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

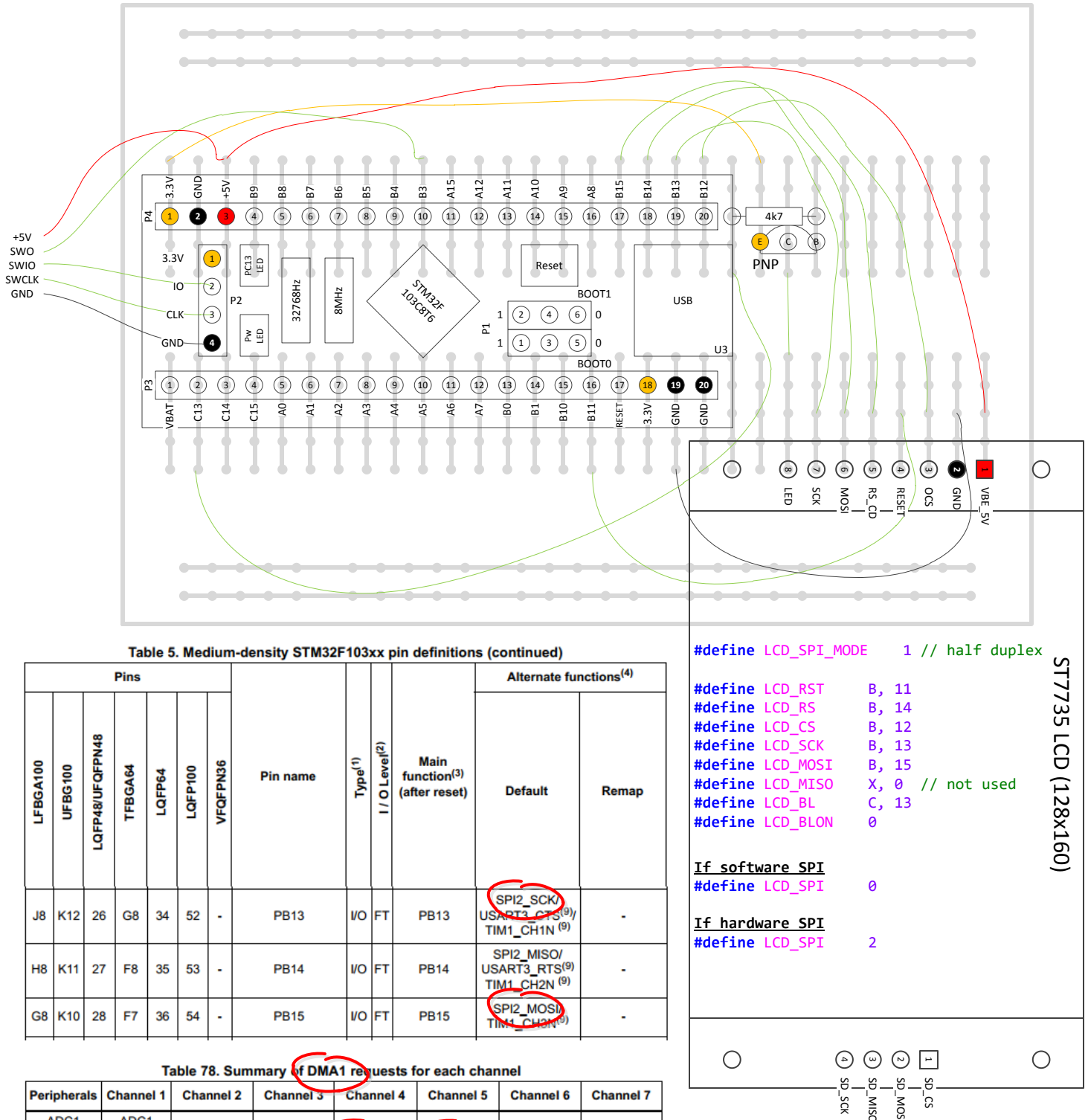


Table 5. Medium-density STM32F103xx pin definitions (continued)

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

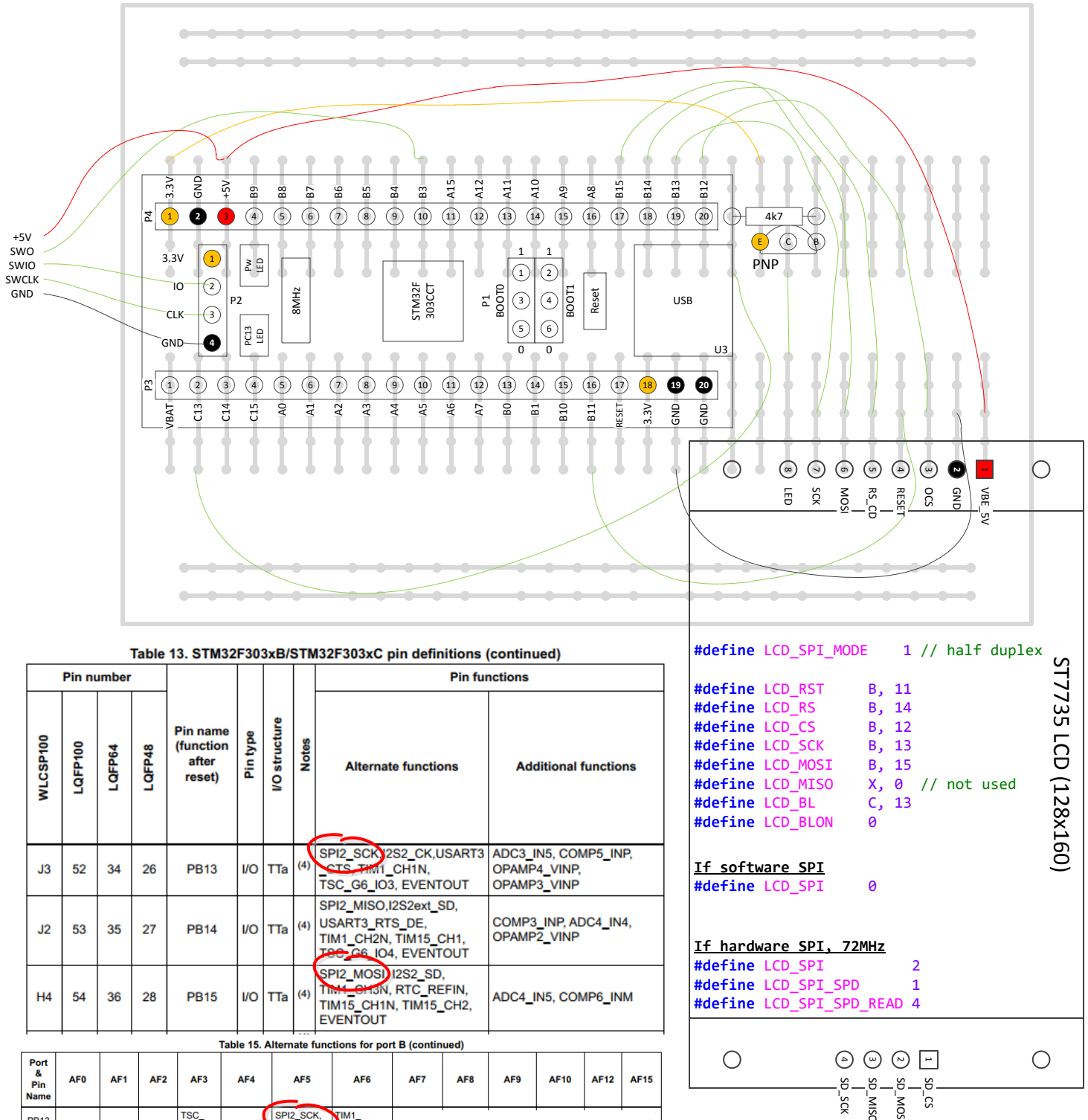


Table 13. STM32F303xB/STM32F303xC pin definitions (continued)

