

Stepper Driver Configurations for SKR PRO V1.1 Board



By

@GadgetAngel



Based on Work by

@rfulling

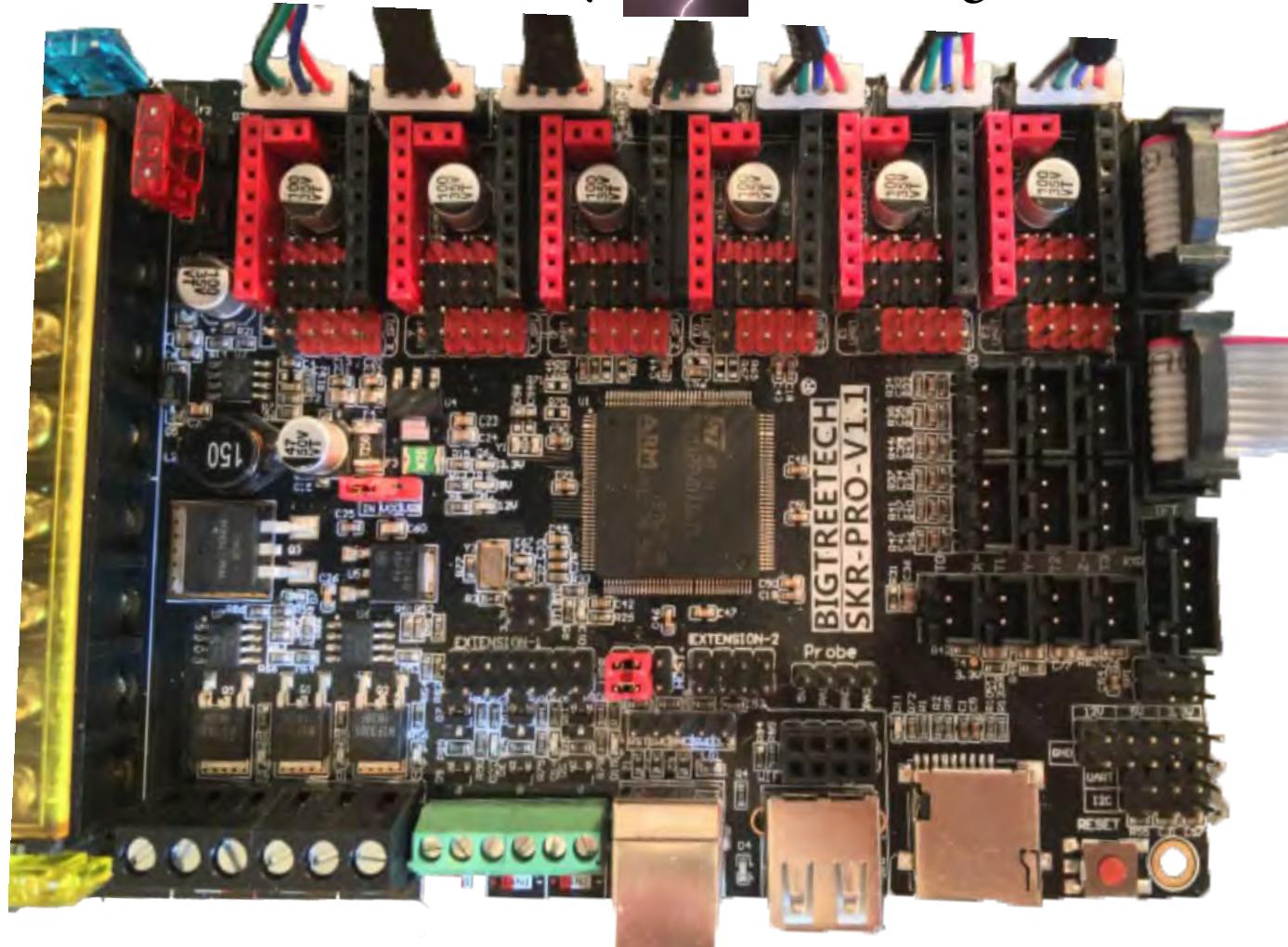


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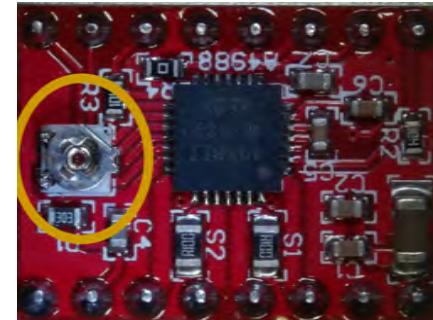
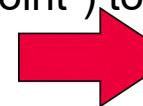
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POLOLU A4988

NOTE: Use the potentiometer (POT) on the top of the board (or use the board's "V_{ref} Test point") to adjust your V_{ref}.



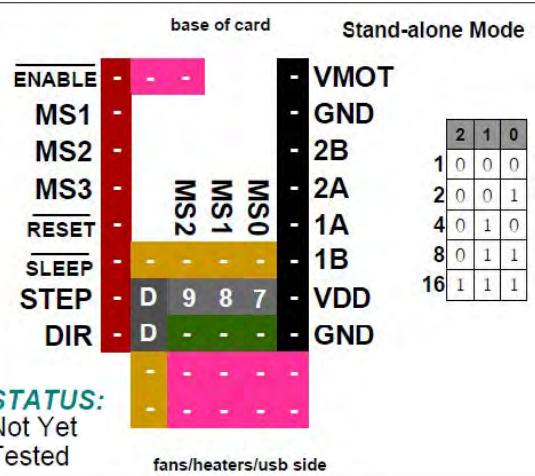
Note: "V_{ref} Test point" location is on the bottom of the driver board.



Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board

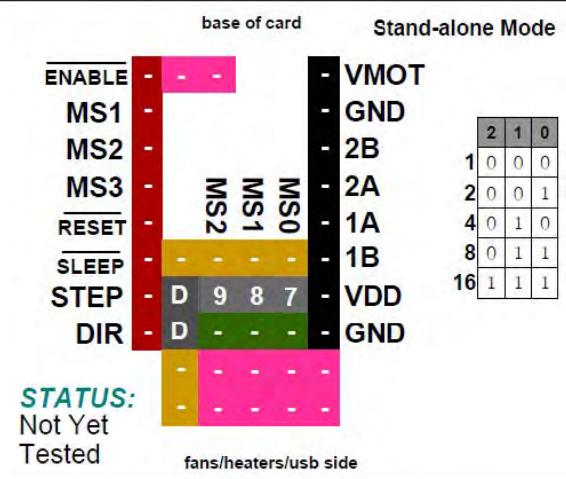
See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: See this video about current sense resistors (R_s) and their possible locations: <https://youtu.be/8wk1elugv5A>

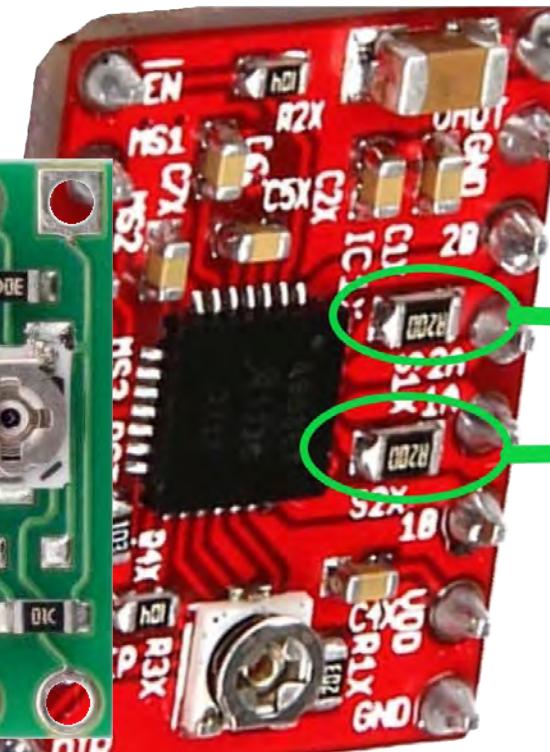
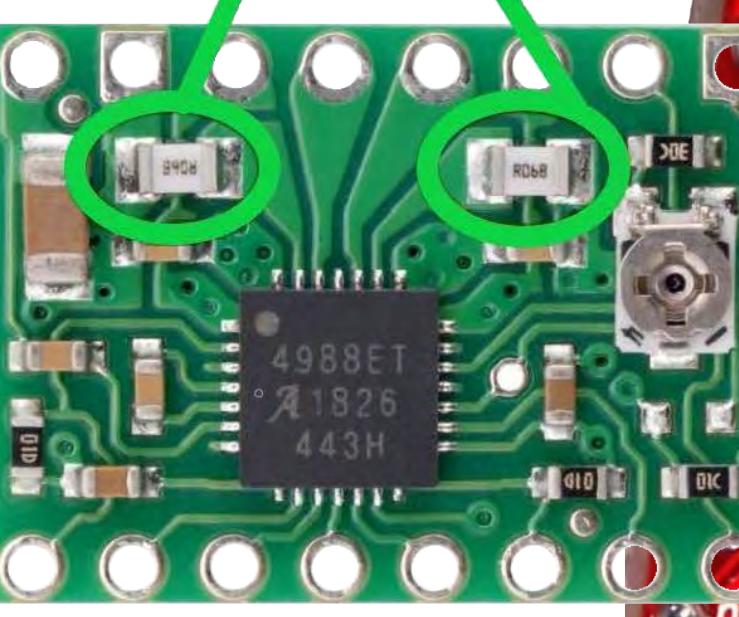


| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|---------------------------------|------|------|-------------------------------|-----------------|
| Pololu A4988 Maximum 16 Subdivision 35V DC 2A (peak) | Low | Low | Low | Full step | 2 Phase |
| | Low | Low | High | Half step | 1-2 Phase |
| | Low | High | Low | Quarter step | W1-2 Phase |
| | Low | High | High | Eighth step | 2W1-2 Phase |
| | High | High | High | Sixteenth step | 4W1-2 Phase |
| Driving Current Calculation Formula R_s (Typical Sense Resistor) = 0.1Ω | $I_{MAX} = V_{ref} / (8 * R_s)$ | | | $V_{ref} = 8 * I_{MAX} * R_s$ | |

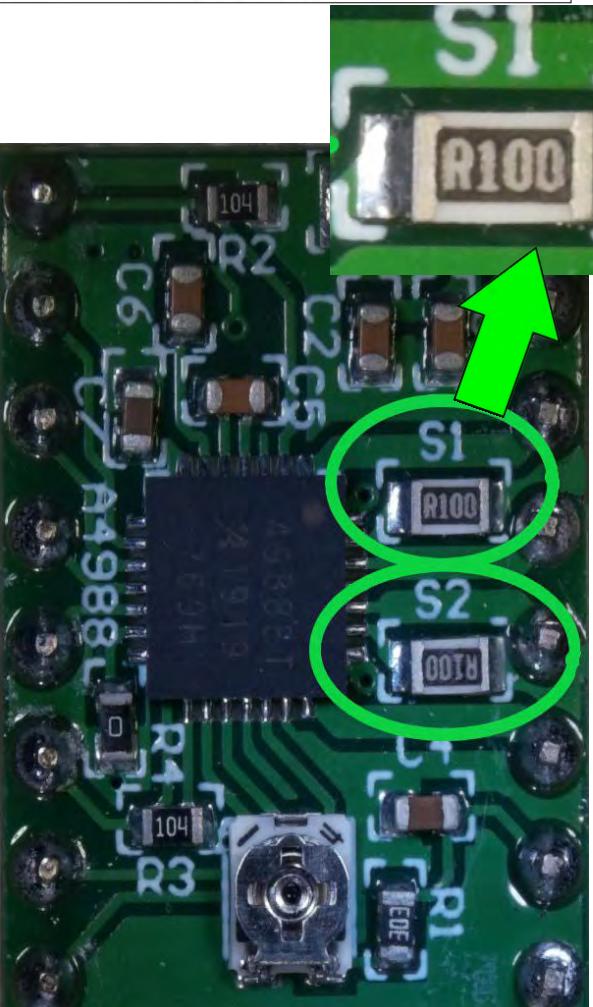
POLOLU A4988



Note: Not all driver boards for the A4988 use the same current sense resistors (R_s); check your driver board for the value of the (R_s) resistors by examining the board, as shown in **GREEN** below. The **GREEN PCB** shows a 0.1 Ohm (R100) sense resistor value. The **RED PCB** shows a 0.2 Ohms (R200) sense resistor value. Sense resistors (R_s) can appear in the following values, (these are just a few values): R050=0.05 Ohms; R068=0.068 Ohms; R100=0.1 Ohms; R200 = 0.2 Ohms.



- $R_s = R050$ is 0.05 Ohms**
- $R_s = R068$ is 0.068 Ohms**
- $R_s = R100$ is 0.1 Ohms**
- $R_s = R150$ is 0.15 Ohms**
- $R_s = R200$ is 0.2 Ohms**
- $R_s = R220$ is 0.22 Ohms**



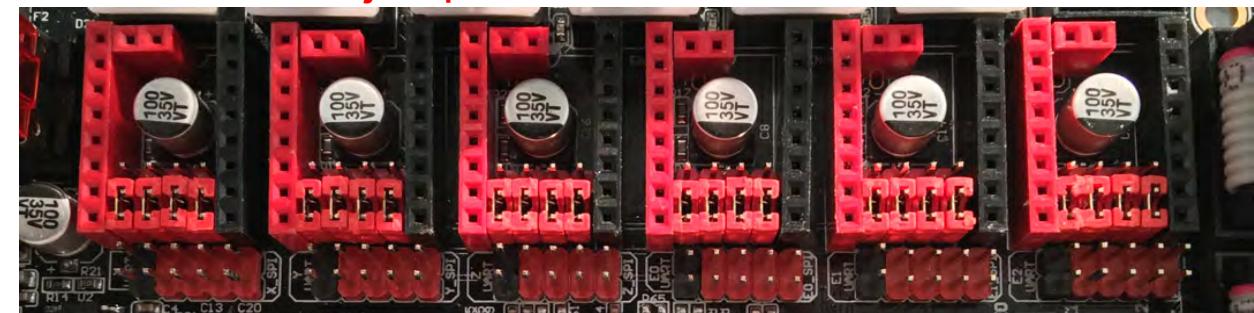
POLOLU A4988

Stand-alone Mode

STEP

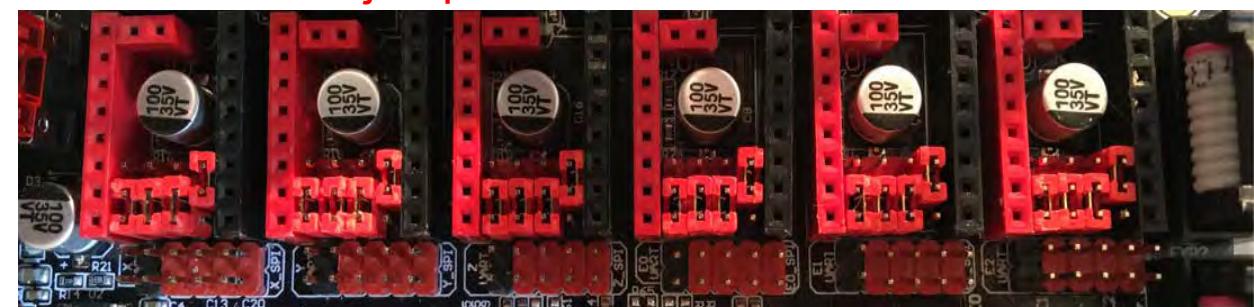
| | | | | |
|--------|---|-----|-----|------|
| ENABLE | - | - | - | VMOT |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 2B |
| MS3 | - | - | - | 2A |
| RESET | - | MS2 | MS1 | MS0 |
| SLEEP | - | - | - | - |
| STEP | D | 9 | 8 | 7 |
| DIR | D | 9 | 8 | 7 |
| | - | - | - | - |
| | - | - | - | - |

Note: The "D" jumper MUST be SET!

**1 / 2**

| | | | | |
|--------|---|-----|-----|------|
| ENABLE | - | - | - | VMOT |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 2B |
| MS3 | - | - | - | 2A |
| RESET | - | MS2 | MS1 | MS0 |
| SLEEP | - | - | - | - |
| STEP | D | 9 | 8 | 7 |
| DIR | D | 9 | 8 | - |
| | - | - | - | - |
| | - | - | - | - |

Note: The "D" jumper MUST be SET!



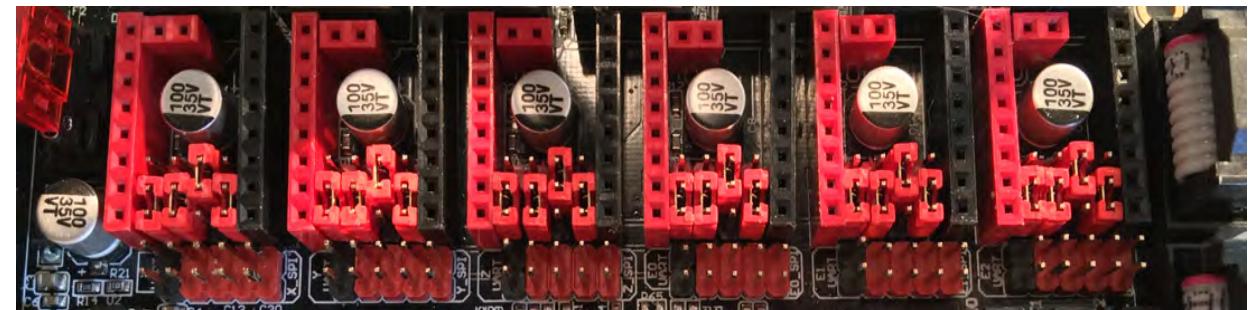
POLOLU A4988

Stand-alone Mode

| | | |
|--------|---------|---------|
| ENABLE | - - | VMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 8 | 1B |
| STEP | D 9 8 7 | VDD |
| DIR | D 9 - 7 | GND |
| | - - - - | - - - - |

1 / 4

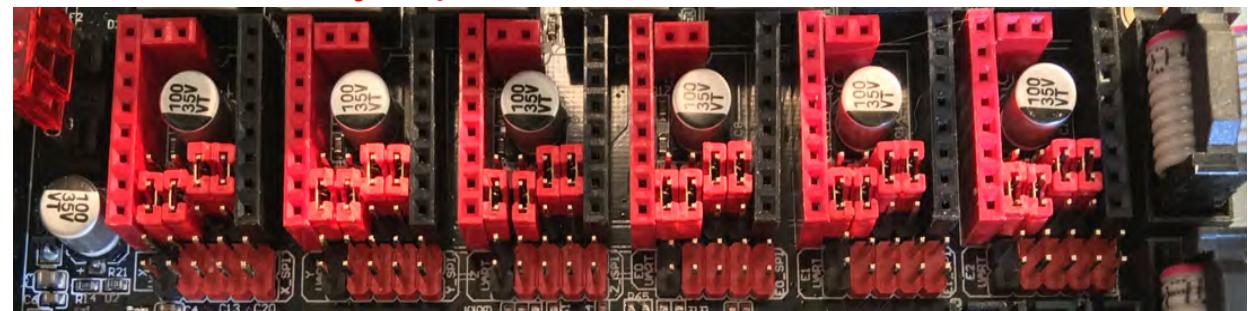
Note: The "D" jumper MUST be SET!



| | | |
|--------|---------|---------|
| ENABLE | - - | VMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 8 7 | 1B |
| STEP | D 9 8 7 | VDD |
| DIR | D 9 - - | GND |
| | - - - - | - - - - |

1 / 8

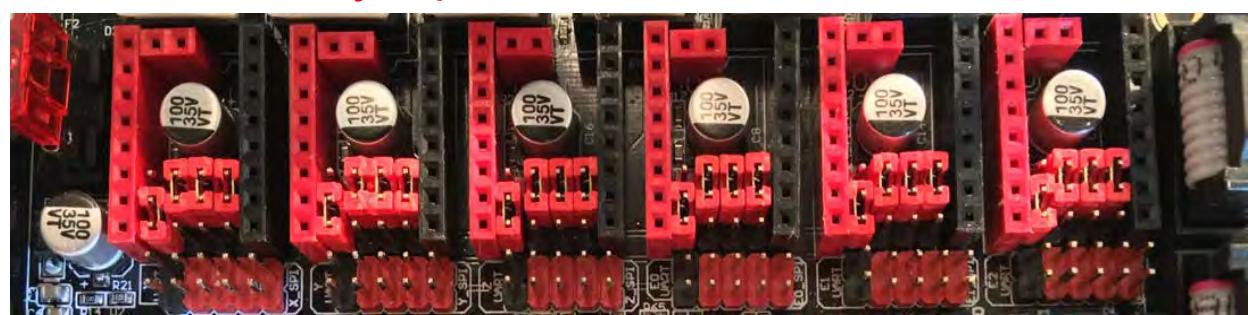
Note: The "D" jumper MUST be SET!



| | | |
|--------|---------|---------|
| ENABLE | - - | VMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 9 8 7 | 1B |
| STEP | D 9 8 7 | VDD |
| DIR | D - - - | GND |
| | - - - - | - - - - |

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Note: The "D" jumper MUST be SET!



