# 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

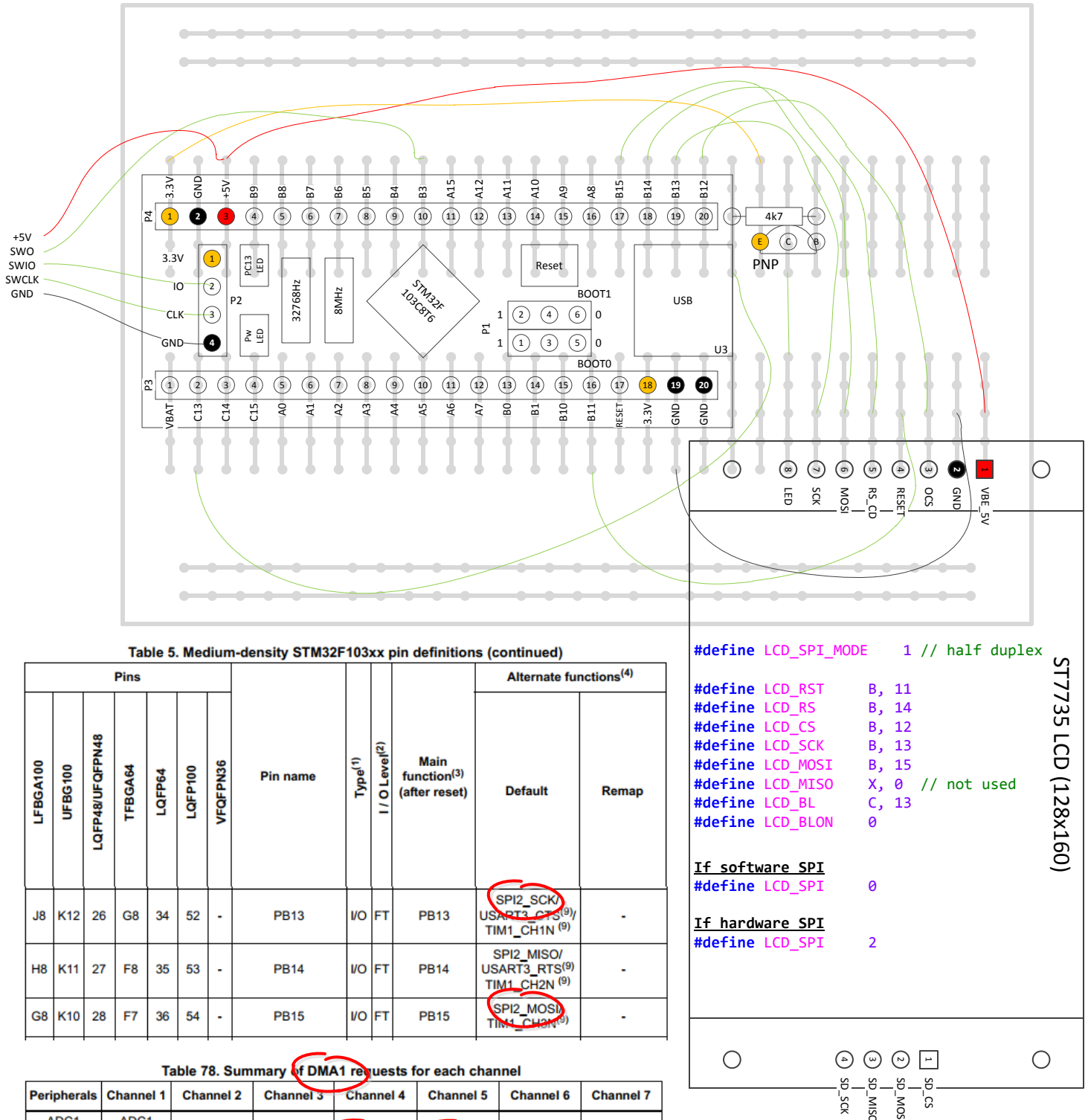



**Table 5. Medium-density STM32F103xx pin definitions (continued)**

| 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 |

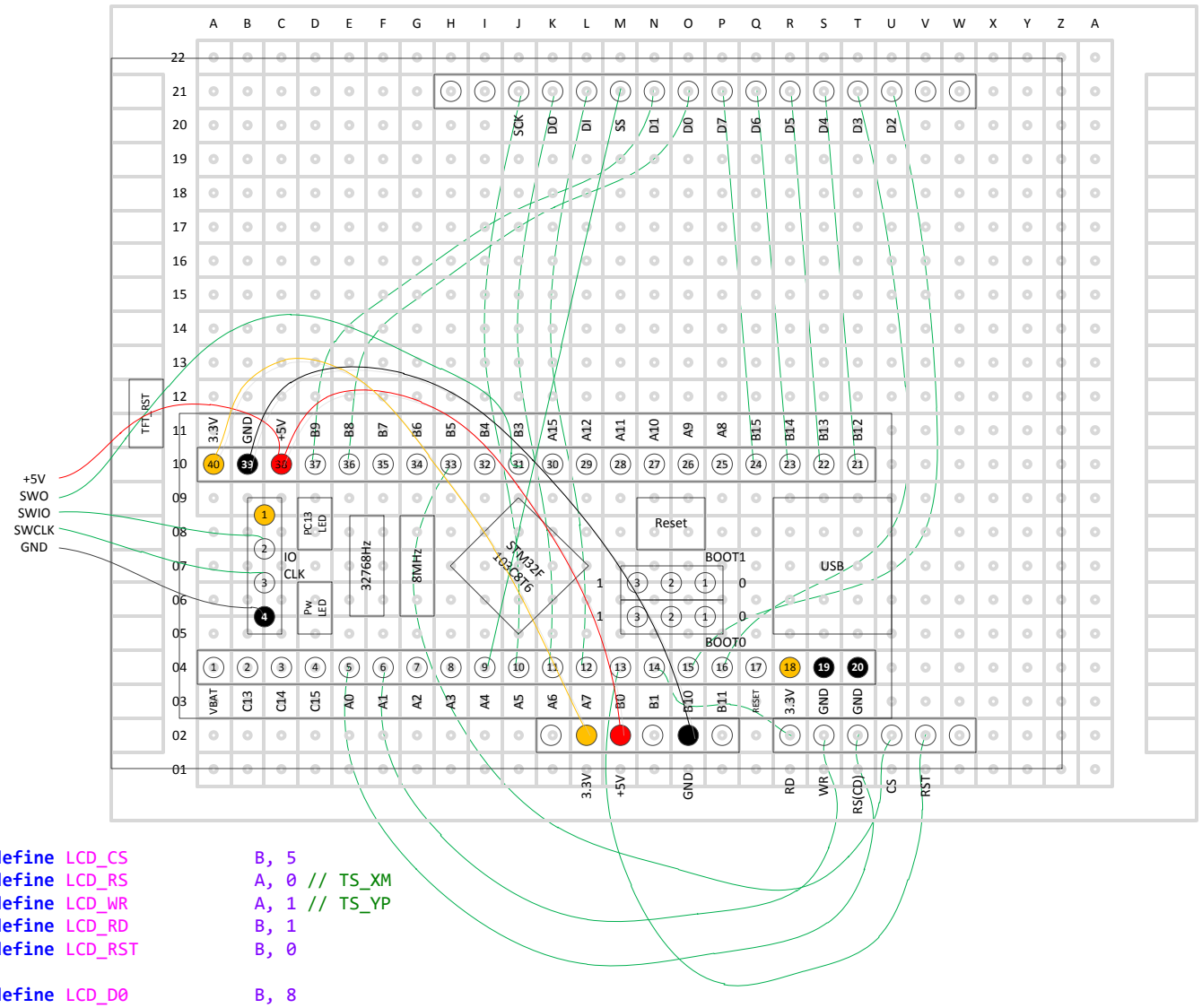
```
If hardware SPI and DMA on
#define LCD_DMA_TX   1, 5, 0 // DMA number, channel, priority
#define LCD_DMA_RX   1, 4, 2 // DMA number, channel, priority
