB15	SPI2_MOSI/ TIM1_CH3N(9)	-

Table 78. Summary of DMA1 requests for each channel

Peripherals	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7
ADC1	ADC1	-	-	-	-	-	-
SPI/I²S	-	SPI1_RX	SPI1_TX	SPI2/I2S2_RX	SPI2/I2S2_TX	-	-
USART	-	USART3_TX	USART3_RX	USART1_TX	USART1_RX	USART2_RX	USART2_TX
I²C	-	-	-	I2C2_TX	I2C2_RX	I2C1_TX	I2C1_RX
TIM3	-	TIM3_CH3	TIM3_CH4 TIM3_UP	-	-	TIM3_CH1 TIM3_TRIG	-
TIM4	TIM4_CH1	-	-	TIM4_CH2	TIM4_CH3	-	TIM4_UP

```
If hardware SPI and DMA on
#define LCD_DMA_TX   1, 5, 0 // DMA number, channel, priority
#define LCD_DMA_RX   1, 4, 2 // DMA number, channel, priority
```

```
#define LCD_SPI_MODE    1 // half duplex

#define LCD_RST     B, 11
#define LCD_RS      B, 14
#define LCD_CS      B, 12
#define LCD_SCK     B, 13
#define LCD_MOSI    B, 15
#define LCD_MISO    X, 0  // not used
#define LCD_BL      C, 13
#define LCD_BLON    0

If software SPI
#define LCD_SPI     0

If hardware SPI
#define LCD_SPI     2
```

```
#define LCD_SCK_EXTRACLK  1 // ST7735: 1 extra clock (when data direction change from write to read)
```

