

# **Artillery Sidewinder X1 v4 / Genius Marlin mode and M600 support HW and SW setup**

**Technical document**

document

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## Change History

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1.0.0	Approved	29/08/2020	Antonino Di Guardo	First version

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## 1 Purpose

This document describes the HW and SW changes needed on both the TFT board and the main board (hosting Marlin FW) to enable Marlin mode on the Artillery Sidewinder X1 v4 / Genius stock HW.

Marlin mode is the menu provided by Marlin FW. It typically needs an external rotary encoder to navigate in the menus, although the mod proposed in this document will also allow to use the touch screen to emulate a rotary encoder. Marlin mode is an alternative to the Touch mode provided by the TFT FW.



Touch Mode



Marlin Mode

## 2 Scope

The scope of this document is to provide all the details to enable Marlin mode on Artillery Sidewinder X1 v4 / Genius stock HW.

**IMPORTANT NOTE:** Marlin mode can be enabled only on MKS TFT v1.4 clone as the one used in the Sidewinder X1 v4 or Genius printers. That means, it is not applicable on previous models such as Sidewinder X1 v1, v2 and v3.

## 3 Intended Audience

The audience of this document is only people having good HW and SW skills.

## 4 Solution Overview

In order to use Marlin mode (12864 emulation mode), you need to make changes on both the HW and FW of the MKS TFT board and the FW of the Marlin board.

The following sections provide the full setup procedure to allow Marlin mode for the Marlin boards reported below:

- MKS Gen L V1.0
- SKR V1.3

## 5 TFT and main board HW

MKS TFT28 v1.4 board clone is based on:

- MKS TFT28 V1.4: **RepRapDiscount FULL GRAPHIC Smart Controller**

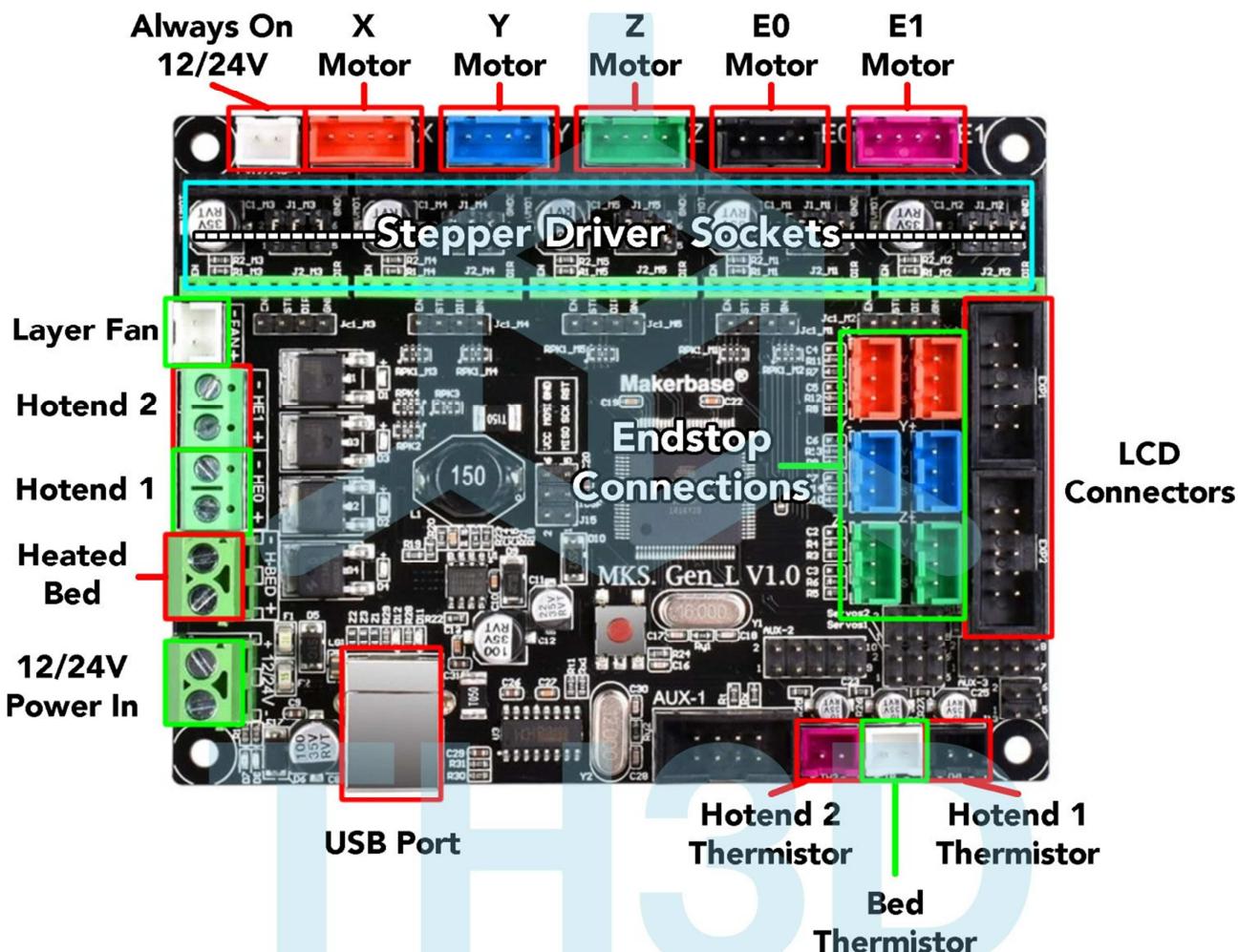
MKS Gen L v1.0 and SKR v1.3 main boards are based on:

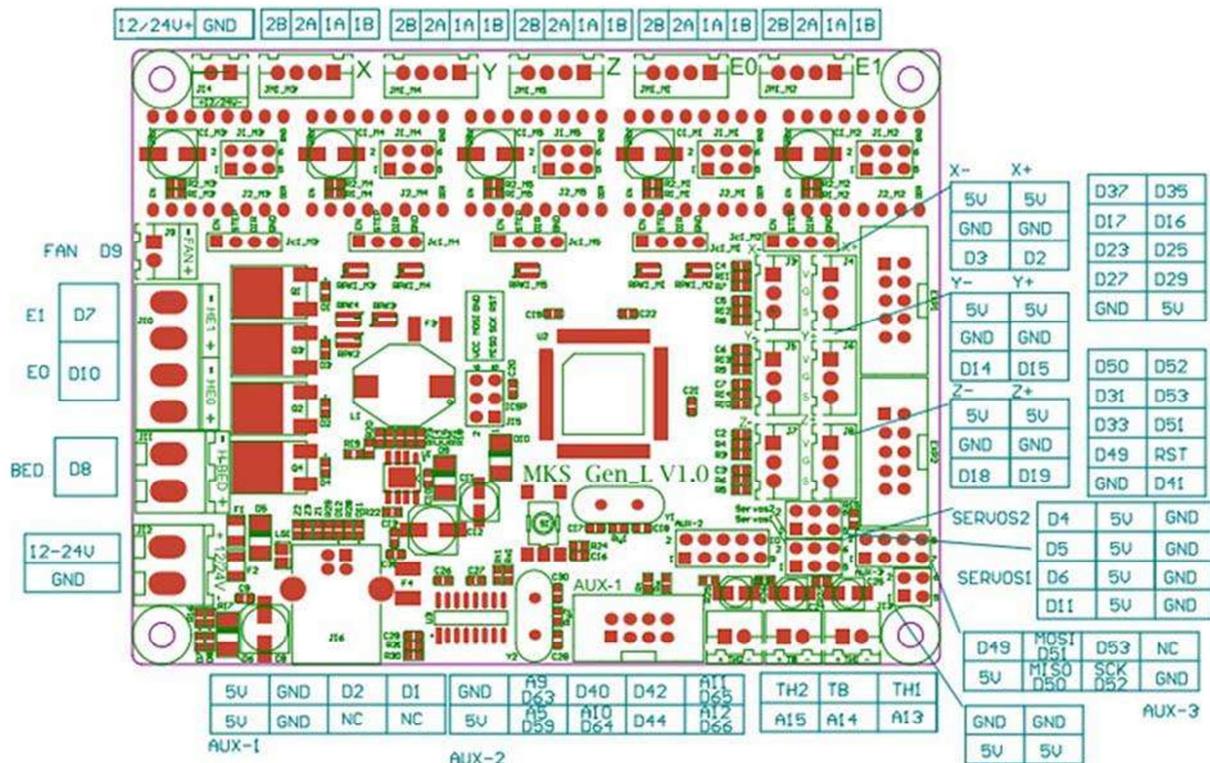
- MKS Gen L V1.0: based on **Arduino Mega with RAMPS v1.4**
- SKR V1.3: based on **BTT SKR v1.3**