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)

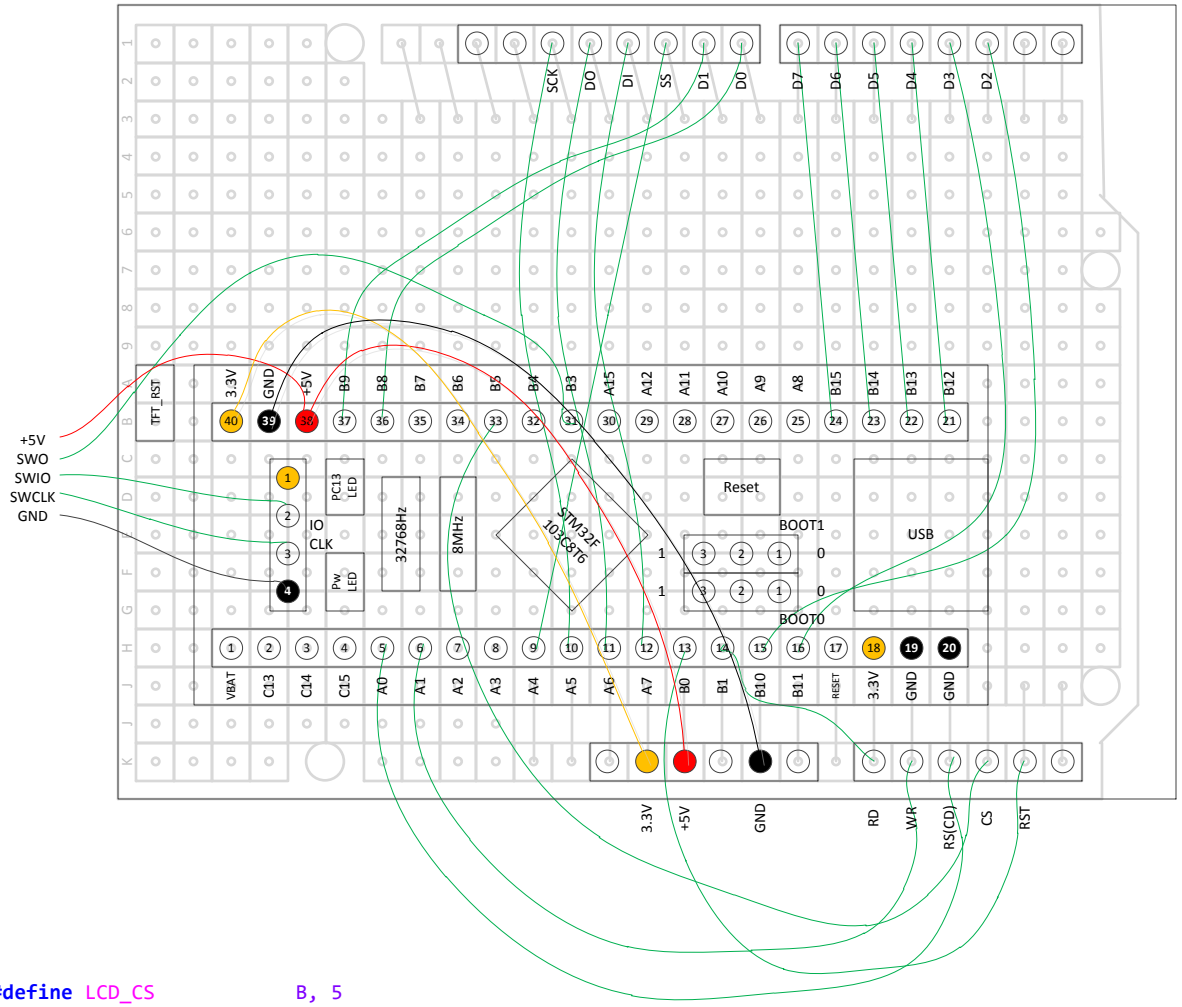
Port & Pin Name	AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7	AF8	AF9	AF10	AF12	AF15
PB13	-	-	-	TSC_G6_IO3	-	SPI2_SCK, I2S2_CK	TIM1_CH1N						
PB14	-	TIM15_CH1	-	TSC_G6_IO4	-	SPI2_MISO, I2S2ext_SD	TIM1_CH2N						
PB15	RTC_REFIN	TIM15_CH2	TIM15_CH1N	-	TIM1_CH3N	SPI2_MOSI, I2S2_SD	-						

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)
```

Stm32f103c8t bluepill gpio 8bit setting

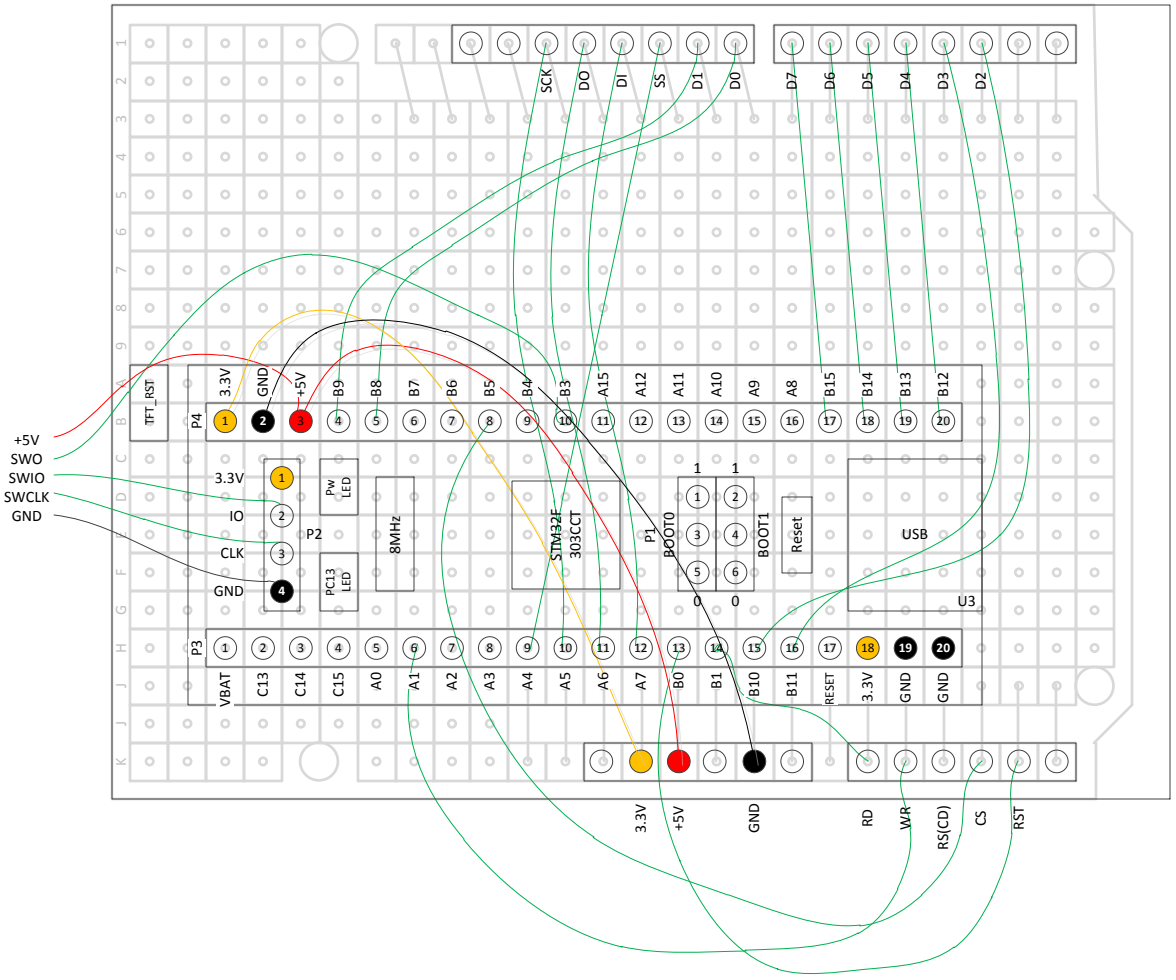