Stm32f303cct – st7735 spi setting

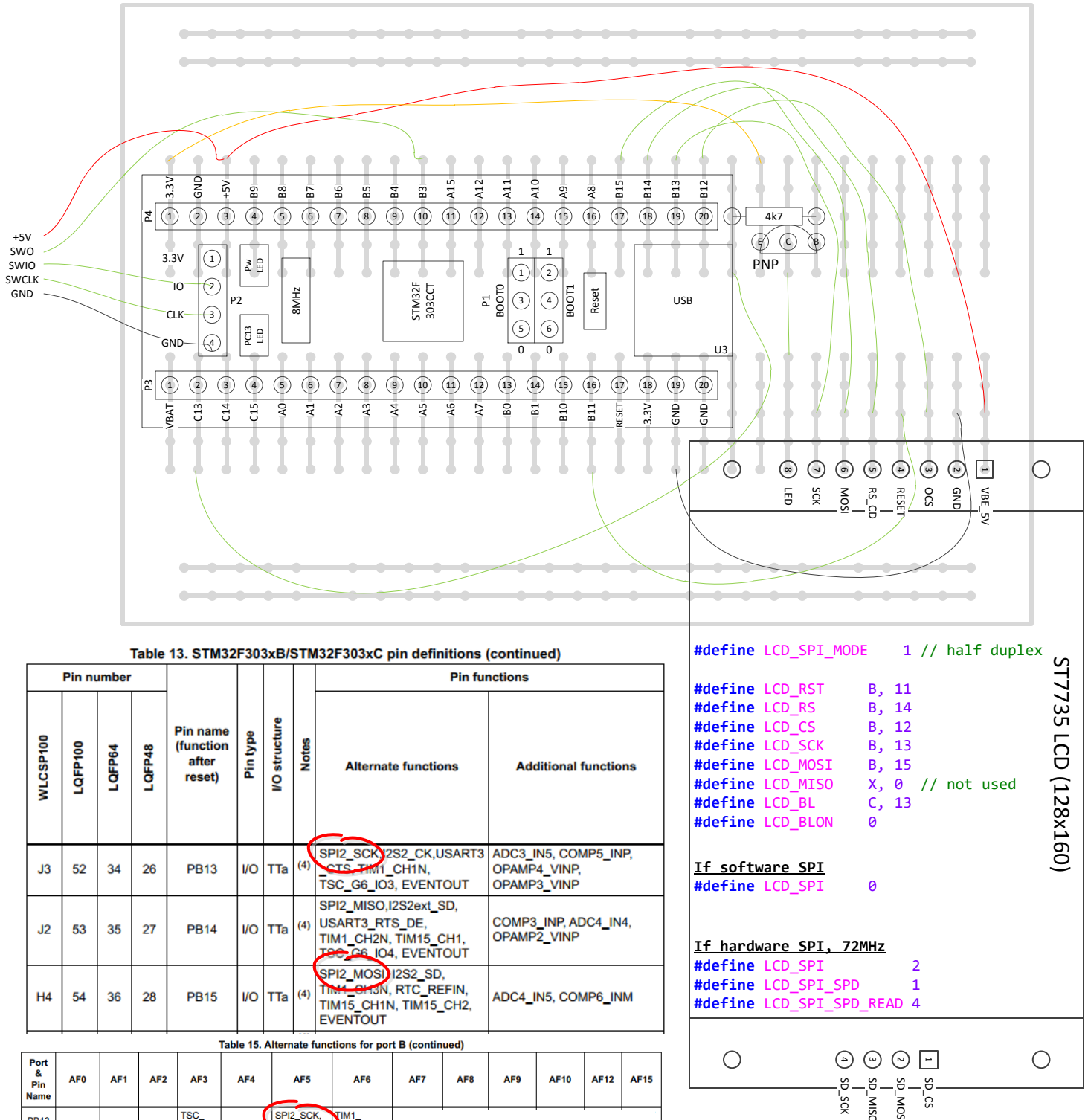


Table 13. STM32F303xB/STM32F303xC pin definitions (continued)

Pin number				Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
WLCSP100	LQFP100	LQFP64	LQFP48					Alternate functions	Additional functions
J3	52	34	26	PB13	I/O	TTa	(4)	SPI2_SCK,I2S2_CK,USART3_CTS, TIM1_CH1N, TSC_G6_IO3, EVENTOUT	ADC3_IN5, COMP5_INP, OPAMP4_VINP, OPAMP3_VINP
J2	53	35	27	PB14	I/O	TTa	(4)	SPI2_MISO,I2S2ext_SD, USART3_RTS_DE, TIM1_CH2N, TIM15_CH1, TSC_G6_IO4, EVENTOUT	COMP3_INP, ADC4_IN4, OPAMP2_VINP
H4	54	36	28	PB15	I/O	TTa	(4)	SPI2_MOSI,I2S2_SD, TIM1_CH3N, RTC_REFIN, TIM15_CH1N, TIM15_CH2, EVENTOUT	ADC4_IN5, COMP6_INM

Table 15. Alternate functions for port B (continued)

Port & Pin Name	AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7	AF8	AF9	AF10	AF12	AF15
PB13	-	-	-	TSC_G6_IO3	-	SPI2_SCK, I2S2_CK	TIM1_CH1N						
PB14	-	TIM15_CH1	-	TSC_G6_IO4	-	SPI2_MISO, I2S2ext_SD	TIM1_CH2N						
PB15	RTC_REFIN	TIM15_CH2	TIM15_CH1N	-	TIM1_CH3N	SPI2_MOSI, I2S2_SD	-						

Table 78. STM32F303xB/C/D/E, STM32F358xC and STM32F398xE summary of DMA1 requests for each channel