The (latest release of) Marlin Setup for POLOLU A4988 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for POLOLU A4988 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using POLOLU A4988 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use POLOLU A4988 drivers. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
Marlin > Configuration.h > E0_DRIVER_TYPE
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC2660', 'TMC5130', 'TMC5160']
676 */
677 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
678 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
679 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
680 //##define X2_DRIVER_TYPE A4988
681 //##define Y2_DRIVER_TYPE A4988
682 //##define Z2_DRIVER_TYPE A4988
683 //##define Z3_DRIVER_TYPE A4988
684 //##define Z4_DRIVER_TYPE A4988
685 //##define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out
686 #define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out
687 //##define E1_DRIVER_TYPE A4988
688 //##define E2_DRIVER_TYPE A4988
689 //##define E3_DRIVER_TYPE A4988
690 //##define E4_DRIVER_TYPE A4988
691 //##define E5_DRIVER_TYPE A4988
692 //##define E6_DRIVER_TYPE A4988
693 //##define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.
Ln 686, Col 63 Spaces: 2 UTF-8 LF C++ Win32 1

```

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU A4988 Drivers

- The end of Marlin setup for POLOLU A4988 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows the project structure under "OPEN EDITORS" and "MARLIN-2.0.X".
- Code Editor:** Displays the `Configuration.h` file with code related to endstop inversion and driver types.
- Terminal:** Shows the build output:

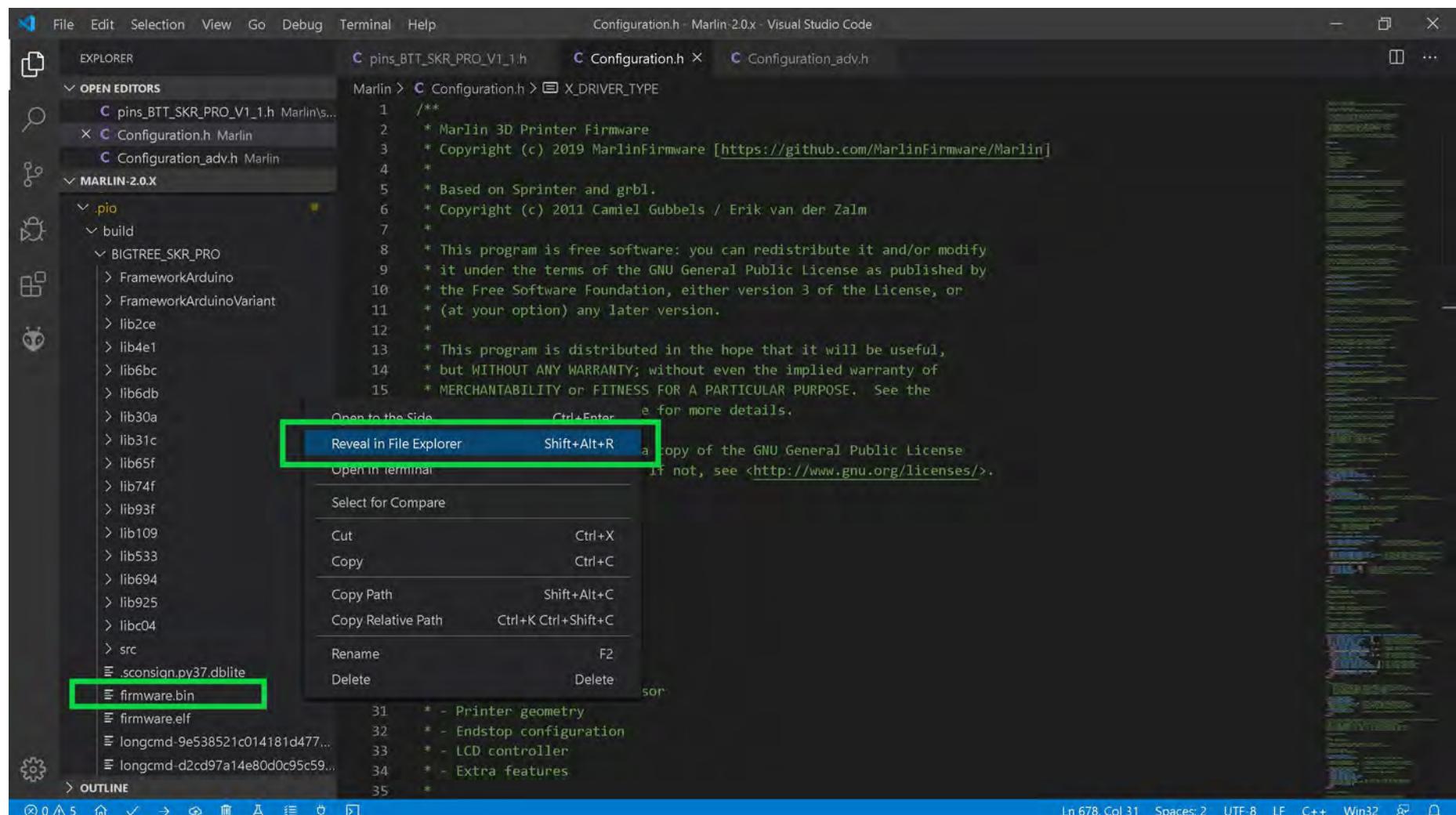
| | | |
|------------------------|---------|--------------|
| BIGTREE_SKR_PRO | SUCCESS | 00:02:31.294 |
| BIGTREE_GTR_12_0 | IGNORED | |
| BIGTREE_BTT002 | IGNORED | |
| teensy31 | IGNORED | |
| teensy35 | IGNORED | |
| esp32 | IGNORED | |
| linux_native | IGNORED | |
| SAMD51_grandcentral_m4 | IGNORED | |
| rumba32_f446ve | IGNORED | |
| mks_rumba32 | IGNORED | |
| include_tree | IGNORED | |

===== 1 succeeded in 00:02:31.294 =====
- Bottom Status Bar:** Shows file count (0), line count (678), column count (31), spaces (2), encoding (UTF-8), line feed (LF), C++, and Win32.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for POLOLU A4988 Drivers

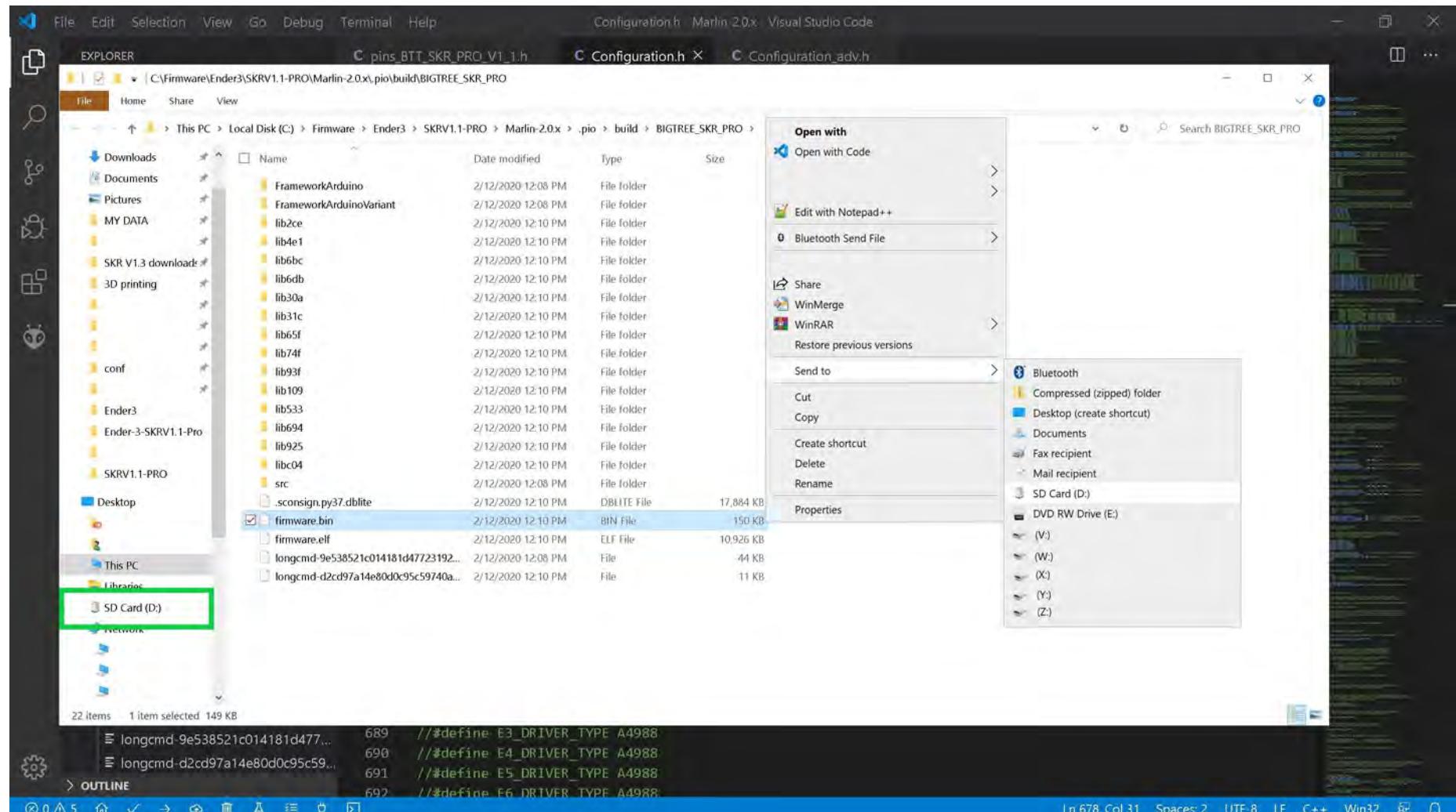
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer window.



- Go to the next page.

The (latest release of) Marlin Setup for POLOLU A4988 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".

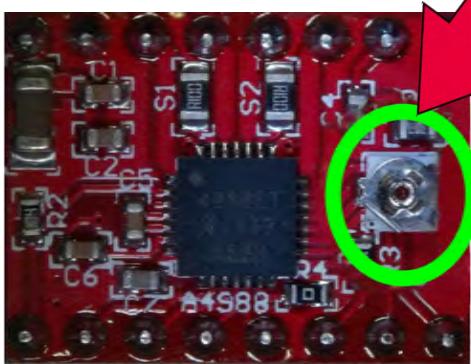


- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

BIQU A4988

| base of card | | Stand-alone Mode | |
|-----------------------|-------------------|------------------|----------|
| ENABLE | - - - | VMOT | GND |
| MS1 | - | 2B | 2 1 0 |
| MS2 | - | 2A | 1 0 0 0 |
| MS3 | - | 1A | 2 0 0 1 |
| RESET | M2 | 4 | 4 0 1 0 |
| SLEEP | M1 | 8 | 8 0 1 1 |
| STEP | M0 | 1B | 16 1 1 1 |
| | | VDD | |
| DIRECTION | D 9 8 7 | GND | |
| | D - - - | | |
| STATUS: | Not Yet Tested | | |
| fans/heaters/usb side | | | |

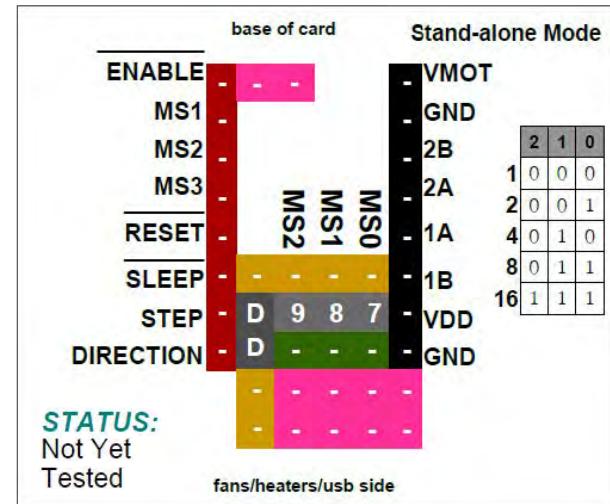
NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.



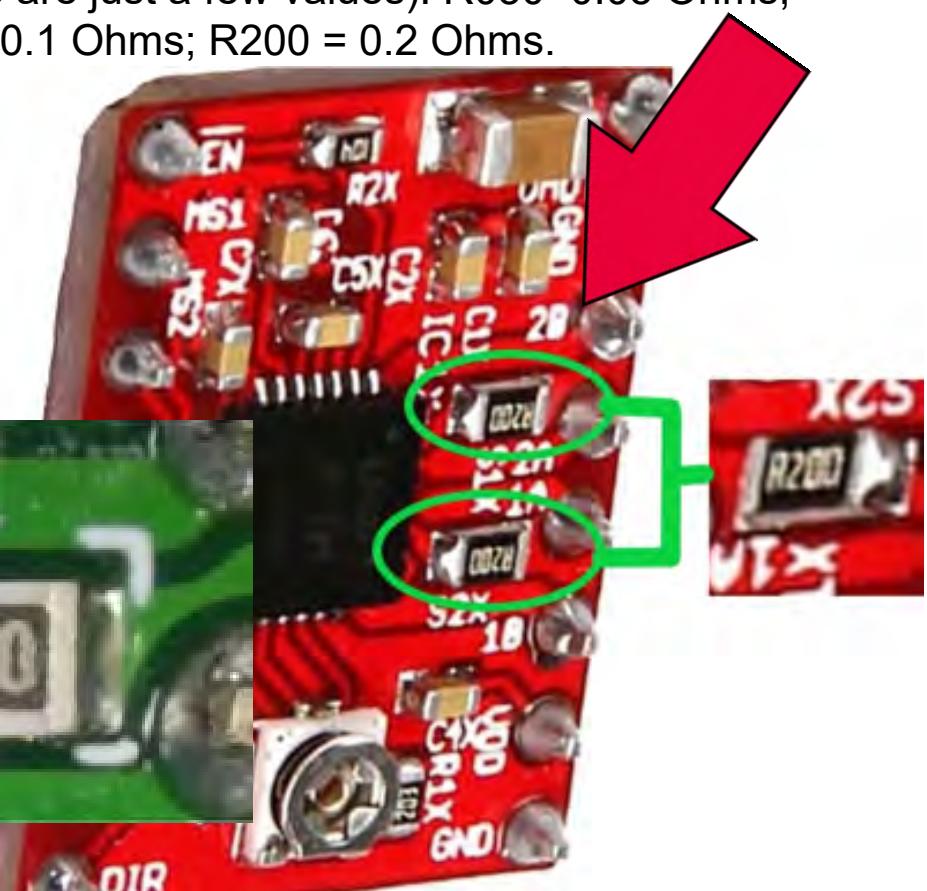
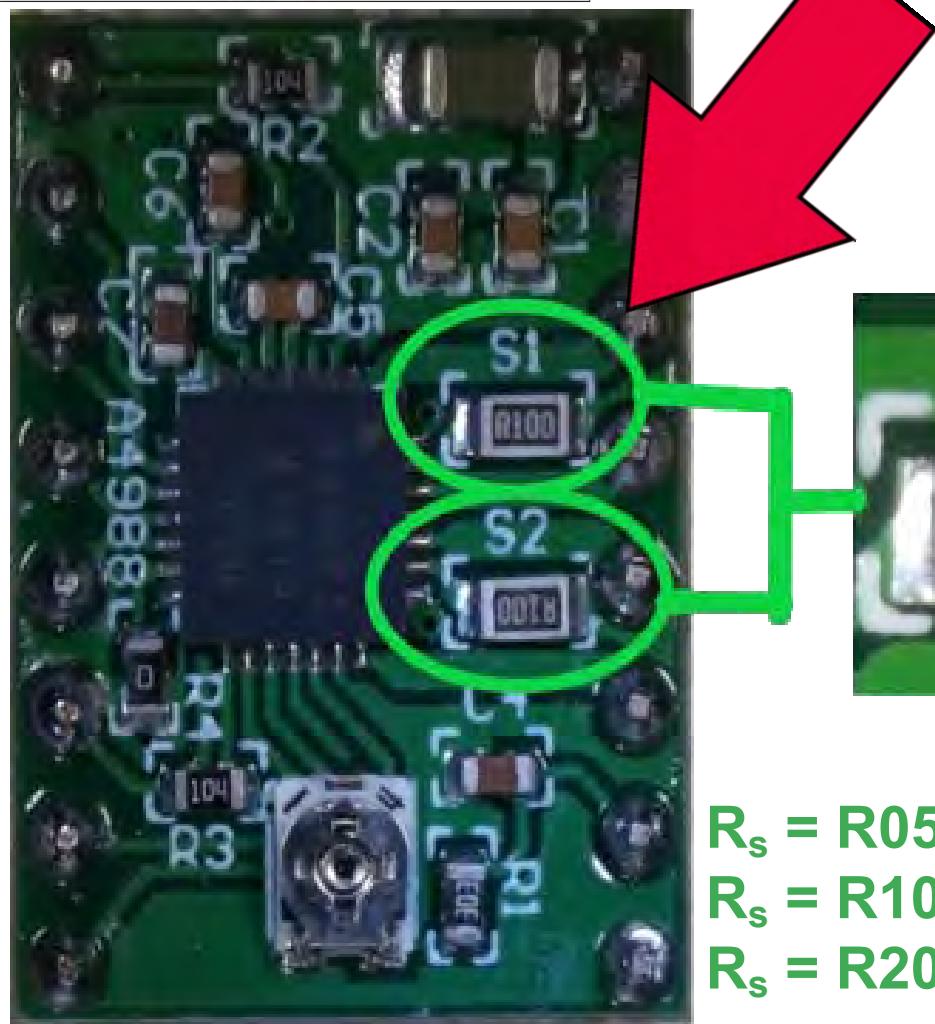
Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board

Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|---------------------------------|------------|------------|-------------------------------|------------------------|
|  BIQU® A4988 Maximum 16 Subdivision 35V DC 2A (peak) | Low | Low | Low | Full step | |
| | Low | Low | High | Half step | 2 Phase |
| | Low | High | Low | Quarter step | 1-2 Phase |
| | Low | High | High | Eighth step | W1-2 Phase |
| | High | High | High | Sixteenth step | 2W1-2 Phase |
| | | | | | 4W1-2 Phase |
| Driving Current Calculation Formula | $I_{MAX} = V_{ref} / (8 * R_s)$ | | | $V_{ref} = 8 * I_{MAX} * R_s$ | |
| R_s (Typical Sense Resistor) = 0.1Ω | | | | | |

BIQU A4988

Note: Not all driver boards for the A4988 use the same current sense resistors (R_s); check your driver board for the value of the (R_s) resistors by examining the board, as shown in **GREEN** below. The **GREEN PCB** shows a 0.1 Ohm (R100) sense resistor value. The **RED PCB** shows a 0.2 Ohms (R200) sense resistor value. Sense resistors (R_s) can appear in the following values, (these are just a few values): R050=0.05 Ohms; R068=0.068 Ohms; R100=0.1 Ohms; R200 = 0.2 Ohms.

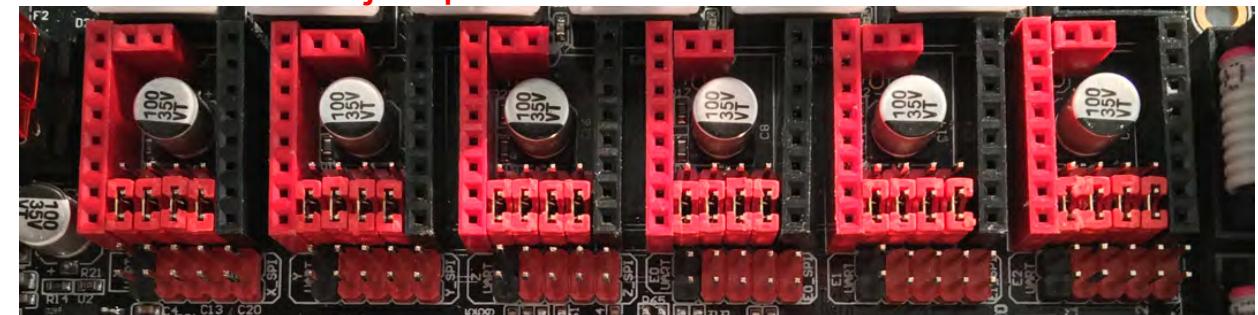


$R_s = R050$ is 0.05 Ohms; $R_s = R068$ is 0.068 Ohms
 $R_s = R100$ is 0.1 Ohms; $R_s = R150$ is 0.15 Ohms
 $R_s = R200$ is 0.2 Ohms; $R_s = R220$ is 0.22 Ohms

BIQU A4988**Stand-alone Mode****STEP**

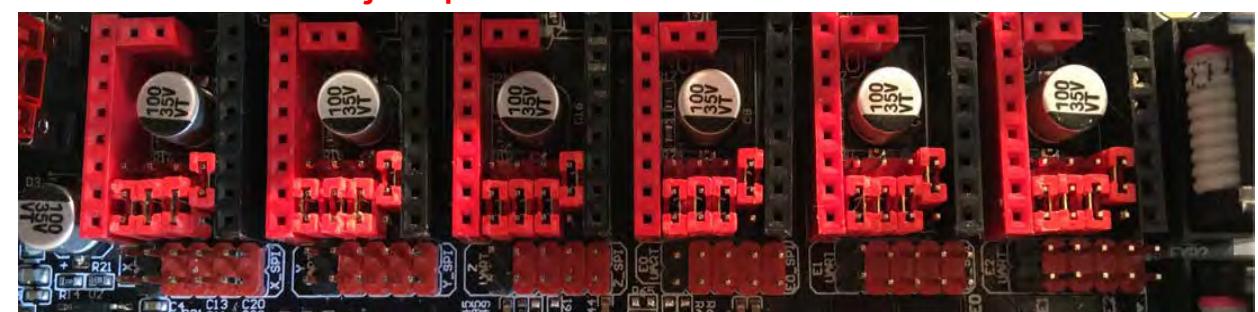
| | | | |
|-----------|-----|-------|------|
| ENABLE | [] | [] | VMOT |
| MS1 | | | GND |
| MS2 | | | 2B |
| MS3 | | | 2A |
| RESET | [] | MS2 | 1A |
| SLEEP | [] | MS1 | 1B |
| STEP | D | 9 8 7 | VDD |
| DIRECTION | D | 9 8 7 | GND |

Note: The "D" jumper MUST be SET!

**1 / 2**

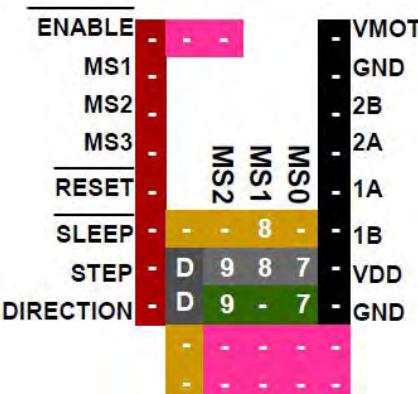
| | | | |
|-----------|-----|-------|------|
| ENABLE | [] | [] | VMOT |
| MS1 | | | GND |
| MS2 | | | 2B |
| MS3 | | | 2A |
| RESET | [] | MS2 | 1A |
| SLEEP | [] | MS1 | 1B |
| STEP | D | 9 8 7 | VDD |
| DIRECTION | D | 9 8 | GND |

Note: The "D" jumper MUST be SET!

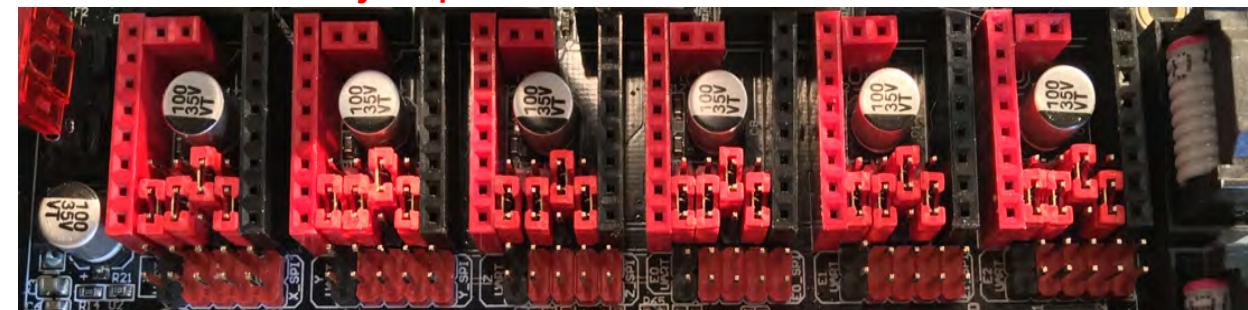


BIQU A4988**Stand-alone Mode**

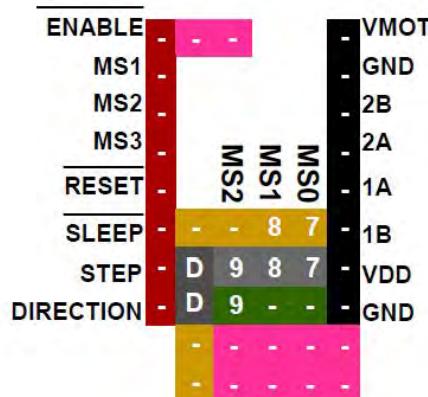
1 / 4



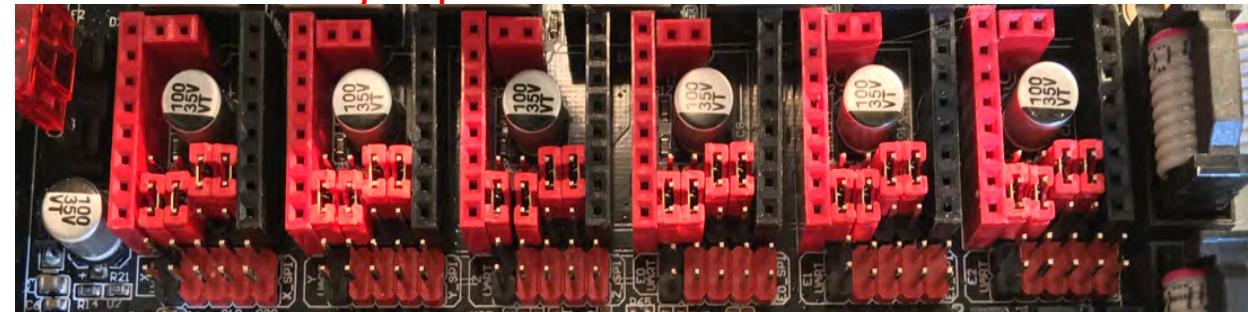
Note: The "D" jumper MUST be SET!



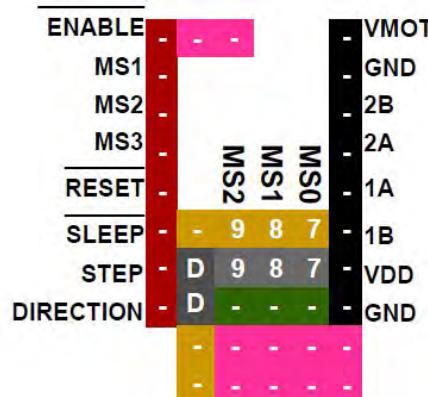
1 / 8



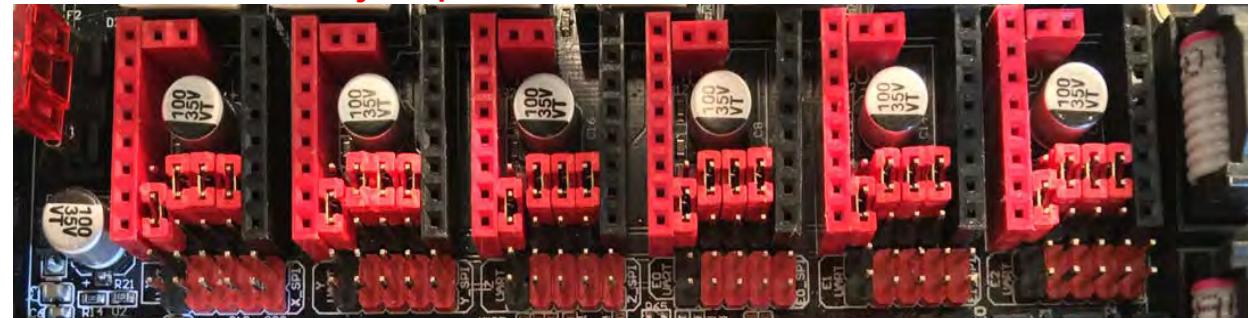
Note: The "D" jumper MUST be SET!



1 / 16



Note: The "D" jumper MUST be SET!



The (latest release of) Marlin Setup for BIQU A4988 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU A4988 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using BIQU A4988 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use BIQU A4988 drivers. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

```

File Edit Selection View Go Debug Terminal Help
Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h
Marlin > Configuration.h > E0_DRIVER_TYPE

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC26X', 'TMC5130']
676 */
677 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
678 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
679 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
680 //#define X2_DRIVER_TYPE A4988
681 //#define Y2_DRIVER_TYPE A4988
682 //#define Z2_DRIVER_TYPE A4988
683 //#define Z3_DRIVER_TYPE A4988
684 //#define Z4_DRIVER_TYPE A4988
685
686 #define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU A4988 Drivers

- The end of Marlin setup for BIQU A4988 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS Marlin > Configuration.h > X_DRIVER_TYPE

C pins_BTT_SKR_PRO_V1_1.h Marlin's... C Configuration.h X Configuration.h Configuration_adv.h Marlin MARLIN-2.0.X C pins_THE_BORG.h C pins_VAKE403D.h > teensy2 > teensy3 C pins.h C pinsDebug_list.h C pinsDebug.h C sensitive_pins.h > sd C MarlinCore.cpp C MarlinCore.h C _Bootscreen.h C _Statusscreen.h C Configuration_adv.h C Configuration.h M Makefile C Marlin.ino C Version.h .gitattributes .gitignore LICENSE platformio.ini { process-palette.json i README.md

pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h

658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
661
662 /*
663 * Stepper Drivers
664 *
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,

PROBLEMS 5 OUTPUT DEBUG CONSOLE TERMINAL

T: Task - Build + ☰

| | |
|------------------------|----------------------|
| STM32F407VC_D130 | IGNORED |
| BIGTREE_SKR_PRO | SUCCESS 00:02:31.294 |
| BIGTREE_SKR_V1_0 | IGNORED |
| BIGTREE_BTT002 | IGNORED |
| teensy31 | IGNORED |
| teensy35 | IGNORED |
| esp32 | IGNORED |
| linux_native | IGNORED |
| SAMD51_grandcentral_m4 | IGNORED |
| rumba32_f446ve | IGNORED |
| mks_rumba32 | IGNORED |
| include_tree | IGNORED |

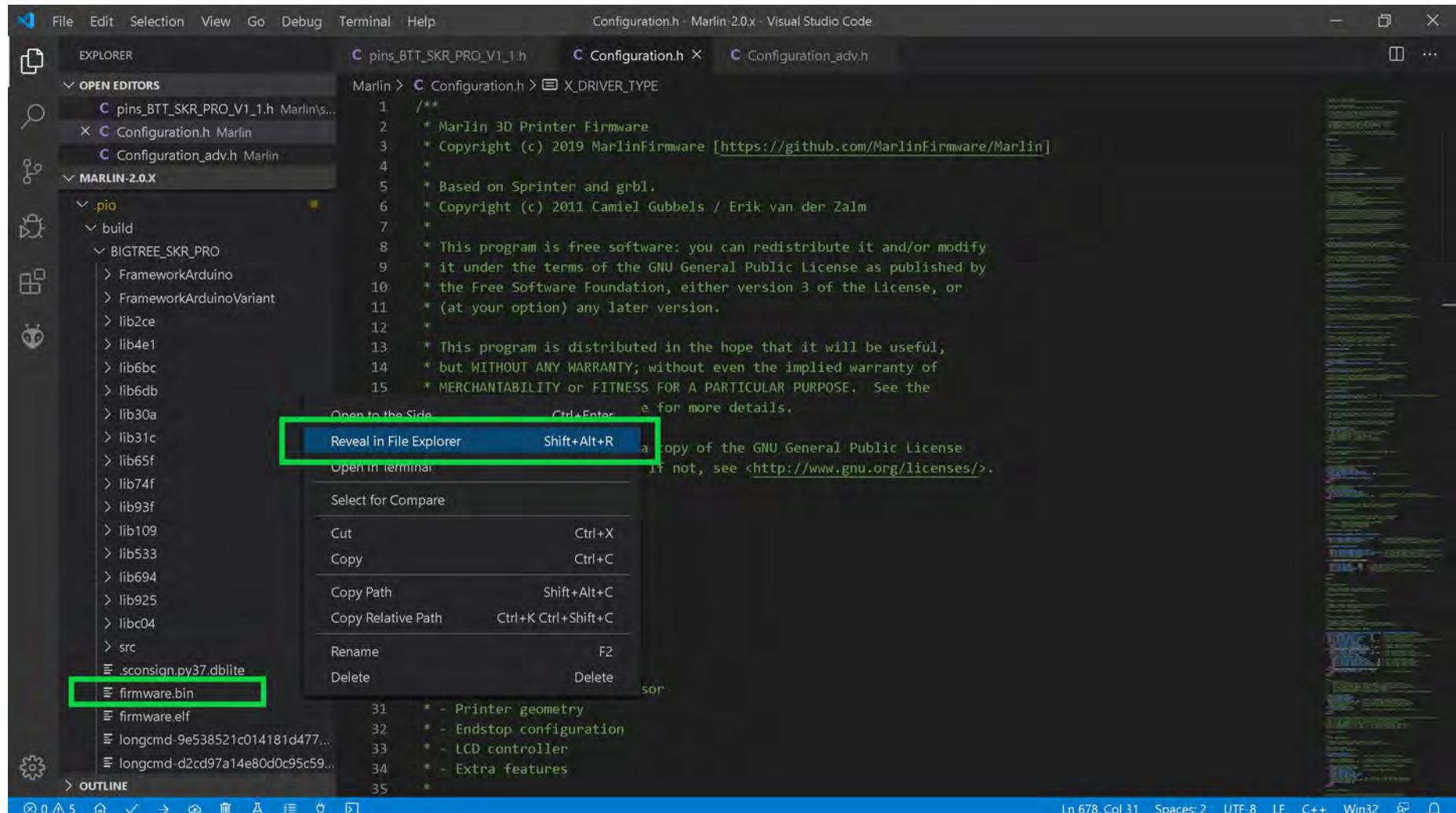
===== 1 succeeded in 00:02:31.294 =====

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU A4988 Drivers

- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer window.

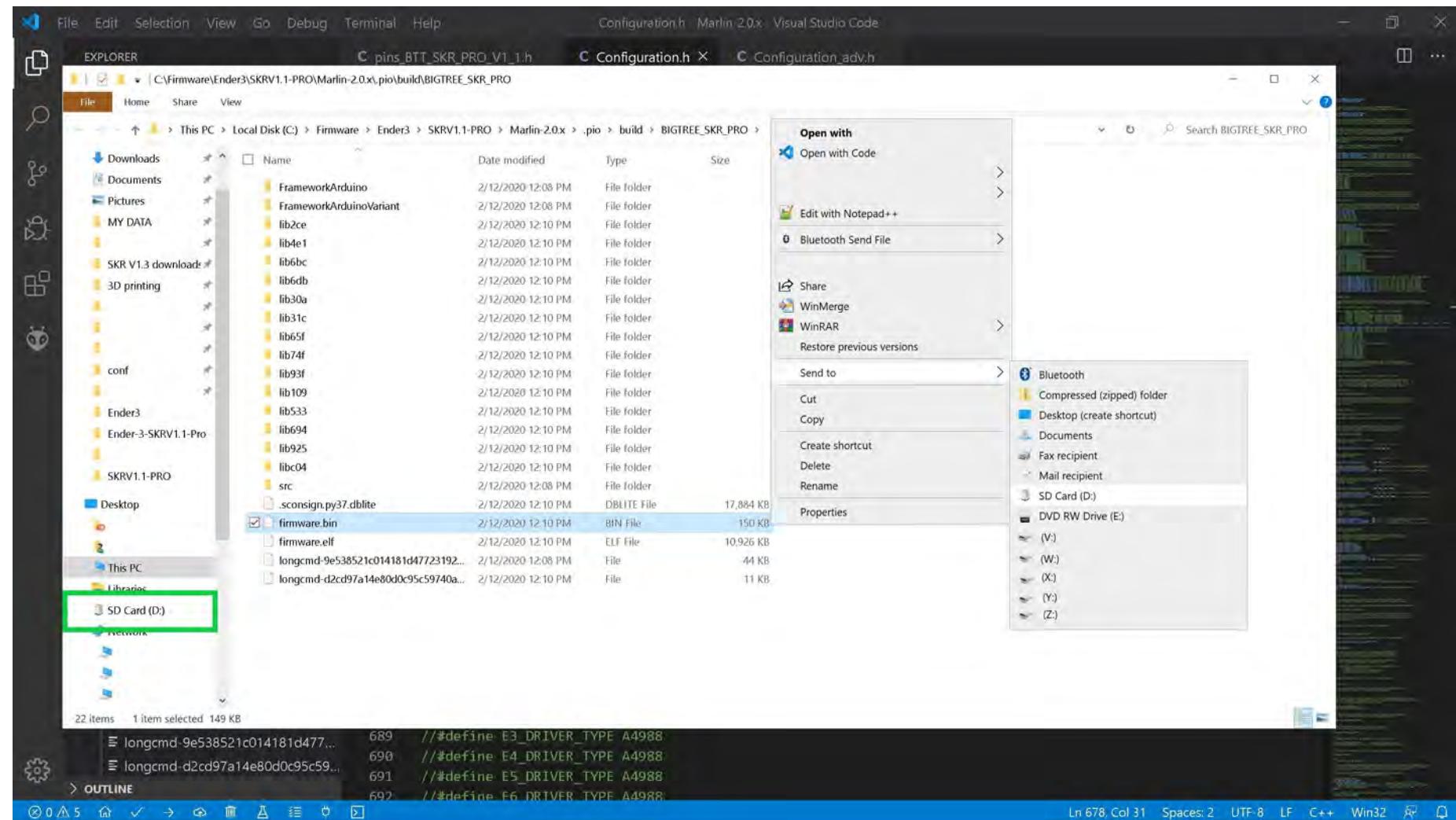


- Go to the next page.

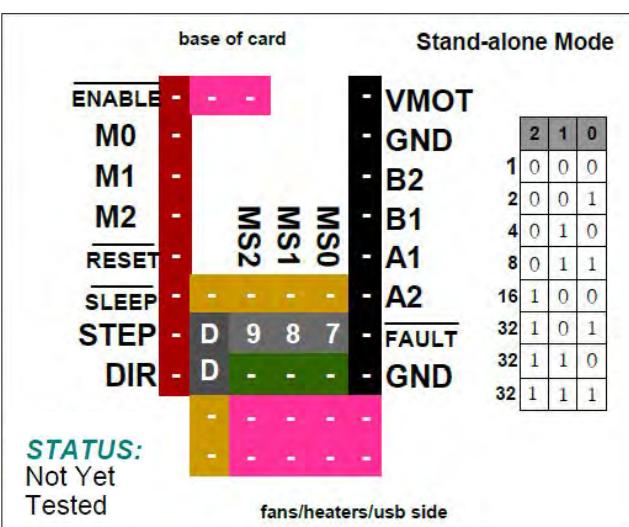
The (latest release of) Marlin Setup for BIQU A4988 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, is in a micro-to-SD-card adapter and plugged into your Windows' SD card reader.

- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



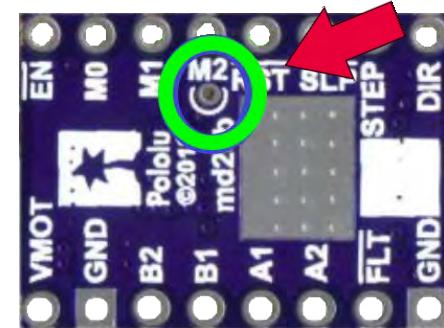
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

DRV8825

NOTE: Use the potentiometer (POT) on the top of the board (or the board's "V_{ref} Test point") to adjust your V_{ref}. See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board

Note: "V_{ref} Test point" location is on the bottom of the driver board, as shown in **GREEN**



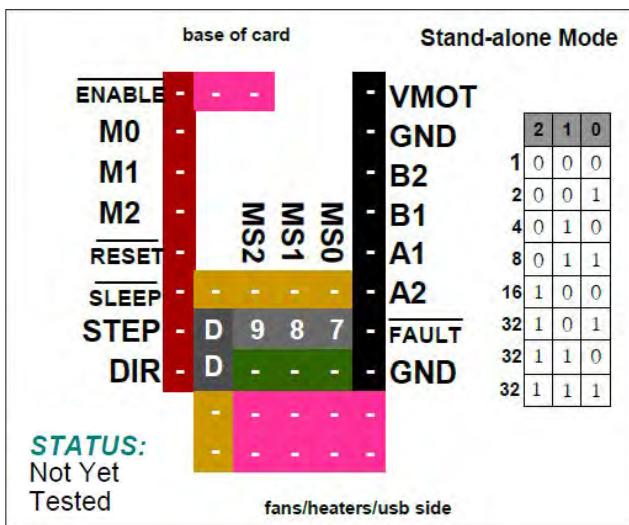
| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|------|------|------|----------------------|--------------------|
| Pololu DRV8825 Maximum 32 Subdivision 45V DC 2.2A (peak) | Low | Low | Low | Full step | 2 Phase |
| | Low | Low | High | Half step | 1-2 Phase |
| | Low | High | Low | 1/4 step | W1-2 Phase |
| | Low | High | High | 1/8 step | 2W1-2 Phase |
| | High | Low | Low | 1/16 step | 4W1-2 Phase |
| | High | Low | High | 1/32 step | 8W1-2 Phase |
| | High | High | Low | 1/32 step | 8W1-2 Phase |
| | High | High | High | 1/32 step | 8W1-2 Phase |

Driving Current Calculation Formula

$$R_S \text{ (Typical Sense Resistor)} = 0.1\Omega$$

$$I_{MAX} = \frac{V_{ref}}{5 * R_S}$$

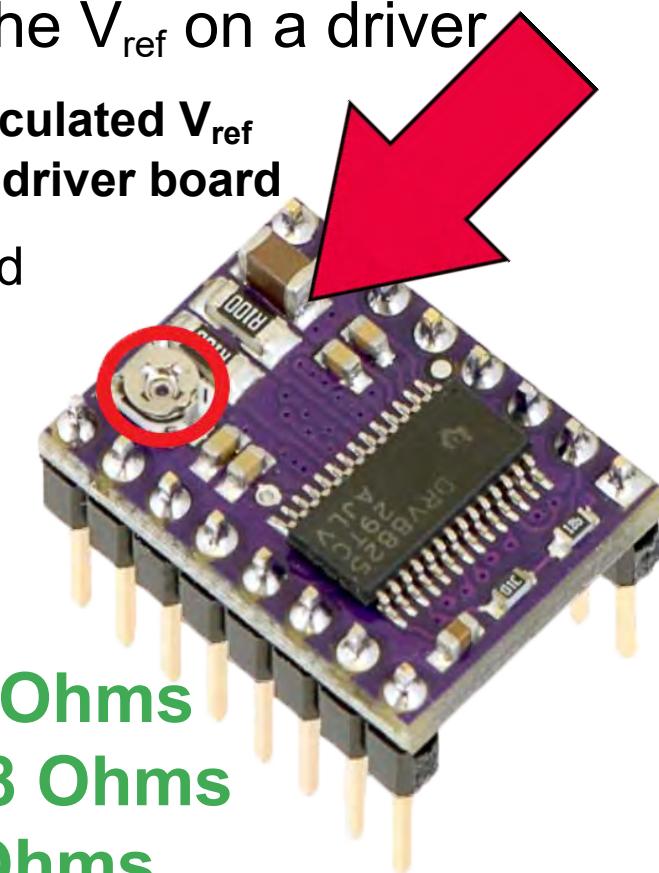
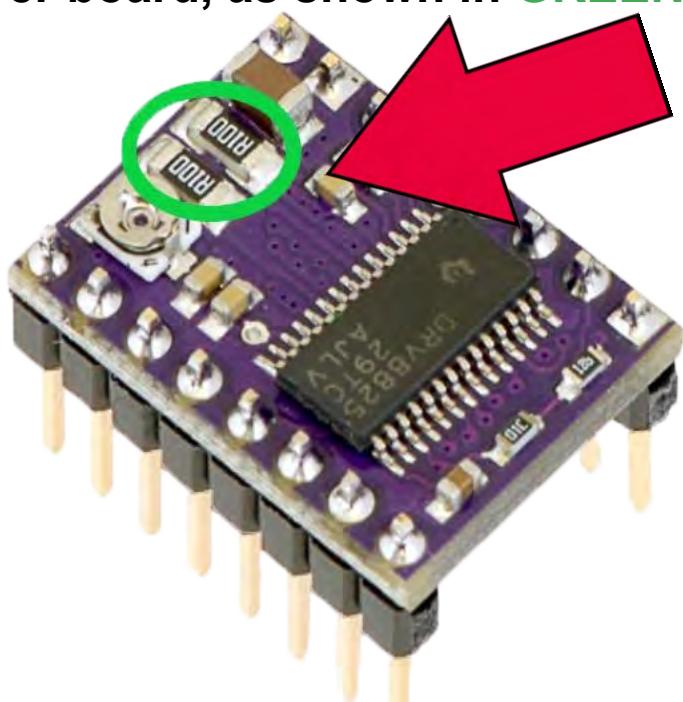
$$V_{ref} = 5 * I_{MAX} * R_S$$

DRV8825

NOTE: Use the potentiometer (POT) on the top of the board (or the board's "V_{ref} Test point") to adjust your V_{ref}. See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board. **Note:** Use 90% of the calculated V_{ref} when tuning the stepper driver board

Note: See this video about current sense resistors (R_s) and their possible locations: <https://youtu.be/8wk1elugv5A>

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN below.



R_s = R050 is 0.05 Ohms

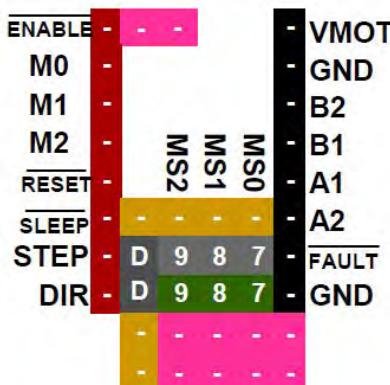
R_s = R068 is 0.068 Ohms

R_s = R100 is 0.1 Ohms

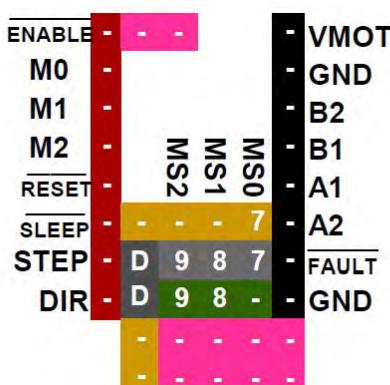
R_s = R150 is 0.15 Ohms

R_s = R200 is 0.2 Ohms

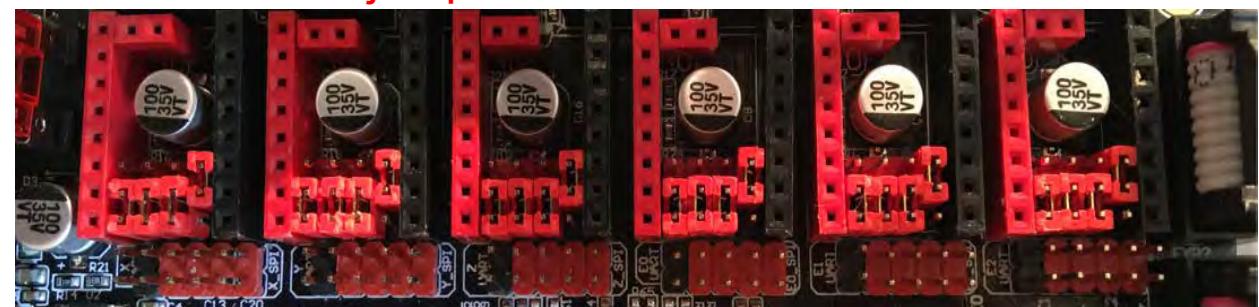
R_s = R220 is 0.22 Ohms

DRV8825**Stand-alone Mode**

Note: The "D" jumper MUST be SET!