```

```
#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)
```

# Stm32f103c8t bluepill gpio 8bit setting

27x22




```
#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 – st7735 spi setting

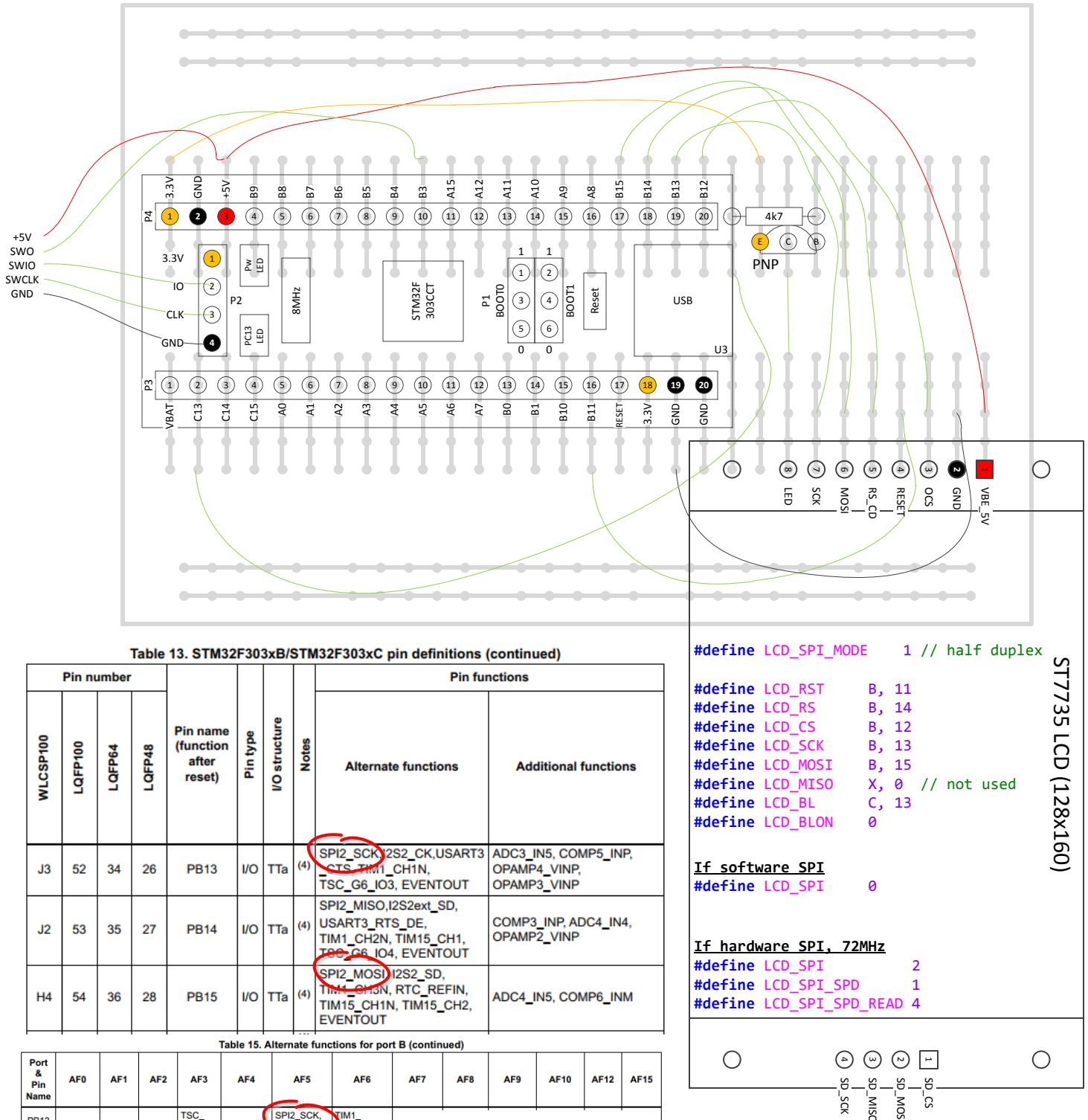



**Table 13. STM32F303xB/STM32F303xC pin definitions (continued)**

| 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 | - | | | | | | |