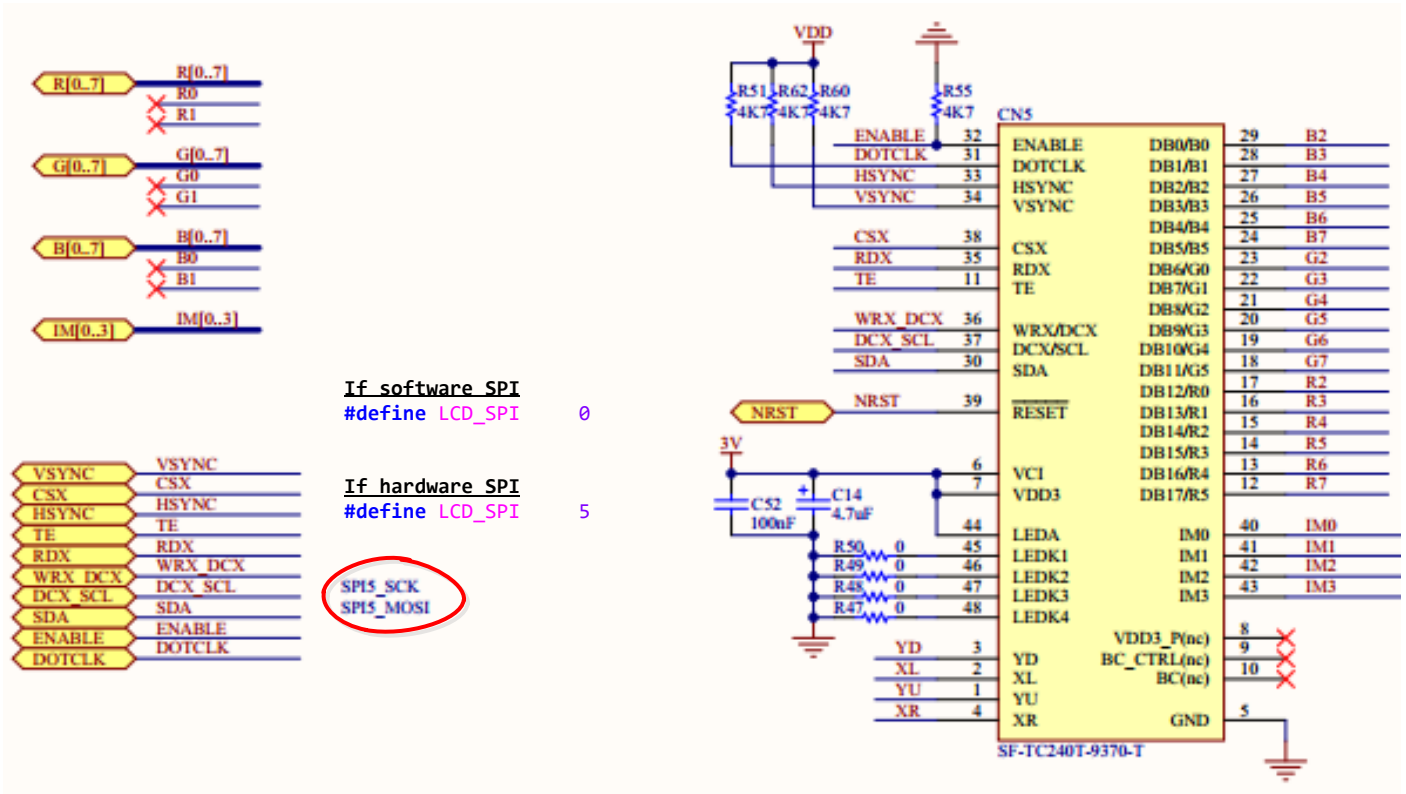
Peripherals	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel6	Channel7
ADC	ADC1	-	-			-	-
SPI	-	SPI1_RX	SP1_TX	SPI2_RX	SPI2_TX	-	-
USART	-	USART3_TX	USART3_RX	USART1_TX	USART1_RX	USART2_RX	USART2_TX
I2C	I2C3_TX(1)	I2C3_RX(1)	-	I2C2_TX	I2C2_RX	I2C1_TX	I2C1_RX

```
#define LCD_SPI_MODE    1 // half duplex

#define LCD_RST     B, 11
#define LCD_RS      B, 14
#define LCD_CS      B, 12
#define LCD_SCK     B, 13
#define LCD_MOSI    B, 15
#define LCD_MISO    X, 0  // not used
#define LCD_BL      C, 13
#define LCD_BLON    0

If software SPI
#define LCD_SPI     0


If hardware SPI, 72MHz
#define LCD_SPI           2
#define LCD_SPI_SPD       1
#define LCD_SPI_SPD_READ  4

If hardware SPI 2
#define LCD_SPI_AFR     5

If hardware SPI and DMA on
#define LCD_DMA_TX  1, 5, 0 // DMA number, channel, priority
#define LCD_DMA_RX  1, 4, 2 // DMA number, channel, priority


#define LCD_SCK_EXTRACLK  1 // ST7735: 1 extra clock (when data direction change from write to read)
```