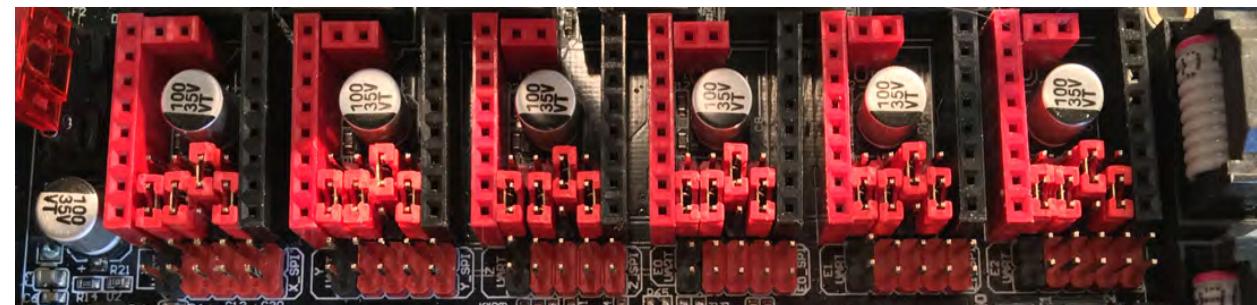
Note: The "D" jumper MUST be SET!



DRV8825**Stand-alone Mode**

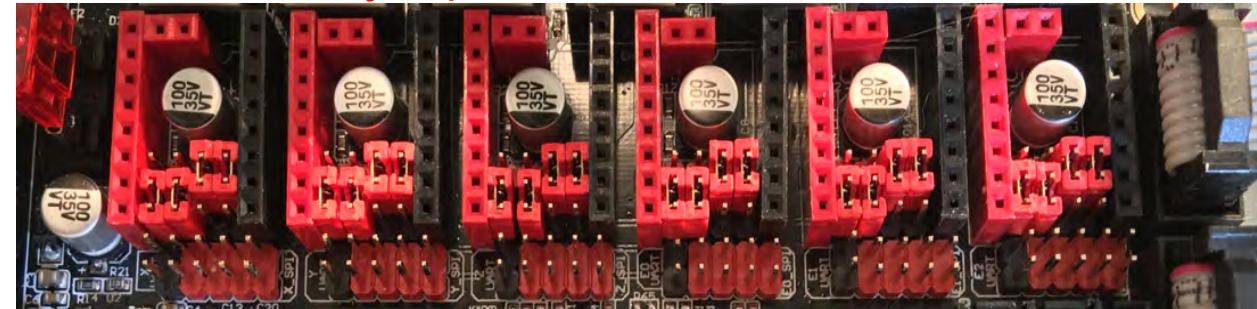
| | | | | | |
|--------|---|-----|-----|------|-------|
| ENABLE | - | - | - | VMOT | |
| M0 | - | - | - | GND | |
| M1 | - | - | - | B2 | |
| M2 | - | - | - | B1 | |
| RESET | - | MS2 | MS1 | MS0 | A1 |
| SLEEP | - | - | 8 | - | A2 |
| STEP | D | 9 | 8 | 7 | FAULT |
| DIR | D | 9 | - | 7 | GND |

1 / 4

Note: The "D" jumper MUST be SET!

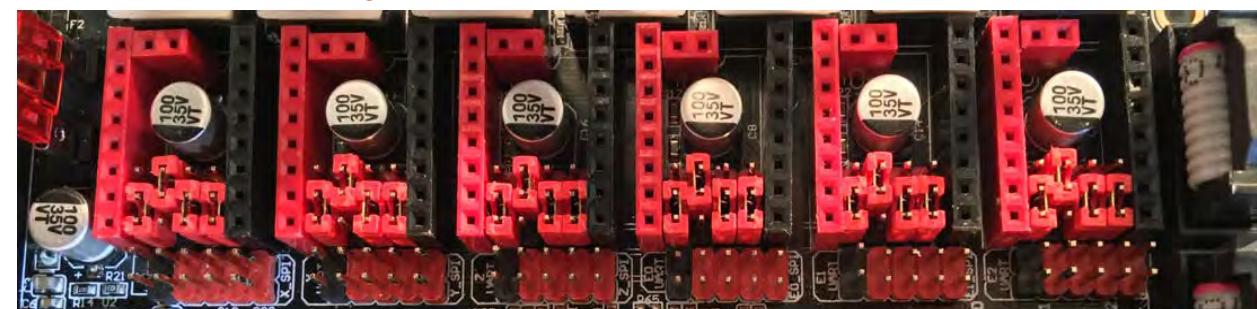
| | | | | | |
|--------|---|-----|-----|------|-------|
| ENABLE | - | - | - | VMOT | |
| M0 | - | - | - | GND | |
| M1 | - | - | - | B2 | |
| M2 | - | - | - | B1 | |
| RESET | - | MS2 | MS1 | MS0 | A1 |
| SLEEP | - | - | 8 | 7 | A2 |
| STEP | D | 9 | 8 | 7 | FAULT |
| DIR | D | 9 | - | 7 | GND |

1 / 8

Note: The "D" jumper MUST be SET!

| | | | | | |
|--------|---|-----|-----|------|-------|
| ENABLE | - | - | - | VMOT | |
| M0 | - | - | - | GND | |
| M1 | - | - | - | B2 | |
| M2 | - | - | - | B1 | |
| RESET | - | MS2 | MS1 | MS0 | A1 |
| SLEEP | - | 9 | - | - | A2 |
| STEP | D | 9 | 8 | 7 | FAULT |
| DIR | D | - | 8 | 7 | GND |

1 / 16

Note: The "D" jumper MUST be SET!

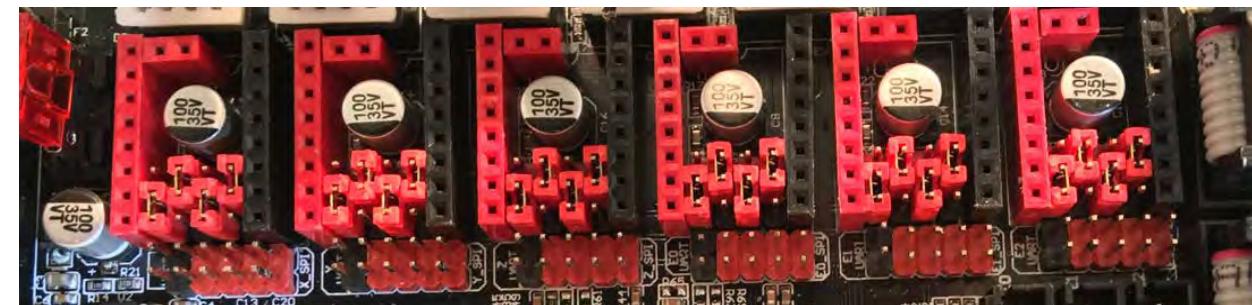
DRV8825**Stand-alone Mode**

| | | | |
|--------|---|-------------------|-------|
| ENABLE | - | - | VMOT |
| M0 | - | - | GND |
| M1 | - | - | B2 |
| M2 | - | - | B1 |
| RESET | - | MS2 MS1 MS0 | A1 |
| SLEEP | - | 9 8 7 | A2 |
| STEP | D | 9 8 7 | FAULT |
| DIR | D | 8 | GND |

1 / 32

Note: All THREE of these settings will work for 1/32, choose your preference!!

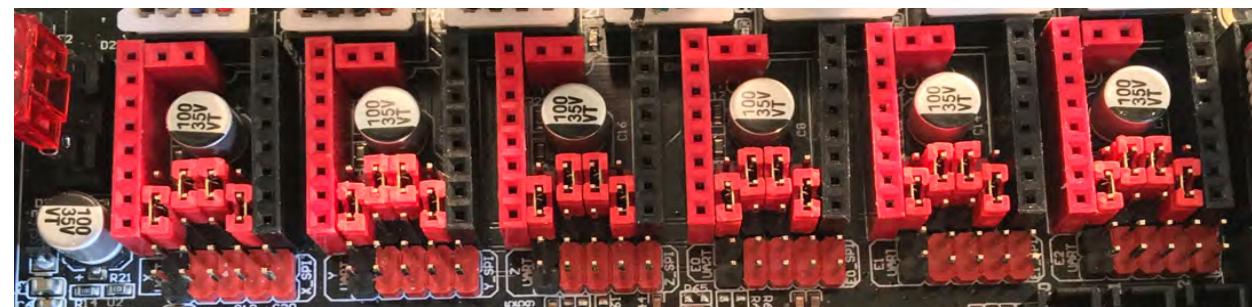
Note: The "D" jumper MUST be SET!



| | | | |
|--------|---|-------------------|-------|
| ENABLE | - | - | VMOT |
| M0 | - | - | GND |
| M1 | - | - | B2 |
| M2 | - | - | B1 |
| RESET | - | MS2 MS1 MS0 | A1 |
| SLEEP | - | 9 8 - | A2 |
| STEP | D | 9 8 7 | FAULT |
| DIR | D | - 7 | GND |

1 / 32

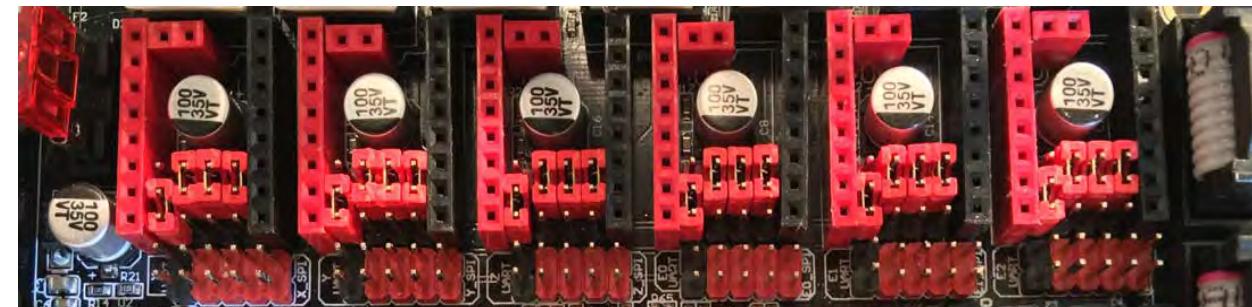
Note: The "D" jumper MUST be SET!



| | | | |
|--------|---|-------------------|-------|
| ENABLE | - | - | VMOT |
| M0 | - | - | GND |
| M1 | - | - | B2 |
| M2 | - | - | B1 |
| RESET | - | MS2 MS1 MS0 | A1 |
| SLEEP | - | 9 8 7 | A2 |
| STEP | D | 9 8 7 | FAULT |
| DIR | D | - - | GND |

1 / 32

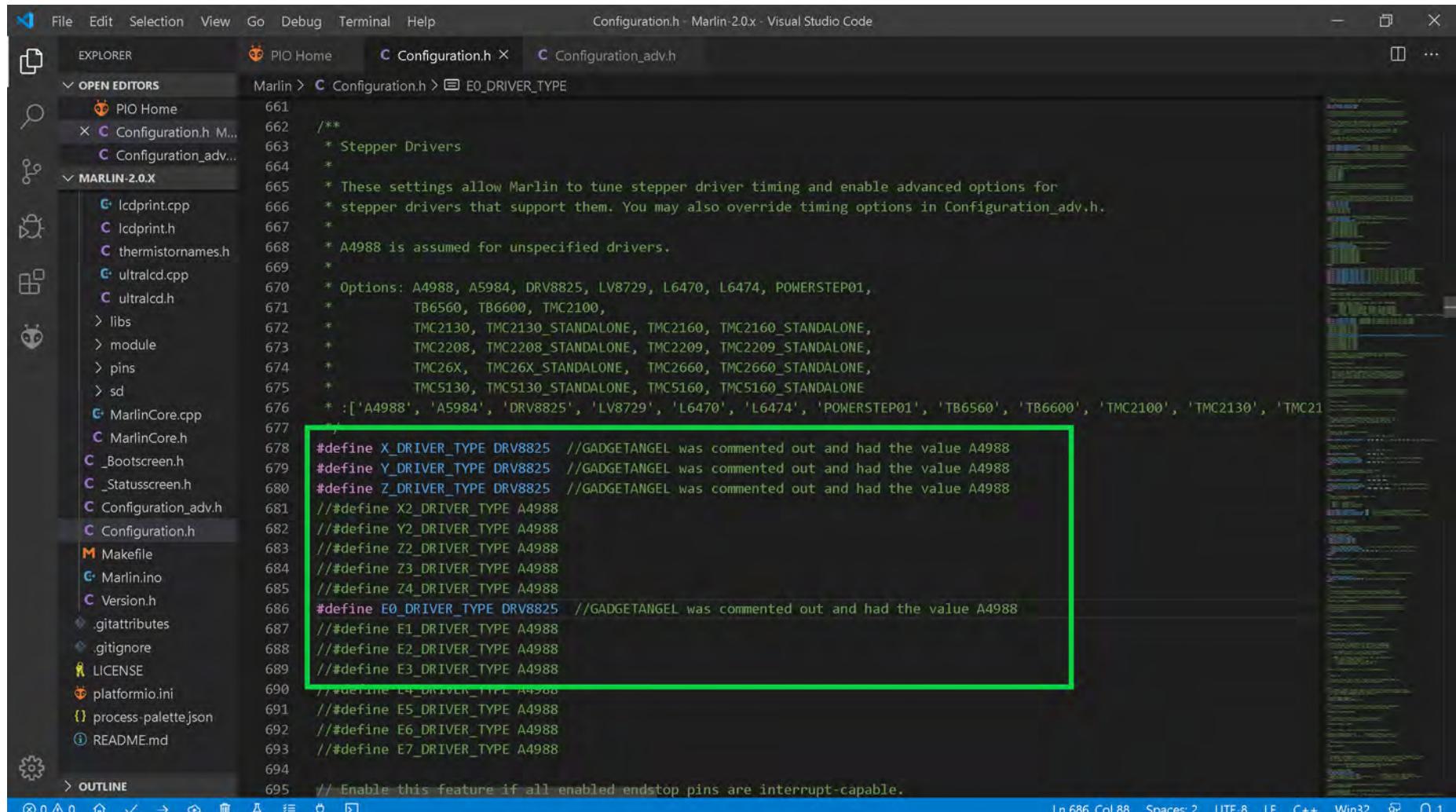
Note: The "D" jumper MUST be SET!



The (latest release of) Marlin Setup for DRV8825 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for DRV8825 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using DRV8825 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use DRV8825 drivers. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Debug, Terminal, Help
- Editor Title:** Configuration.h - Marlin-2.0.x - Visual Studio Code
- Left Sidebar (EXPLORER):**
 - OPEN EDITORS:** PIO Home, Configuration.h (highlighted), Configuration_adv.h
 - MARLIN-2.0.X:**
 - Lcdprint.cpp, Lcdprint.h, thermistornames.h, ultralcd.cpp, ultralcd.h
 - > libs
 - > module
 - > pins
 - > sd
 - MarlinCore.cpp, MarlinCore.h, Bootscreen.h, Statusscreen.h, Configuration_adv.h (highlighted), Configuration.h (highlighted), Makefile, Marlin.ino, Version.h, .gitattributes, .gitignore, LICENSE, platformio.ini, process-palette.json, README.md
- Editor Content:** The code for Configuration.h, specifically the E0_DRIVER_TYPE section. A green box highlights the driver configuration section where comments are being removed. The code includes defines for X, Y, Z, and E0 axes.
- Bottom Status Bar:** Ln 686, Col 88, Spaces: 2, UTF-8, LF, C++, Win32, Q 1

```

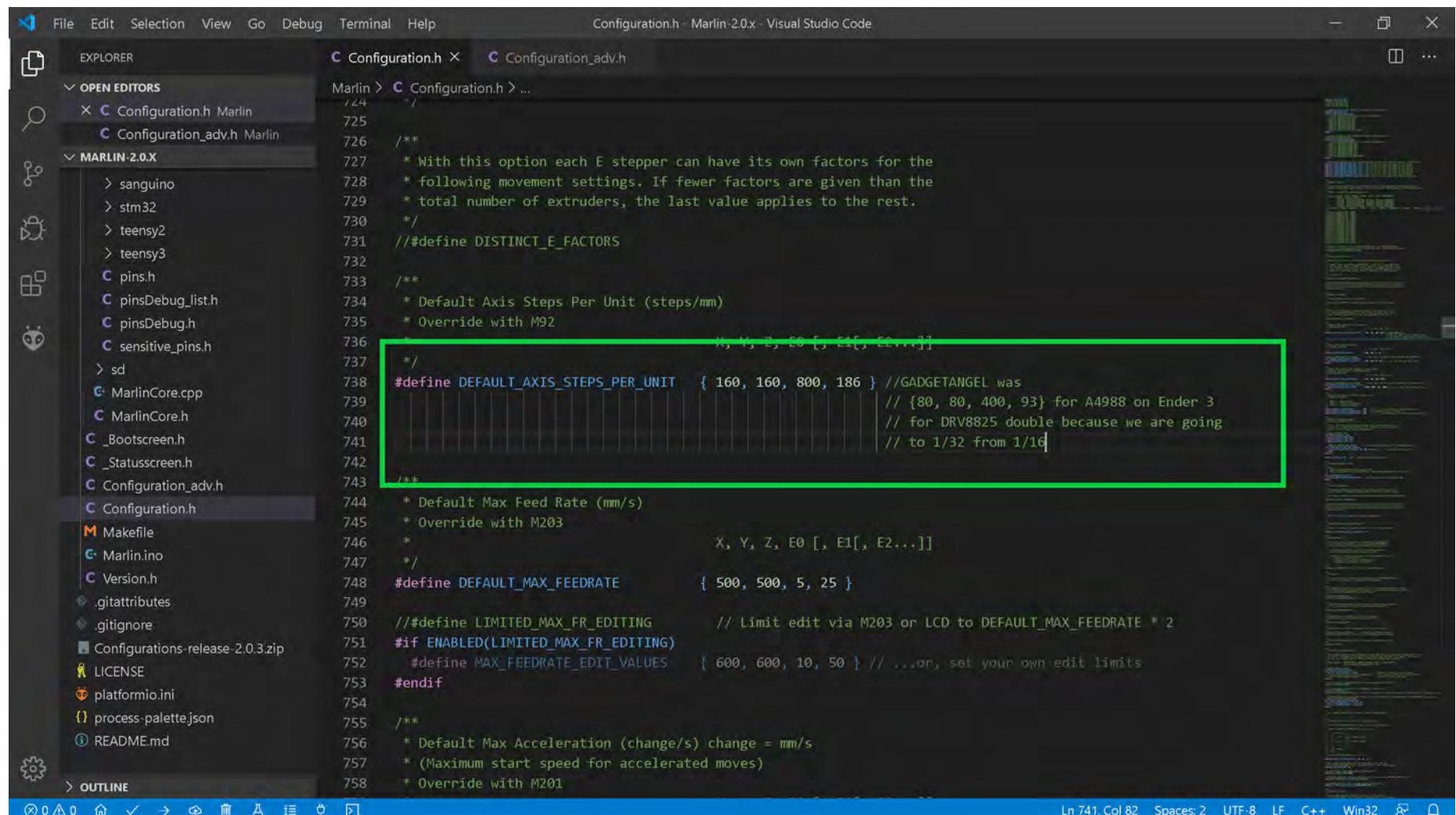
661 /**
662 * Stepper Drivers
663 */
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC2660', 'TMC5130', 'TMC5160']
676 */
677 #define X_DRIVER_TYPE DRV8825 //GADGETANGEL was commented out and had the value A4988
678 #define Y_DRIVER_TYPE DRV8825 //GADGETANGEL was commented out and had the value A4988
679 #define Z_DRIVER_TYPE DRV8825 //GADGETANGEL was commented out and had the value A4988
680 //#define X2_DRIVER_TYPE A4988
681 //#define Y2_DRIVER_TYPE A4988
682 //#define Z2_DRIVER_TYPE A4988
683 //#define Z3_DRIVER_TYPE A4988
684 //#define Z4_DRIVER_TYPE A4988
685 #define E0_DRIVER_TYPE DRV8825 //GADGETANGEL was commented out and had the value A4988
686 //#define E1_DRIVER_TYPE A4988
687 //#define E2_DRIVER_TYPE A4988
688 //#define E3_DRIVER_TYPE A4988
689 //#define E4_DRIVER_TYPE A4988
690 //#define E5_DRIVER_TYPE A4988
691 //#define E6_DRIVER_TYPE A4988
692 //#define E7_DRIVER_TYPE A4988
693
694 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for DRV8825 Drivers

- We are changing from A4988 stepper motor drivers on the Ender 3 to DRV8825 stepper motor drivers for each axis and the extruder stepper motor driver. We will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin configuration header. A green rectangular box highlights the following line of code:

```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// for DRV8825 double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom indicates the current file is 'Configuration.h - Marlin 2.0.x - Visual Studio Code', line 741, column 82, with 2 spaces, using UTF-8 encoding, C++ language, and Win32 terminal.

- Go to the next page.

The (latest release of) Marlin Setup for DRV8825 Drivers

- The end of Marlin setup for DRV8825 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS Marlin > Configuration.h > X_DRIVER_TYPE

C pins_BTT_SKR_PRO_V1_1.h C Configuration.h C Configuration_adv.h

C pins_BTT_SKR_PRO_V1_1.h Marlin's... X C Configuration.h Marlin C Configuration_adv.h Marlin

MARLIN-2.0.X

C pins_THE_BORG.h
C pins_VAKE403D.h
> teensy2
> teensy3
C pins.h
C pinsDebug_list.h
C pinsDebug.h
C sensitive_pins.h
> sd
G MarlinCore.cpp
C MarlinCore.h
C _Bootscreen.h
C _Statusscreen.h
C Configuration_adv.h
C Configuration.h
M Makefile
G Marlin.ino
C Version.h
.gitattributes
.gitignore
LICENSE
platformio.ini
{} process-palette.json
① README.md

PROBLEMS 5 OUTPUT DEBUG CONSOLE TERMINAL 1: Task - Build +

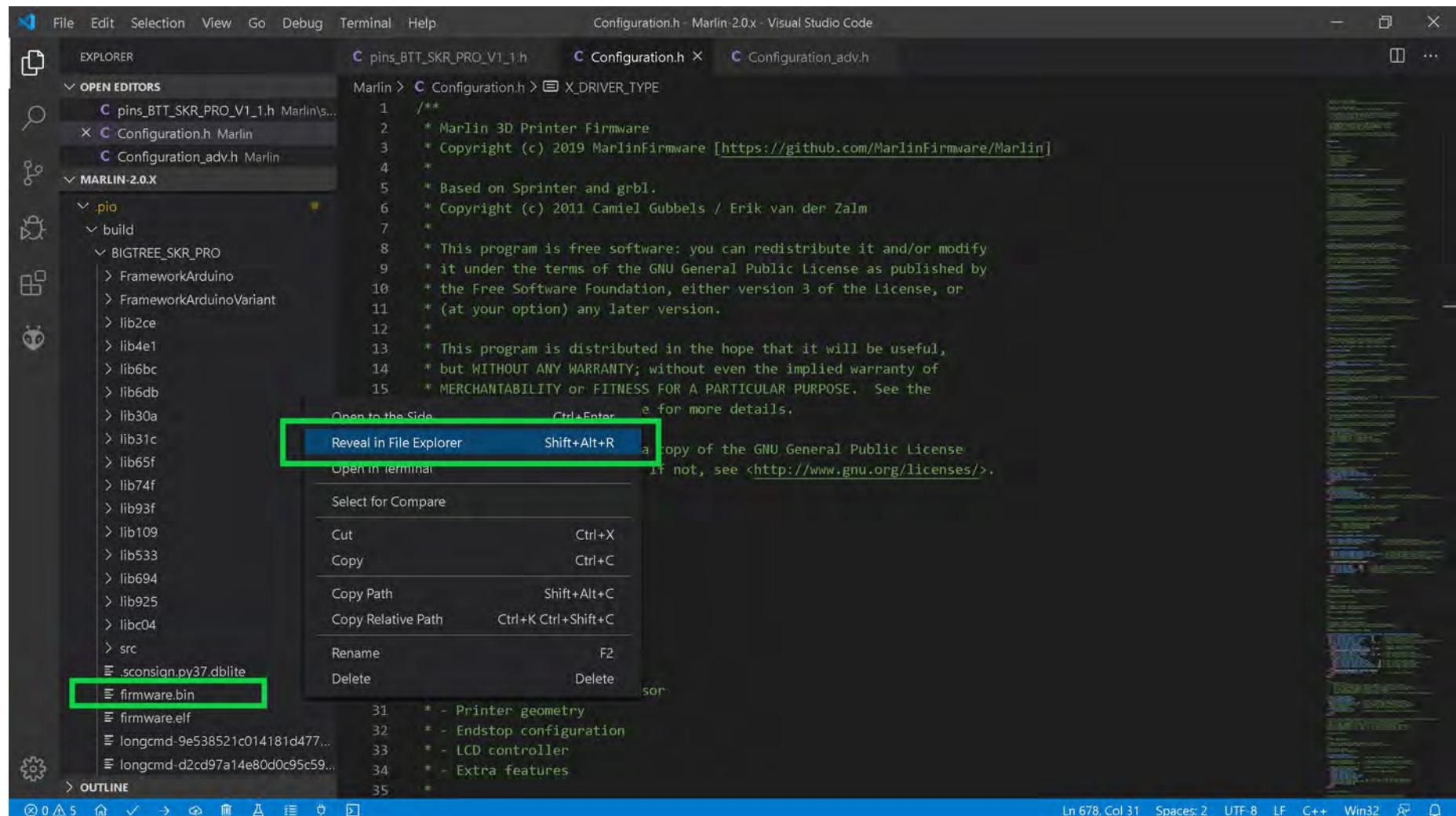
CTR2047MC_13_V0
BIGTREE_SKR_PRO SUCCESS 00:02:31.294
BIGTREE_BTT002 IGNORED
teensy31 IGNORED
teensy35 IGNORED
esp32 IGNORED
linux_native IGNORED
SAMD51_grandcentral_m4 IGNORED
rumba32_f446ve IGNORED
mks_rumba32 IGNORED
include_tree IGNORED
===== 1 succeeded in 00:02:31.294 =====

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for DRV8825 Drivers

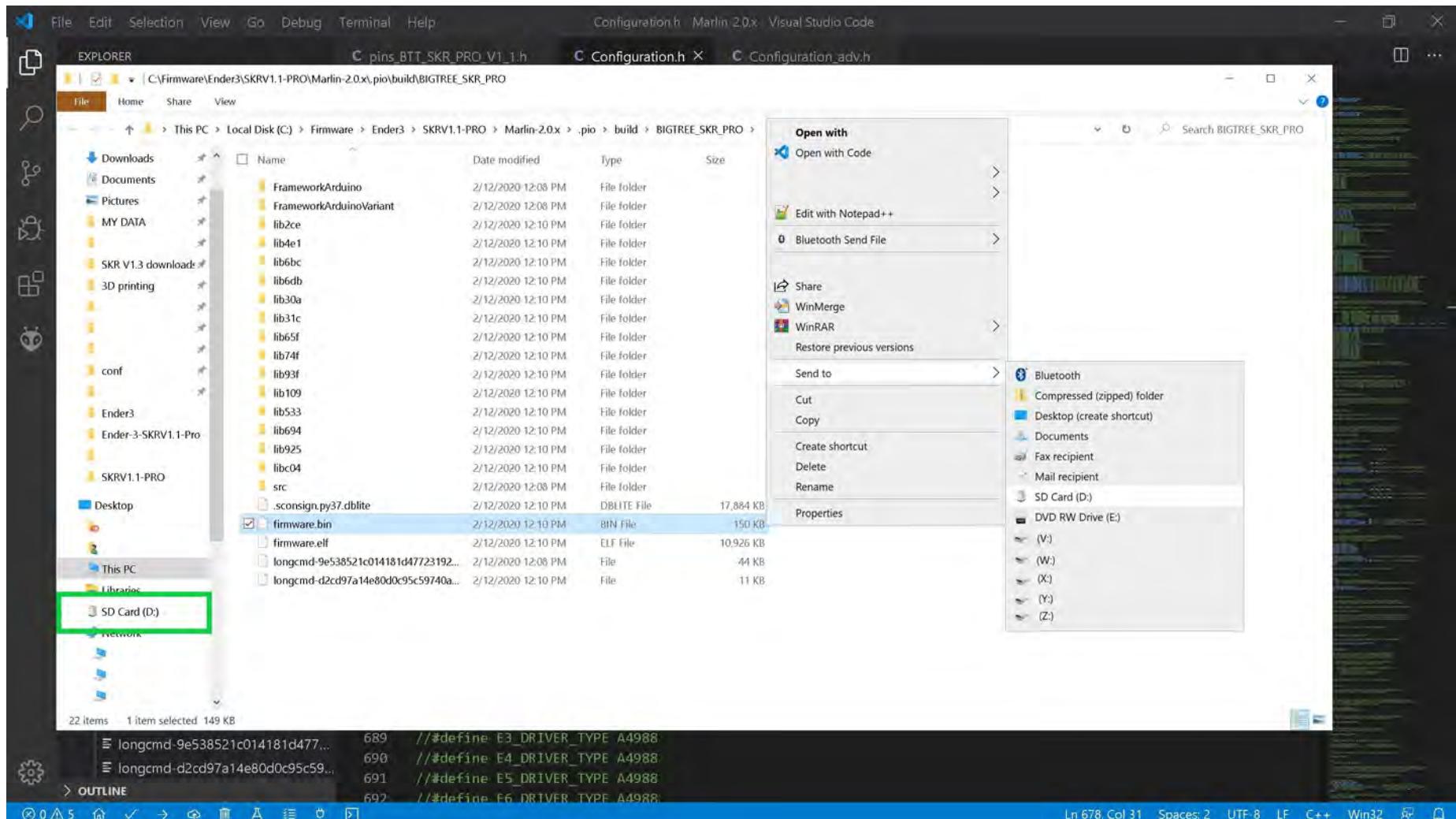
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



- Go to the next page.

The (latest release of) Marlin Setup for DRV8825 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".

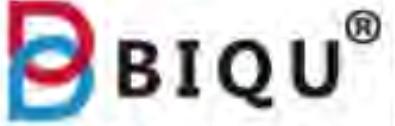


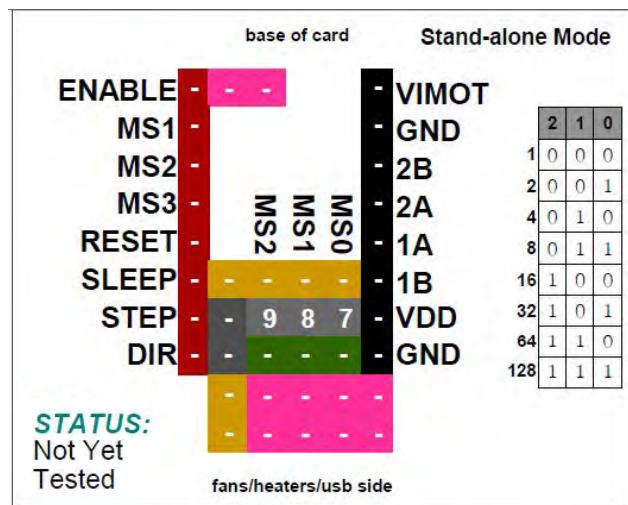
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

| | base of card | Stand-alone Mode |
|---------|-----------------------|------------------|
| ENABLE | - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | MS2 MS1 MS0 | 2A |
| RESET | - | 1A |
| SLEEP | - | 1B |
| STEP | 9 8 7 | VDD |
| DIR | - | GND |
| STATUS: | Not Yet Tested | |
| | fans/heaters/usb side | |

BIQU LV8729

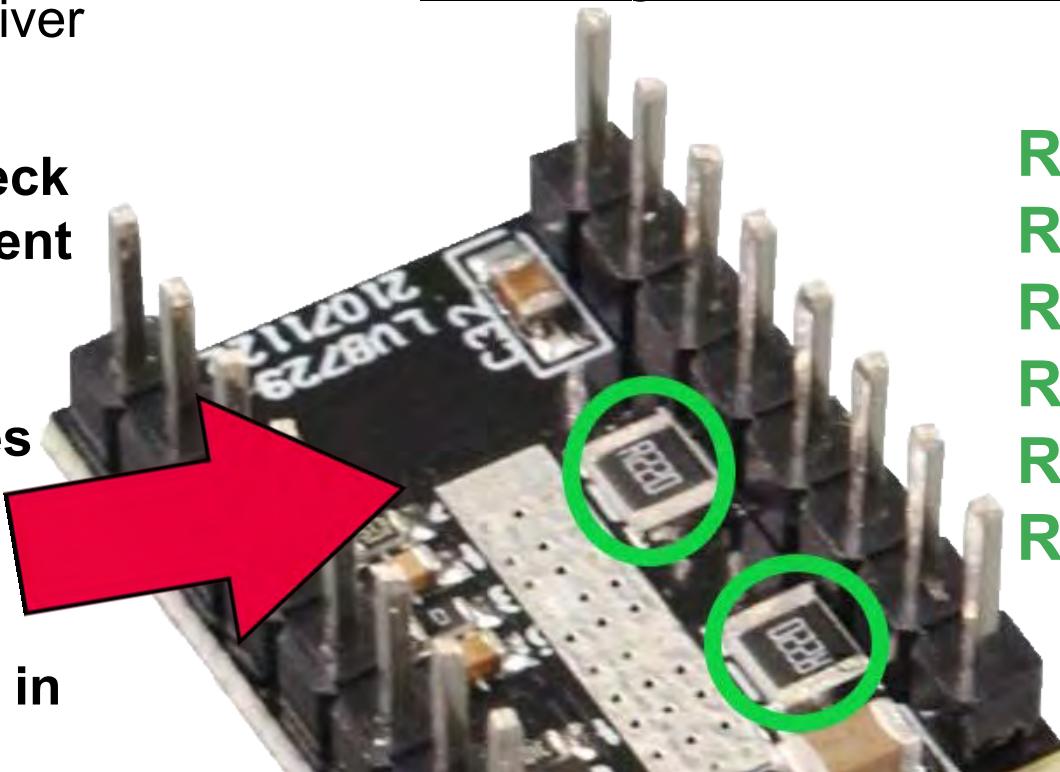
Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|-------------------------------------|------|-------------------------------|----------------------|-----------------|
|  LV8729 Maximum 128 Subdivision 36V DC 1.5A (peak) | Low | Low | Low | Full Step | 2 Phase |
| | Low | Low | High | 1/2 Step | 1-2 Phase |
| | Low | High | Low | 1/4 Step | W1-2 Phase |
| | Low | High | High | 1/8 Step | 2W1-2 Phase |
| | High | Low | Low | 1/16 Step | 4W1-2 Phase |
| | High | Low | High | 1/32 Step | 8W1-2 Phase |
| | High | High | Low | 1/64 Step | 16W1-2 Phase |
| | High | High | High | 1/128 Step | 32W1-2 Phase |
| Driving Current Calculation Formula R_S (Typical Sense Resistor)=0.22Ω | $I_{MAX} = \frac{V_{ref}}{5 * R_S}$ | | $V_{ref} = 5 * I_{MAX} * R_S$ | | |



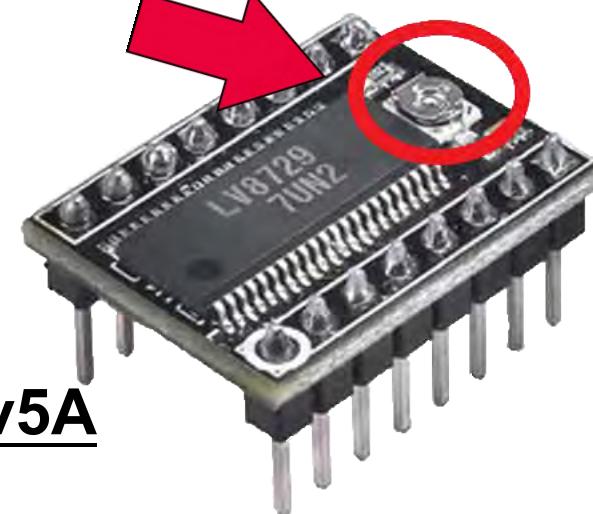
Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN



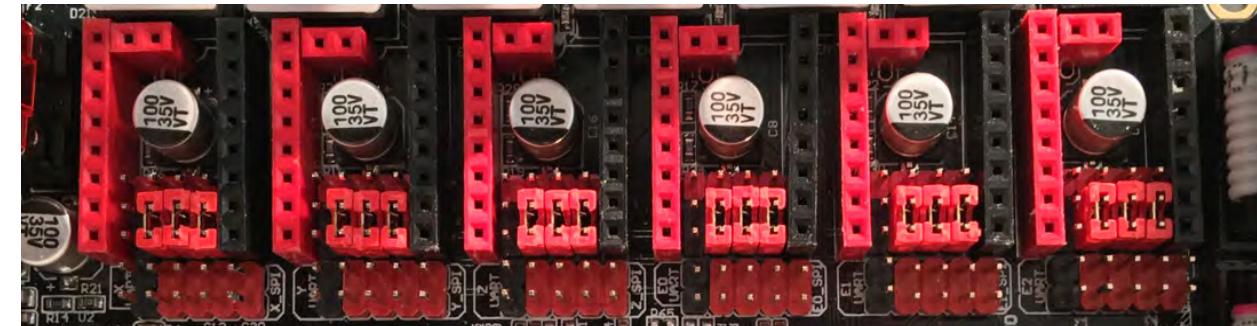
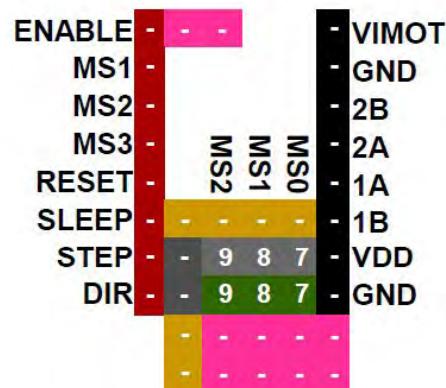
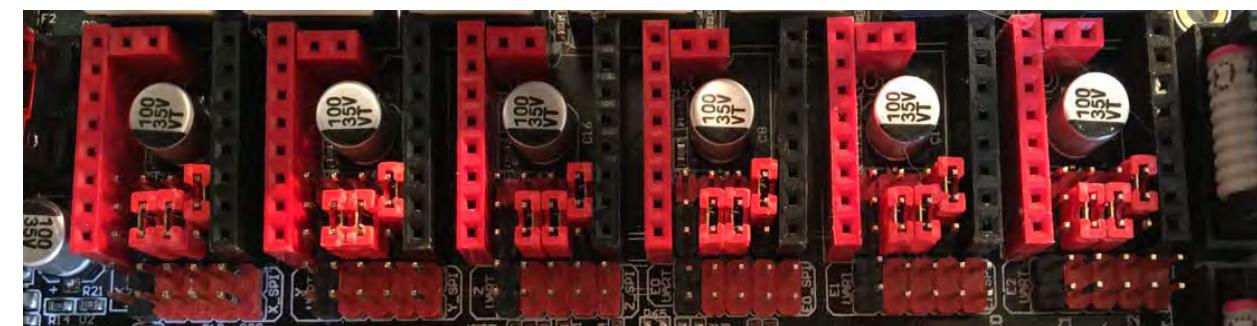
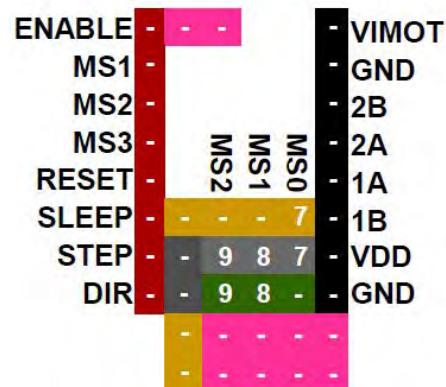
BIQU LV8729

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.



Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>

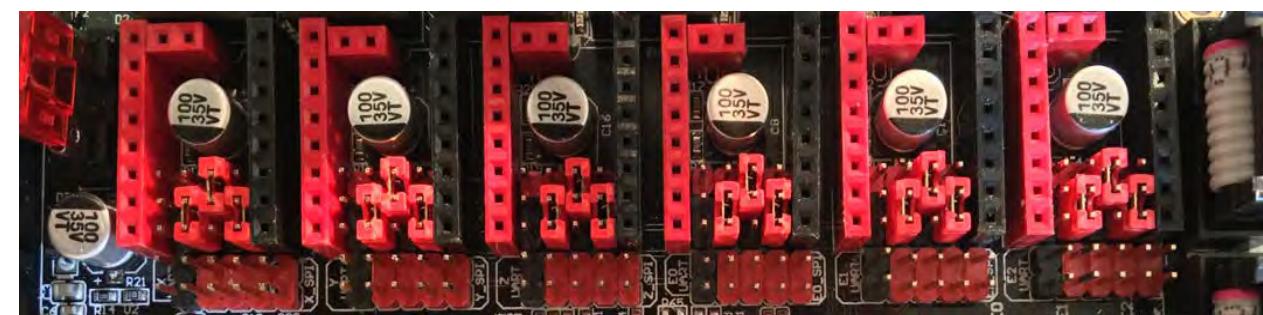
$R_s = R050$ is 0.05 Ohms
 $R_s = R068$ is 0.068 Ohms
 $R_s = R100$ is 0.1 Ohms
 $R_s = R150$ is 0.15 Ohms
 $R_s = R200$ is 0.2 Ohms
 $R_s = R220$ is 0.22 Ohms

BIQU LV8729**Stand-alone Mode****STEP****1 / 2**

BIQU LV8729**Stand-alone Mode**

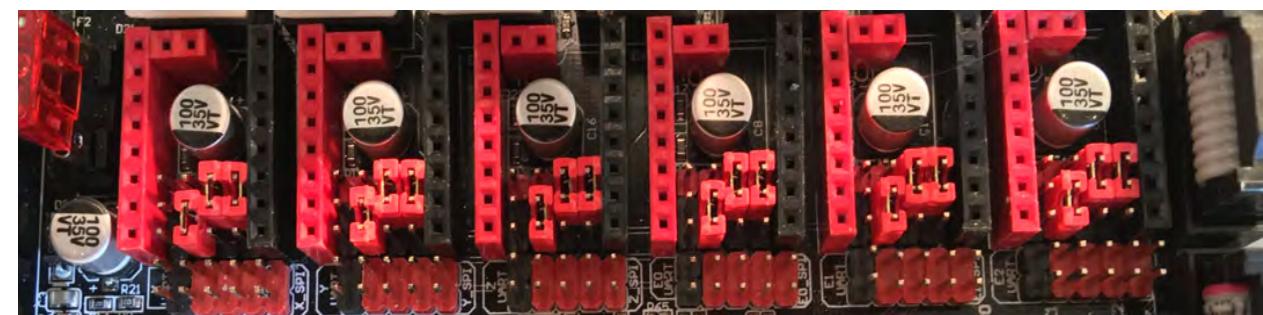
1 / 4

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | MS2 | 2A |
| RESET | MS1 | 1A |
| SLEEP | 8 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 9 | GND |



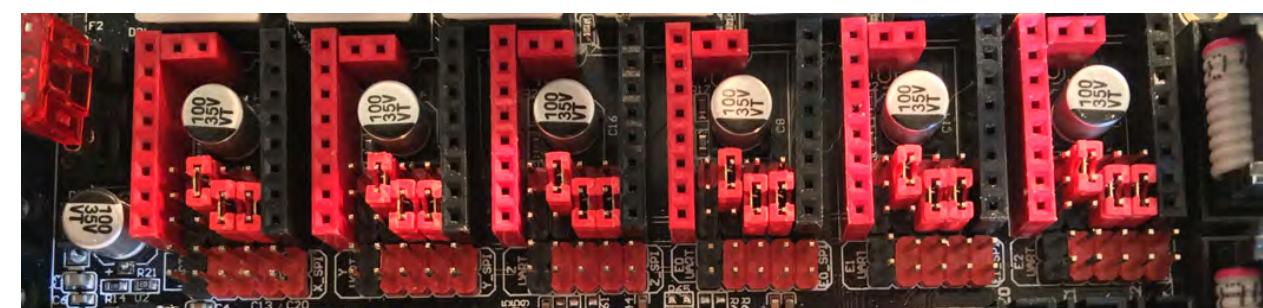
1 / 8

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | MS2 | 2A |
| RESET | MS1 | 1A |
| SLEEP | 8 7 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 9 | GND |



1 / 16

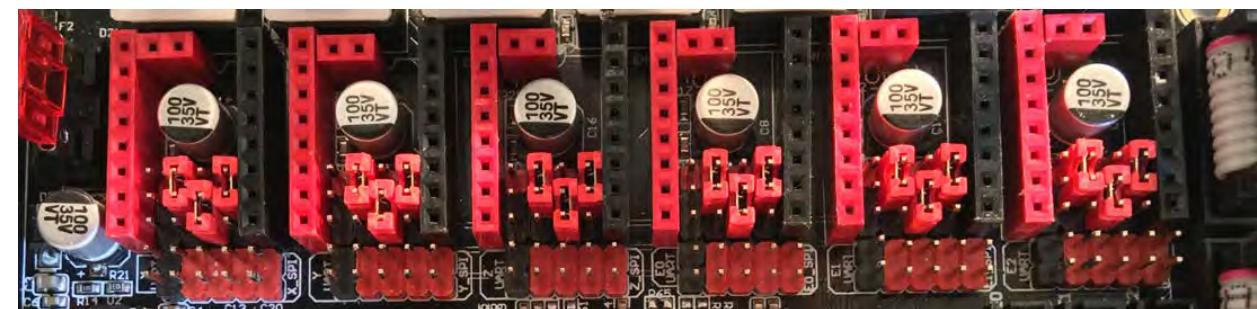
| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | MS2 | 2A |
| RESET | MS1 | 1A |
| SLEEP | 9 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 8 7 | GND |



BIQU LV8729**Stand-alone Mode**

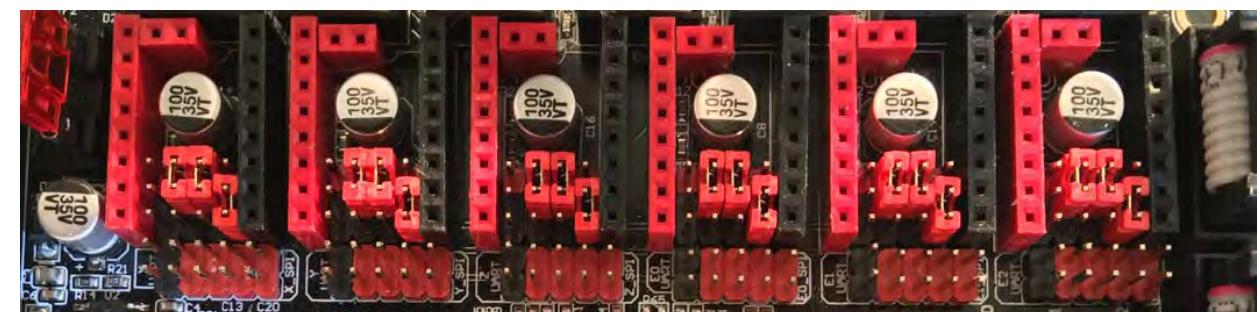
1 / 32

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 9 7 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | - 8 - | GND |



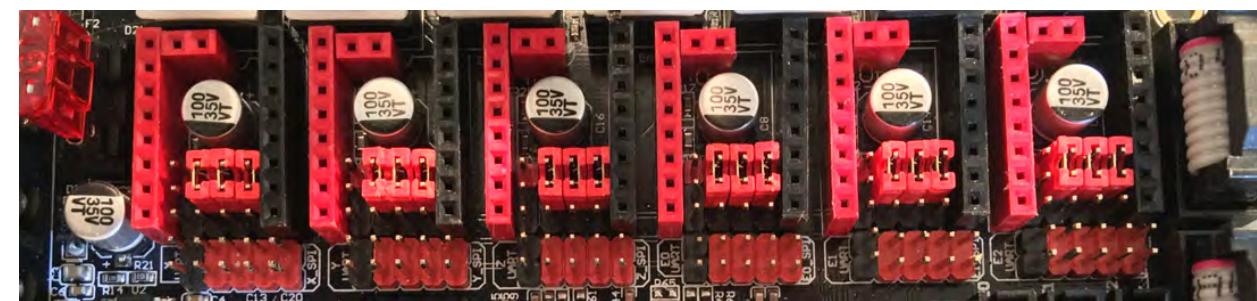
1 / 64

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 9 8 - | 1B |
| STEP | 9 8 7 | VDD |
| DIR | - - 7 | GND |



1 / 128

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 9 8 7 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | - - - | GND |



The (latest release of) Marlin Setup for BIQU LV8729 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU LV8729 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using BIQU LV8729 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use BIQU LV8729 drivers. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

```

File Edit Selection View Go Debug Terminal Help
Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
PIO Home Configuration.h M... Configuration_adv.h
MARLIN-2.0.X
  LCDprint.cpp
  LCDprint.h
  thermistornames.h
  ultralcd.cpp
  ultralcd.h
  > libs
  > module
  > pins
  > sd
  MarlinCore.cpp
  MarlinCore.h
  Bootscreen.h
  Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  LICENSE
  platformio.ini
  process-palette.json
  README.md

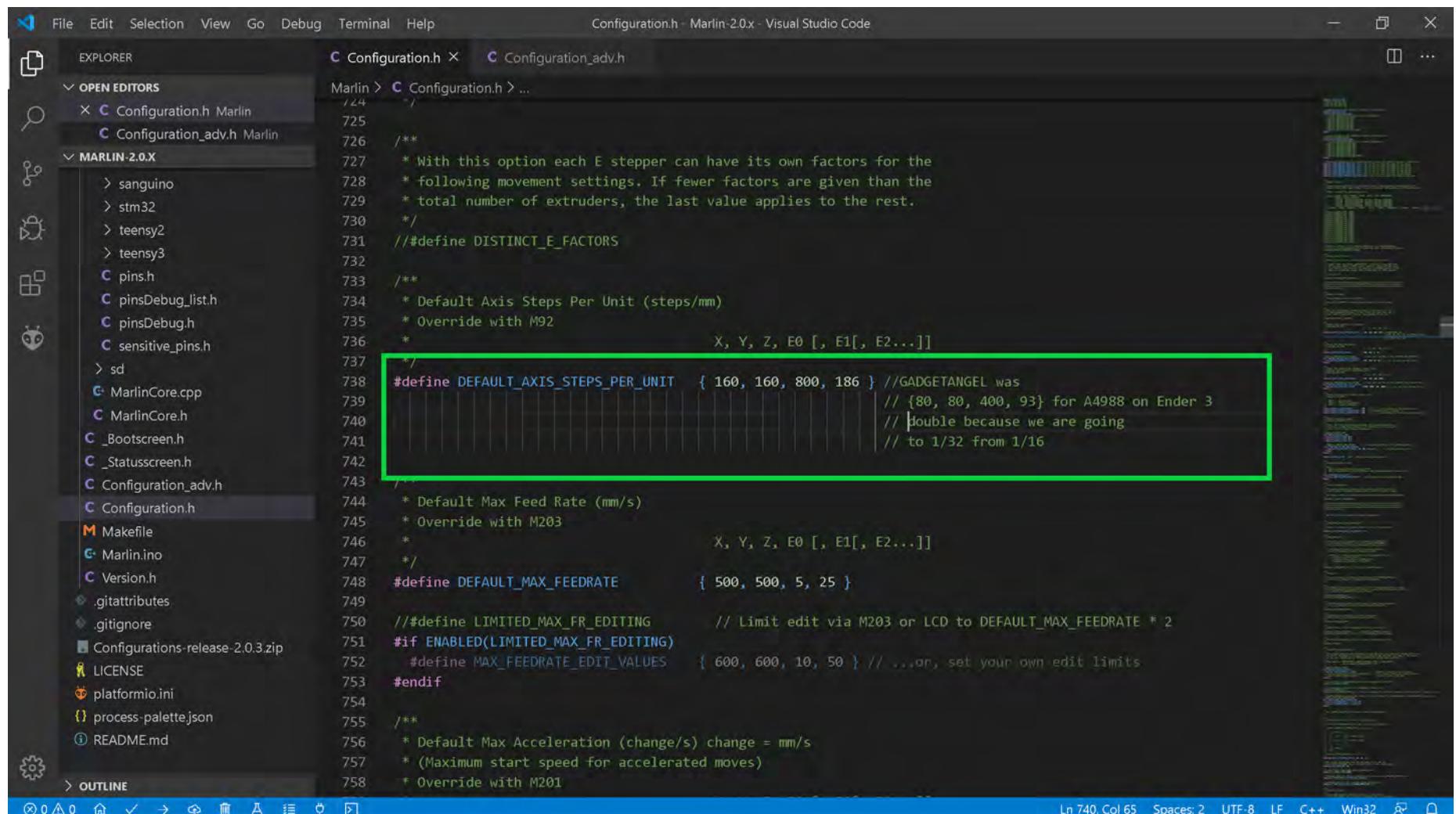
  661
  662 /**
  663 * Stepper Drivers
  664 *
  665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
  666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
  667 *
  668 * A4988 is assumed for unspecified drivers.
  669 *
  670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
  671 *           TB6560, TB6600, TMC2100,
  672 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
  673 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
  674 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
  675 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
  676 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2
  677 */
  678 #define X_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
  679 #define Y_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
  680 #define Z_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
  681 //#define X2_DRIVER_TYPE A4988
  682 //#define Y2_DRIVER_TYPE A4988
  683 //#define Z2_DRIVER_TYPE A4988
  684 //#define Z3_DRIVER_TYPE A4988
  685 //#define Z4_DRIVER_TYPE A4988
  686 #define E0_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
  687 //#define E1_DRIVER_TYPE A4988
  688 //#define E2_DRIVER_TYPE A4988
  689 //#define E3_DRIVER_TYPE A4988
  690 //#define E4_DRIVER_TYPE A4988
  691 //#define E5_DRIVER_TYPE A4988
  692 //#define E6_DRIVER_TYPE A4988
  693 //#define E7_DRIVER_TYPE A4988
  694
  695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU LV8729 Drivers

- We are changing from A4988 stepper motor drivers on the Ender 3 to LV8729 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following line of code:

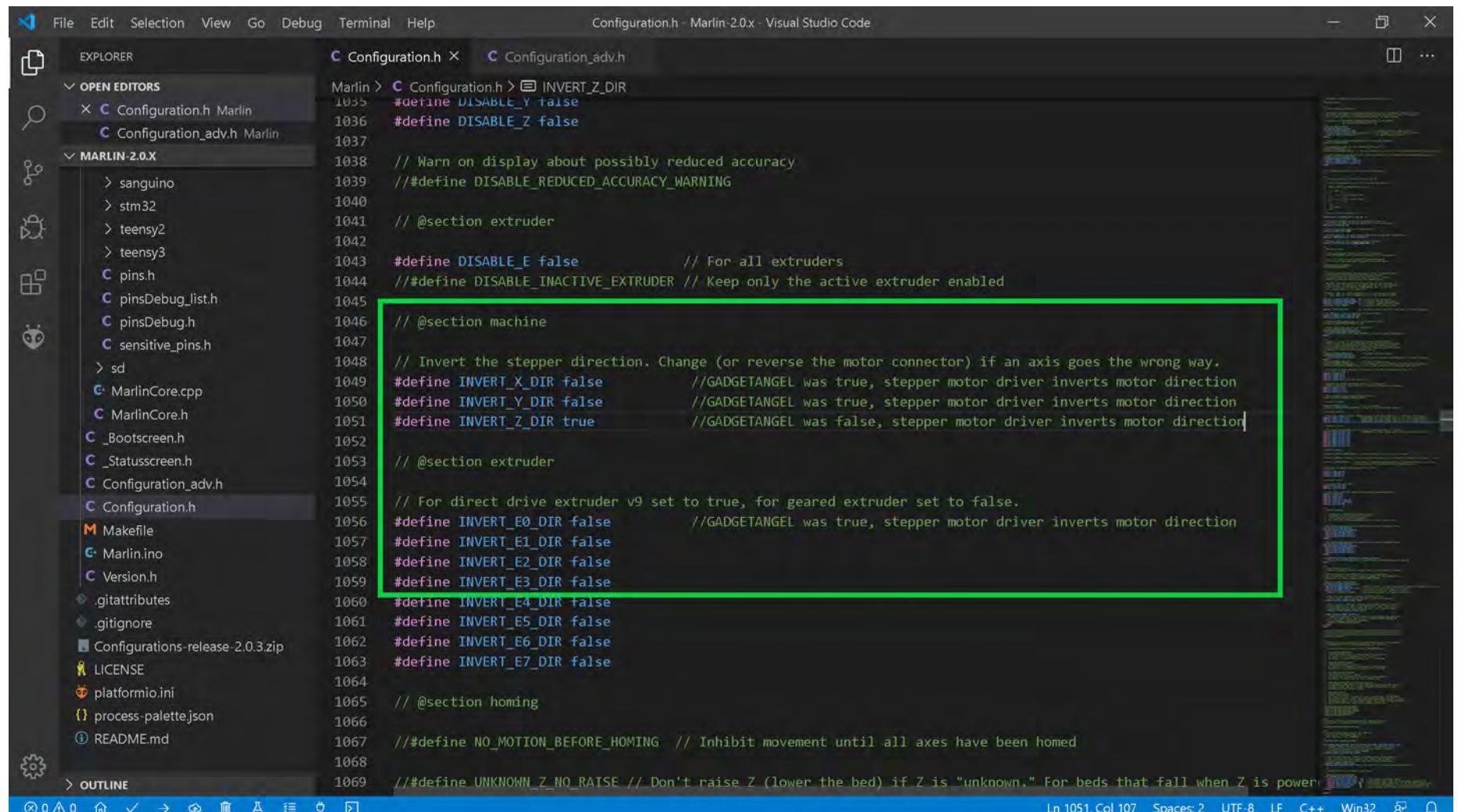
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// Double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom indicates the current line (Ln 740), column (Col 65), and other settings like spaces (Spaces: 2), encoding (UTF-8), line endings (LF), and file type (C++). The left sidebar shows the project structure with various Marlin source files and configuration files.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU LV8729 Drivers

- Since the A4988 driver is what my Ender 3 used, but, now I want to use LV8729 drivers, I must invert the stepper motor direction because the LV8729 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the LV8729 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as show in the **GREEN** box below



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS Configuration.h Configuration_adv.h

```

Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false          // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060
1061 #define INVERT_E4_DIR false
1062 #define INVERT_E5_DIR false
1063 #define INVERT_E6_DIR false
1064 #define INVERT_E7_DIR false
1065
1066 // @section homing
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RATSE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered on

```

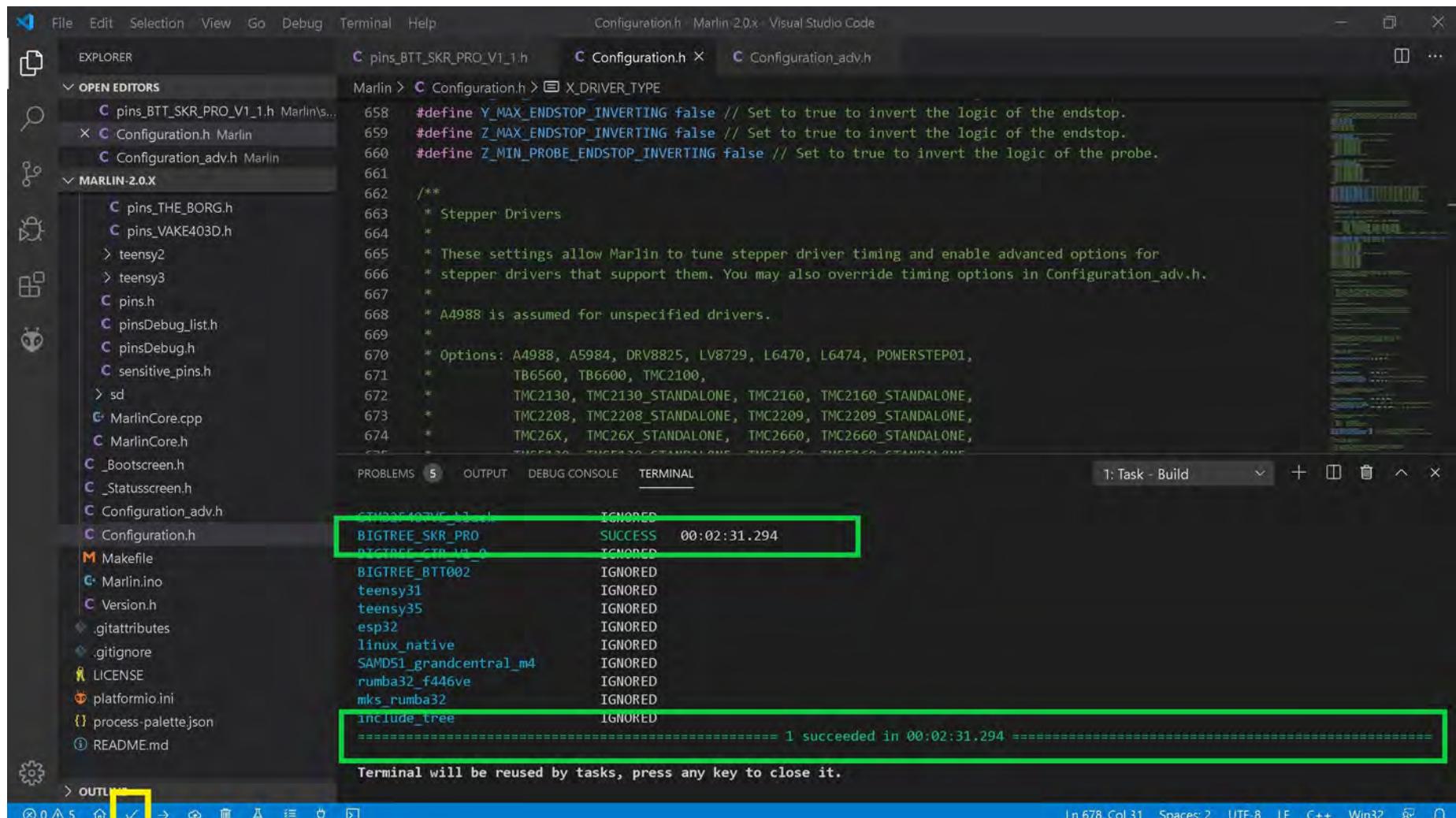
OUTLINE

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU LV8729 Drivers

- The end of Marlin setup for BIQU LV8729 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the following details:

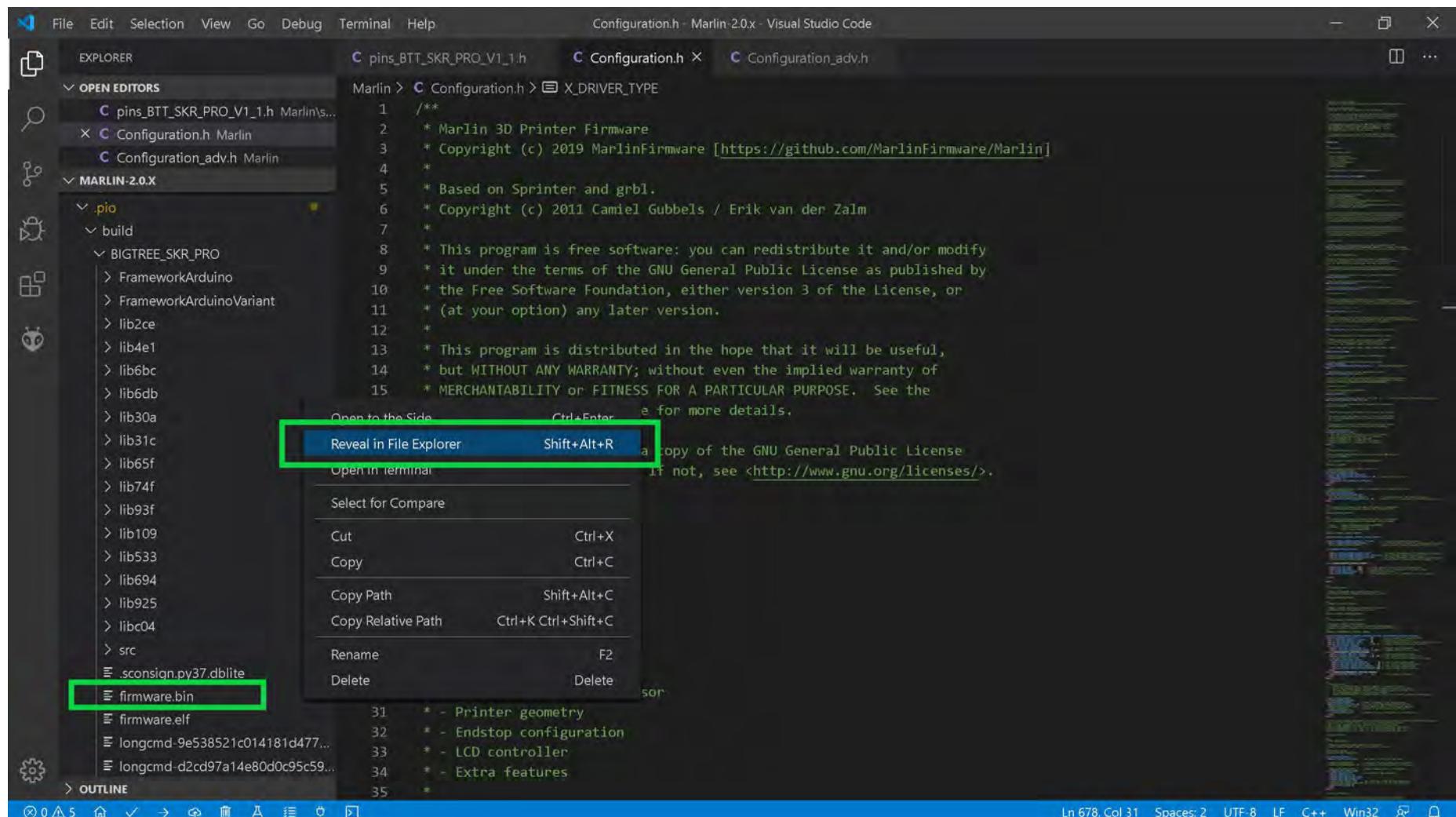
- File Explorer:** Shows the project structure under "OPEN EDITORS" and "MARLIN-2.0.X".
- Editors:** Three files are open: Configuration.h, Configuration_adv.h, and pins_BTT_SKR_PRO_V1_1.h.
- Terminal:**
 - Output: "1 Task - Build" is selected.
 - Content: Shows the compilation process for various boards. The first two lines are highlighted in green:


```
BIGTREE_SKR_PRO           IGNORED
BIGTREE_SKR_V1_0             IGNORED
```
 - Bottom of the terminal window: "Terminal will be reused by tasks, press any key to close it."
 - Status bar at the bottom right: "Ln 678, Col 31 Spaces: 2 UTF-8 LF C++ Win32" with a yellow box highlighting the "C++" icon.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU LV8729 Drivers

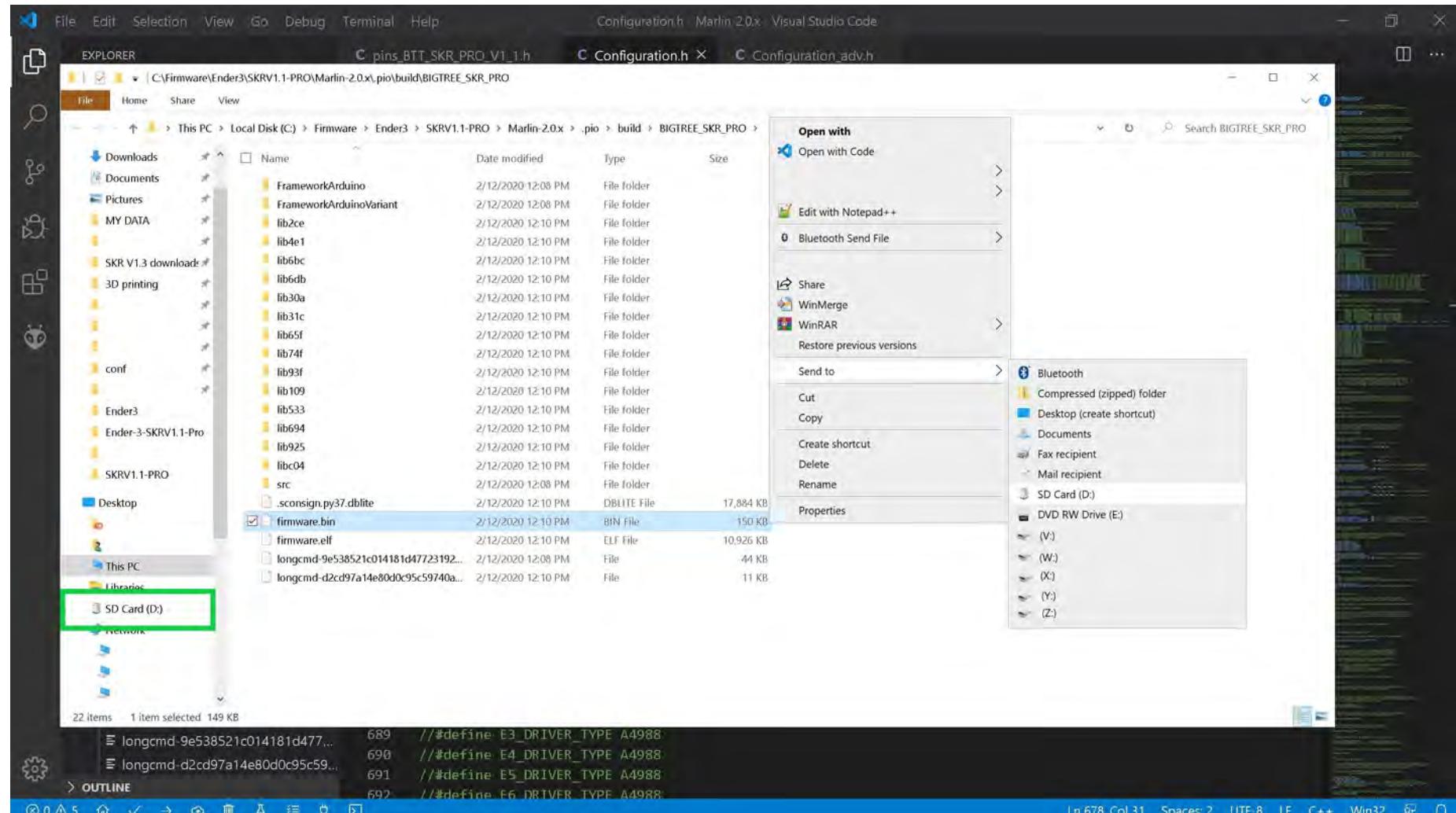
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



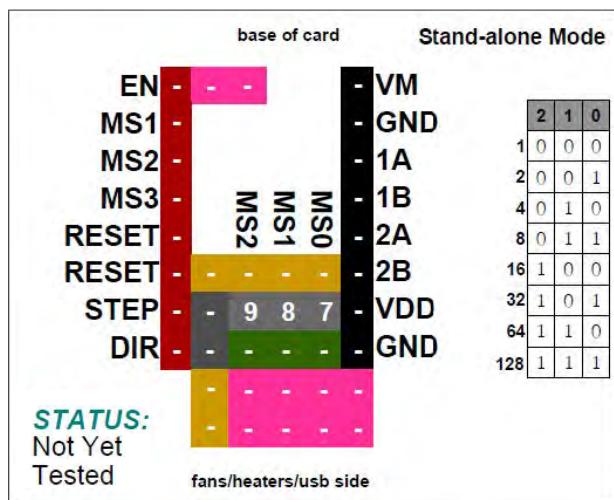
- Go to the next page.

The (latest release of) Marlin Setup for BIQU LV8729 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

FYSETC LV8729

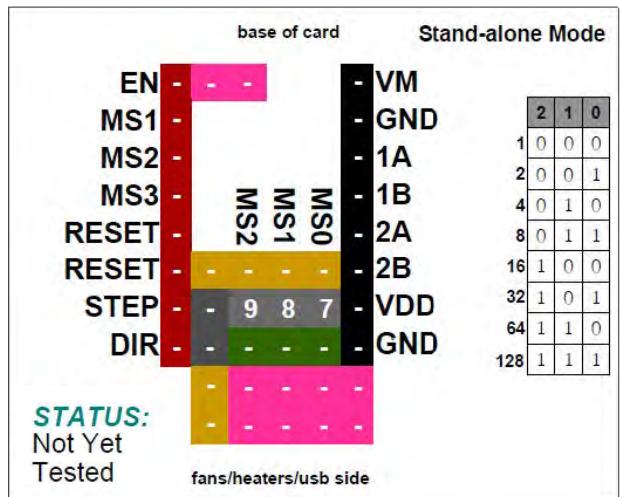
Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|------|------|------|----------------------|-----------------|
| FYSETC LV8729 Maximum 128 Subdivision 36V DC 1.5A (peak) | Low | Low | Low | Full Step | 2 Phase |
| | Low | Low | High | 1/2 Step | 1-2 Phase |
| | Low | High | Low | 1/4 Step | W1-2 Phase |
| | Low | High | High | 1/8 Step | 2W1-2 Phase |
| | High | Low | Low | 1/16 Step | 4W1-2 Phase |
| | High | Low | High | 1/32 Step | 8W1-2 Phase |
| | High | High | Low | 1/64 Step | 16W1-2 Phase |
| | High | High | High | 1/128 Step | 32W1-2 Phase |

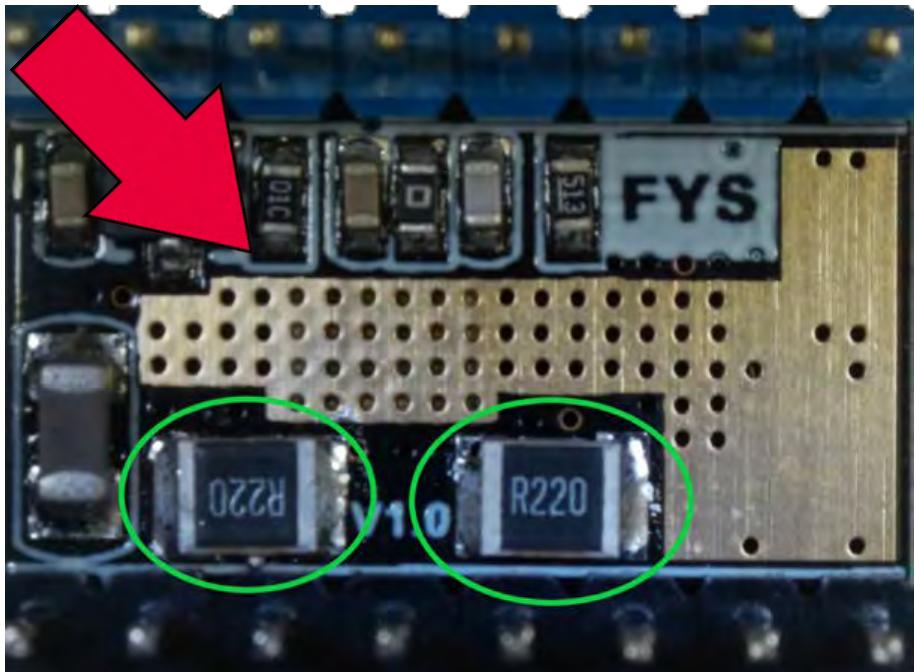
| Driving Current Calculation Formula |
|--|
| R_S (Typical Sense Resistor) = 0.22Ω |

$$I_{MAX} = \frac{V_{ref}}{5 * R_S}$$

$$V_{ref} = 5 * I_{MAX} * R_S$$

FYSETC LV8729

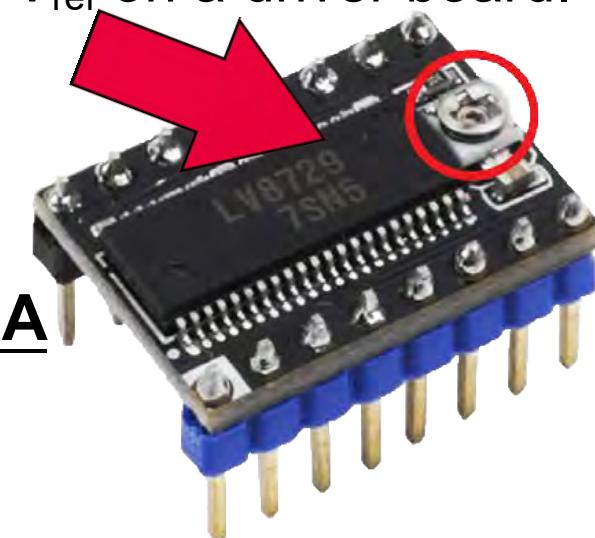
Note: Check your current sense resistors (R_s) values on the driver board, as shown in **GREEN**



Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [**Appendix A**](#) for instructions on how to set the V_{ref} on a driver board.

Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>



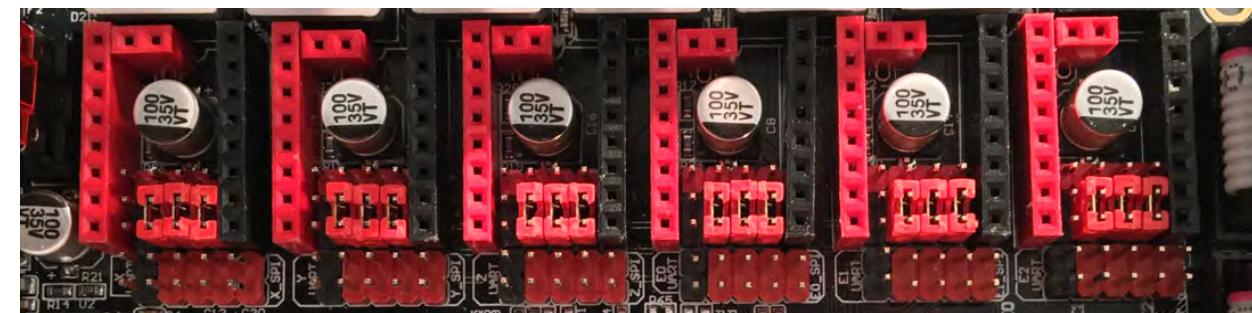
$R_s = R050$ is 0.05 Ohms;
 $R_s = R068$ is 0.068 Ohms
 $R_s = R100$ is 0.1 Ohms;
 $R_s = R150$ is 0.15 Ohms
 $R_s = R200$ is 0.2 Ohms;
 $R_s = R220$ is 0.22 Ohms

FYSETC LV8729

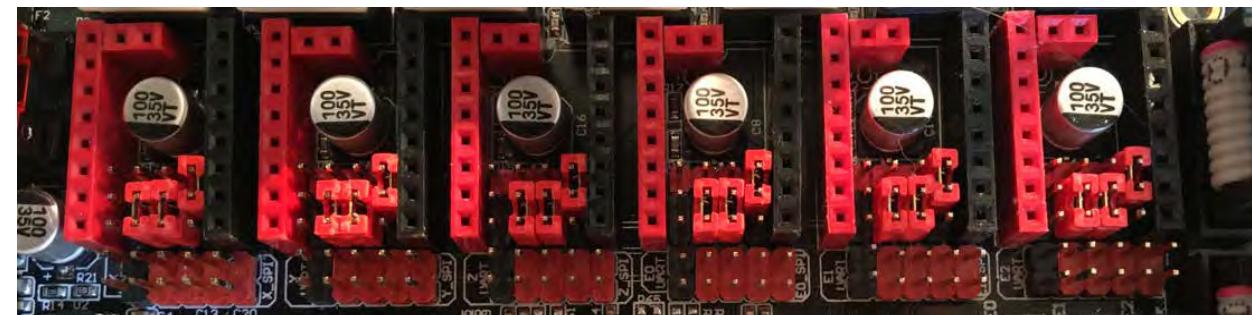
Stand-alone Mode

STEP

| | | | | |
|-------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | 2A |
| RESET | - | - | - | 2B |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | 8 | 7 |
| | | | | VDD |
| | | | | GND |

**1 / 2**

| | | | | |
|-------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | 2A |
| RESET | - | - | - | 2B |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | 8 | - |
| | | | | VDD |
| | | | | GND |

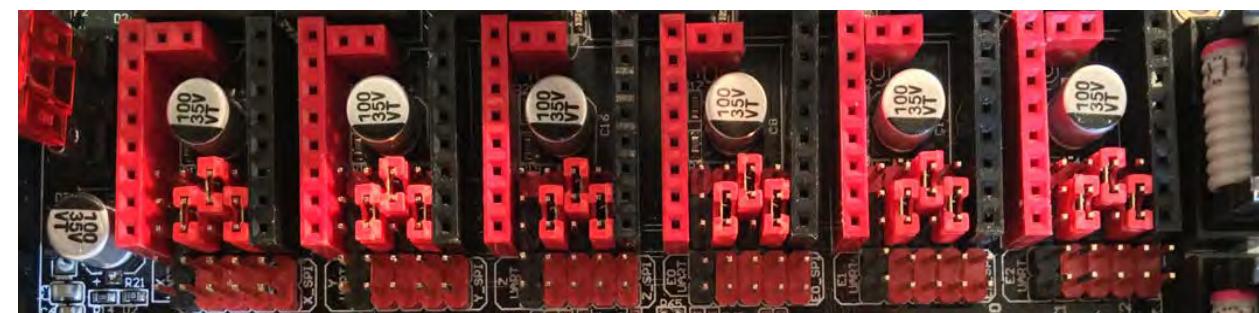


FYSETC LV8729

Stand-alone Mode

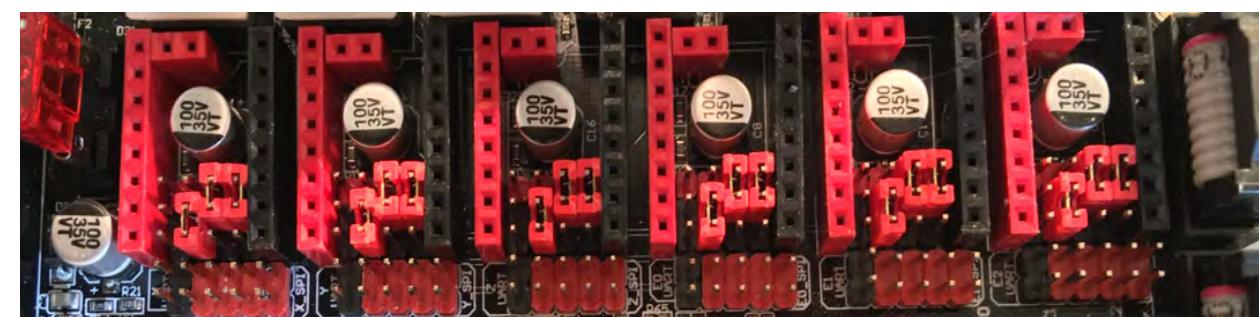
1 / 4

| | | | | |
|-------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | 2A |
| RESET | - | 8 | - | 2B |
| STEP | - | 9 | 8 | VDD |
| DIR | - | 9 | 7 | GND |



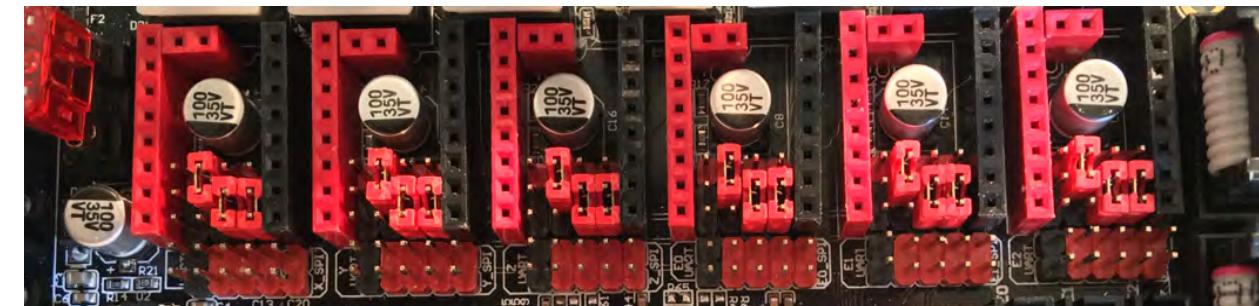
1 / 8

| | | | | |
|-------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | 2A |
| RESET | - | 8 | 7 | 2B |
| STEP | - | 9 | 8 | VDD |
| DIR | - | 9 | - | GND |



1 / 16

| | | | | |
|-------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | 2A |
| RESET | - | 9 | - | 2B |
| STEP | - | 9 | 8 | VDD |
| DIR | - | - | 8 | GND |

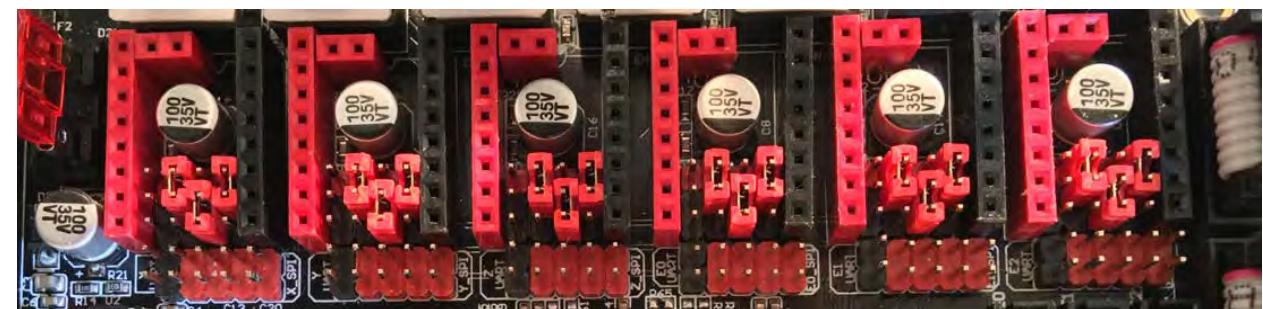


FYSETC LV8729

Stand-alone Mode

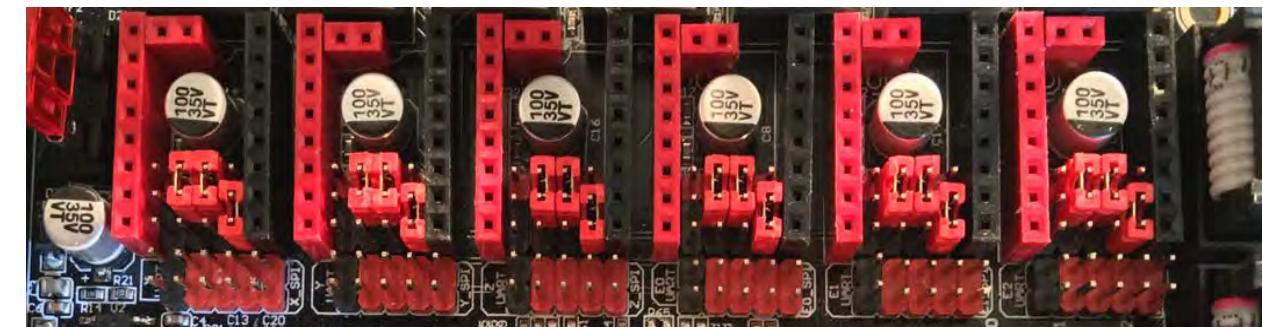
1 / 32

| | | | | |
|-------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | 2A |
| RESET | - | 9 | 7 | 2B |
| STEP | - | 9 | 8 | VDD |
| DIR | - | 8 | - | GND |



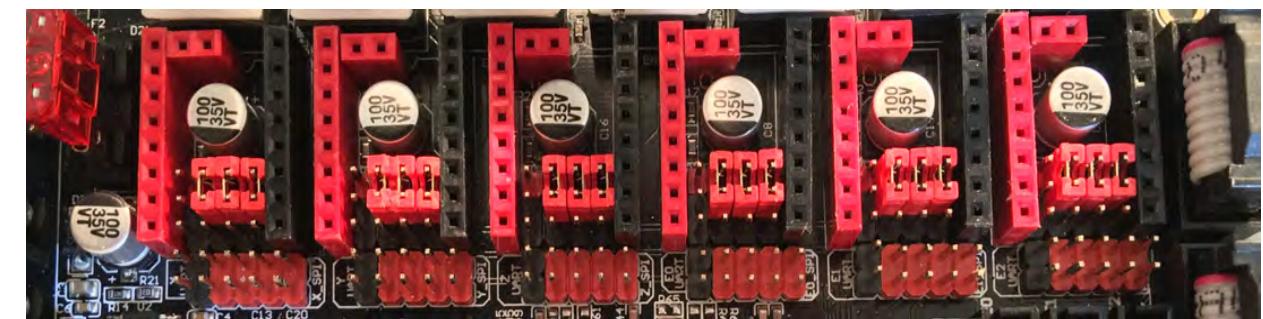
1 / 64

| | | | | |
|-------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | 2A |
| RESET | - | 9 | 8 | 2B |
| STEP | - | 9 | 8 | VDD |
| DIR | - | 7 | - | GND |



1 / 128

| | | | | |
|-------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | 2A |
| RESET | - | 9 | 8 | 2B |
| STEP | - | 9 | 8 | VDD |
| DIR | - | 7 | - | GND |



The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for FYSETC LV8729 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using FYSETC LV8729 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use FYSETC LV8729 drivers. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

```

File Edit Selection View Go Debug Terminal Help
Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h
Marlin > Configuration.h > E0_DRIVER_TYPE

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130', 'TMC5160']
676 */
677
#define X_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
#define Y_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
#define Z_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
#define E0_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
#define E1_DRIVER_TYPE A4988
#define E2_DRIVER_TYPE A4988
#define E3_DRIVER_TYPE A4988
#define E4_DRIVER_TYPE A4988
#define E5_DRIVER_TYPE A4988
#define E6_DRIVER_TYPE A4988
#define E7_DRIVER_TYPE A4988
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

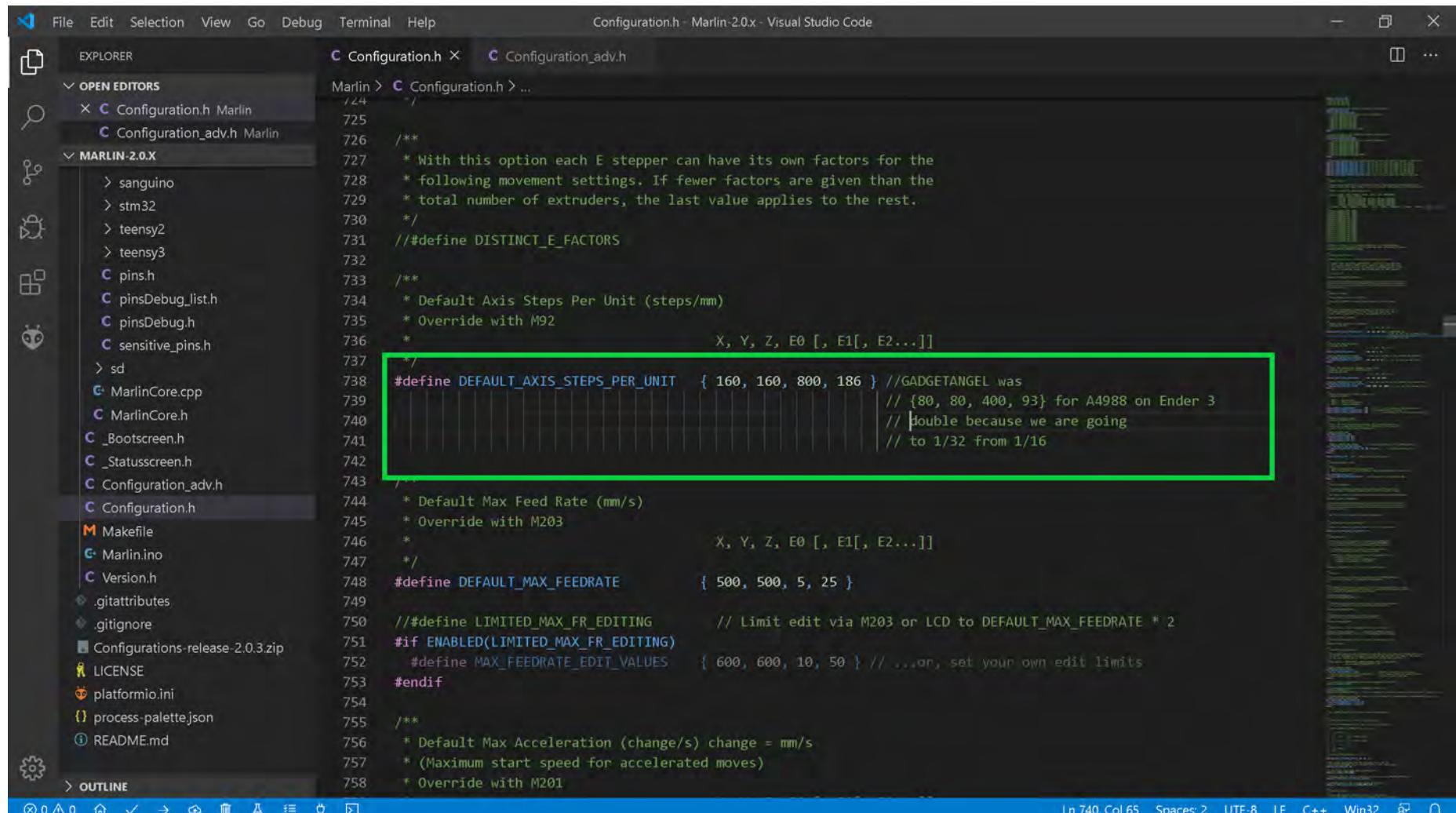
```

Ln 686, Col 87 Spaces: 2 UTF-8 LF C++ Win32 1

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

- We are changing from A4988 stepper motor drivers on the Ender 3 to LV8729 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following line of code:

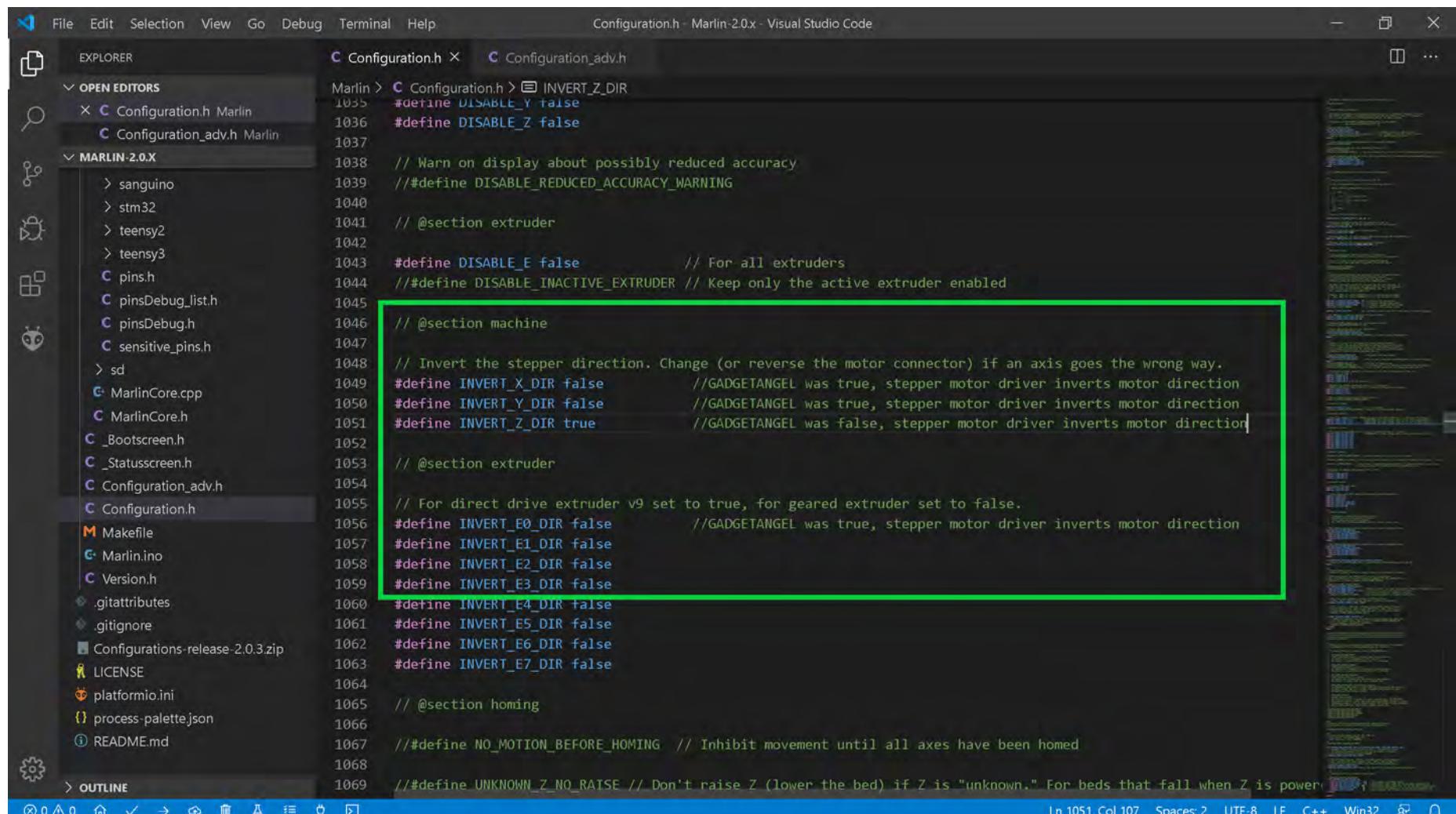
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// Double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom indicates the current line (Ln 740), column (Col 65), and other settings like spaces (Spaces: 2), encoding (UTF-8), and file type (C++). The left sidebar shows the project structure with various Marlin source files and configuration files like `Configuration.h` and `Configuration_adv.h`.

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

- Since the A4988 driver is what my Ender 3 used, but, now I want to use LV8729 drivers, I must invert the stepper motor direction because the LV8729 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the LV8729 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as show in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor has a dark theme. A green rectangular box highlights a specific section of the code. The code in the highlighted area is:

```

1035 #define INVERT_Z_DIR false
1036 #define DISABLE_Y false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

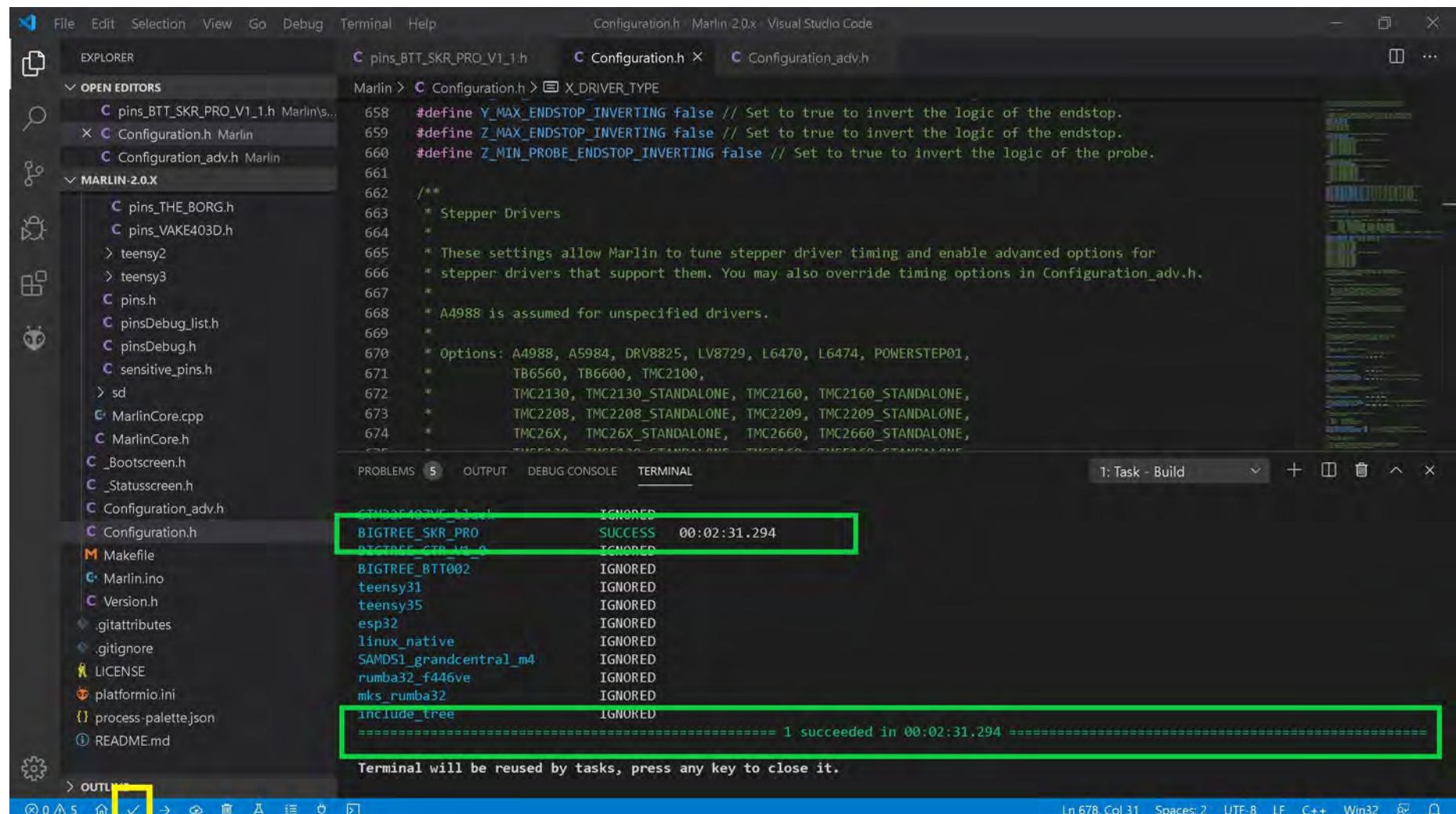
```

The status bar at the bottom right shows: Ln 1051, Col 107, Spaces: 2, UTF-8, LF, C++, Win32.

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

- The end of Marlin setup for FYSETC LV8729 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the Marlin repository open. The left sidebar shows files like Configuration.h, pins_BTT_SKR_PRO_V1_1.h, and Configuration_adv.h. The main editor window displays the Configuration.h file with code related to stepper drivers and endstops. The bottom right terminal window shows the build process:

```

Configuration.h Marlin 2.0.x Visual Studio Code

Marlin > C Configuration.h > X_DRIVER_TYPE
      pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h

658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC2225_STANDALONE, TMC2225_STANDALONE, TMC2225_STANDALONE

1: Task - Build
+ - x
PROBLEMS 5 OUTPUT DEBUG CONSOLE TERMINAL
BIGTREE_SKR_PRO SUCCESS 00:02:31.294
BIGTREE_SKR_1.0 IGNORED
BIGTREE_BTT002 IGNORED
teensy31 IGNORED
teensy35 IGNORED
esp32 IGNORED
linux_native IGNORED
SAMD51_grandcentral_m4 IGNORED
rumba32_f446ve IGNORED
mks_rumba32 IGNORED
include_tree IGNORED
=====
1 succeeded in 00:02:31.294 =====

Terminal will be reused by tasks, press any key to close it.