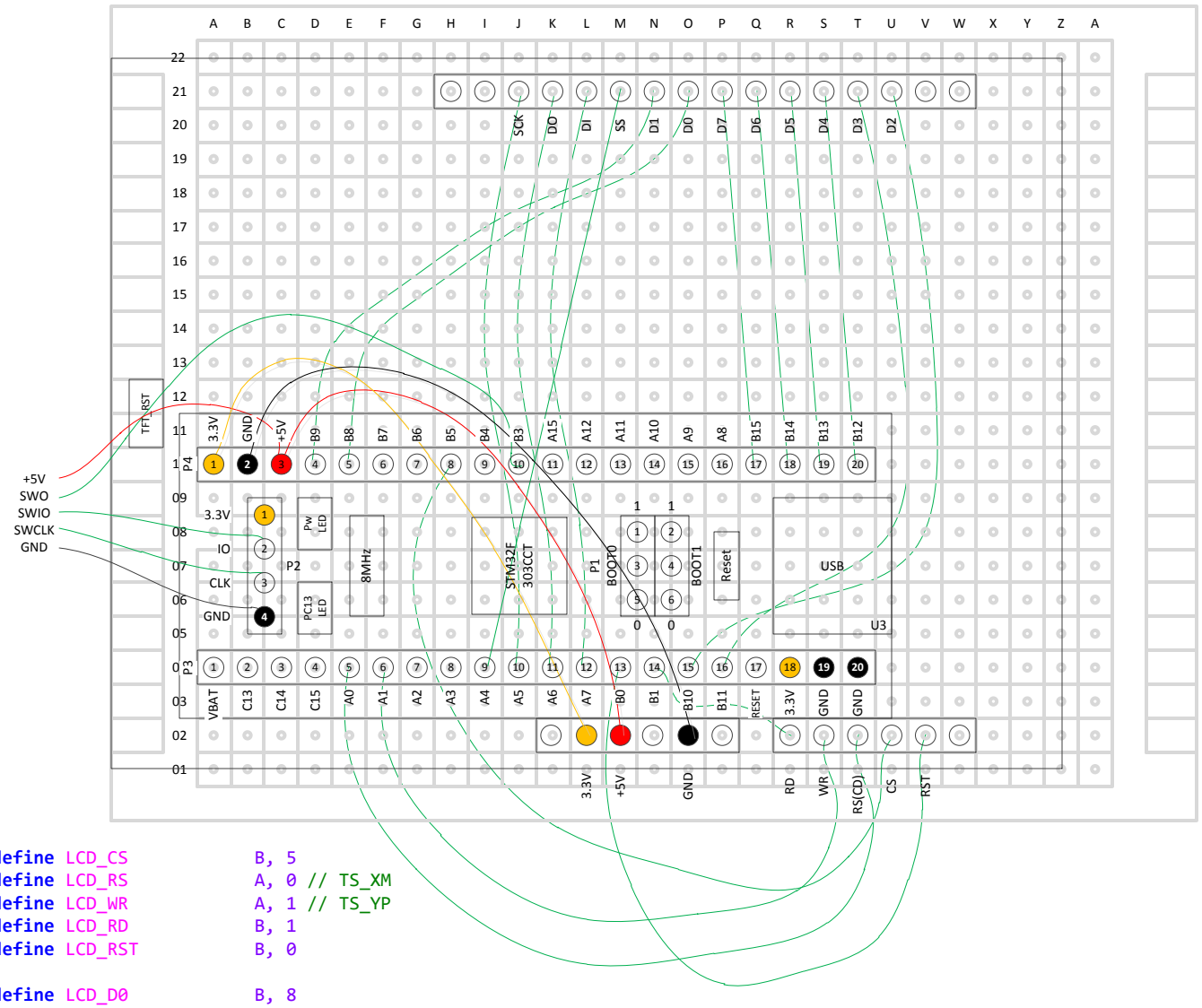
**Table 78. STM32F303xB/C/D/E, STM32F358xC and STM32F398xE summary of DMA1 requests for each channel**

| 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)
```

Stm32f303cct gpio 8bit setting

27x22

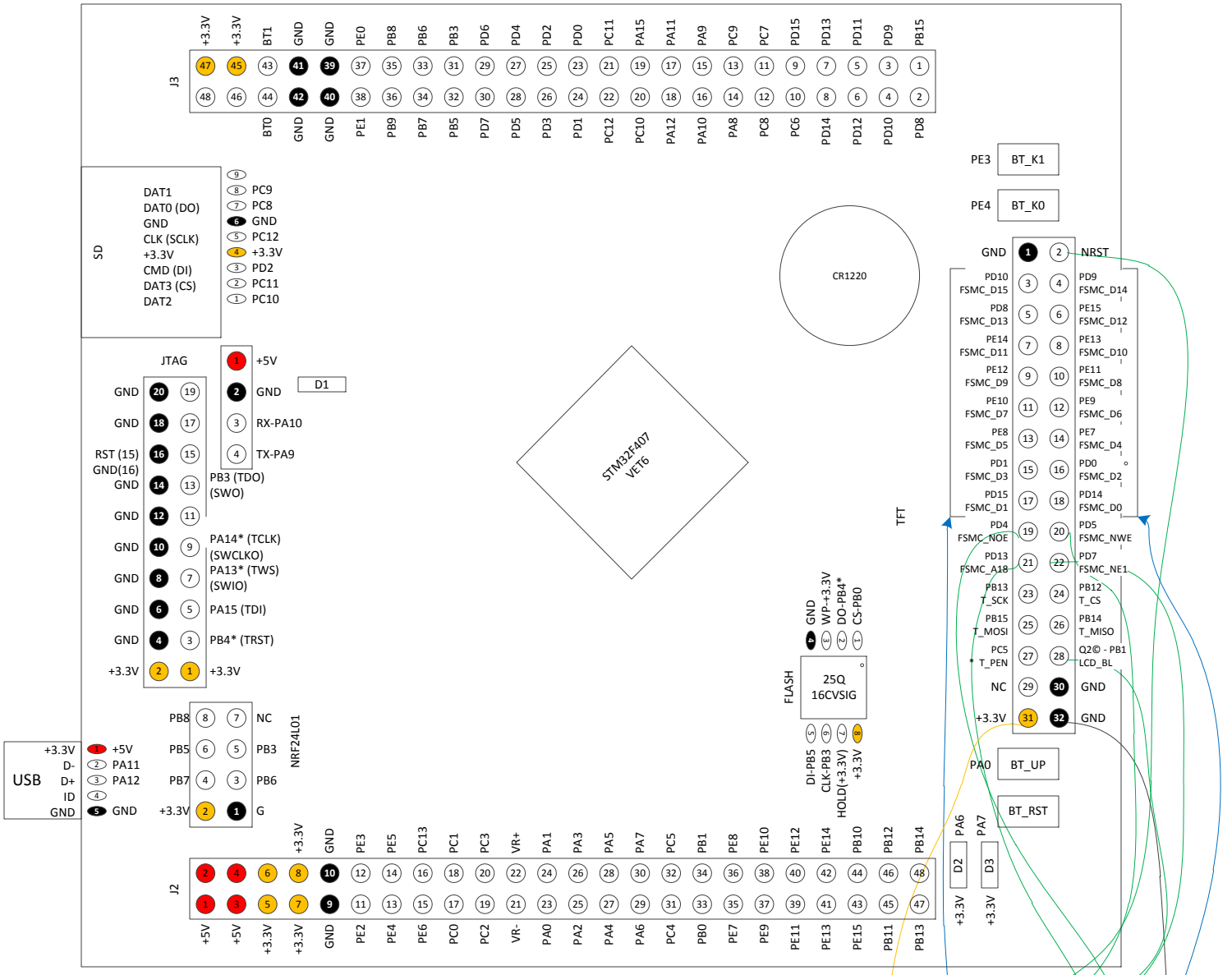



```
#define LCD_CS            B, 5
#define LCD_RS            A, 0 // TS_XM
#define LCD_WR            A, 1 // TS_YP
#define LCD_RD            B, 1