On Marlin FW, the pinout for these boards are provided on:

- MKS Gen L V1.0: **Marlin-2.0.x/Marlin/src/pins/ramps/pins\_RAMPS.h**
- SKR V1.3: **Marlin-2.0.x/Marlin/src/pins/lpc1768/pins\_BTT\_SKR\_V1\_3.h**

## 5.1 MKS Gen L V1.0





### 5.1.1 MKS Gen L V1.0 pinout schema

## 6 TFT HW changes

On the MKS TFT, the SPI3 is used for Marlin mode. PB3 pin on the SPI3 (pin number 89 on the TFT's STM32 chip) is also needed but that pin is not exposed to any pin header on

the TFT board. This means that PB3 pin must be wired from the TFT's STM32 chip to a free pin header on the TFT board.

#### NOTES:

1. Wiring PB3 pin to a free pin header on the TFT board requires good soldering skill.  
If you don't have good soldering skill, **DO NOT** try to make any change.  
Otherwise, you will probably damage the TFT board.
2. To reduce the effect of EMI, it is strongly suggested to use single cables (possibly shielded) for all the SPI pins (SPI3\_SCK, SPI3\_MOSI\_PIN). For the encoder pins, a flat cable can be used.
3. In case LCD Encoder's sliding buttons (pin LCD\_ENCA\_PIN and LCD\_ENCB\_PIN) don't produce any movement on menu, try to increase the delay LCD\_ENCODER\_DELAY in Configuration.h (e.g. 64) in the TFT FW.

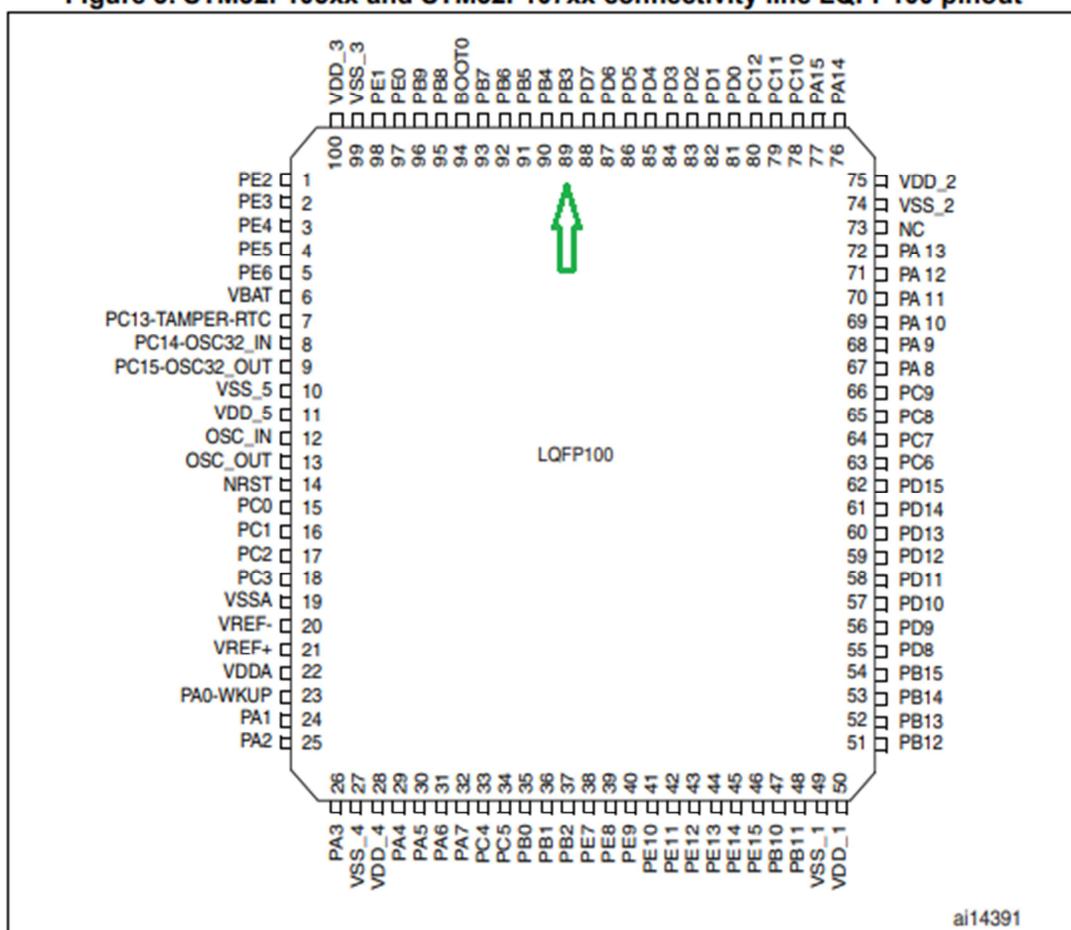
#### 6.1.1 MKS TFT28 V1.4 pinout schema changes

The picture below shows the pinout schema for the STM32F107VC chip mounted on the MKS TFT v1.4 highlighting the PB3 pin (pin number 89 on the TFT's STM32 chip) that must be wired to the board:

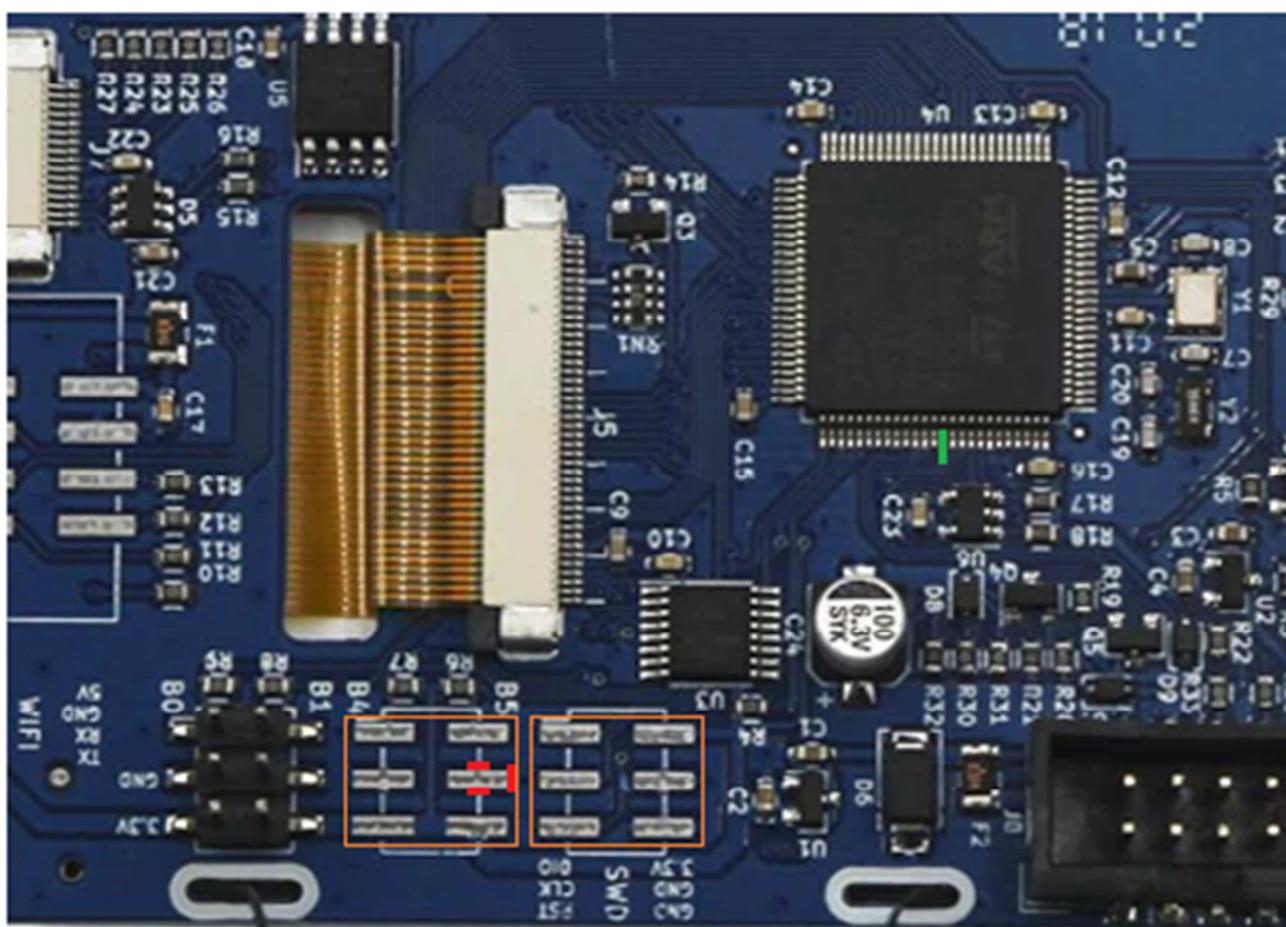
## STM32F105xx, STM32F107xx

## Pinouts and pin description

Figure 3. STM32F105xx and STM32F107xx connectivity line LQFP100 pinout



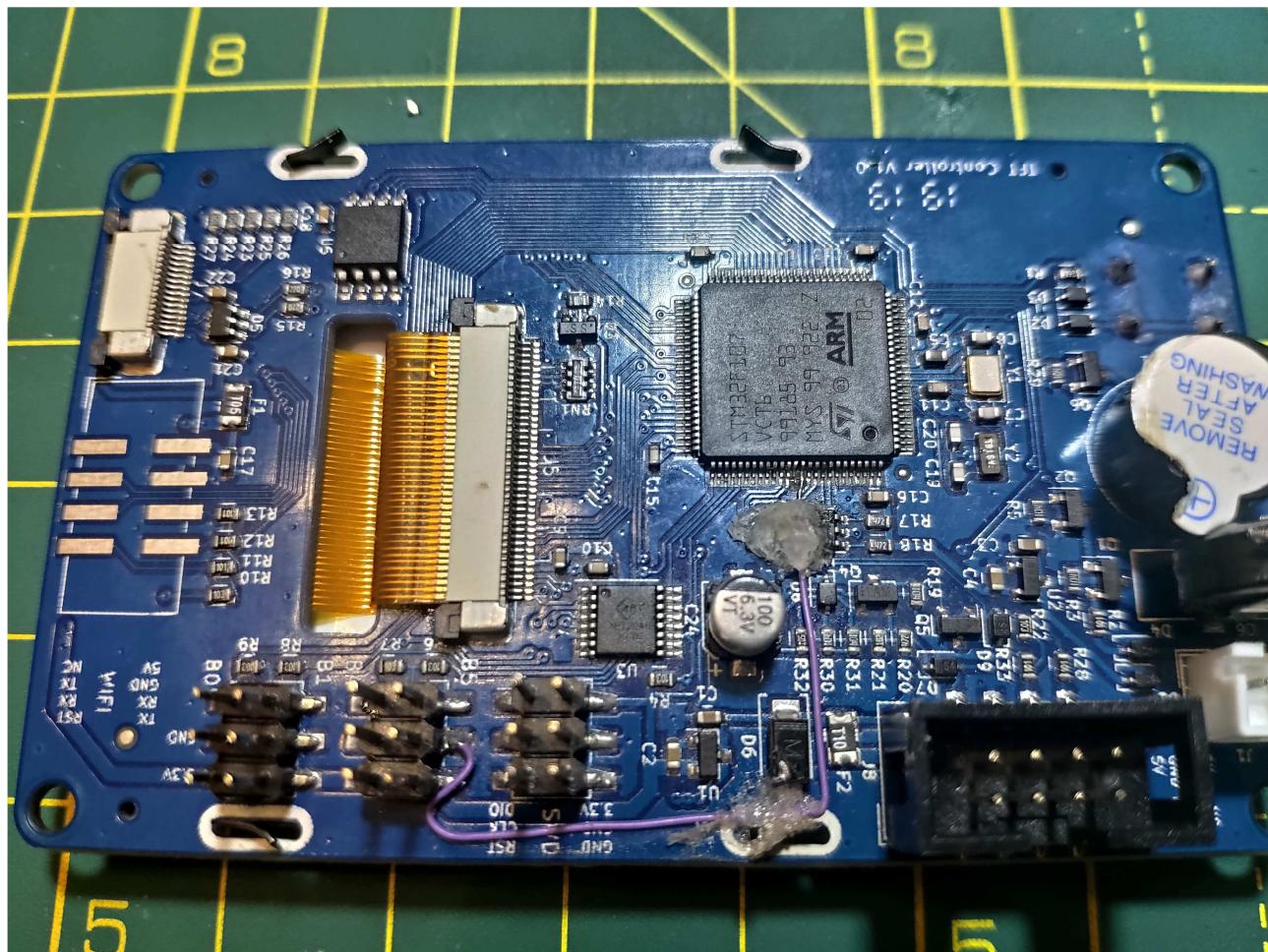
The picture below shows the changes to apply on the TFT board:



1. cut the traces indicated by the 3 red lines. That will allow to reserve the pad close to B5 to the new B3 pin header
2. solder a 3x2 SMD pin header (as the one used for B0 and B1) in both the areas covered by the orange rectangles
3. solder a wire (e.g. a wire wrapping wire) from pin number 89 on the TFT's STM32 chip (indicated by the green line) to the new B3 pin header. On the picture, the pin covered by the green line is the 12<sup>th</sup> starting from the right