```
#define LCD_CS            B, 5
#define LCD_RS            A, 0 // TS_XM
#define LCD_WR            A, 1 // TS_YP
#define LCD_RD            B, 1
#define LCD_RST           B, 0

#define LCD_D0            B, 8
#define LCD_D1            B, 9
#define LCD_D2            B, 10
#define LCD_D3            B, 11
#define LCD_D4            B, 12
#define LCD_D5            B, 13
#define LCD_D6            B, 14 // TS_XP
#define LCD_D7            B, 15 // TS_YM

#define LCD_BL            X, 0
#define LCD_BLON          0

#define TS_ADC            1  // ADC1, ADC2
#define TS_XM_AN          X, 0
#define TS_YP_AN          X, 0
#define TS_XM_ADCCH       0  // ADC12_IN0
#define TS_YP_ADCCH       1  // ADC12_IN1

#define LCD_WRITE_DELAY   0  // (72MHz)
#define LCD_READ_DELAY    1  // (72MHz)
#define TS_AD_DELAY     500
```

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
G2	L2	10	G2	14	23	7	PA0-WKUP	I/O	-	PA0	WKUP/ USART2_CTS(9)/ ADC12_IN0/ TIM2_CH1_ ETR(9)	-
H2	M2	11	H2	15	24	8	PA1	I/O	-	PA1	USART2_RTS(9)/ ADC12_IN1/ TIM2_CH2(9)	-

Stm32f303cct gpio 8bit setting

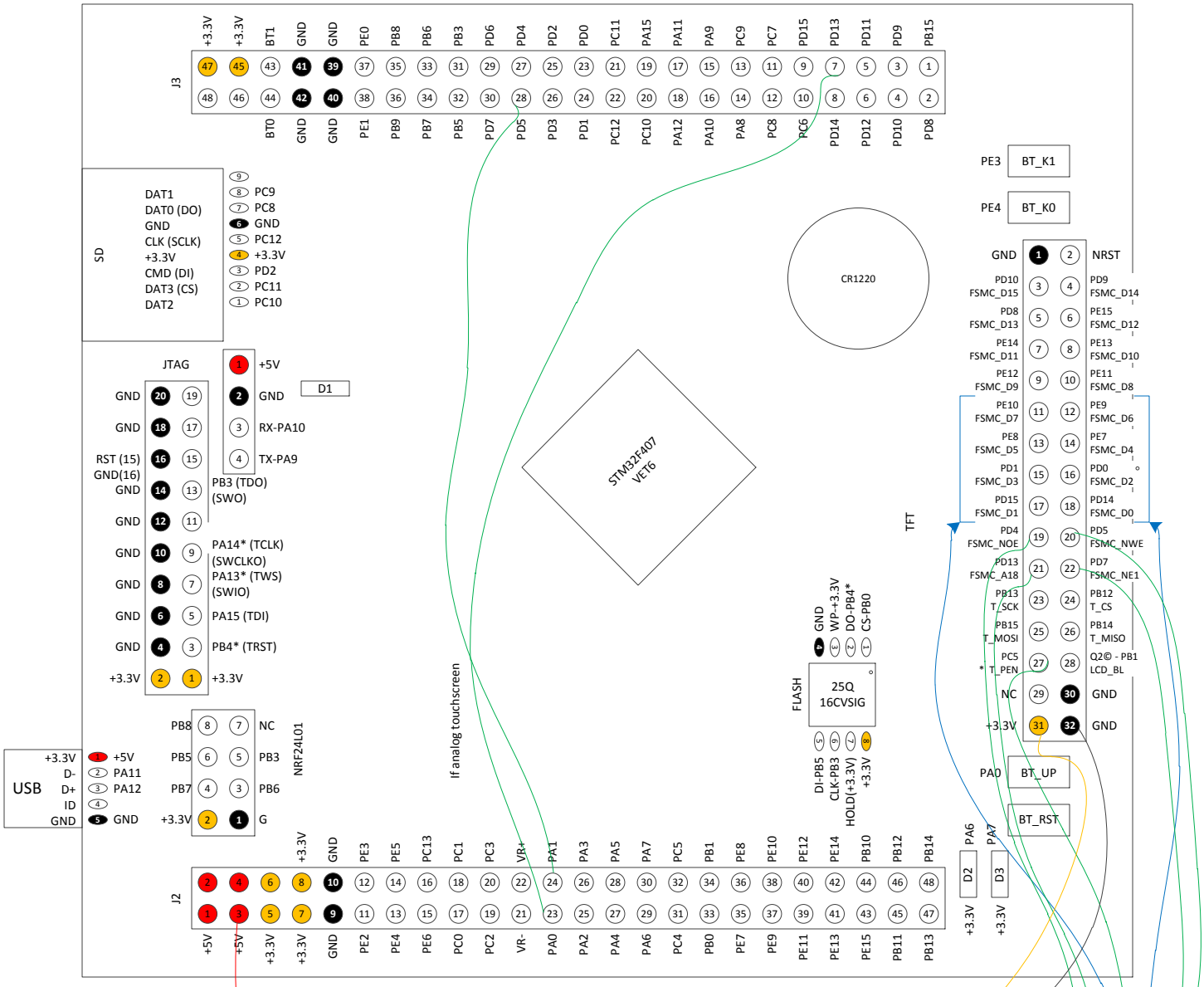



```
#define LCD_CS            B, 5
#define LCD_RS            A, 0 // TS_XM
#define LCD_WR            A, 1 // TS_YP
#define LCD_RD            B, 1
#define LCD_RST           B, 0

#define LCD_D0            B, 8
#define LCD_D1            B, 9
#define LCD_D2            B, 10
#define LCD_D3            B, 11
#define LCD_D4            B, 12
#define LCD_D5            B, 13
#define LCD_D6            B, 14 // TS_XP
#define LCD_D7            B, 15 // TS_YM

#define LCD_BL            X, 0
#define LCD_BLON          0

#define TS_ADC            1  // ADC1
#define TS_XM_AN          X, 0
#define TS_YP_AN          X, 0
#define TS_XM_ADCCH       1  // ADC1_IN1
#define TS_YP_ADCCH       2  // ADC1_IN2