Stm32f429 discovery - ili9341 spi setting

STM32 pin		Board function																		
Main function	LQFP144	System	VCP	SDRAM	LCD-TFT	LCD-RGB	LCD-SPI	L3GD20	USB	LED	Push-button	I²C Ext	Touch panel	Free I/O	Power supply	CN2	CN3	CN6	P1	P2
BOOT0	138	BOOT0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-
NRST	25	NRST	-	-	RESET	RESET	RESET	-	-	-	B2	-	-	-	-	5	-	-	-	12
PA0	34	-	-	-	-	-	-	-	-	-	B1	-	-	-	-	-	-	-	-	18
PC2	28	-	-	-	CSX	CSX	CSX	-	-											6
PD13	82	-	-		WRX	-	DCX	-	-											7
PF7	19	-	-	-	DCX	-	SCL	SCK	-											
PF8	20	-	-	-	-	-	-	MISO	-	-	-	-	-	-	-	-	-	-	-	5
PF9	21	-	-	-	SDA	-	SDI/SDO	MOSI	-	-	-	-	-	-	-	-	-	-	-	8

```
#define LCD_SPI_MODE    1 // half duplex

#define LCD_RST     X, 0  // not used
#define LCD_RS      D, 13
#define LCD_CS      C, 2
#define LCD_SCK     F, 7
#define LCD_MOSI    F, 9
#define LCD_MISO    X, 0  // not used (half duplex)
#define LCD_BL      X, 0  // not used
#define LCD_BLON    0
```



Stm32f429 discovery - ili9341 spi setting

Table 12. STM32F427xx and STM32F429xx alternate function mapping (continued)

Port	AF0 SYS	AF1 TIM1/2	AF2 TIM3/4/5	AF3 TIM8/9/ 10/11	AF4 I2C1/ 2/3	AF5 SPI1/2/ 3/4/5/6	AF6 SPI2/3/ SAI1	AF7 SPI3/ USART1/ 2/3	AF8 USART6/ UART4/5/7 /8	AF9 CAN1/2/ TIM12/13/14 /LCD	AF10 OTG2_HS /OTG1_ FS	AF11 ETH	AF12 FMC/SDIO /OTG2_FS	AF13 DCMI	AF14 LCD	AF15 SYS
PF7	-	-	-	TIM11_ CH1	-	SPI5_ SCK	SAI1_ MCLK_B	-	UART7_Tx	-	-	-	FMC_ NREG	-	-	EVEN TOUT
PF8	-	-	-	-	-	SPI5_ MISO	SAI1_ SCK_B						FMC_ NIOWR	-	-	EVEN TOUT
PF9	-	-	-	-	-	SPI5_ MOSI	SAI1_ FS_B						FMC_CD	-	-	EVEN TOUT

```
If hardware SPI 5
#define LCD_SPI_AFR     5
```

Table 43. DMA2 request mapping

Peripheral requests	Stream 0	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5	Stream 6	Stream 7
Channel 0	ADC1	SAI1_A(1)	TIM8_CH1 TIM8_CH2 TIM8_CH3	SAI1_A(1)	ADC1	SAI1_B(1)	TIM1_CH1 TIM1_CH2 TIM1_CH3	
Channel 1		DCMI	ADC2	ADC2	SAI1_B(1)	SPI6_TX(1)	SPI6_RX(1)	DCMI
Channel 2	ADC3	ADC3		SPI5_RX(1)	SPI5_TX(1)	CRYP_OUT	CRYP_IN	HASH_IN
Channel 3	SPI1_RX		SPI1_RX	SPI1_TX		SPI1_TX		
Channel 4	SPI4_RX(1)	SPI4_TX(1)	USART1_RX	SDIO		USART1_RX	SDIO	USART1_TX
Channel 5								
Channel 6								
Channel 7		TIM8_UP	TIM8_CH1	TIM8_CH2	TIM8_CH3	SPI5_RX(1)	SPI5_TX(1)	TIM8_CH4 TIM8_TRIG TIM8_COM

```
If hardware SPI and DMA on
#define LCD_DMA_TX   2, 2, 4, 0 // DMA number, channel, stream, priority
#define LCD_DMA_RX   2, 2, 3, 2 // DMA number, channel, stream, priority
```

1. These requests are available on STM32F42xxx and STM32F43xxx.

```
#define LCD_SCK_EXTRACLK   0 // ILI9341: 0 extra clock (when data direction change from write to read)
```