#### 6.1.2 MKS TFT28 V1.4 new pinout schema

The picture below shows the new pinout of the TFT board after the changes reported on section 6.1.1:



## 7 FW and HW connection schema

### 7.1 Standard connection schema

According to the pinout schemas reported on sections 5.1.1 and 6.1.2 for the main board and the TFT respectively, the table below reports the standard pins connections:

MKS TFT FW pins	MKS TFT HW pins	MKS TFT board pins		MKS Gen L V1.0 HW pins	SKR V1.3 HW pins	Marlin FW pins
LCD_ENCA_PIN	PA13	JTAG DIO	=>	EXP2_D31	EXPA2_08_PIN	BTN_EN1
LCD_ENCB_PIN	PA14	JTAG CLK	=>	EXP2_D33	EXPA2_06_PIN	BTN_EN2
LCD_BTN_PIN	PB4	B4	=>	EXP1_D35	EXPA2_09_PIN	BTN_ENC
SPI3_CS_PIN	PB1	B1	=>	EXP1_D16	EXPA2_04_PIN	LCD_PINS_RS
SPI3_SCK_PIN	PB3	B3	=>	EXP1_D23	EXPA2_05_PIN	LCD_PINS_D4
SPI3_MOSI_PIN	PB5	B5	=>	EXP1_D17	EXPA2_03_PIN	LCD_PINS_ENABLE

## 7.2 Optimized connection schema

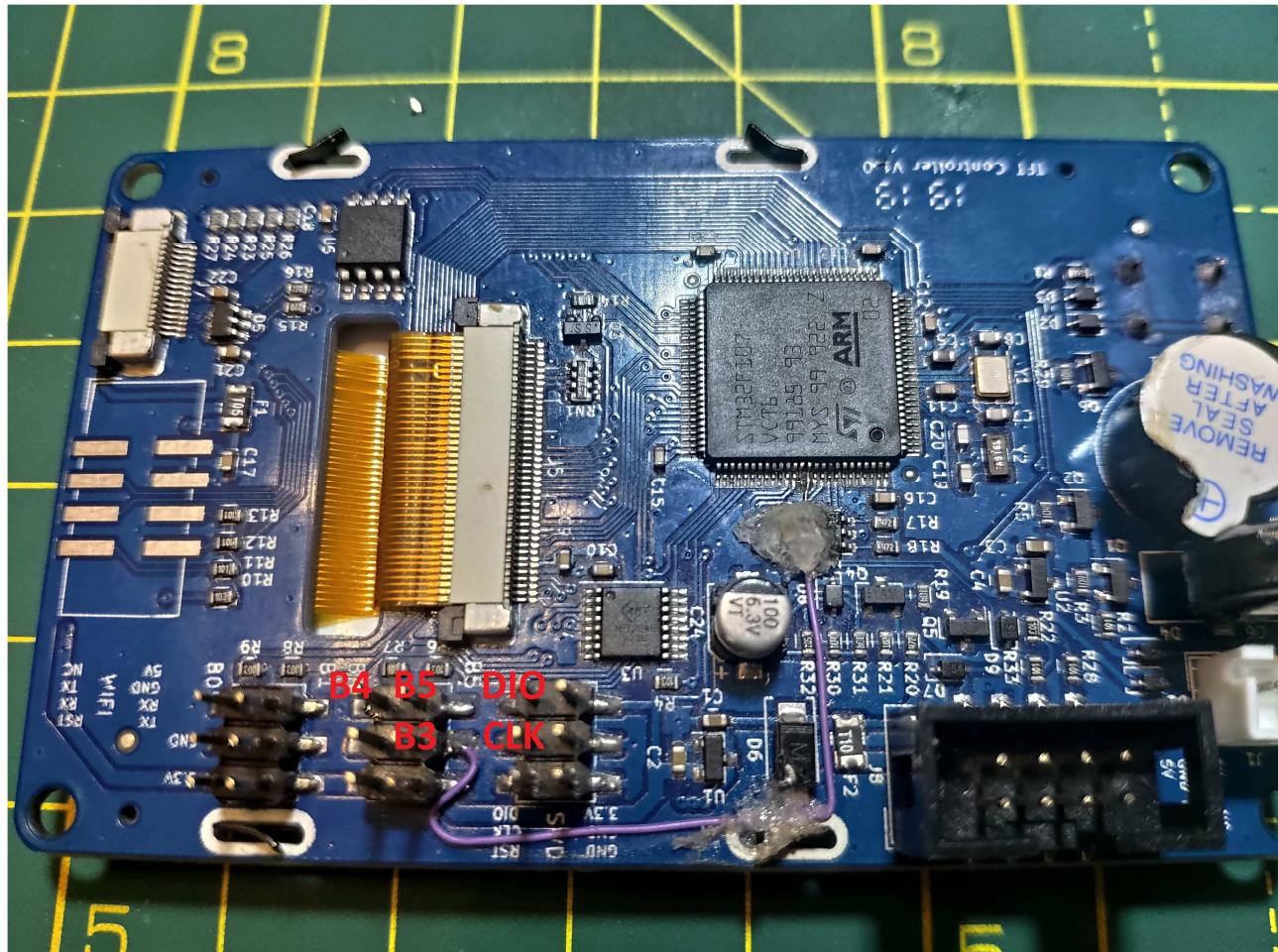
The standard connection schema reported on section 7.1 can be optimized according to:

- the standard pins assignment for the MKS GEN L v1.0 board can be changed in order to allow the use of only the EXP1 connector, avoiding the use for the EXP2 connector (for BTN\_EN1 and BTN\_EN2)
- the SPI3\_CS\_PIN (B1) is not mandatory for MKS TFT v1.4, so it is not needed. Being not needed anymore, this will also allow to continue to use B1 pin for the filament runout sensor provided in the stock Artillery printers

Based on the two bullets above, the table below reports the optimized pins connections that will be configured in the next sections:

MKS TFT FW pins	MKS TFT HW pins	MKS TFT board pins		MKS Gen L V1.0 HW pins	SKR V1.3 HW pins	Marlin FW pins
LCD_ENCA_PIN	PA13	JTAG DIO	=>	EXP1_D16	EXPA2_08_PIN	BTN_EN1
LCD_ENCB_PIN	PA14	JTAG CLK	=>	EXP1_D25	EXPA2_06_PIN	BTN_EN2
LCD_BTN_PIN	PB4	B4	=>	EXP1_D35	EXPA2_09_PIN	BTN_ENC
SPI3_SCK_PIN	PB3	B3	=>	EXP1_D23	EXPA2_05_PIN	LCD_PINS_D4
SPI3_MOSI_PIN	PB5	B5	=>	EXP1_D17	EXPA2_03_PIN	LCD_PINS_ENABLE