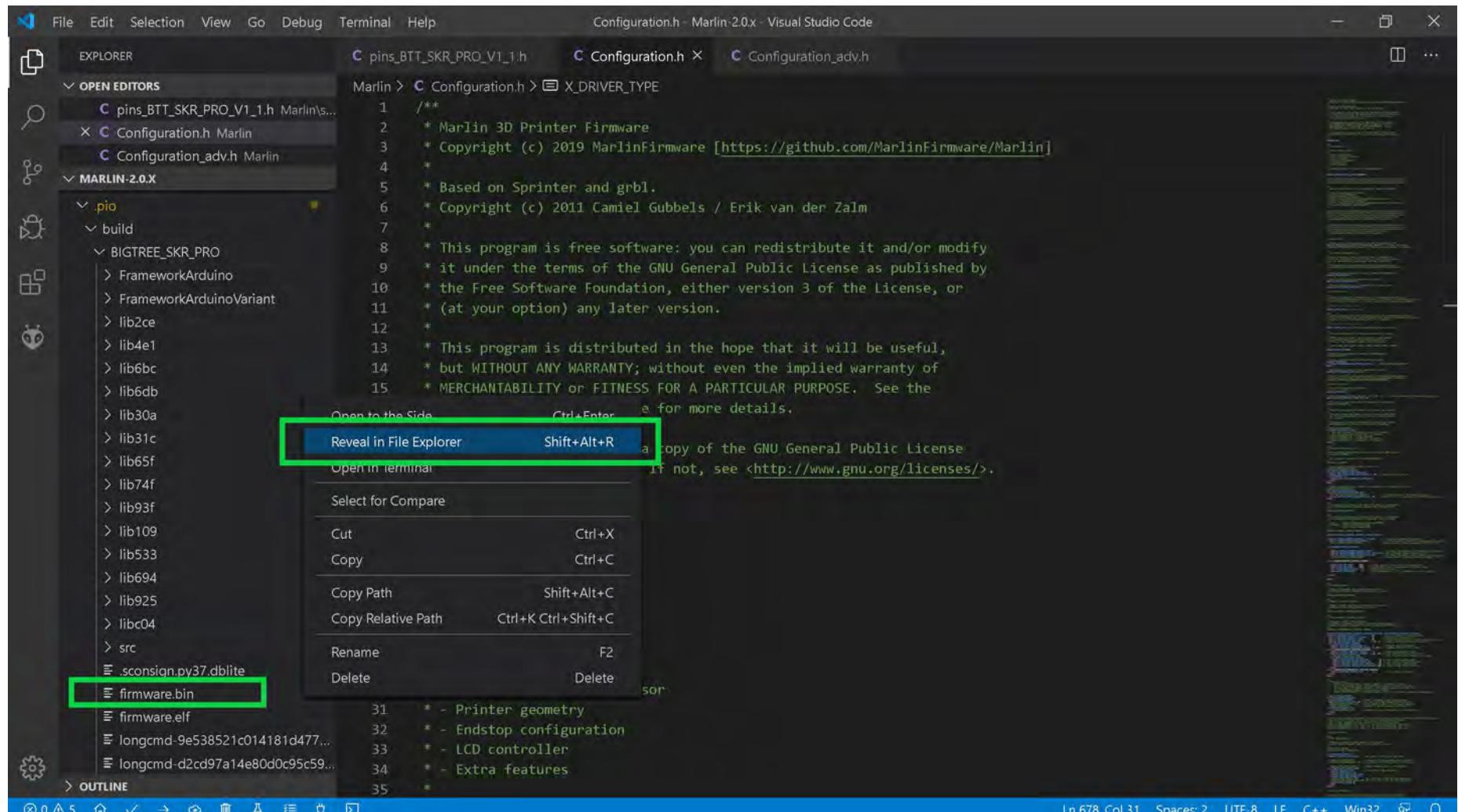
```

A yellow box highlights the checkmark icon in the bottom-left toolbar, and two green boxes highlight the successful compilation message in the terminal output.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

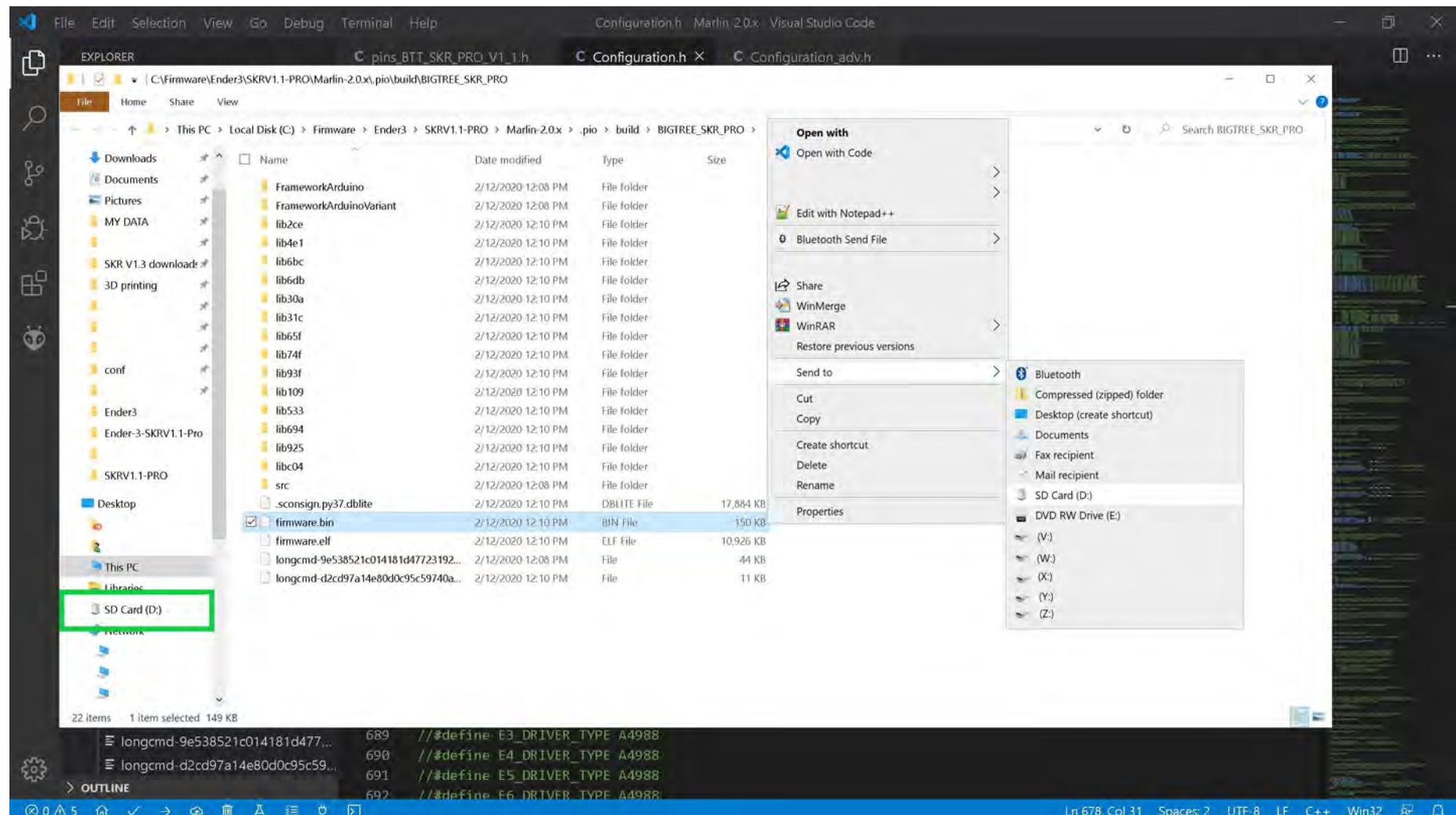
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



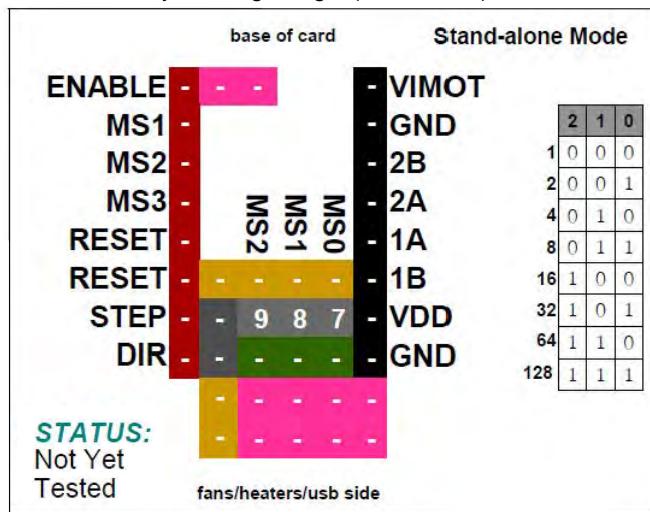
- Go to the next page.

The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".

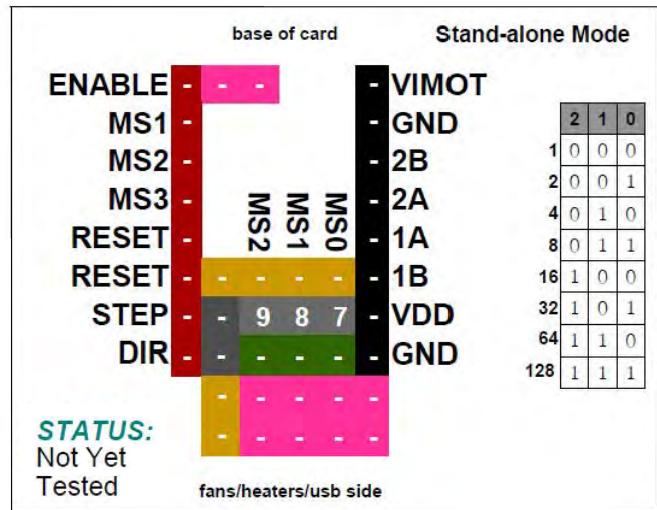


- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

LERDGE LV8729

Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|-------------------------------------|------|-------------------------------|----------------------|-----------------|
|  LV8729 Maximum 128 Subdivision 36V DC 1.5A (peak) | Low | Low | Low | Full Step | 2 Phase |
| | Low | Low | High | 1/2 Step | 1-2 Phase |
| | Low | High | Low | 1/4 Step | W1-2 Phase |
| | Low | High | High | 1/8 Step | 2W1-2 Phase |
| | High | Low | Low | 1/16 Step | 4W1-2 Phase |
| | High | Low | High | 1/32 Step | 8W1-2 Phase |
| | High | High | Low | 1/64 Step | 16W1-2 Phase |
| | High | High | High | 1/128 Step | 32W1-2 Phase |
| Driving Current Calculation Formula | $I_{MAX} = \frac{V_{ref}}{5 * R_S}$ | | $V_{ref} = 5 * I_{MAX} * R_S$ | | |
| R_S (Typical Sense Resistor) = 0.22Ω | | | | | |

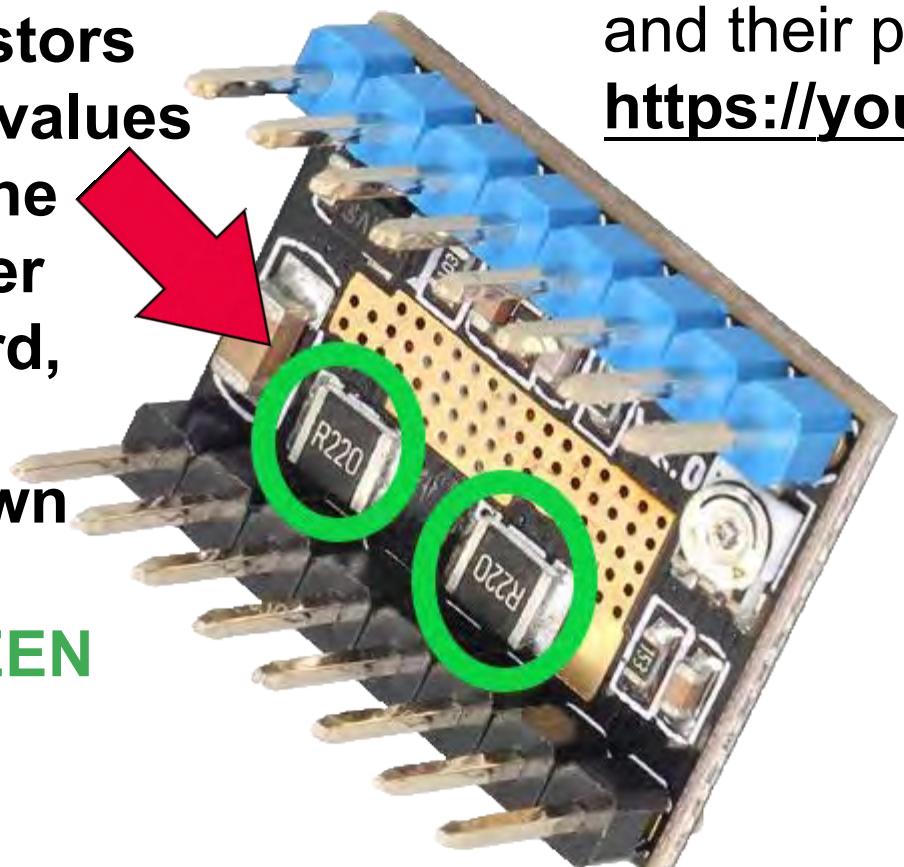


LERDGE LV8729

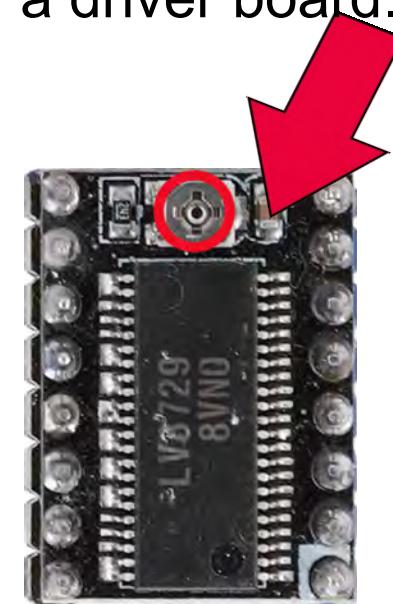
Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN



Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>



$R_s = R050$ is 0.05 Ohms

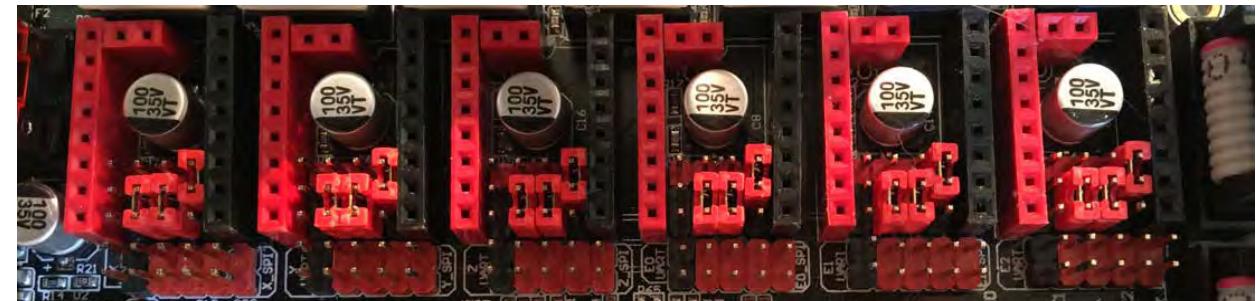
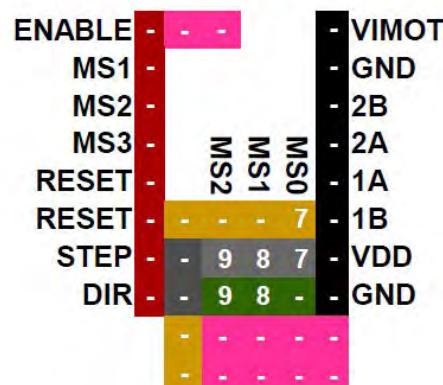
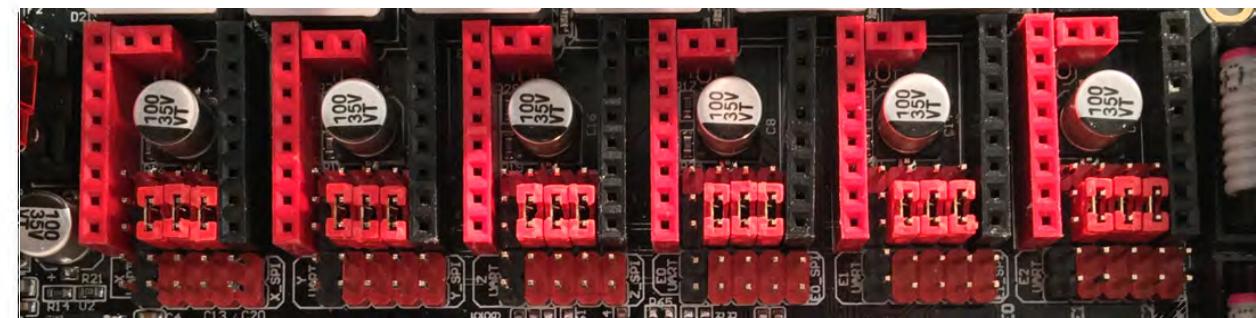
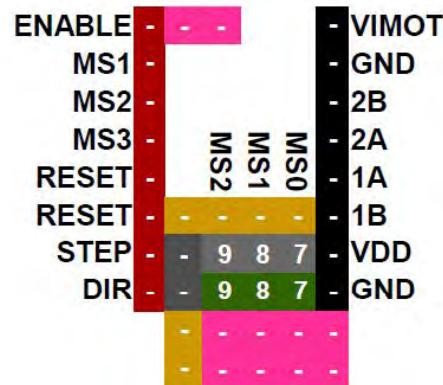
$R_s = R068$ is 0.068 Ohms

$R_s = R100$ is 0.1 Ohms

$R_s = R150$ is 0.15 Ohms

$R_s = R200$ is 0.2 Ohms

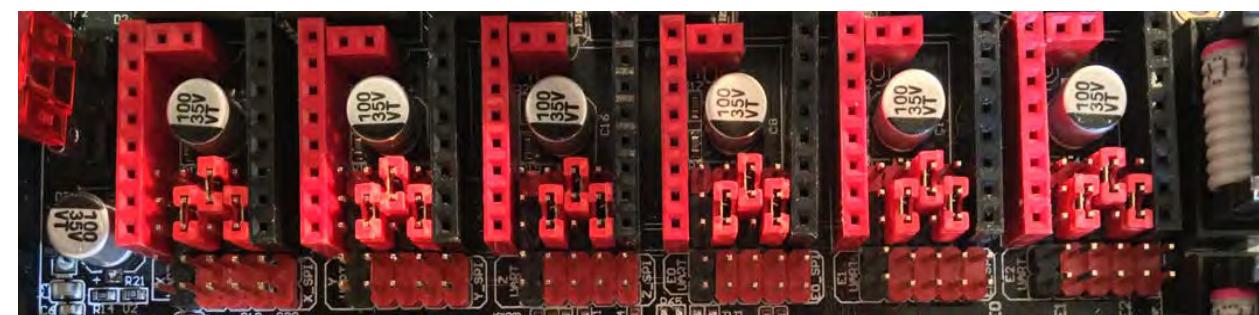
$R_s = R220$ is 0.22 Ohms

LERDGE LV8729**Stand-alone Mode**

LERDGE LV8729**Stand-alone Mode**

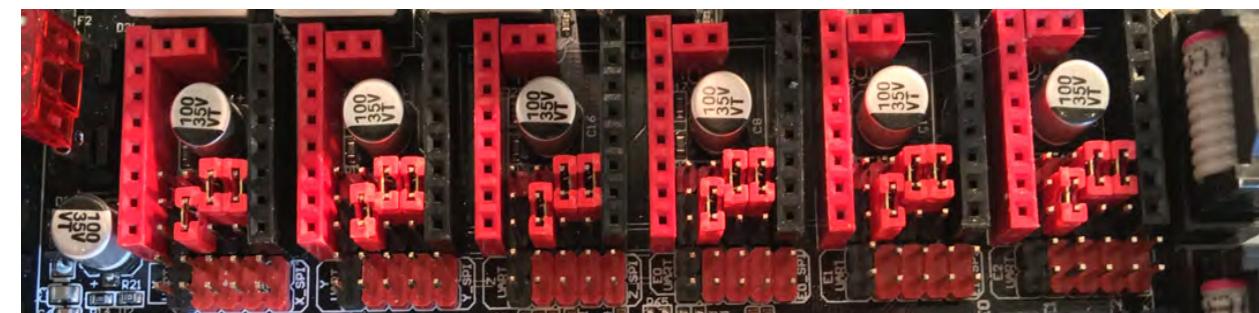
1 / 4

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| RESET | 8 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 9 - 7 | GND |



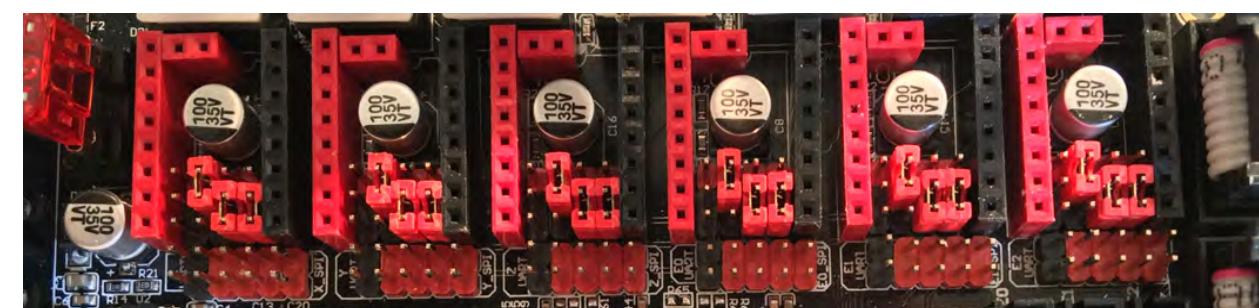
1 / 8

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| RESET | 8 7 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 9 - - | GND |



1 / 16

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| RESET | 9 - - | 1B |
| STEP | 9 8 7 | VDD |
| DIR | - 8 7 | GND |



LERDGE LV8729**Stand-alone Mode**

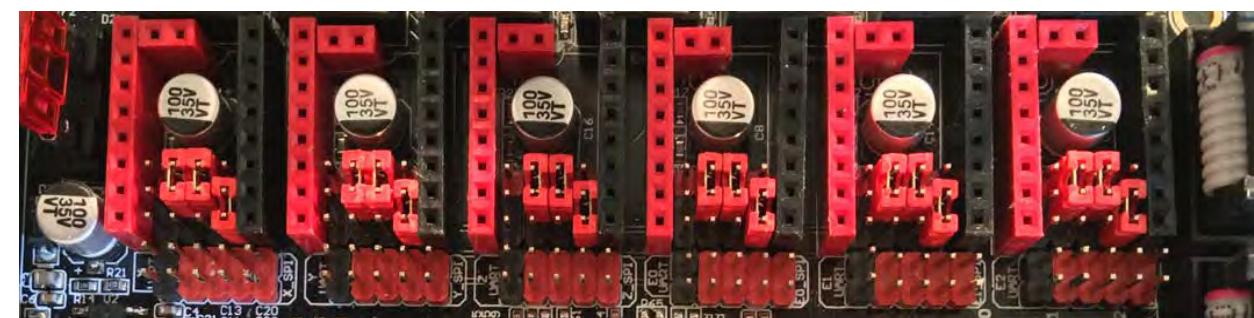
1 / 32

| | | |
|--------|-----|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | MS1 |
| RESET | 9 | 7 |
| STEP | 9 | 8 |
| DIR | 8 | - |
| | - | - |



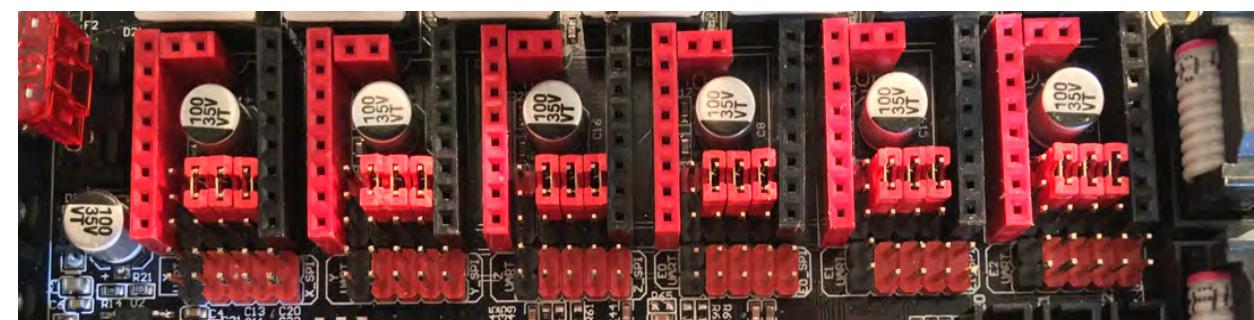
1 / 64

| | | |
|--------|-----|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | MS1 |
| RESET | 9 | 8 |
| STEP | 9 | 8 |
| DIR | 7 | GND |
| | - | - |



1 / 128

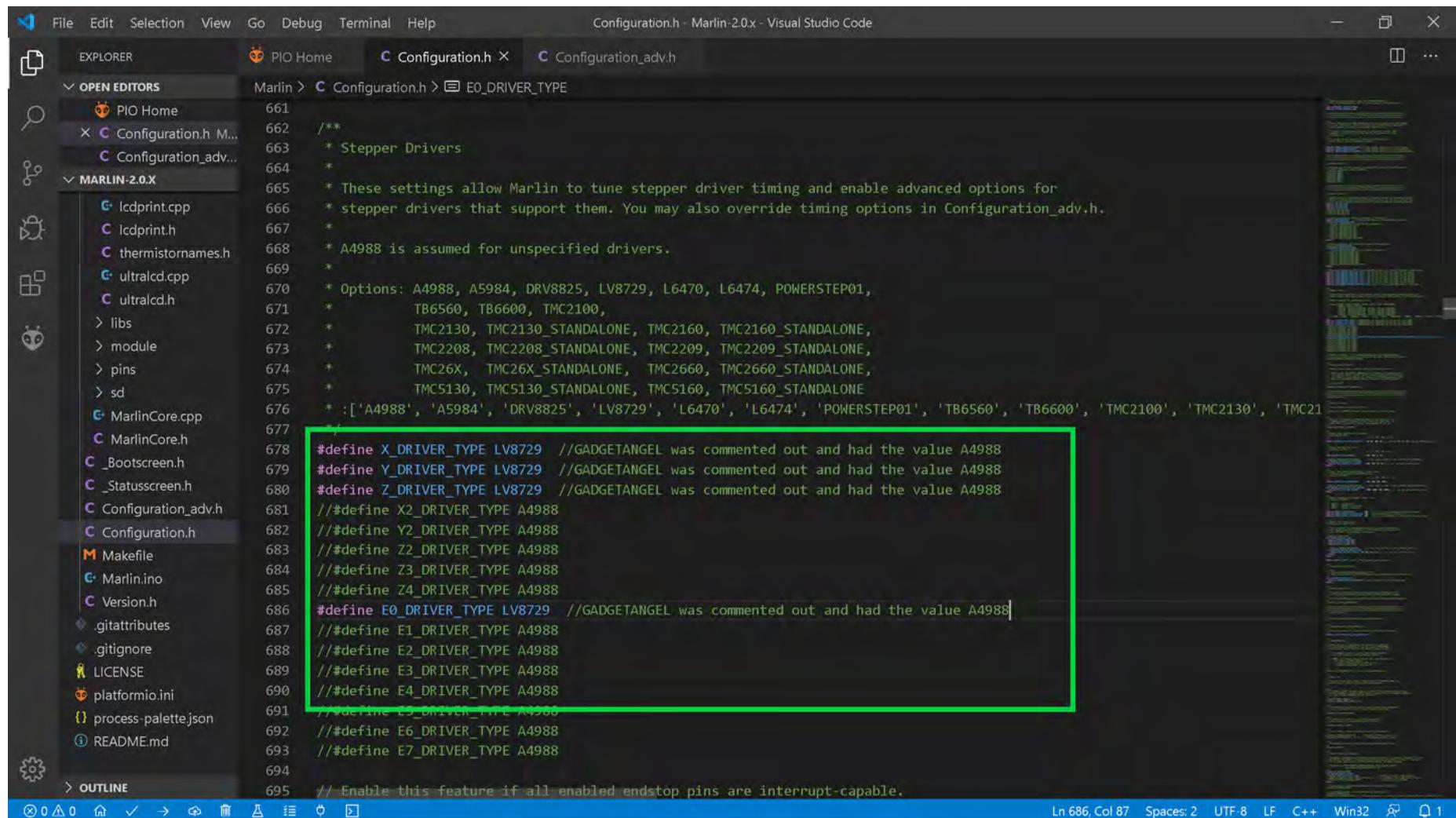
| | | |
|--------|-----|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | MS1 |
| RESET | 9 | 8 |
| STEP | 9 | 8 |
| DIR | 7 | GND |
| | - | - |



The (latest release of) Marlin Setup for LERDGE LV8729 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for Lerdge LV8729 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using Lerdge LV8729 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use Lerdge LV8729 drivers. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



```

File Edit Selection View Go Debug Terminal Help
Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h
Marlin > Configuration.h > EO_DRIVER_TYPE

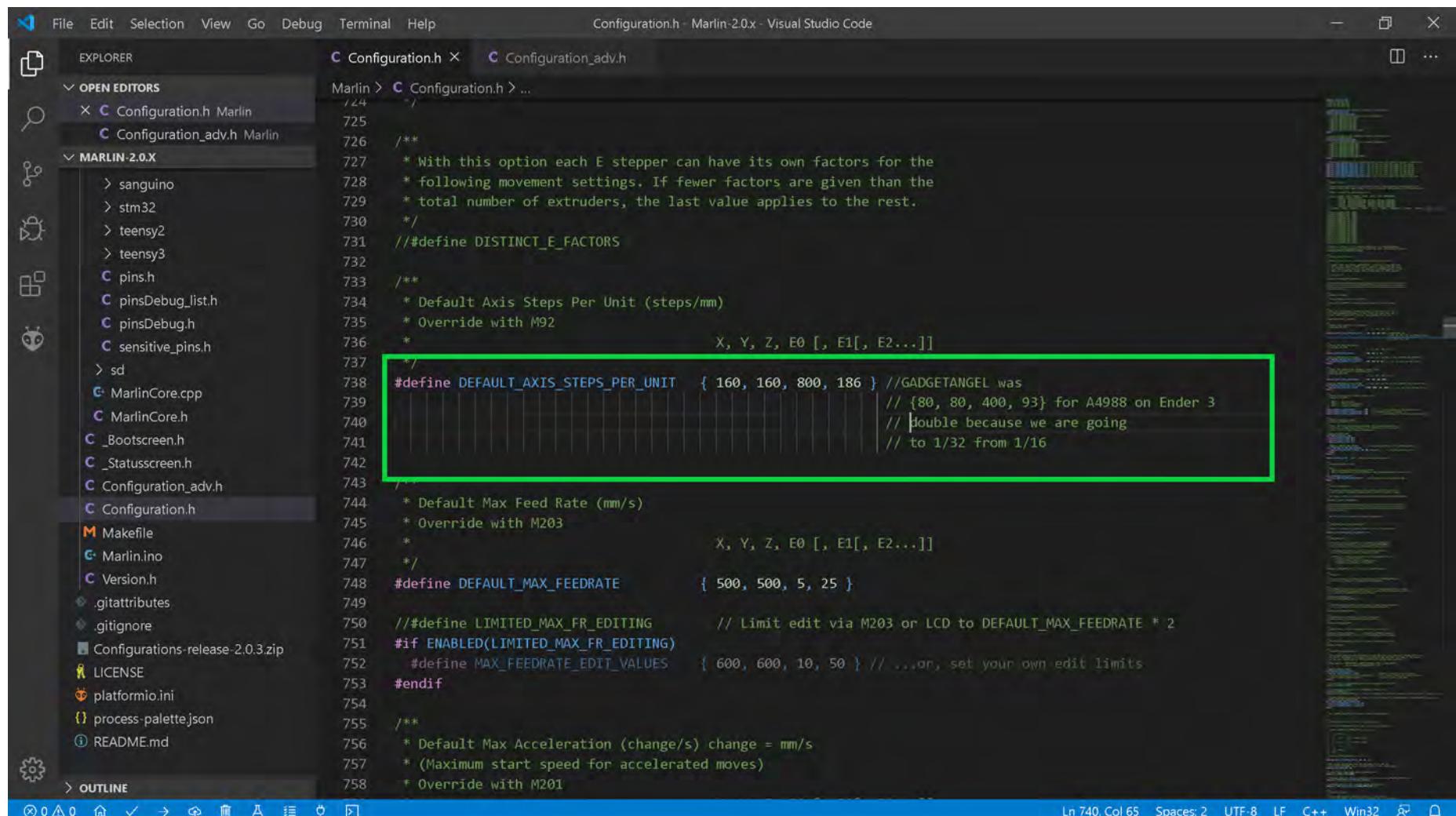
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130']
676 */
677
#define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out and had the value A4988
#define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out and had the value A4988
#define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out and had the value A4988
#define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out and had the value A4988
#define E1_DRIVER_TYPE A4988
#define E2_DRIVER_TYPE A4988
#define E3_DRIVER_TYPE A4988
#define E4_DRIVER_TYPE A4988
#define E5_DRIVER_TYPE A4988
#define E6_DRIVER_TYPE A4988
#define E7_DRIVER_TYPE A4988
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for LERDGE LV8729 Drivers