#define LCD_WRITE_DELAY   1  // (72MHz)
#define LCD_READ_DELAY    2  // (72MHz)
#define TS_AD_DELAY     500
```

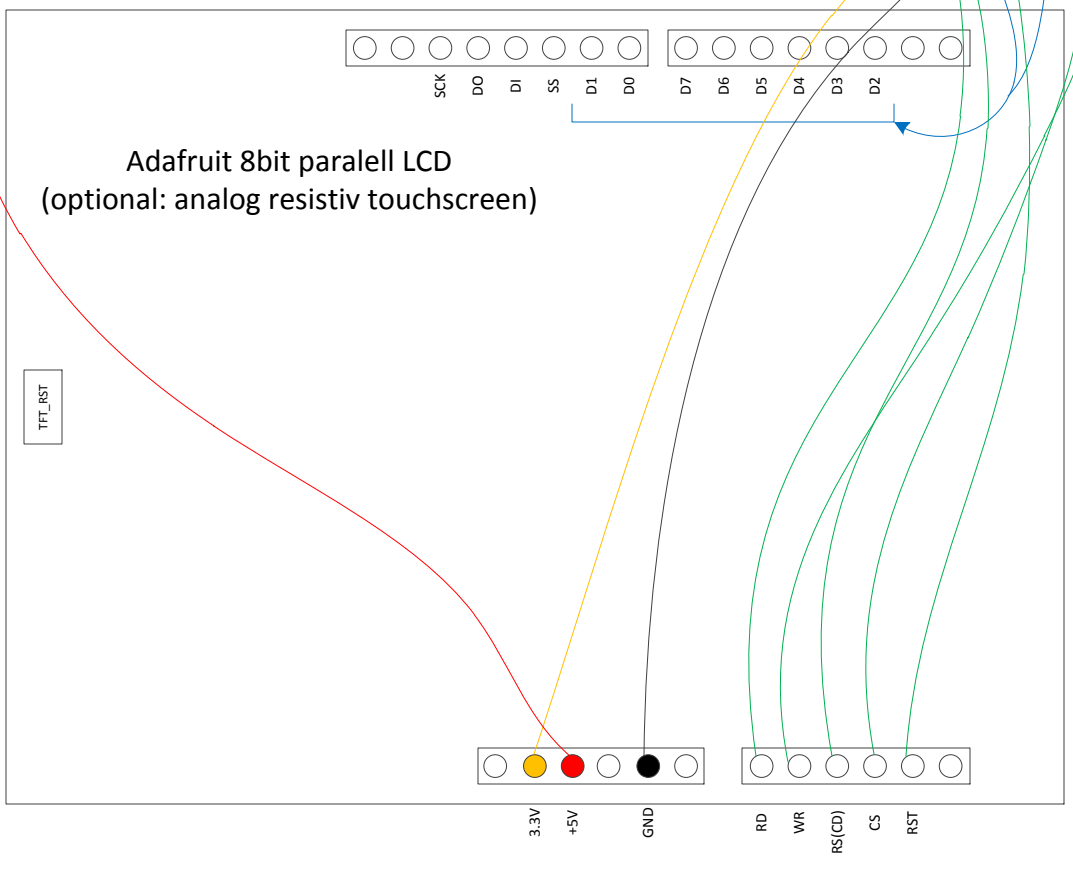
Table 13. STM32F303xB/STM32F303xC pin definitions (continued)

Pin number				Pin name (function after reset)	Pin type	I/O structure	Notes	Pin functions	
WLCSP100	LQFP100	LQFP64	LQFP48					Alternate functions	Additional functions
H9	23	14	10	PA0	I/O	TTa	(4)	USART2_CTS, TIM2_CH1_ETR,TIM8_BKIN, TIM8_ETR,TSC_G1_IO1, COMP1_OUT, EVENTOUT	ADC1_IN1, COMP1_INM, RTC_TAMP2, WKUP1, COMP7_INP
J9	24	15	11	PA1	I/O	TTa	(4)	USART2_RTS_DE, TIM2_CH2, TSC_G1_IO2, TIM15_CH1N, RTC_REFIN, EVENTOUT	ADC1_IN2, COMP1_INP, OPAMP1_VINP, OPAMP3_VINP

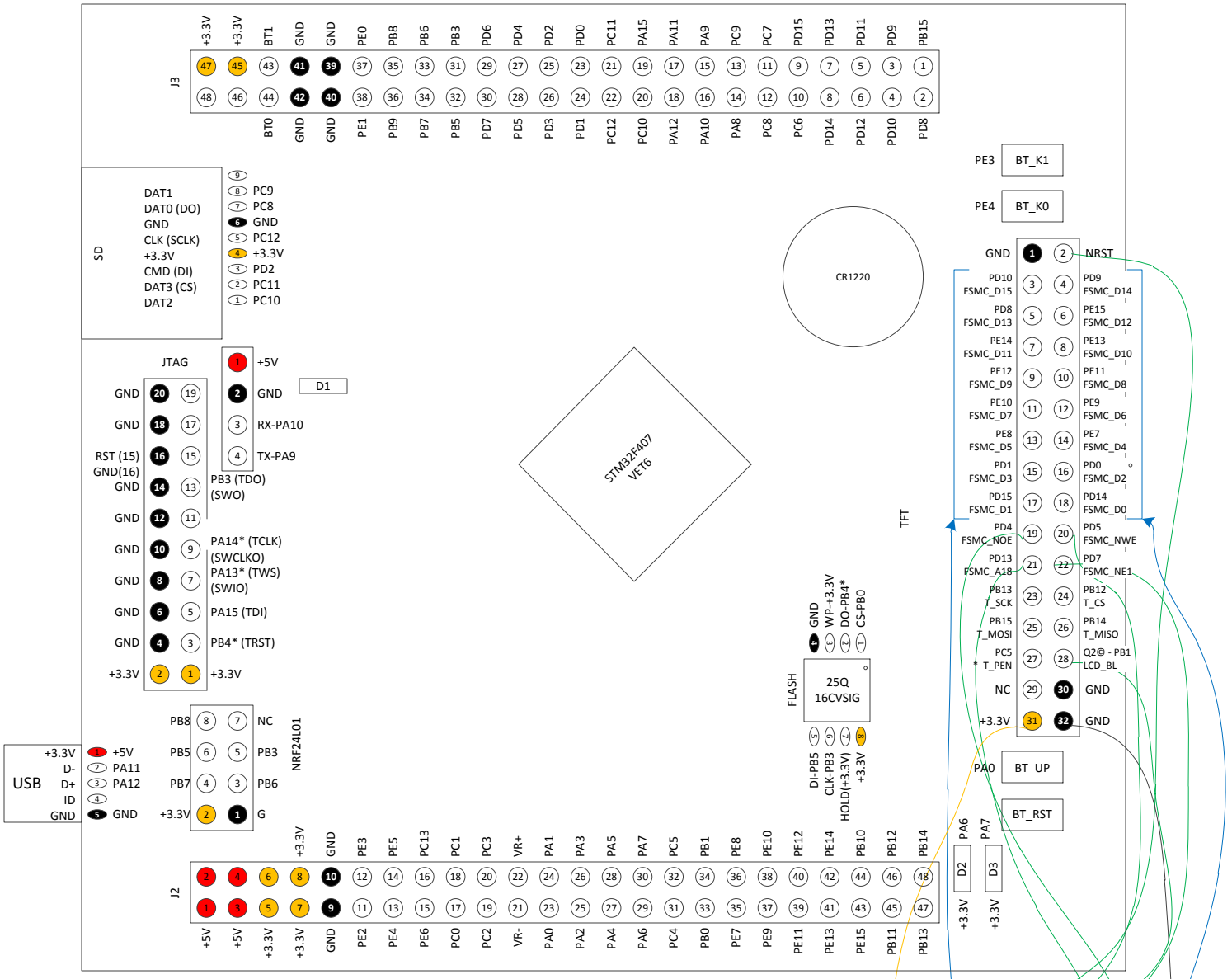
Stm32f407vet gpio 16bit setting