### 7.2.1 MKS TFT V1.4 optimized pinout schema



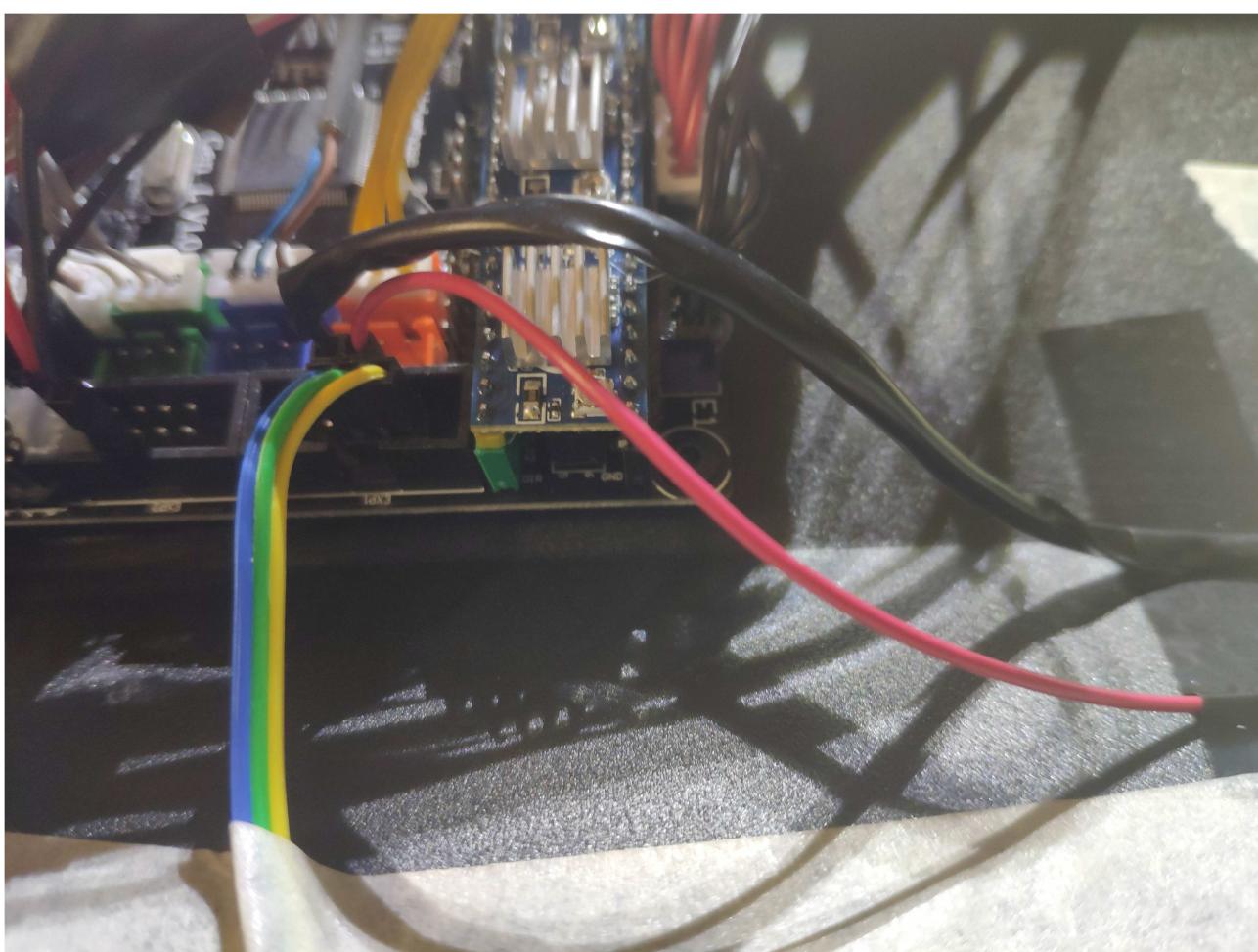
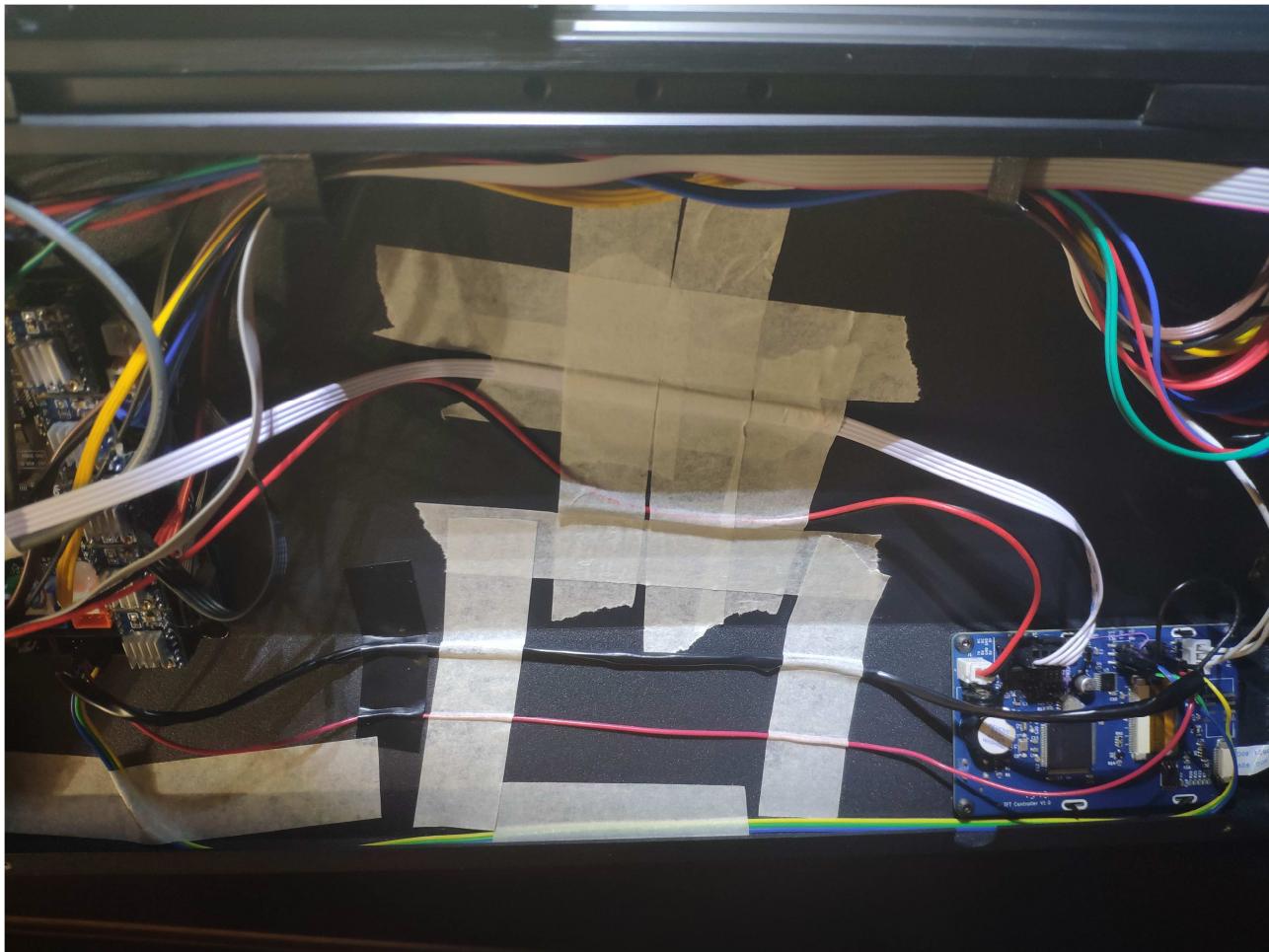
### 7.2.2 MKS Gen L V1.0 optimized pinout schema