- We are changing from A4988 stepper motor drivers on the Ender 3 to LV8729 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following line of code:

```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// Double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom indicates the current line (Ln 740), column (Col 65), and other settings like spaces (Spaces: 2), encoding (UTF-8), line endings (LF), and file type (C++). The left sidebar shows the project structure with various Marlin source files and configuration files.

- Go to the next page.

The (latest release of) Marlin Setup for LERDGE LV8729 Drivers

- Since the A4988 driver is what my Ender 3 used, but, now I want to use LV8729 drivers, **I must invert the stepper motor direction** because the LV8729 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the LV8729 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as show in the **GREEN** box below

The screenshot shows the Visual Studio Code interface with the following details:

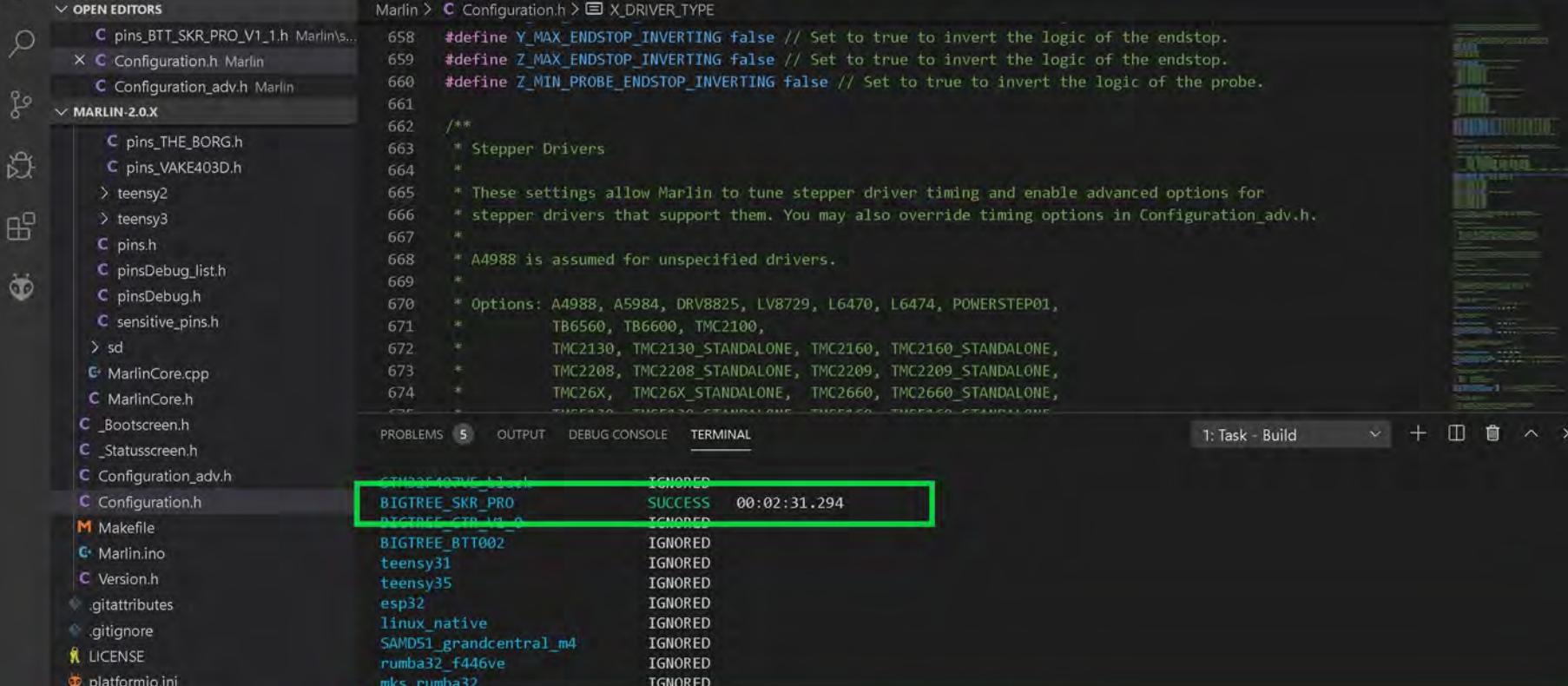
- File Menu:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Title Bar:** Configuration.h - Marlin-2.0.x - Visual Studio Code.
- Left Sidebar (EXPLORER):** Shows the project structure under MARLIN-2.0.X, including files like Configuration.h, Configuration_adv.h, sanguino, stm32, teensy2, teensy3, pins.h, pinsDebug_list.h, pinsDebug.h, sensitive_pins.h, sd, MarlinCore.cpp, MarlinCore.h, _Bootscreen.h, _Statusscreen.h, Configuration_adv.h, Configuration.h, Makefile, Marlin.ino, Version.h, .gitattributes, .gitignore, Configurations-release-2.0.3.zip, LICENSE, platformio.ini, process-palette.json, README.md, and OUTLINE.
- Right Sidebar:** Shows a vertical stack of code snippets or preview windows.
- Code Editor:** The Configuration.h file is open, showing C/C++ code. A green rectangular box highlights the following section of code:

```
1049 #define INVERT_X_DIR false           //GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false           //GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true            //GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false          //GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
```
- Bottom Status Bar:** Shows line 1051, column 107, spaces 2, UTF-8, LF, C++, Win32, and a refresh icon.

- Go to the next page.

The (latest release of) Marlin Setup for LERDGE LV8729 Drivers

- The end of Marlin setup for LERDGE LV8729 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows a Visual Studio Code interface with the following details:

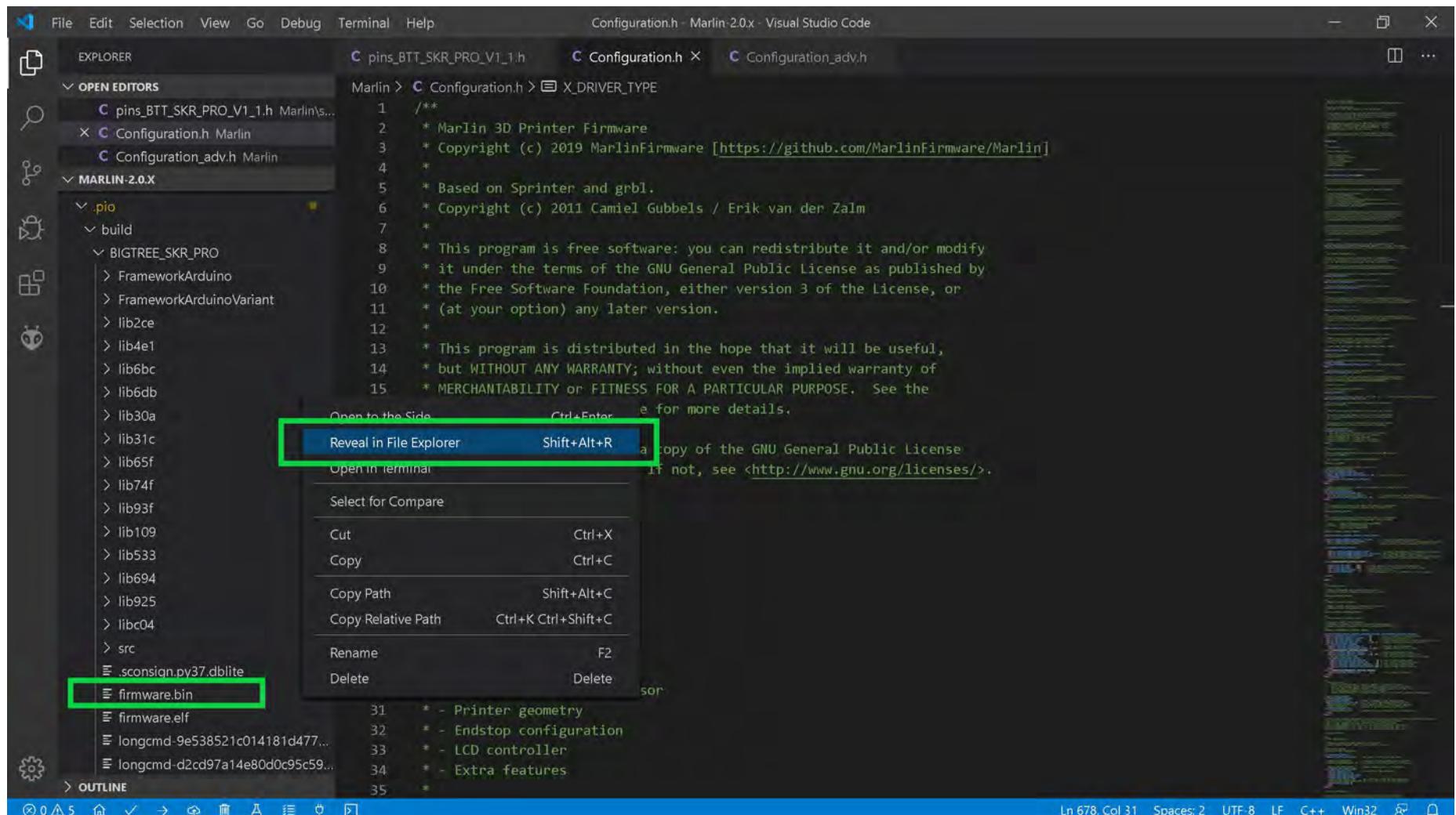
- File Explorer:** On the left, it lists files and folders under "OPEN EDITORS" and "MARLIN-2.0.X".
- Editor:** The main editor area displays code from "pins_BTT_SKR_PRO_V1_1.h" and "Configuration.h".
- Terminal:** A terminal window at the bottom shows the output of a build command. The output is:

```
=====  
include_tree IGNORED  
===== 1 succeeded in 00:02:31.294 =====
```
- Bottom Status Bar:** Shows file statistics: "In 678, Col 31, Spaces: 2, UTF-8, LF, C++, Win32".

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for LERDGE LV8729 Drivers

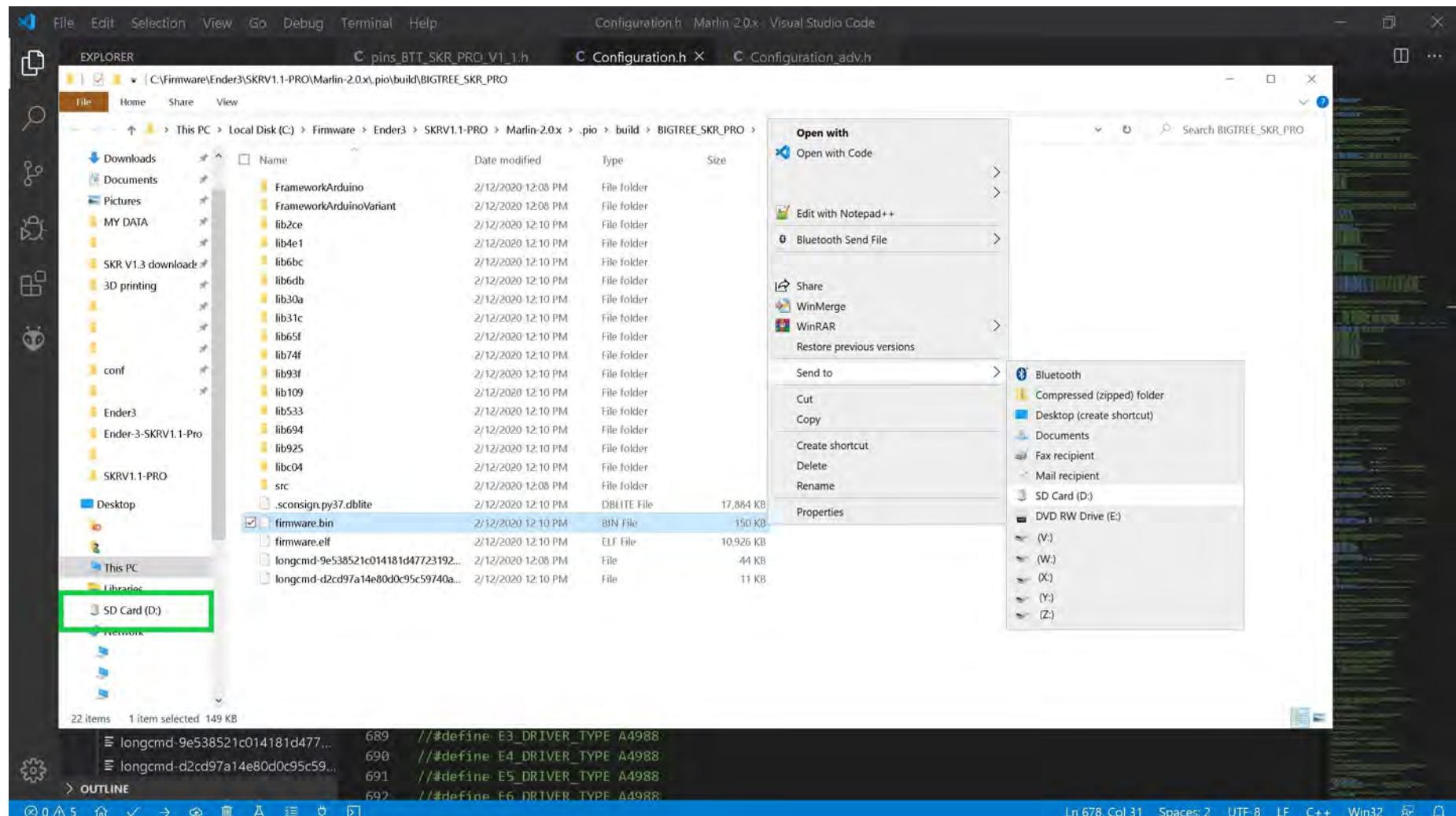
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



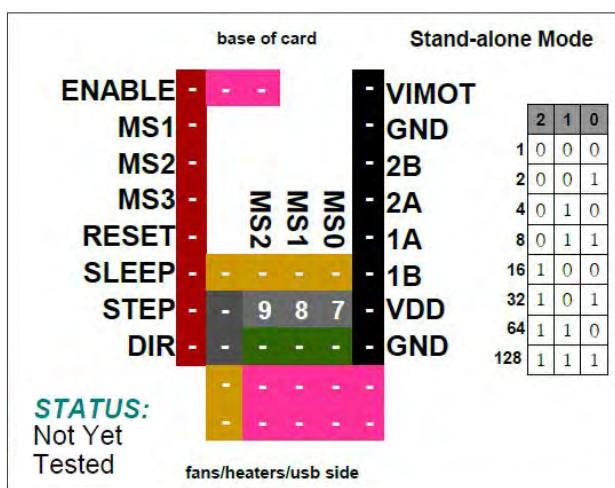
- Go to the next page.

The (latest release of) Marlin Setup for LERDGE LV8729 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



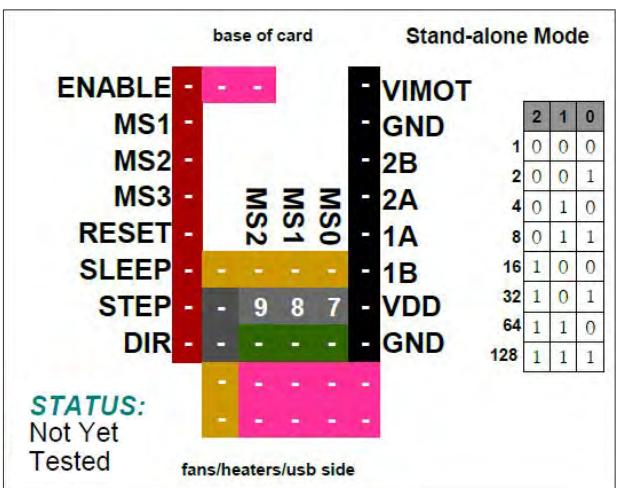
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.



MKS LV8729

Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|--|-------------------------------------|------|-------------------------------|----------------------|-----------------|
|  Makerbase LV8729 Maximum 128 Subdivision 36V DC 1.5A (peak) | Low | Low | Low | Full Step | 2 Phase |
| | Low | Low | High | 1/2 Step | 1-2 Phase |
| | Low | High | Low | 1/4 Step | W1-2 Phase |
| | Low | High | High | 1/8 Step | 2W1-2 Phase |
| | High | Low | Low | 1/16 Step | 4W1-2 Phase |
| | High | Low | High | 1/32 Step | 8W1-2 Phase |
| | High | High | Low | 1/64 Step | 16W1-2 Phase |
| | High | High | High | 1/128 Step | 32W1-2 Phase |
| Driving Current Calculation Formula | $I_{MAX} = \frac{V_{ref}}{5 * R_S}$ | | $V_{ref} = 5 * I_{MAX} * R_S$ | | |
| R_S (Typical Sense Resistor) = 0.22Ω | | | | | |



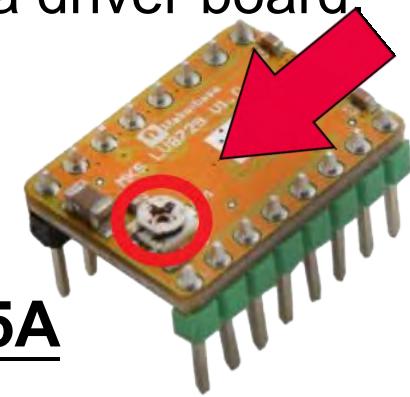
Note: Check your current sense resistor (R_s) value on the driver board, as shown in GREEN

MKS LV8729

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [**Appendix A**](#) for instructions on how to set the V_{ref} on a driver board.

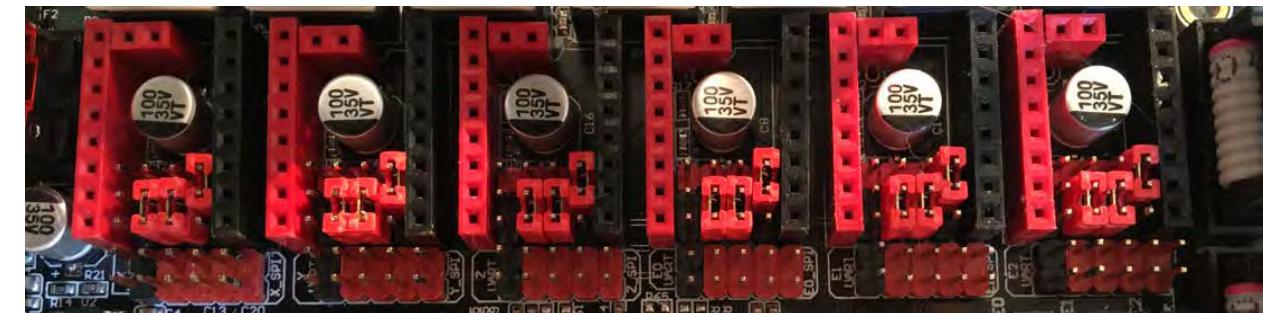
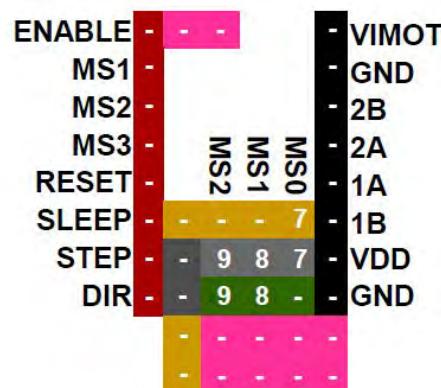
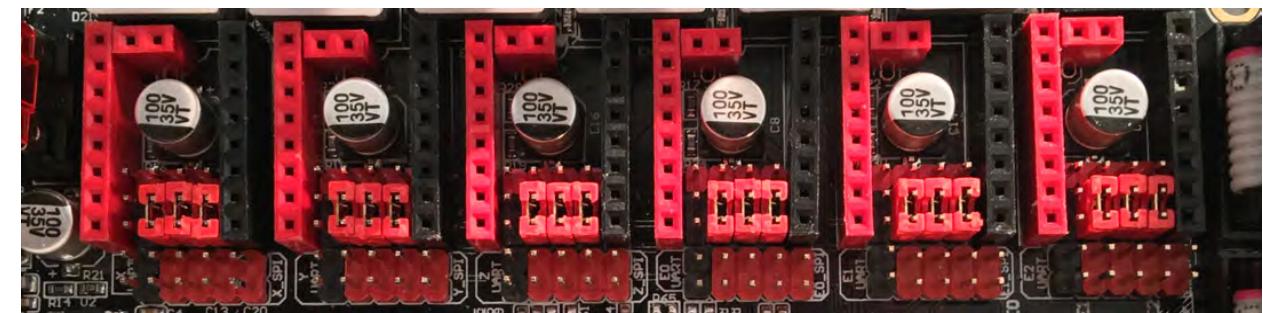
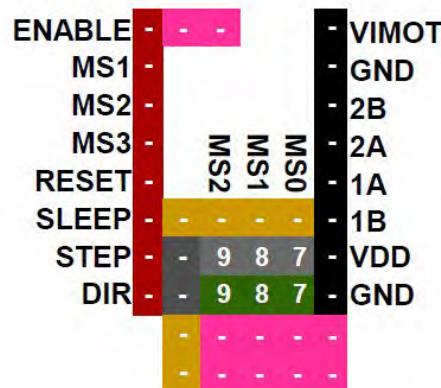
Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>



- $R_s = R050$ is 0.05 Ohms
- $R_s = R068$ is 0.068 Ohms
- $R_s = R100$ is 0.1 Ohms
- $R_s = R150$ is 0.15 Ohms
- $R_s = R200$ is 0.2 Ohms
- $R_s = R220$ is 0.22 Ohms

MKS LV8729

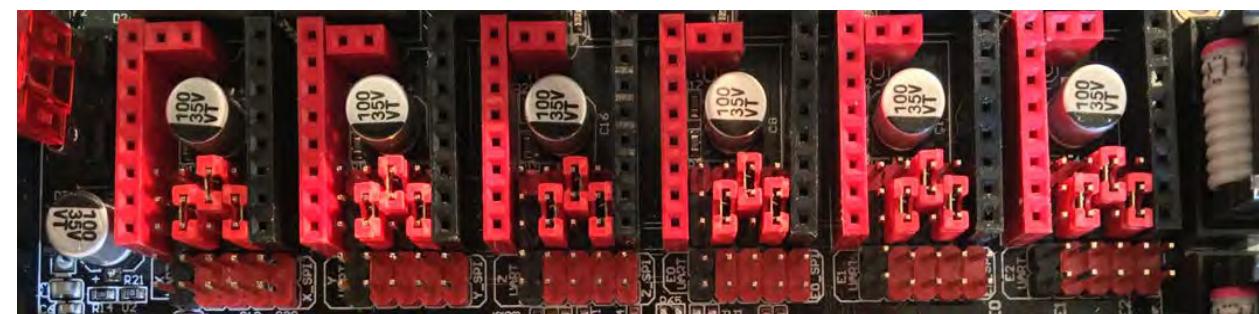
Stand-alone Mode



MKS LV8729**Stand-alone Mode**

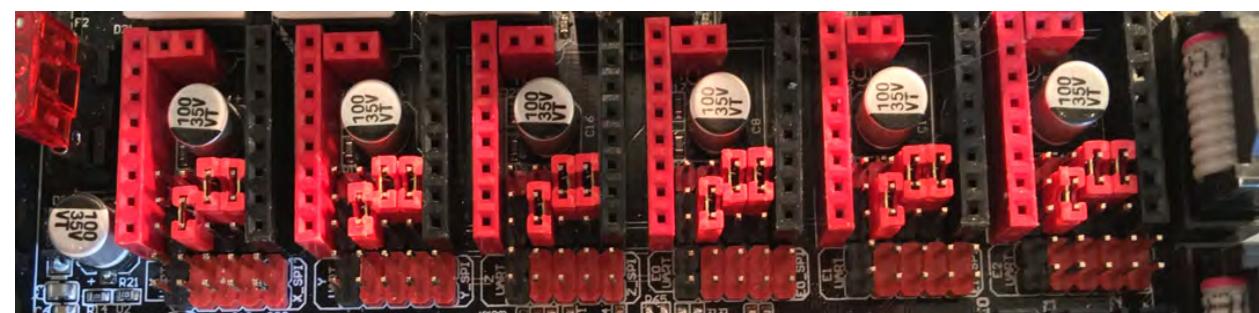
1 / 4

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | MS2 | 2A |
| RESET | MS1 | 1A |
| SLEEP | 8 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 9 - 7 | GND |



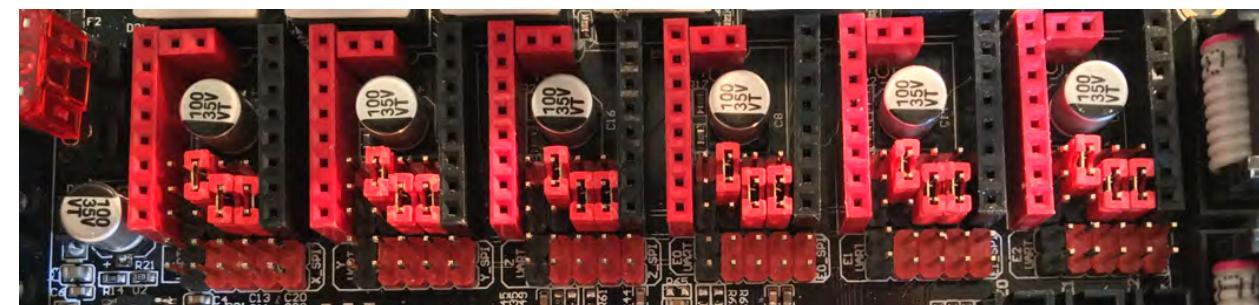
1 / 8

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | MS2 | 2A |
| RESET | MS1 | 1A |
| SLEEP | 8 7 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 9 - - | GND |



1 / 16

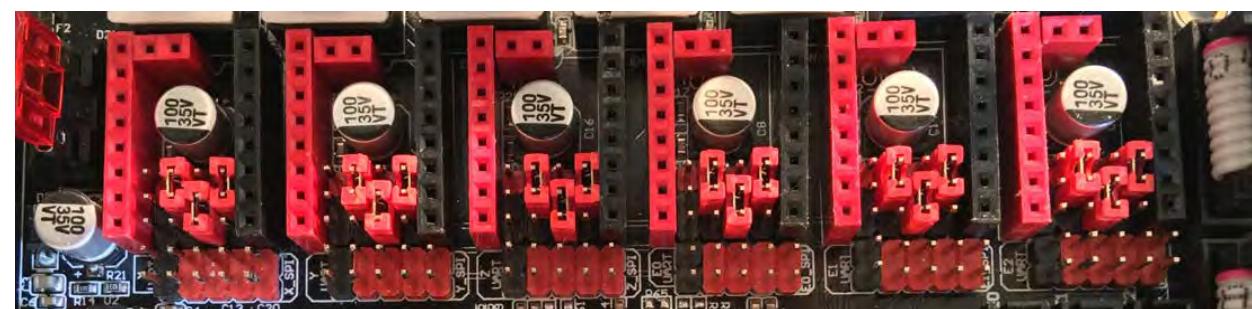
| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | MS2 | 2A |
| RESET | MS1 | 1A |
| SLEEP | 9 - - | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 8 7 | GND |



MKS LV8729**Stand-alone Mode**

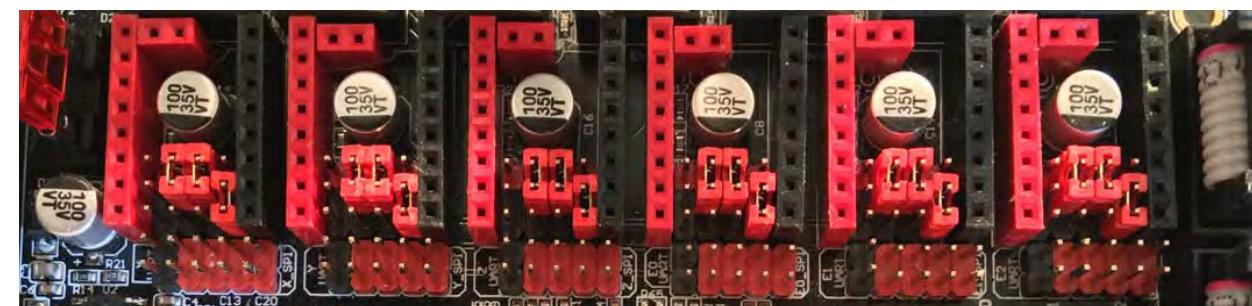
1 / 32

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 9 7 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 8 | GND |



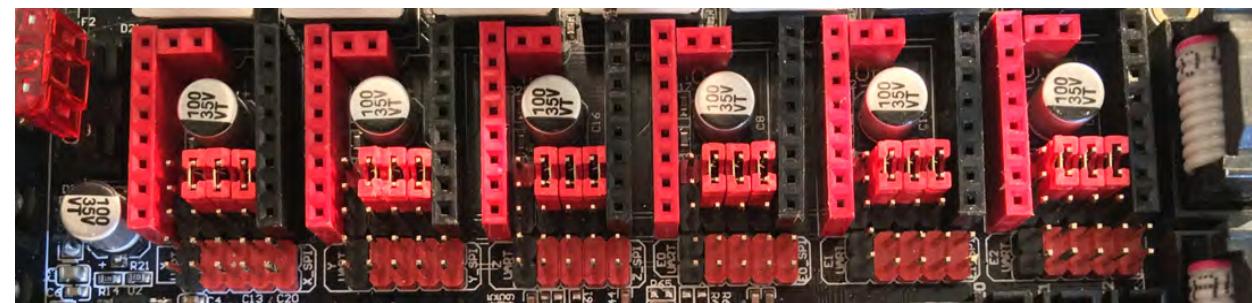
1 / 64

| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 9 8 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | 7 | GND |



1 / 128

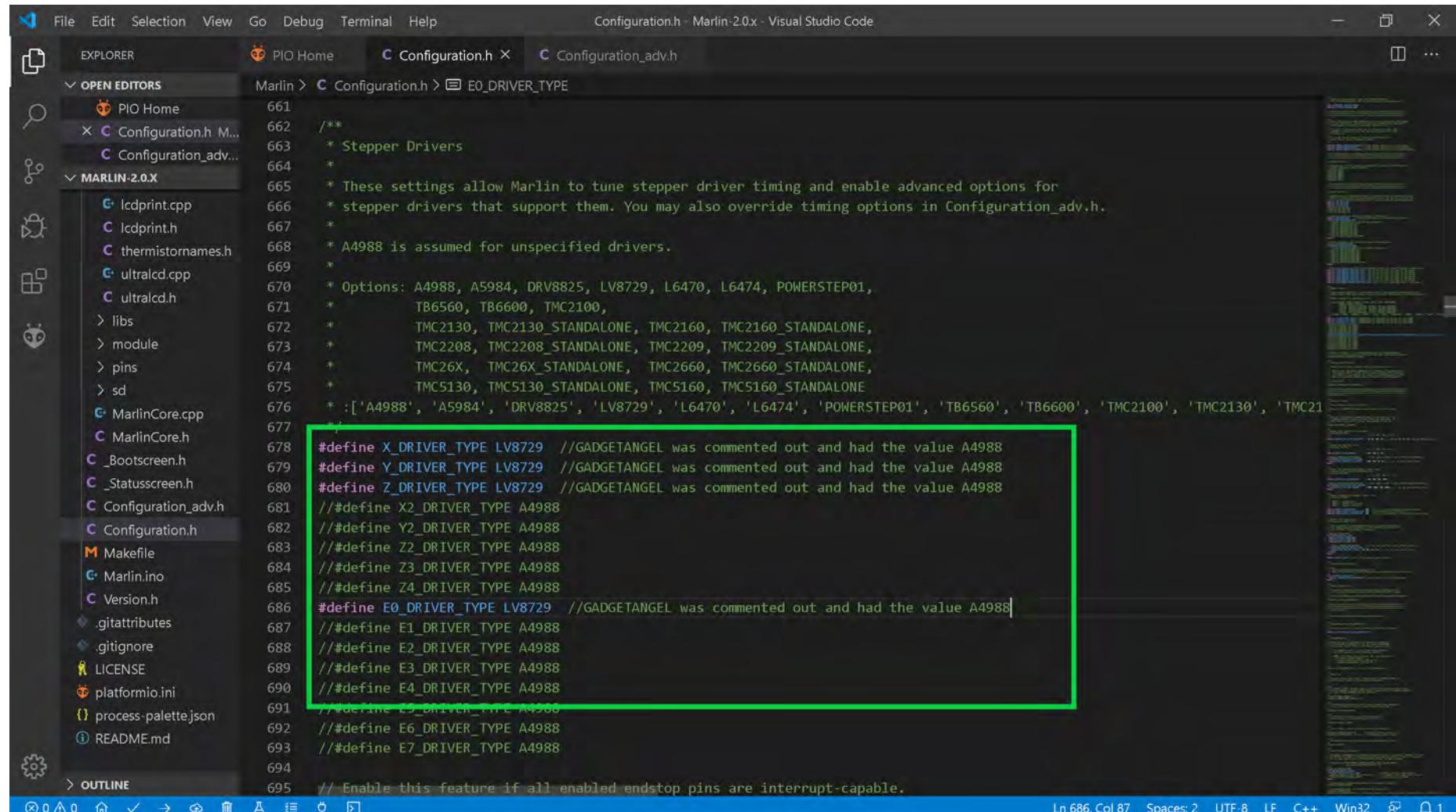
| | | |
|--------|-------|-------|
| ENABLE | - - | VIMOT |
| MS1 | - | GND |
| MS2 | - | 2B |
| MS3 | - | 2A |
| RESET | MS2 | 1A |
| SLEEP | 9 8 7 | 1B |
| STEP | 9 8 7 | VDD |
| DIR | - - | GND |



The (latest release of) Marlin Setup for MKS LV8729 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for MKS LV8729 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using MKS LV8729 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use MKS LV8729 drivers. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following configuration for stepper drivers:

```

661  /**
662  * Stepper Drivers
663  */
664  *
665  * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666  * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667  *
668  * A4988 is assumed for unspecified drivers.
669  *
670  * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671  *           TB6560, TB6600, TMC2100,
672  *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673  *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674  *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675  *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
676  *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2
677  */
678 #define X_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694 // Enable this feature if all enabled endstop pins are interrupt-capable.