```
#define LCD_CS    D, 7
#define LCD_RS    D, 13
#define LCD_WR    D, 5
#define LCD_RD    D, 4
#define LCD_RST   C, 5

#define LCD_D0    D, 14
#define LCD_D1    D, 15
#define LCD_D2    D, 0
#define LCD_D3    D, 1
#define LCD_D4    E, 7
#define LCD_D5    E, 8
#define LCD_D6    E, 9
#define LCD_D7    E, 10

#define LCD_BL    B, 1
#define LCD_BLON  0

#define LCD_WRITE_DELAY 1
#define LCD_READ_DELAY  2

If analog touchscreen:
#define TS_XM_AN  A, 0
#define TS_YP_AN  A, 1

#define TS_XM_ADCCH  0
#define TS_YP_ADCCH  1

#define TS_AD_DELAY  500
```



Stm32f407vet gpio 16bit setting



ILI9341 (16bit)

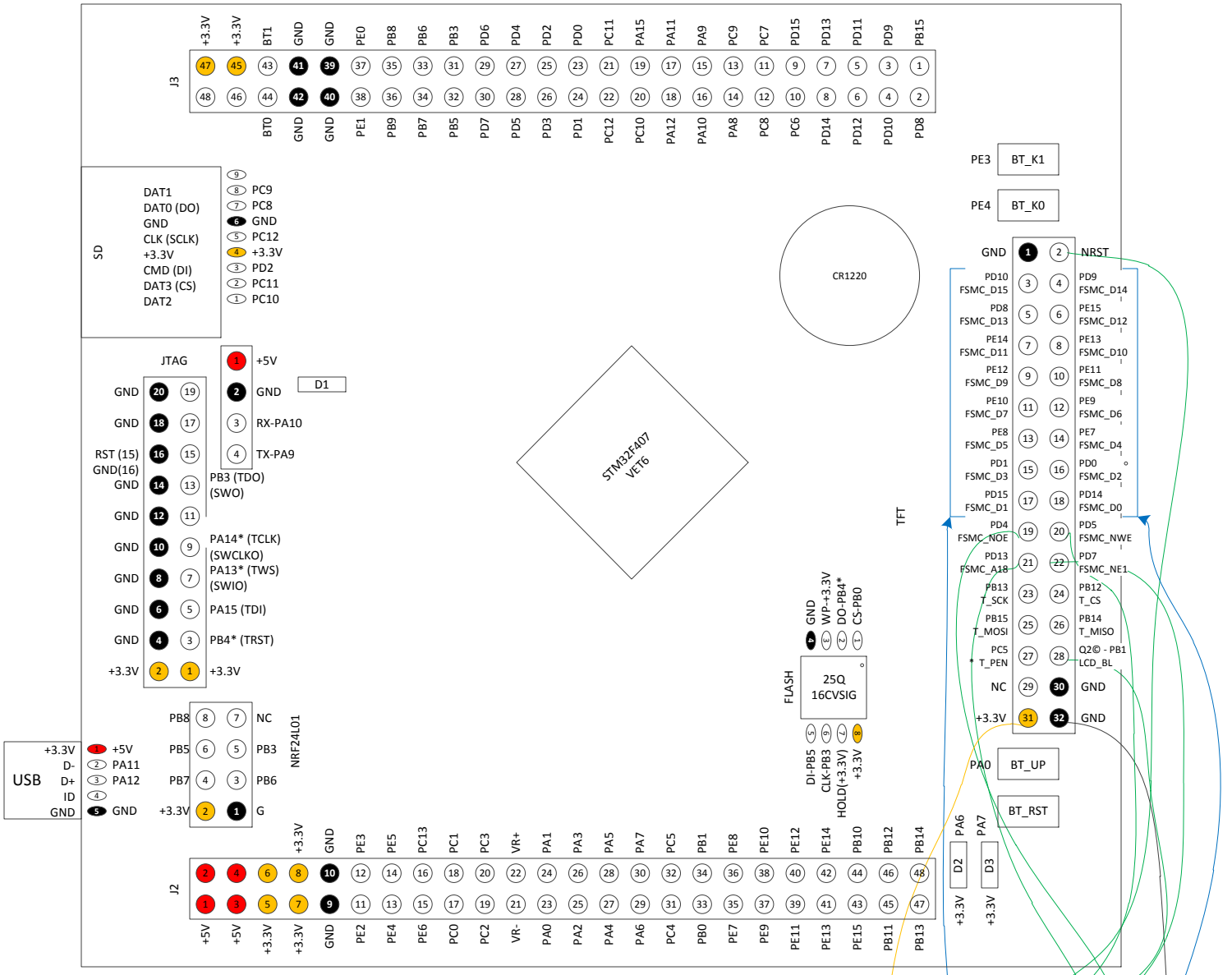
```
#define LCD_D0          D, 14
#define LCD_D1          D, 15
#define LCD_D2          D, 0
#define LCD_D3          D, 1
#define LCD_D4          E, 7
#define LCD_D5          E, 8
#define LCD_D6          E, 9
#define LCD_D7          E, 10
#define LCD_D8          E, 11
#define LCD_D9          E, 12
#define LCD_D10         E, 13
#define LCD_D11         E, 14
#define LCD_D12         E, 15
#define LCD_D13         D, 8
#define LCD_D14         D, 9
#define LCD_D15         D, 10

#define LCD_CS          D, 7
#define LCD_RS          D, 13
#define LCD_WR          D, 5
#define LCD_RD          D, 4
#define LCD_RST         X, 0