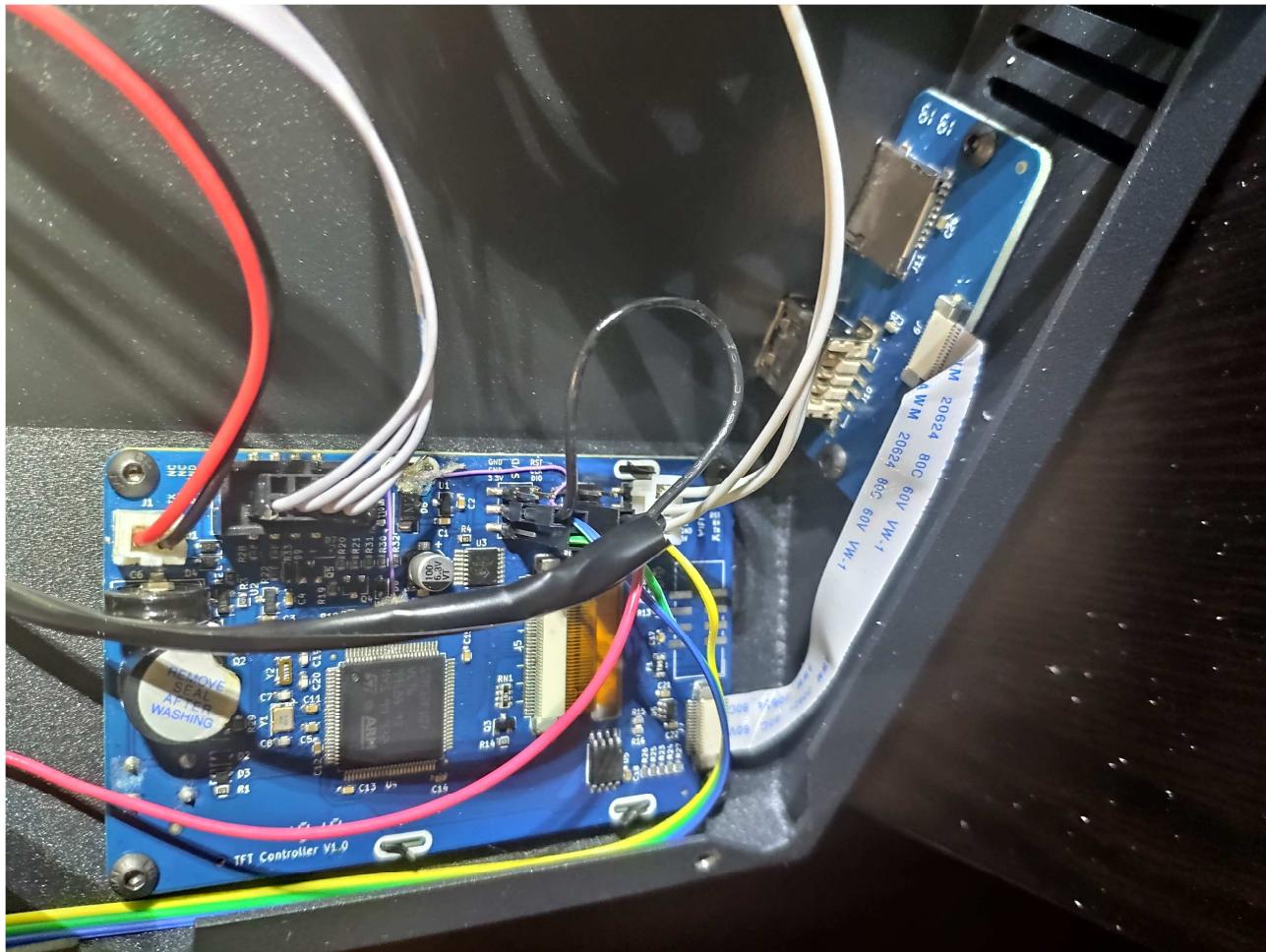
D50   1 2   D52	(BEEPER_PIN)   1 2   <b>D35</b> ( <b>BTN_ENC</b> )
(LCD_PINS_D5) D31   3 4   D53 (SDSS)	(LCD_PINS_ENABLE)   3 4   <b>D17</b> ( <b>BTN_EN1</b> )
(LCD_PINS_D6) D33   5 6   D51	(LCD_PINS_D4)   5 6   <b>D23</b> ( <b>BTN_EN2</b> )
(SD_DETECT_PIN) D49   7 8   RST	(LCD_PINS_RS)   7 8   D29 (LCD_PINS_D7)
GND   9 10   D41 (KILL_PIN)	GND   9 10   5V

EXP2    EXP1

## 8 TFT and main board cabling

The pictures below report the cabling used to guarantee low EMI in order Marlin menu is correctly displayed on the TFT:





## 8.1 Troubleshooting

The presence of EMI typically causes the following side effects:

- Marlin menu is correctly displayed only powering the printer via USB cable.  
Powering the printer with main power causes artefacts or a black screen
- Marlin menu periodically moves from a menu to another one. This is due to EMI on BTN\_ENC (push button) and/or BTN\_EN1/BTN\_EN2 signals

### **IMPORTANT NOTE:**

In order to reduce the effect of EMI, the better solution is to use shielded cables in particular for LCD\_PINS\_D4 (SPI3\_SCK\_PIN) and LCD\_PINS\_ENABLE (SPI3\_MOSI\_PIN).

In the pictures above the black cable (LCD\_PINS\_D4) was shielded and the shield was connected to the GND pin header on the TFT's DEBUG connector. However, a better solution (the classic shielding procedure) is to connect the shields, on both sides of the cable, to two equipotential points in the chassis.

## 9 FW changes

In order to implement the connection schema reported on section 7.2, few changes on FW must be provided. The changes reported in the following sections are based on the last official BTT FW v0.26.1 (last update 2020/08/30) and Marlin FW v2.0.6.1 (last update 2020/08/30).

### 9.1 MKS TFT V1.4

On TFT FW, in **BIGTREETECH-**

**TouchScreenFirmware/TFT/src/User/Variants/pin\_MKS\_TFT32\_V1\_4.h** file, uncomment and set the following existing parameters as reported below:

```
// ST7920 Simulator SPI pins
#define ST7920_SPI      _SPI3           // uncomment to enable Marlin mode
```

The setting above will enable the Marlin mode switch on the TFT. See section 10 on how to switch from Touch mode to Marlin mode and viceversa.

```
// Marlin mode + LCD Encoder support
#ifndef ST7920_SPI
    #define SPI3_PIN_SMART_USAGE          // if enabled, it avoids any SPI3 CS pin usage and free the MISO (PB4 pin) for encoder pins

    #define LCD_ENCA_PIN    PA13          // map ENCA pin to JTAG DIO pin
    #define LCD_ENCB_PIN    PA14          // map ENCB pin to JTAG CLK pin

#endif SPI3_PIN_SMART_USAGE
    #define LCD_BTN_PIN     PB4           // map BTN pin to PB4 pin
#else
    #define LCD_BTN_PIN     PB0           // map BTN pin to PB0 pin

    #define SPI3_CS_PIN     PB1           // CS pin used for SPI3 slave mode mapped to PB1 pin
#endif
```

The settings above will map the TFT's pins according to section 7.2.1.