#define LCD_RST           B, 0

#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

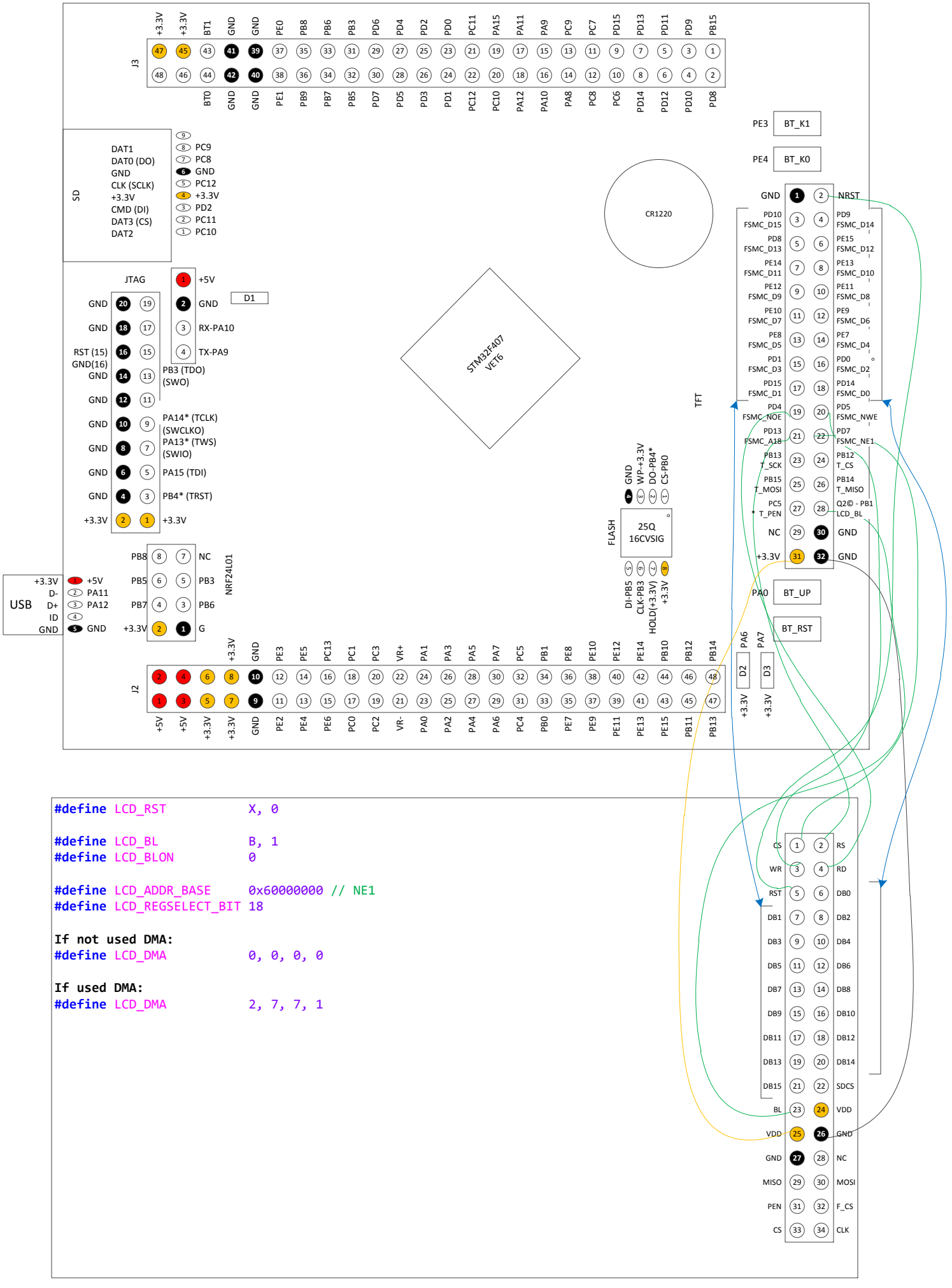



```
#define LCD_D0          D, 14
#define LCD_D1          D, 15
#define LCD_D2          D, 0
#define LCD_D3          D, 1
#define LCD_D4          E, 7
#define LCD_D5          E, 8
#define LCD_D6          E, 9
#define LCD_D7          E, 10
#define LCD_D8          E, 11