#define LCD_BL          B, 1
#define LCD_BLON        0

#define LCD_WRITE_DELAY 0
#define LCD_READ_DELAY  1
```

CS 1 2 RS
WR 3 4 RD
RST 5 6 DB0
DB1 7 8 DB2
DB3 9 10 DB4
DB5 11 12 DB6
DB7 13 14 DB8
DB9 15 16 DB10
DB11 17 18 DB12
DB13 19 20 DB14
DB15 21 22 SDCS
BL 23 24 VDD
VDD 25 26 GND
GND 27 28 NC
MISO 29 30 MOSI
PEN 31 32 F_CS
CS 33 34 CLK

Optimalization

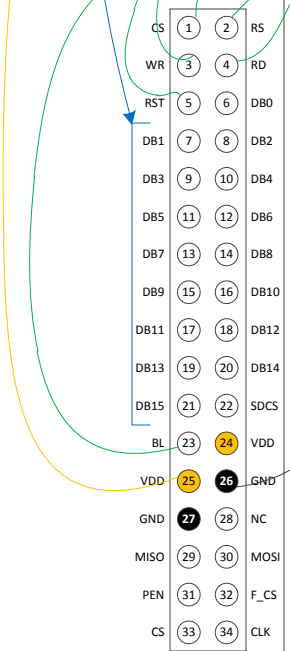
```
// 16 adatláb kimenetre állítása (adatirány: STM32 -> LCD)
#define LCD_DIRWRITE { \
GPIOD->MODER = (GPIOD->MODER & ~((3 << 2 * 14) | (3 << 2 * 15) | (3 << 2 * 0) | (3 << 2 * 1) | (3 << 2 * 8) | (3 << 2 * 9) | (3 << 2 * 10)))  | \
                               ((1 << 2 * 14) | (1 << 2 * 15) | (1 << 2 * 0) | (1 << 2 * 1) | (1 << 2 * 8) | (1 << 2 * 9) | (1 << 2 * 10));   \
GPIOE->MODER = (GPIOE->MODER & ~((3 << 2 * 7)  | (3 << 2 * 8)  | (3 << 2 * 9) | (3 << 2 * 10) | (3 << 2 * 11)  |
                                (3 << 2 * 12) | (3 << 2 * 13) | (3 << 2 * 14)  | (3 << 2 * 15))) | \
                               ((1 << 2 * 7)  | (1 << 2 * 8)  | (1 << 2 * 9) | (1 << 2 * 10) | (1 << 2 * 11)  |
                                (1 << 2 * 12) | (1 << 2 * 13) | (1 << 2 * 14)  | (1 << 2 * 15));   }
// 16 adatláb bemenetre állítása (adatirány: STM32 <- LCD)
#define LCD_DIRREAD { \
GPIOD->MODER = (GPIOD->MODER & ~((3 << 2 * 14) | (3 << 2 * 15) | (3 << 2 * 0) | (3 << 2 * 1) | (3 << 2 * 8) | (3 << 2 * 9) | (3 << 2 * 10)))  | \
                               ((0 << 2 * 14) | (0 << 2 * 15) | (0 << 2 * 0) | (0 << 2 * 1) | (0 << 2 * 8) | (0 << 2 * 9) | (0 << 2 * 10));   \
GPIOE->MODER = (GPIOE->MODER & ~((3 << 2 * 7)  | (3 << 2 * 8)  | (3 << 2 * 9) | (3 << 2 * 10) | (3 << 2 * 11)  |
                                (3 << 2 * 12) | (3 << 2 * 13) | (3 << 2 * 14)  | (3 << 2 * 15))) | \
                               ((0 << 2 * 7)  | (0 << 2 * 8)  | (0 << 2 * 9) | (0 << 2 * 10) | (0 << 2 * 11)  |
                                (0 << 2 * 12) | (0 << 2 * 13) | (0 << 2 * 14)  | (0 << 2 * 15));   }
// 16 adatláb írása, STM32 -> LCD (a kiirandó adat a makro dt paraméterében van)
#define LCD_WRITE(dt) { \
GPIOD->ODR = (GPIOD->ODR & ~((1 << 14) | (1 << 15) | (1 << 0) | (1 << 1) | (1 << 8) | (1 << 9) | (1 << 10))) |        \
                           (((dt & 0b00000011) << 14) | ((dt & 0b00001100) >> 2) | ((dt & 0b1110000000000000) >> 5)); \
GPIOE->ODR = (GPIOE->ODR & ~((1 << 7) | (1 << 8) | (1 << 9) | (1 << 10) | (1 << 11) | (1 << 12) | (1 << 13) | (1 << 14) | (1 << 15))) |        \
                           ((dt & 0b0001111111110000) << (7 - 4));                          }
// 16 adatláb olvasása, STM32 <- LCD (az olvasott adat dt paraméterben megadott változoba kerül)
#define LCD_READ(dt) { \
dt = ((GPIOD->IDR & 0b1100000000000000) >> (14 - 0)) | ((GPIOD->IDR & 0b0000000000000011) << (2 - 0)) | ((GPIOD->IDR & 0b0000001100000000) << (13 - 8)) | \
     ((GPIOE->IDR & 0b1111111110000000) >> (7 - 4)); }
```

Stm32f407vet fsmc 16bit setting

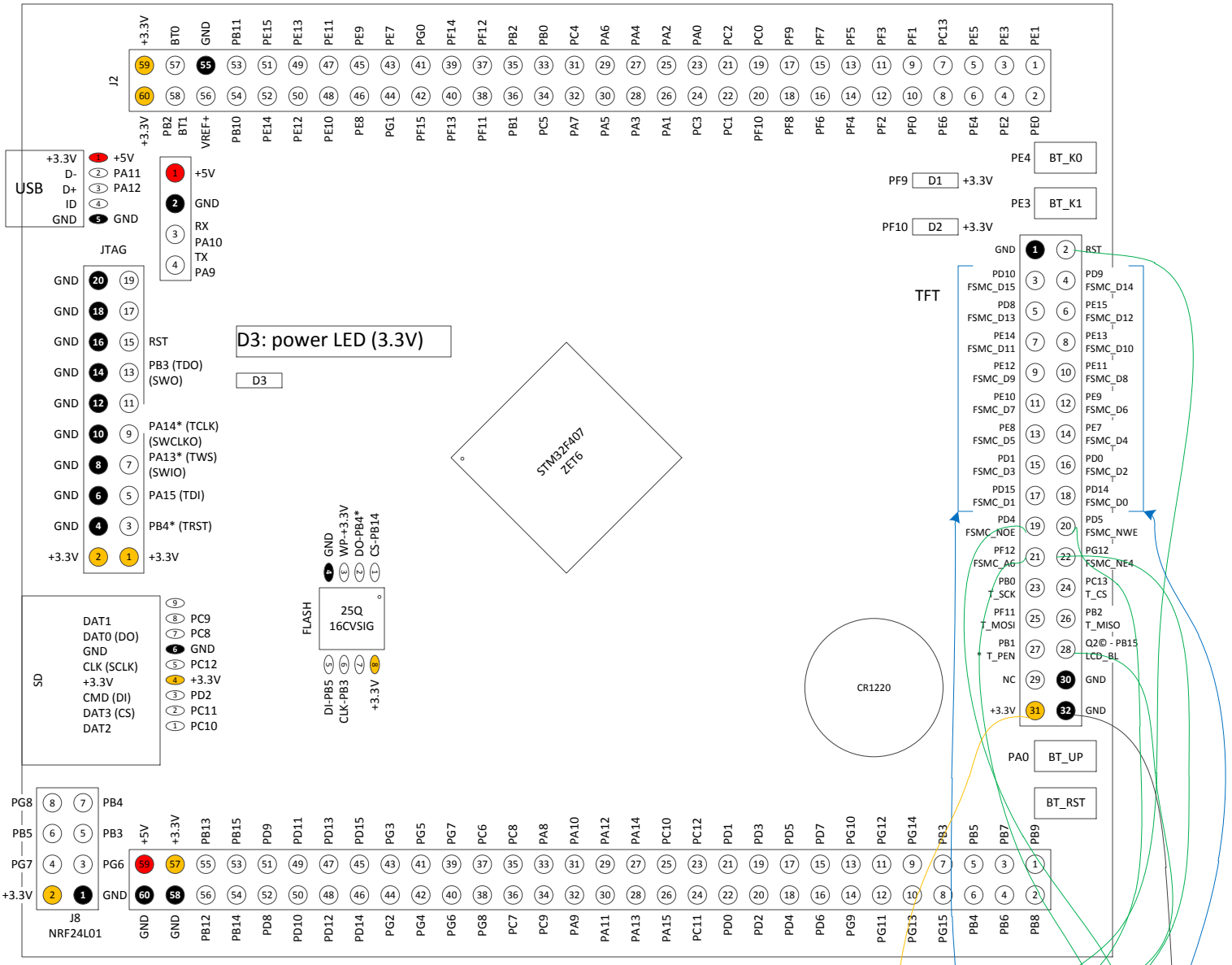


ILI9341 (16bit)