## 9.2 MKS Gen L V1.0

On Marlin FW, in **Marlin-2.0.x/Marlin/Configuration.h** file, uncomment and set the following existing parameters as reported below:

```
//  
// RepRapDiscount FULL GRAPHIC Smart Controller  
// https://reprap.org/wiki/RepRapDiscount_Full_Graphic_Smart_Controller  
//  
#define REPRAP_DISCOUNT_FULL_GRAPHIC_SMART_CONTROLLER
```

The setting above will enable the Marlin mode on the Marlin board. This means that the main board will communicate with the TFT providing the Marlin menu.

On Marlin FW, in **Marlin-2.0.x/Marlin/src/pins/ramps/pins\_RAMPS.h** file, set the following existing parameters as reported below:

1. at about row number 483:

```
#else  
//      #define LCD_PINS_RS          16  
//      #define LCD_PINS_RS          27  
//      #define LCD_PINS_ENABLE       17  
//      #define LCD_PINS_D4           23  
//      #define LCD_PINS_D5           25  
//      #define LCD_PINS_D6           27  
//      #define LCD_PINS_D5           31  
//      #define LCD_PINS_D6           33  
#endif
```

2. at about row number 525:

```
#else  
//      #define BTN_EN1            31  
//      #define BTN_EN2            33  
//      #define BTN_EN1            16  
//      #define BTN_EN2            25  
#endif
```

The settings above will map the TFT's pins according to section 7.2.2.

### 9.3 SKR V1.3

On Marlin FW, in **Marlin-2.0.x/Marlin/Configuration.h** file, uncomment and set the following existing parameters as reported below:

```
//  
// Factory display for Creality CR-10  
// https://www.aliexpress.com/item/32833148327.html  
//  
// This is RAMPS-compatible using a single 10-pin connector.  
// (For CR-  
10 owners who want to replace the Melzi Creality board but retain the display)  
//  
#define CR10_STOCKDISPLAY
```

The setting above will enable the Marlin mode on the Marlin board. This means that the main board will communicate with the TFT providing the Marlin menu.

On Marlin FW, in **Marlin-2.0.x/Marlin/src/pins/Ipc1768/pins\_BTT\_SKR\_V1\_3.h** file, set the following existing parameters as reported below:

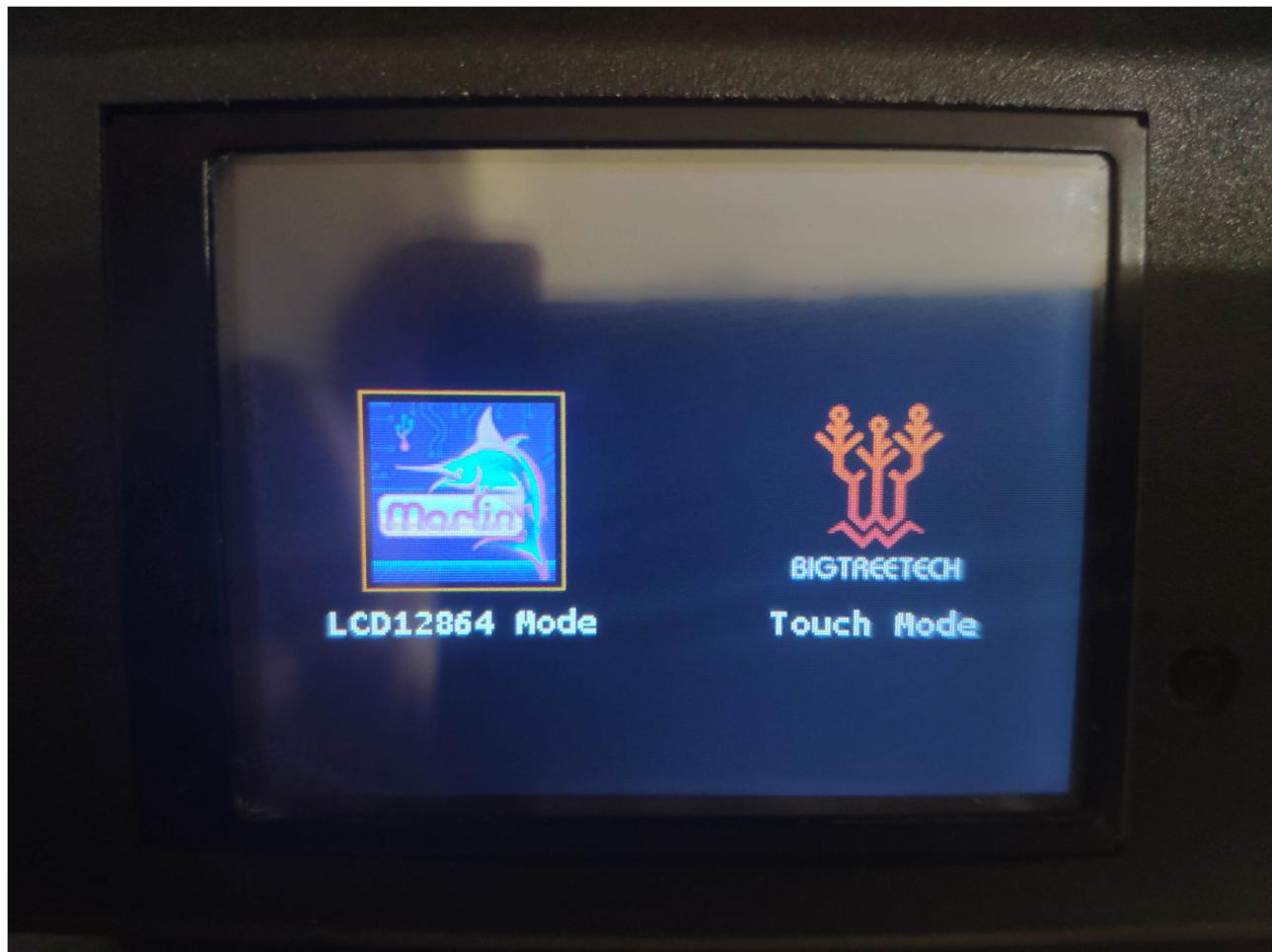
1. at about row number 253:

```
#elif ENABLED(CR10_STOCKDISPLAY)  
  
    #define LCD_PINS_RS          EXPA1_04_PIN  
  
    #define BTN_EN1              EXPA1_08_PIN  
    #define BTN_EN2              EXPA1_06_PIN  
    #define BTN_ENC              EXPA1_09_PIN // (58) open-drain  
  
    #define LCD_PINS_ENABLE      EXPA1_03_PIN  
    #define LCD_PINS_D4          EXPA1_05_PIN
```