#define LCD_D9          E, 12
#define 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
```

## Optimalization

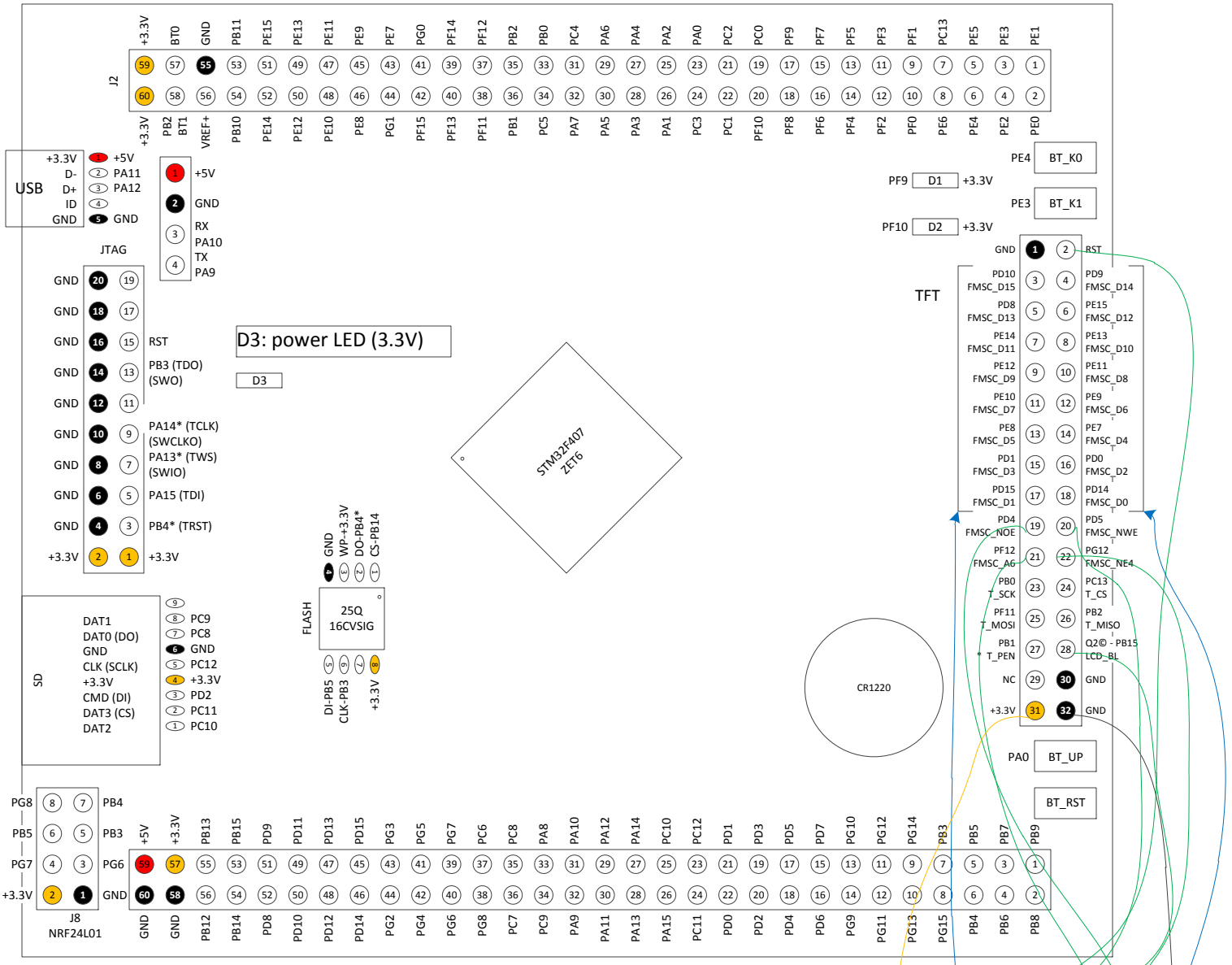
```
// 16 adatláb kimenetre állítása (adatirány: STM32 -> LCD)
#define LCD_DIRWRITE { \
GPIOD->MODER = (GPIOD->MODER & ~((3 << 2 * 14) | (3 << 2 * 15) | (3 << 2 * 0) | (3 << 2 * 1) | (3 << 2 * 8) | (3 << 2 * 9) | (3 << 2 * 10)))  | \