```
#define LCD_RST           X, 0

#define LCD_BL            B, 1
#define LCD_BLON          0

#define LCD_ADDR_BASE     0x60000000 // FSMC_NE1
#define LCD_REGSELECT_BIT 18         // FSMC_A18

If not used DMA:
#define LCD_DMA           0, 0, 0, 0

If used DMA:
#define LCD_DMA           2, 7, 7, 1 // MEM to MEM
```

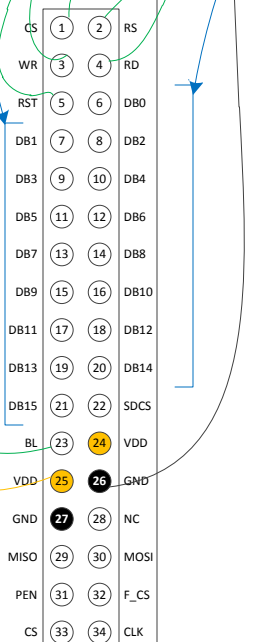


Stm32f407zet gpio 16bit setting



ILI9341 (16bit)

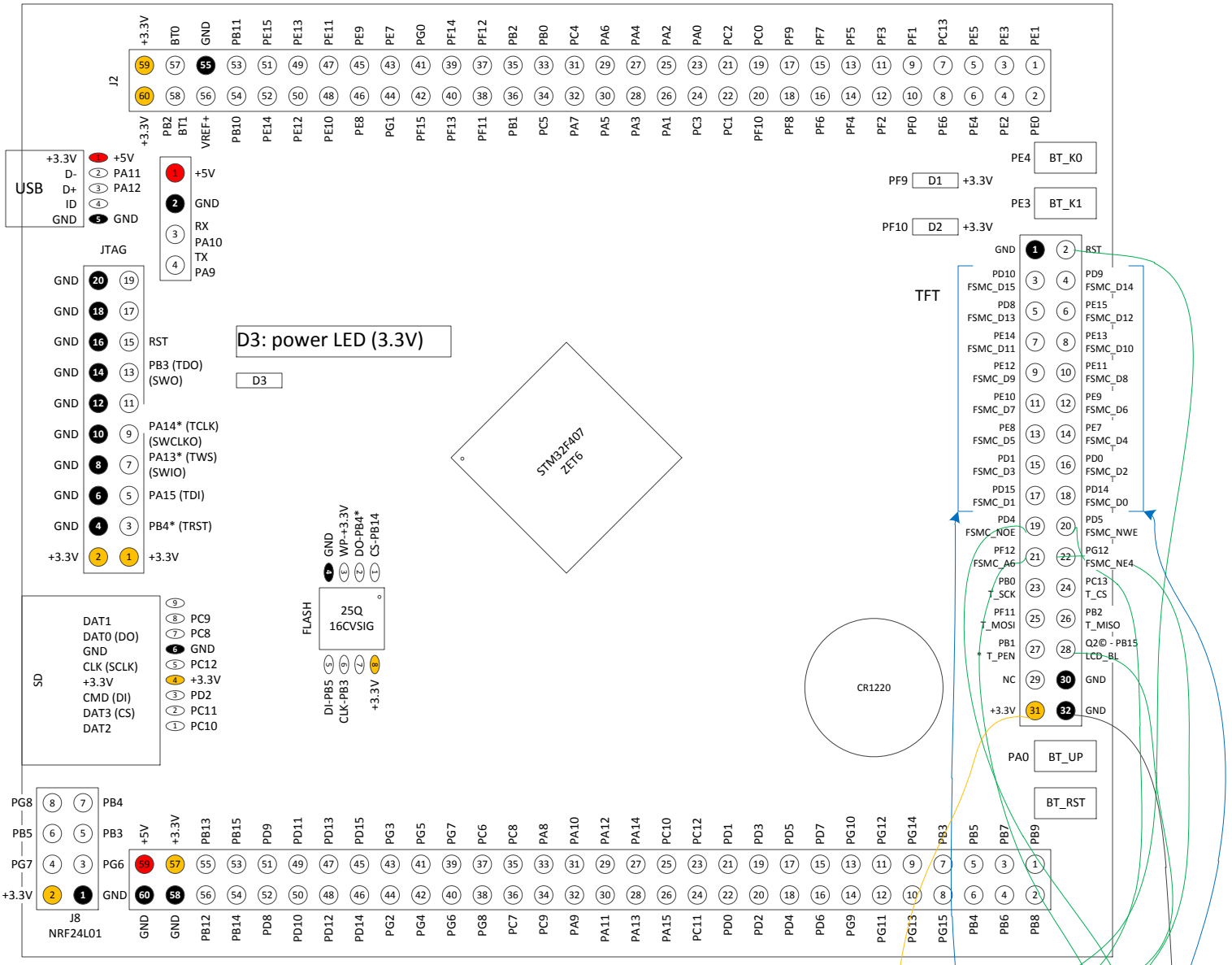
```
#define LCD_D0          D, 14
#define LCD_D1          D, 15
#define LCD_D2          D, 0
#define LCD_D3          D, 1
#define LCD_D4          E, 7
#define LCD_D5          E, 8
#define LCD_D6          E, 9
#define LCD_D7          E, 10
#define LCD_D8          E, 11
#define LCD_D9          E, 12
#define LCD_D10         E, 13
#define LCD_D11         E, 14
#define LCD_D12         E, 15
#define LCD_D13         D, 8
#define LCD_D14         D, 9
#define LCD_D15         D, 10

#define LCD_CS          G, 12
#define LCD_RS          F, 12
#define LCD_WR          D, 5
#define LCD_RD          D, 4
#define LCD_RST         X, 0