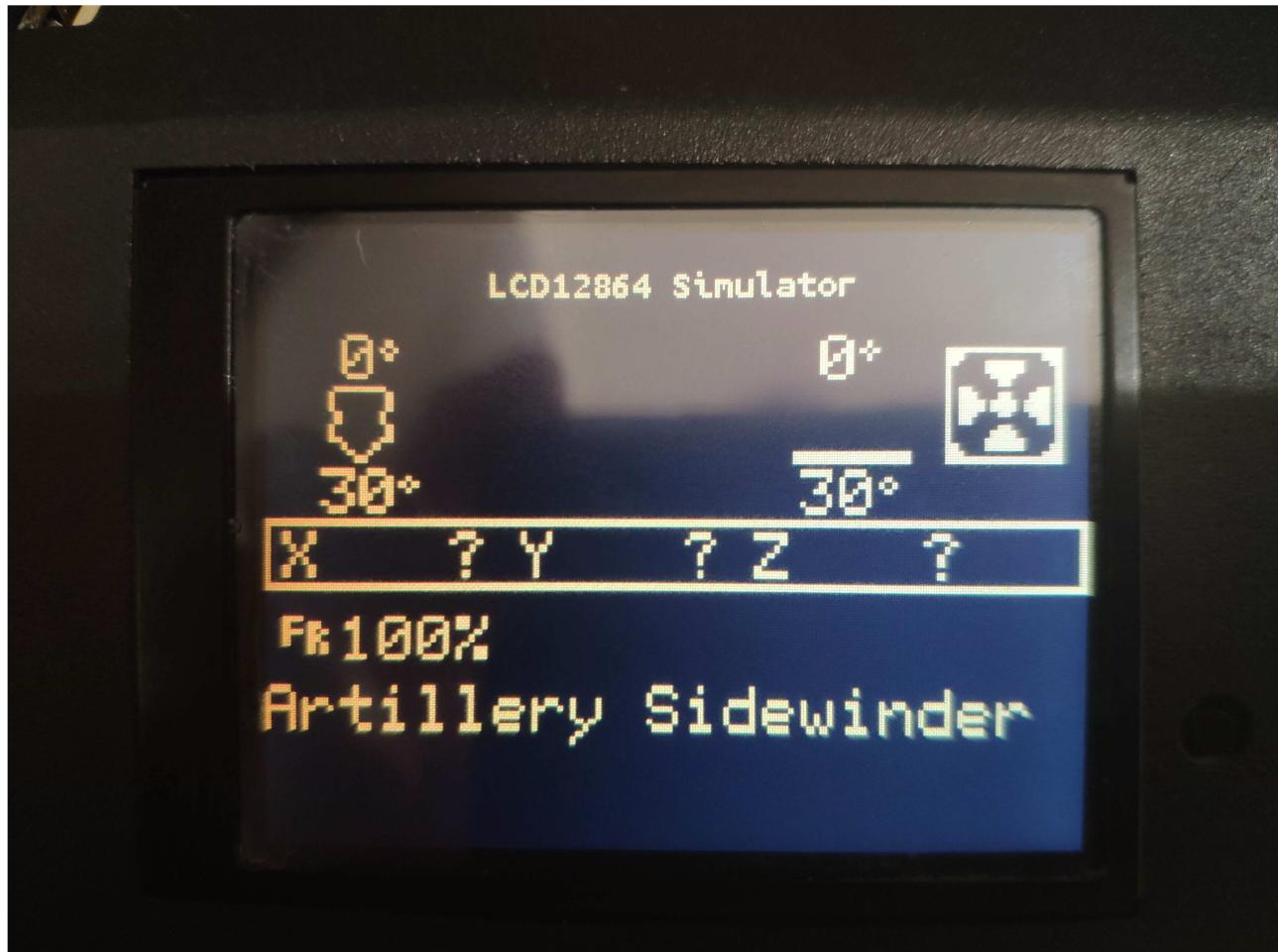
The settings above will map the TFT's pins according to section 7.2.

## 10 Switching from Touch mode to Marlin mode

You can switch from Touch mode to Marlin mode or viceversa simply with a long touch on the center of the screen. A menu like the following is displayed. Simply press on the menu's icon you want to switch to.



Pressing on the Marlin icon, the following menu must be displayed:



If the above menu is not shown (a black screen is shown) press on the upper right corner of the screen as also described on section 11.

## 11 Using LCD encoder

The TFT FW emulates a rotary encoder through the use of the touch screen. The touch screen portion reserved to the emulated rotary encoder is about 1/5 of the screen width starting from the right.

The picture below shows the different areas monitored by the LCD encoder:



- push button: press on the top right area of the screen to open a selected menu or to confirm an action
- navigate buttons: slide from top to bottom (to move down) or bottom to top (to move up) in the right part of the screen, just below the area reserved to the push button, to select a menu

## 12 Enabling M600 (Advanced Pause Feature)

The M600 gcode support is used to allow filament change at the specified layers (where the M600 gcode is provided) on a gcode file. When provided, it instructs the Marlin FW to:

1. pause the print
2. change the filament
3. resume the print

M600 is already emulated by the BTT FW when printing from the TFT's SD or USB slots. The TFT FW intercepts the M600 gcode and replace it with a pause gcode sent to Marlin FW. From the TFT, the user will change the filament and then will finally resume the print.

However, if an onboard SD (SD card reader mounted on the Marlin board) is present, the print from that SD slot is totally handled by the Marlin FW and not by the TFT FW. This happens even if you browse the SD card and start the print from the BTT FW. In this case the only way to allow the filament change is to enable M600 gcode support on Marlin FW.

On Marlin FW, in **Marlin-2.0.x/Marlin/Configuration.h** file, uncomment and set the following existing parameters as reported below:

```
/***
 * Nozzle Park
 *
 * Park the nozzle at the given XYZ position on idle or G27.
 *
 * The "P" parameter controls the action applied to the Z axis:
 *
 *   P0  (Default) If Z is below park Z raise the nozzle.
 *   P1  Raise the nozzle always to Z-park height.
 *   P2  Raise the nozzle by Z-park amount, limited to Z_MAX_POS.
 */
#define NOZZLE_PARK_FEATURE
```

```
//
// RepRapDiscount FULL GRAPHIC Smart Controller
// https://reprap.org/wiki/RepRapDiscount_Full_Graphic_Smart_Controller
//
#define REPRAP_DISCOUNT_FULL_GRAPHIC_SMART_CONTROLLER
```

or any other LCD type (Character-based LCDs or Graphical LCDs), in case you don't have Marlin mode already enabled in your Marlin FW. This setting is needed to allow to purge more filament or resume the print. Otherwise (if no LCD type is enabled), the print will be automatically resumed even if you didn't press on "purge more" or "continue" buttons.

On Marlin FW, in **Marlin-2.0.x/Marlin/Configuration\_adv.h** file, uncomment and set the following existing parameters as reported below:

```
/***
 * Emergency Command Parser
 *
 * Add a low-level parser to intercept certain commands as they
 * enter the serial receive buffer, so they cannot be blocked.
 * Currently handles M108, M112, M410, M876
 * NOTE: Not yet implemented for all platforms.
 */
#define EMERGENCY_PARSER
```

```
/***
 * Advanced Pause
 * Experimental feature for filament change support and for parking the nozzle when
 * paused.
 * Adds the GCode M600 for initiating filament change.
 * If PARK_HEAD_ON_PAUSE enabled, adds the GCode M125 to pause printing and park the
 * nozzle.
 *
 * Requires an LCD display.
 * Requires NOZZLE_PARK_FEATURE.
 * This feature is required for the default FILAMENT_RUNOUT_SCRIPT.
 */
#define ADVANCED_PAUSE_FEATURE
```

```
/***
 * Host Action Commands
 *
 * Define host streamer action commands in compliance with the standard.
 *
 * See https://reprap.org/wiki/G-code#Action\_commands
 * Common commands ..... poweroff, pause, paused, resume, resumed, cancel
 * G29_RETRY_AND_RECOVER .. probe_rewipe, probe_failed
 *
 * Some features add reason codes to extend these commands.
 *
 * Host Prompt Support enables Marlin to use the host for user prompts so
 * filament runout and other processes can be managed from the host side.
 */

```

```
#define HOST_ACTION_COMMANDS  
#if ENABLED(HOST_ACTION_COMMANDS)  
    #define HOST_PROMPT_SUPPORT  
#endif
```