                               ((1 << 2 * 14) | (1 << 2 * 15) | (1 << 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

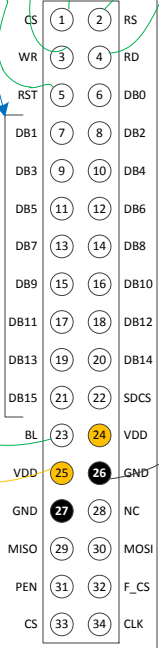



```
#define LCD_RST           X, 0

#define LCD_BL            B, 1
#define LCD_BLON          0

#define LCD_ADDR_BASE     0x60000000 // NE1
#define LCD_REGSELECT_BIT 18

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

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

# Stm32f407zet gpio 16bit setting



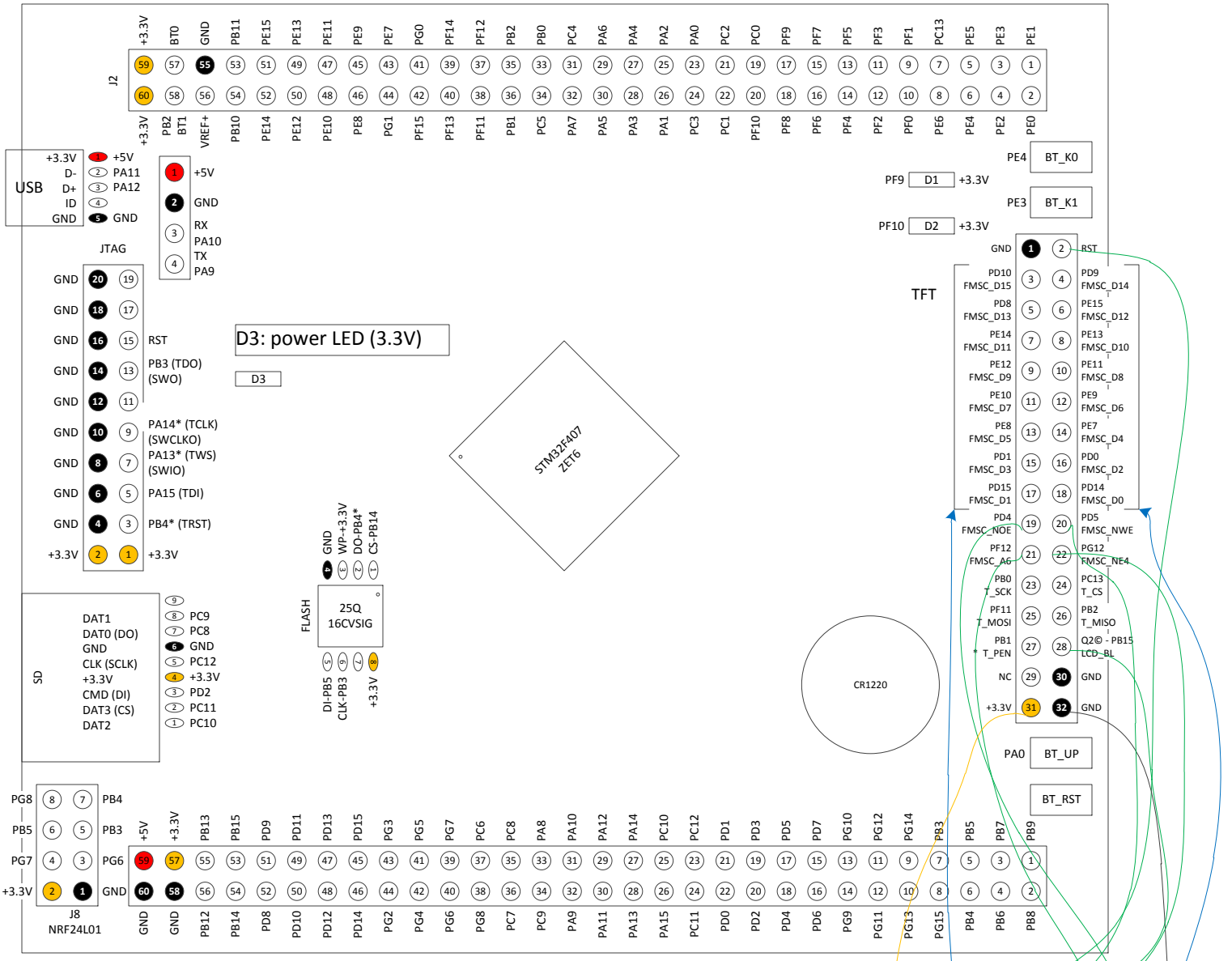

```
#define LCD_D0          D, 14
#define LCD_D1          D, 15
#define LCD_D2          D, 0
#define LCD_D3          D, 1
#define LCD_D4          E, 7
#define LCD_D5          E, 8
#define LCD_D6          E, 9
#define LCD_D7          E, 10
#define LCD_D8          E, 11
#define LCD_D9          E, 12