#define LCD_BL          B, 15
#define LCD_BLON        0

#define LCD_WRITE_DELAY 0
#define LCD_READ_DELAY  1
```



Optimalization

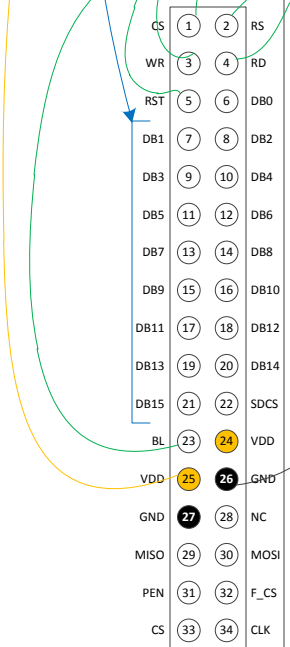
```
// 16 adatláb kimenetre állítása (adatirány: STM32 -> LCD)
#define LCD_DIRWRITE { \
GPIOD->MODER = (GPIOD->MODER & ~((3 << 2 * 14) | (3 << 2 * 15) | (3 << 2 * 0) | (3 << 2 * 1) | (3 << 2 * 8) | (3 << 2 * 9) | (3 << 2 * 10)))  | \
                               ((1 << 2 * 14) | (1 << 2 * 15) | (1 << 2 * 0) | (1 << 2 * 1) | (1 << 2 * 8) | (1 << 2 * 9) | (1 << 2 * 10));   \
GPIOE->MODER = (GPIOE->MODER & ~((3 << 2 * 7)  | (3 << 2 * 8)  | (3 << 2 * 9) | (3 << 2 * 10) | (3 << 2 * 11)  |
                                (3 << 2 * 12) | (3 << 2 * 13) | (3 << 2 * 14)  | (3 << 2 * 15))) | \
                               ((1 << 2 * 7)  | (1 << 2 * 8)  | (1 << 2 * 9) | (1 << 2 * 10) | (1 << 2 * 11)  |
                                (1 << 2 * 12) | (1 << 2 * 13) | (1 << 2 * 14)  | (1 << 2 * 15));   }
// 16 adatláb bemenetre állítása (adatirány: STM32 <- LCD)
#define LCD_DIRREAD { \
GPIOD->MODER = (GPIOD->MODER & ~((3 << 2 * 14) | (3 << 2 * 15) | (3 << 2 * 0) | (3 << 2 * 1) | (3 << 2 * 8) | (3 << 2 * 9) | (3 << 2 * 10)))  | \
                               ((0 << 2 * 14) | (0 << 2 * 15) | (0 << 2 * 0) | (0 << 2 * 1) | (0 << 2 * 8) | (0 << 2 * 9) | (0 << 2 * 10));   \
GPIOE->MODER = (GPIOE->MODER & ~((3 << 2 * 7)  | (3 << 2 * 8)  | (3 << 2 * 9) | (3 << 2 * 10) | (3 << 2 * 11)  |
                                (3 << 2 * 12) | (3 << 2 * 13) | (3 << 2 * 14)  | (3 << 2 * 15))) | \
                               ((0 << 2 * 7)  | (0 << 2 * 8)  | (0 << 2 * 9) | (0 << 2 * 10) | (0 << 2 * 11)  |
                                (0 << 2 * 12) | (0 << 2 * 13) | (0 << 2 * 14)  | (0 << 2 * 15));   }
// 16 adatláb írása, STM32 -> LCD (a kiirandó adat a makro dt paraméterében van)
#define LCD_WRITE(dt) { \
GPIOD->ODR = (GPIOD->ODR & ~((1 << 14) | (1 << 15) | (1 << 0) | (1 << 1) | (1 << 8) | (1 << 9) | (1 << 10))) |        \
                            (((dt & 0b00000011) << 14) | ((dt & 0b00001100) >> 2) | ((dt & 0b1110000000000000) >> 5)); \
GPIOE->ODR = (GPIOE->ODR & ~((1 << 7) | (1 << 8) | (1 << 9) | (1 << 10) | (1 << 11) | (1 << 12) | (1 << 13) | (1 << 14) | (1 << 15))) |        \
                           ((dt & 0b0001111111110000) << (7 - 4));                          }
// 16 adatláb olvasása, STM32 <- LCD (az olvasott adat dt paraméterben megadott változoba kerül)
#define LCD_READ(dt) { \
dt = ((GPIOD->IDR & 0b1100000000000000) >> (14 - 0)) | ((GPIOD->IDR & 0b0000000000000011) << (2 - 0)) | ((GPIOD->IDR & 0b0000001100000000) << (13 - 8)) | \
     ((GPIOE->IDR & 0b1111111110000000) >> (7 - 4)); }
```

Stm32f407zet fsmc16bit setting



ILI9341 (16bit)

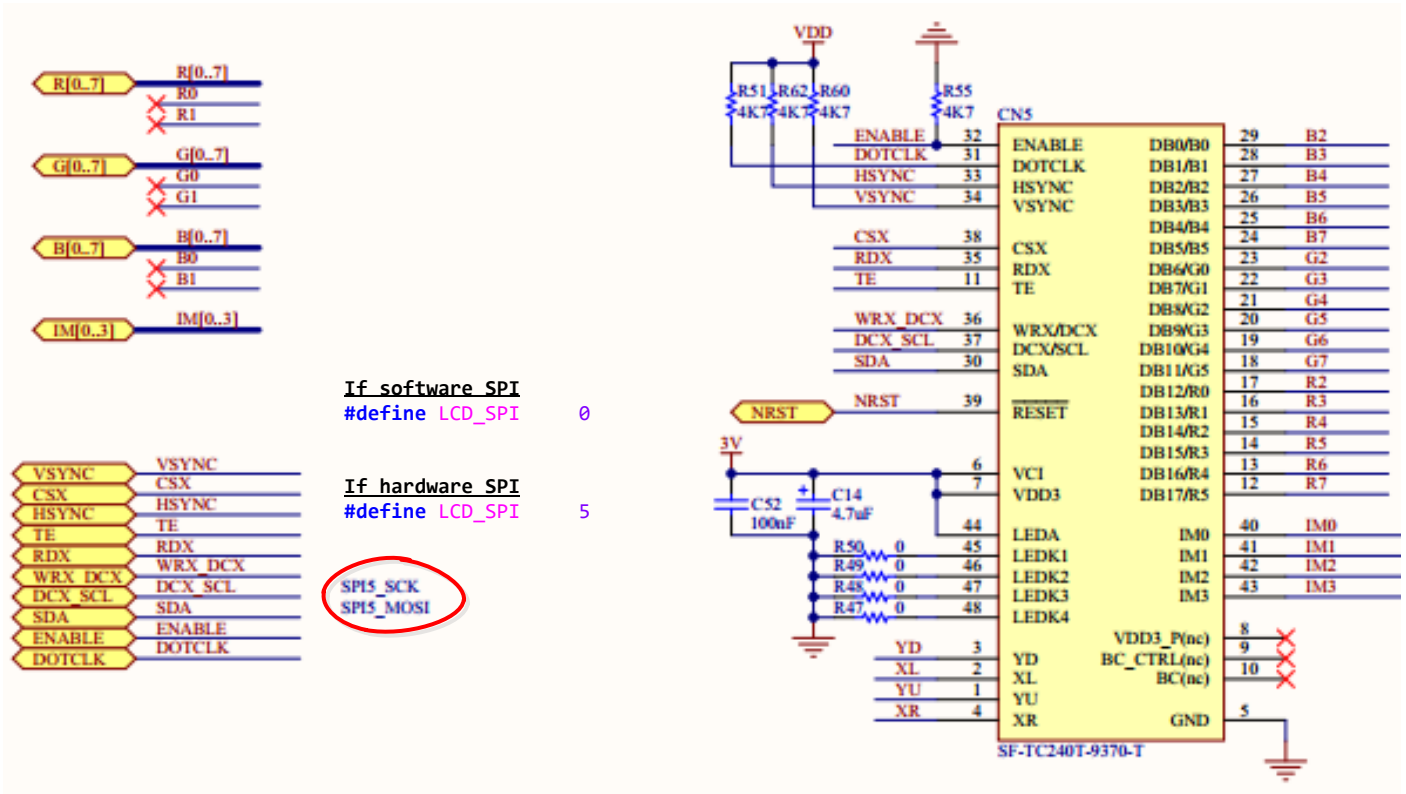
```
#define LCD_RST           X, 0

#define LCD_BL            B, 15
#define LCD_BLON          0

#define LCD_ADDR_BASE     0x6C000000 // FSMC_NE4
#define LCD_REGSELECT_BIT 6

If not used DMA:
#define LCD_DMA           0, 0, 0, 0

If used DMA:
#define LCD_DMA           2, 7, 7, 1
```



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)
```