#define 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
```



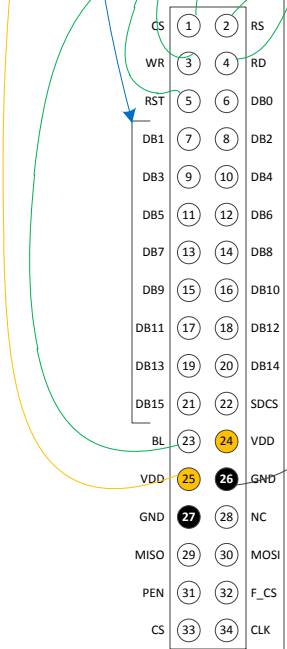

## Optimalization

```
// 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



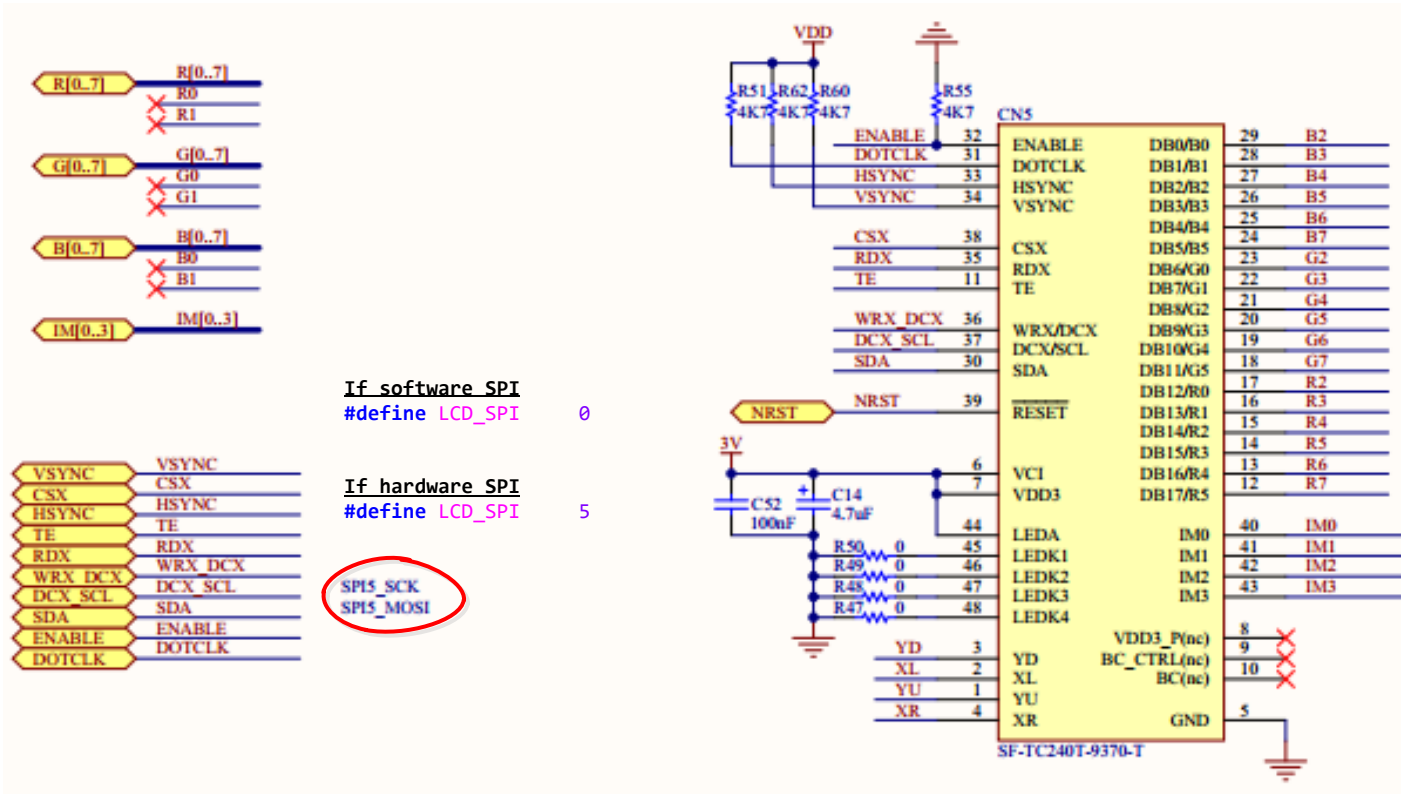

```
#define LCD_RST           X, 0

#define LCD_BL            B, 15
#define LCD_BLON          0

#define LCD_ADDR_BASE     0x6C000000 // 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)
```