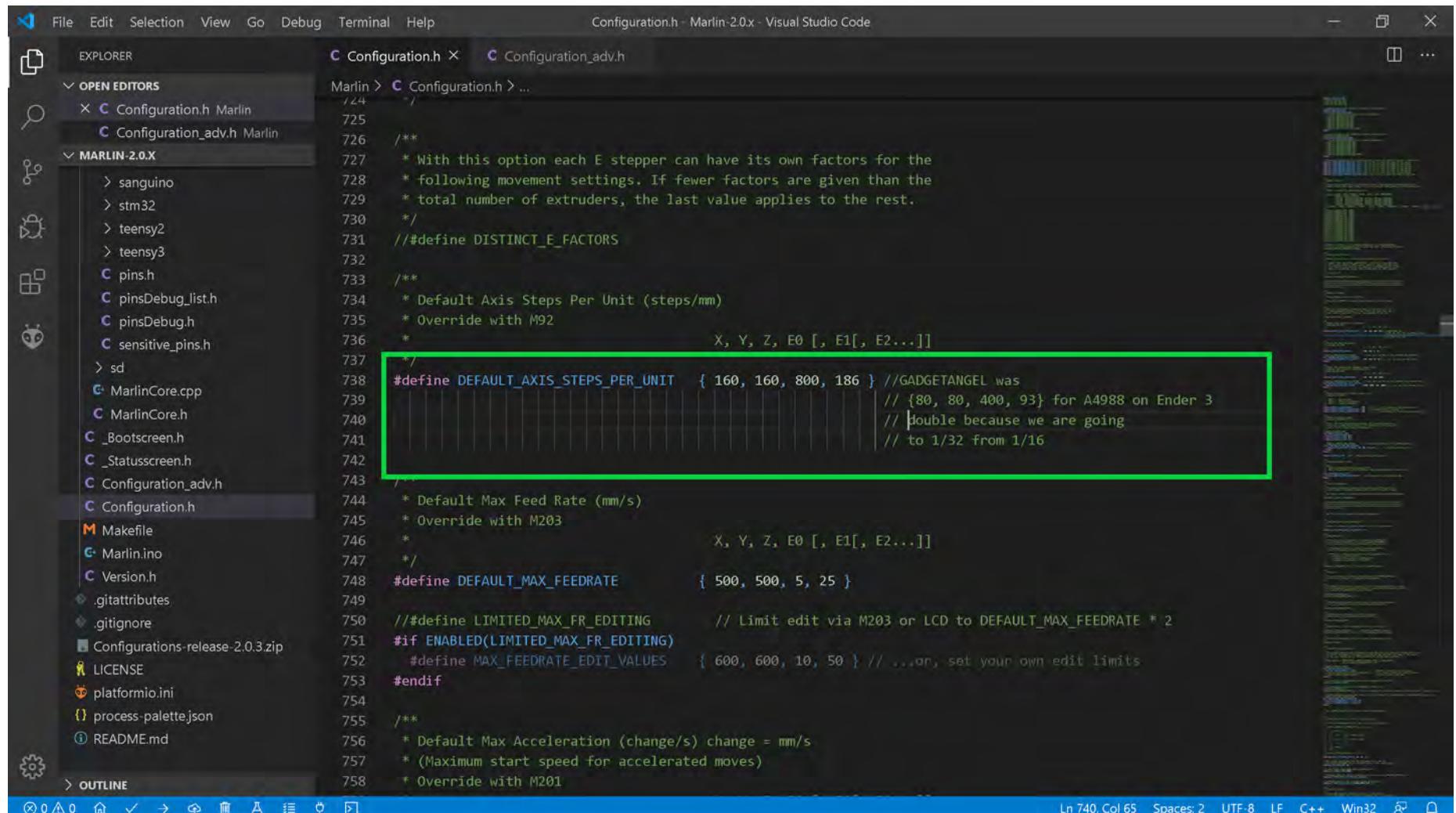
```

A green rectangular box highlights the driver type definitions for axes X, Y, Z, and E0, specifically the lines starting with `#define`. These lines were previously commented out with double slashes (//).

- Go to the next page.

The (latest release of) Marlin Setup for MKS LV8729 Drivers

- We are changing from A4988 stepper motor drivers on the Ender 3 to LV8729 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS MARLIN-2.0.X

```

Configuration.h x Configuration_adv.h
Marlin > Configuration.h ...
724
725
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } // GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // Double because we are going
741 // to 1/32 from 1/16
742
743 /**
744 * Default Max Feed Rate (mm/s)
745 * Override with M203
746 * X, Y, Z, E0 [, E1[, E2...]]
747 */
748 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }
749
750 // #define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
751 #if ENABLED(LIMITED_MAX_FR_EDITING)
752 #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ...or, set your own edit limits
753 #endif
754
755 /**
756 * Default Max Acceleration (change/s) change = mm/s
757 * (Maximum start speed for accelerated moves)
758 * Override with M201

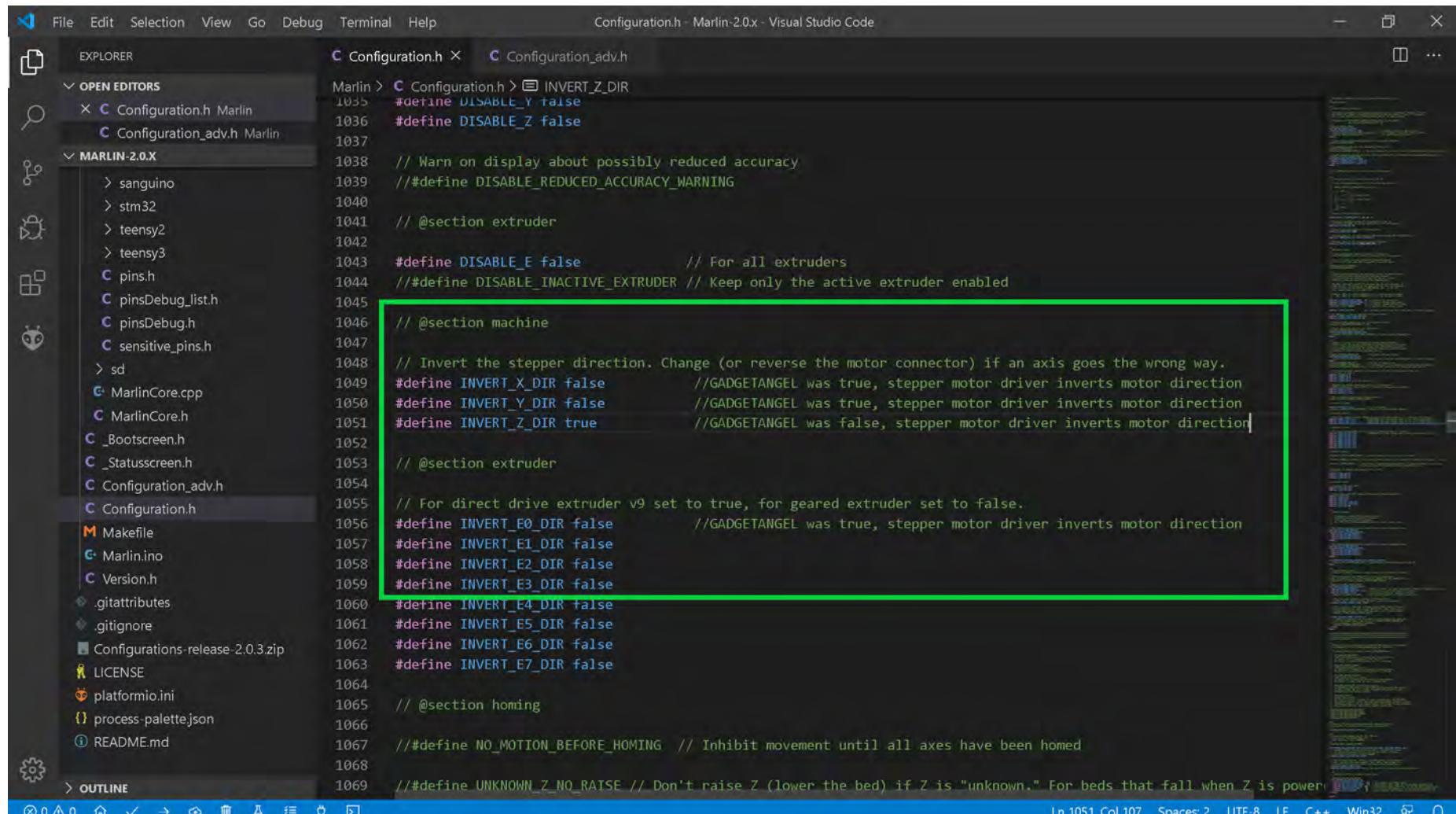
```

Ln 740, Col 65 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for MKS LV8729 Drivers

- Since the A4988 driver is what my Ender 3 used, but, now I want to use LV8729 drivers, I must invert the stepper motor direction because the LV8729 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the LV8729 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as show in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights several lines of code related to stepper motor direction inversion:

```

Marlin > C Configuration.h > #define INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

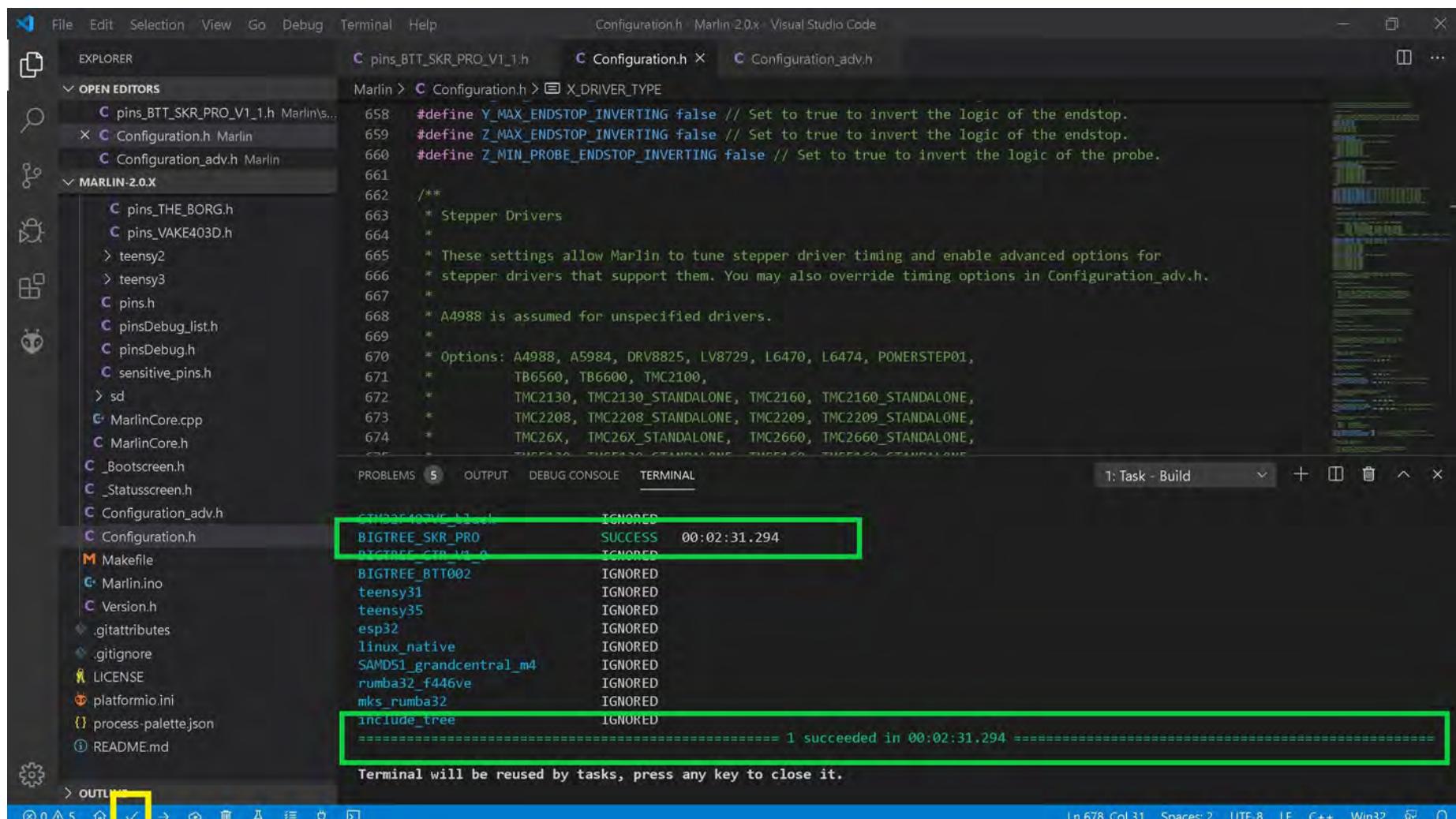
```

The green box covers the following lines: 1049, 1050, 1051, 1056, 1057, 1058, 1059, 1060, 1061, 1062, 1063, and 1064.

- Go to the next page.

The (latest release of) Marlin Setup for MKS LV8729 Drivers

- The end of Marlin setup for MKS LV8729 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the Marlin 2.0.x repository open. The left sidebar shows the file structure under 'OPEN EDITORS' and 'MARLIN-2.0.X'. The main editor area displays Configuration.h with code related to driver types and stepper drivers. The bottom right terminal window shows the build process:

```

CTM2208_TMC2130_12_0: IGNORED
BIGTREE_SKR_PRO: SUCCESS 00:02:31.294
BIGTREE_CTP_12_0: IGNORED
BIGTREE_BTT002: IGNORED
teensy31: IGNORED
teensy35: IGNORED
esp32: IGNORED
linux_native: IGNORED
SAMD51_grandcentral_m4: IGNORED
rumba32_f446ve: IGNORED
mks_rumba32: IGNORED
include_tree: IGNORED
=====
===== 1 succeeded in 00:02:31.294 =====

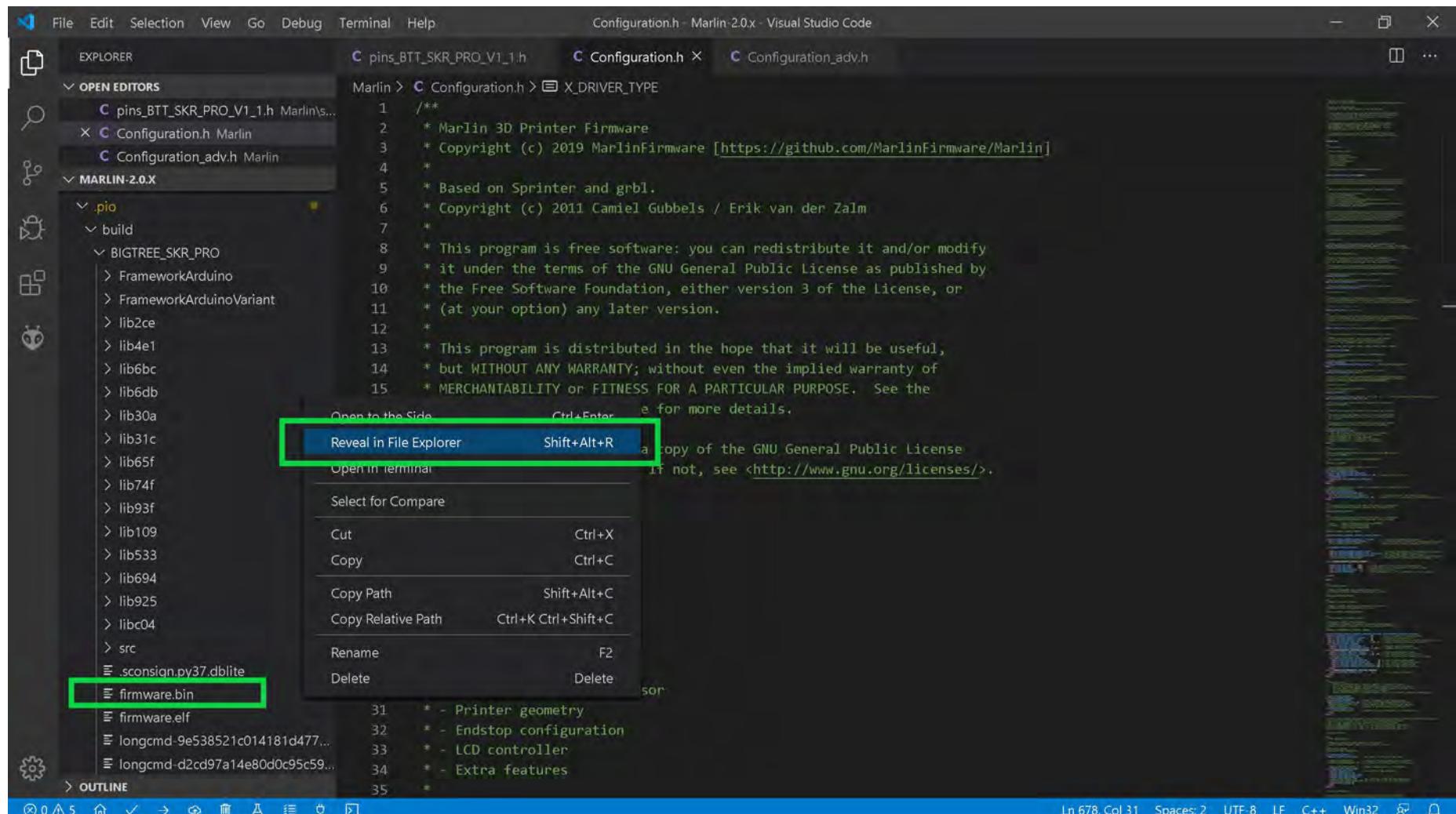
```

The terminal message indicates a successful build. A yellow box highlights the checkmark icon in the bottom-left corner of the terminal tab bar, and a green box highlights the success message in the terminal output.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for MKS LV8729 Drivers

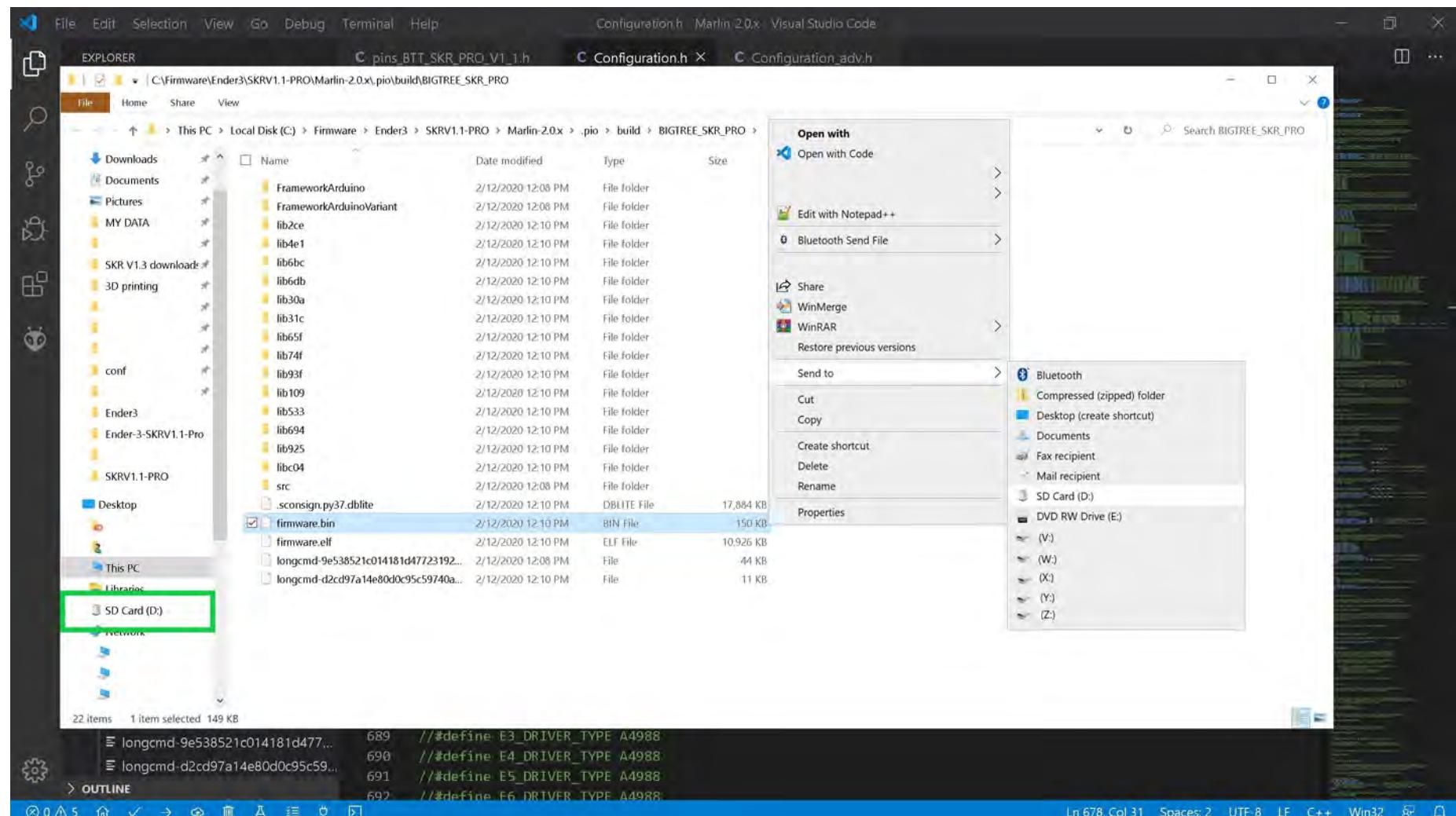
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



- Go to the next page.

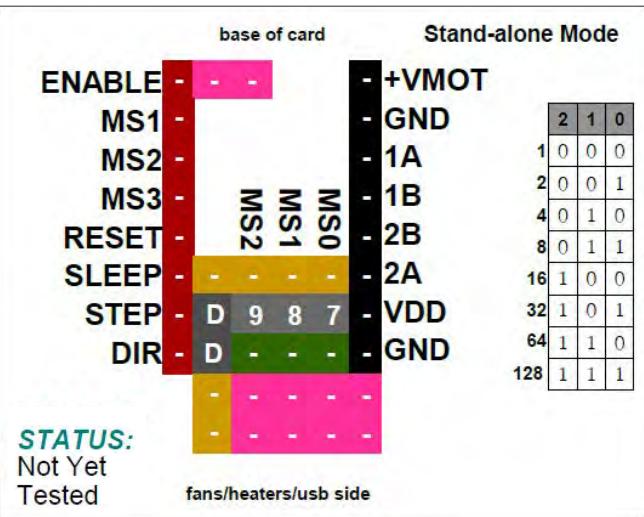
The (latest release of) Marlin Setup for MKS LV8729 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

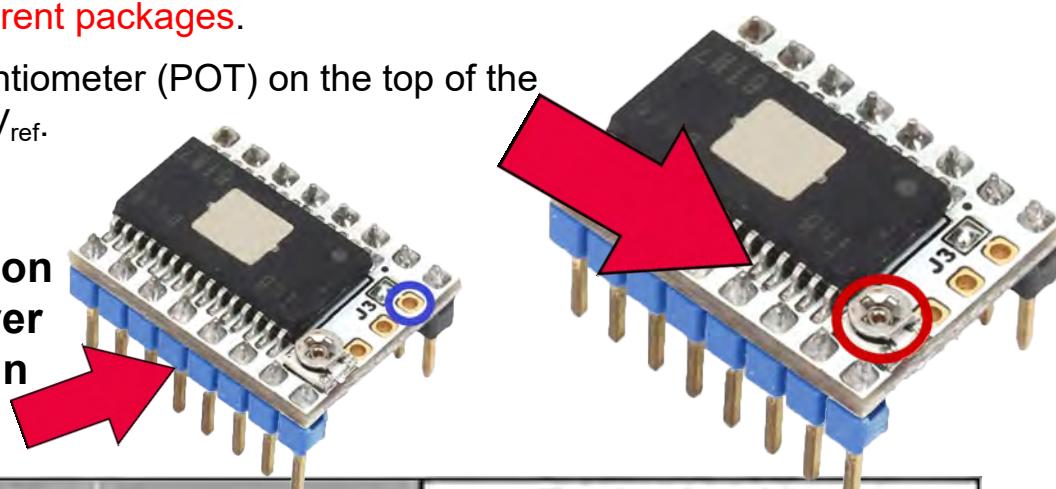
FYSETC S6128 V1.1



FYSETC S6128 V1.1 states: "SureStepr SD6128 is a stepper driver board based on the THB6128 chip"; my understanding is that the **THB6128** and the **LV8729** are **the same chip in different packages**.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} .

Note: " V_{ref} Test point" location is on the top of the driver board, as shown in **BLUE**



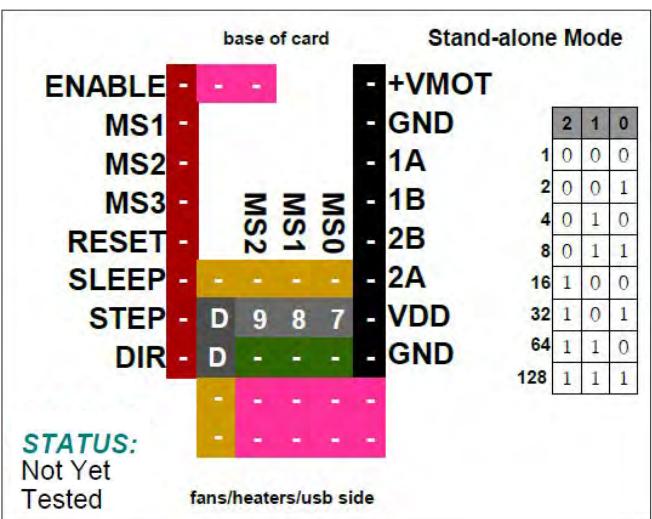
| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|--|------|------|------|----------------------|---------------------|
| FYSETC SureStepr SD6128 | Low | Low | Low | Full Step | 2 Phase |
| | Low | Low | High | 1/2 Step | 1-2 Phase |
| | Low | High | Low | 1/4 Step | W1-2 Phase |
| | Low | High | High | 1/8 Step | 2W1-2 Phase |
| | High | Low | Low | 1/16 Step | 4W1-2 Phase |
| | High | Low | High | 1/32 Step | 8W1-2 Phase |
| | High | High | Low | 1/64 Step | 16W1-2 Phase |
| | High | High | High | 1/128 Step | 32W1-2 Phase |

| Driving Current Calculation Formula |
|--|
| R_S (Typical Sense Resistor) = 0.1Ω |

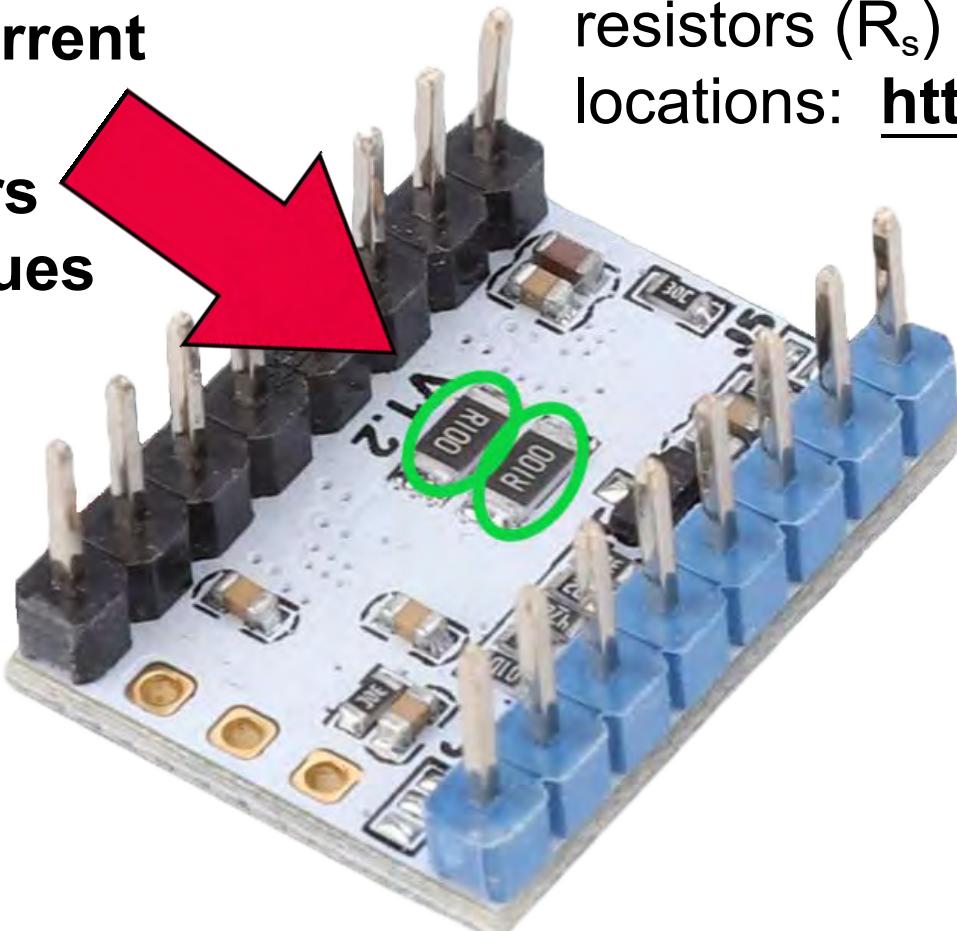
$$I_{MAX} = \frac{V_{ref}}{5 * R_S}$$

$$V_{ref} = 5 * I_{MAX} * R_S$$

FYSETC S6128 V1.1



Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN



Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [**Appendix A**](#) for instructions on how to set the V_{ref} on a driver board.

Note: See this video about current sense resistors (R_s) and their possible locations: <https://youtu.be/8wk1elugv5A>

$R_s = R050$ is 0.05 Ohms

$R_s = R068$ is 0.068 Ohms

$R_s = R100$ is 0.1 Ohms

$R_s = R150$ is 0.15 Ohms

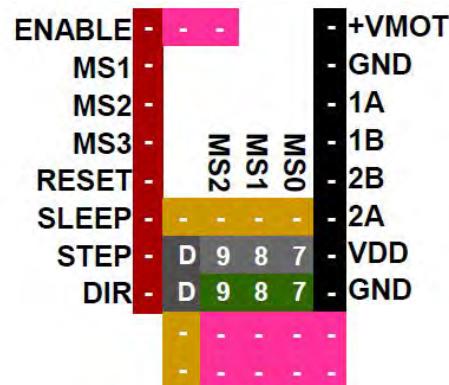
$R_s = R200$ is 0.2 Ohms

$R_s = R220$ is 0.22 Ohms

FYSETC S6128 V1.1

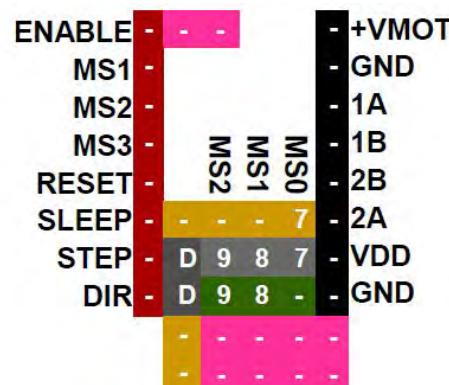
Stand-alone Mode

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.



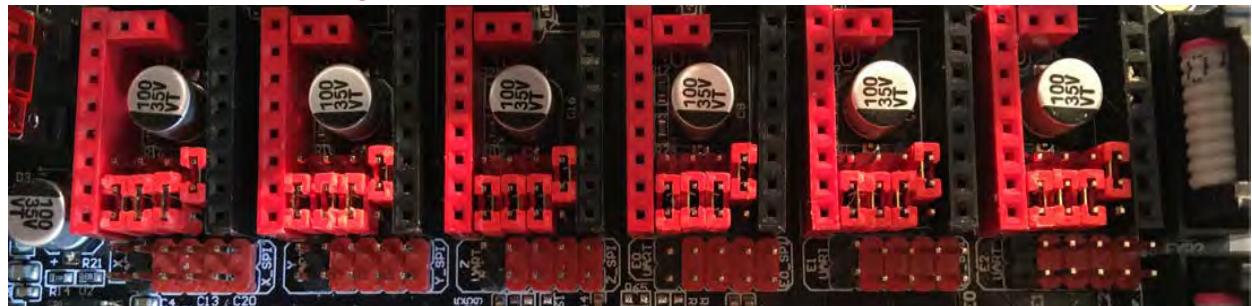
STEP

Note: The "D" jumper MUST be SET!



1 / 2

Note: The "D" jumper MUST be SET!



FYSETC S6128 V1.1

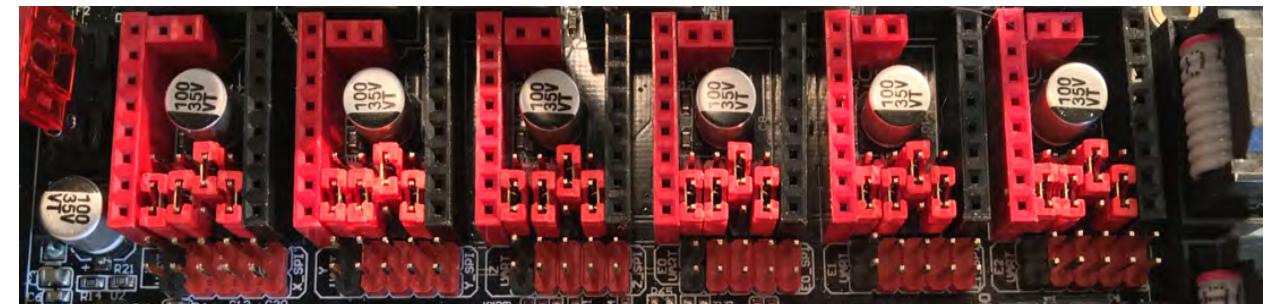
Stand-alone Mode

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.

| | | |
|--------|-------------------|-------|
| ENABLE | - - | +VMOT |
| MS1 | - | GND |
| MS2 | - | 1A |
| MS3 | MS2 MS1 MS0 | 1B |
| RESET | - - | 2B |
| SLEEP | 8 | 2A |
| STEP | D 9 8 7 | VDD |
| DIR | D 9 - 7 | GND |
| | - - - | - |

1 / 4

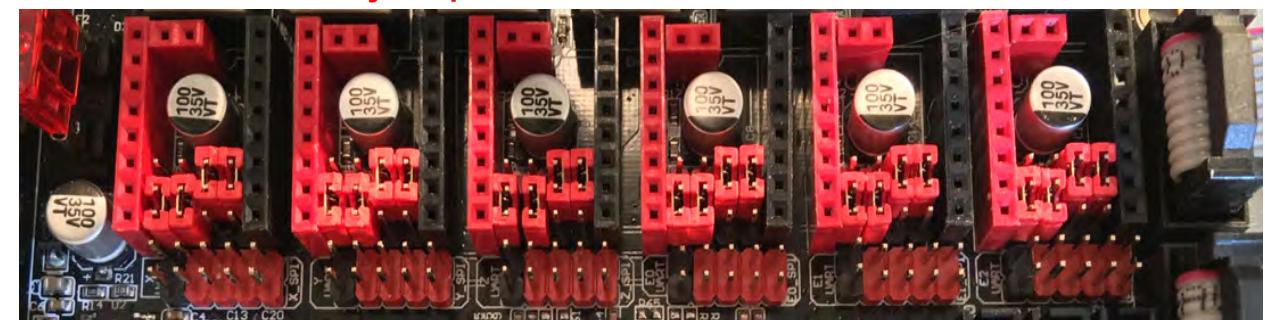
Note: The "D" jumper MUST be SET!



| | | |
|--------|-------------------|-------|
| ENABLE | - - | +VMOT |
| MS1 | - | GND |
| MS2 | - | 1A |
| MS3 | MS2 MS1 MS0 | 1B |
| RESET | - - | 2B |
| SLEEP | 8 7 | 2A |
| STEP | D 9 8 7 | VDD |
| DIR | D 9 - - | GND |
| | - - - | - |

1 / 8

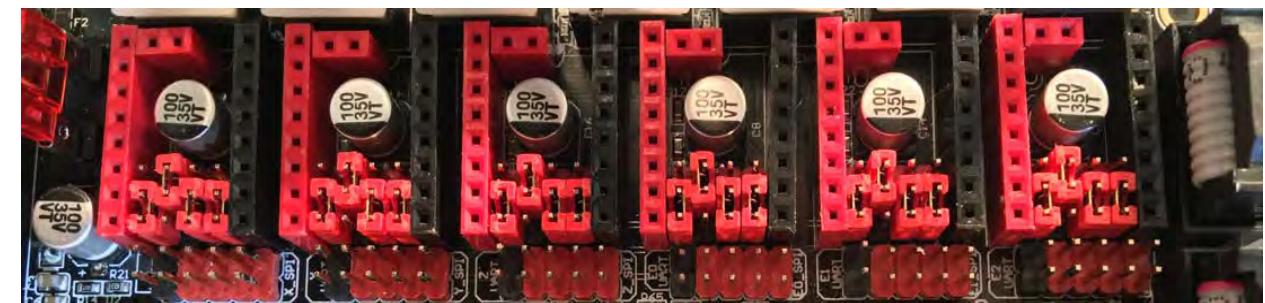
Note: The "D" jumper MUST be SET!



| | | |
|--------|-------------------|-------|
| ENABLE | - - | +VMOT |
| MS1 | - | GND |
| MS2 | - | 1A |
| MS3 | MS2 MS1 MS0 | 1B |
| RESET | - - | 2B |
| SLEEP | 9 - - | 2A |
| STEP | D 9 8 7 | VDD |
| DIR | D 8 7 | GND |
| | - - - | - |

1 / 16

Note: The "D" jumper MUST be SET!



FYSETC S6128 V1.1

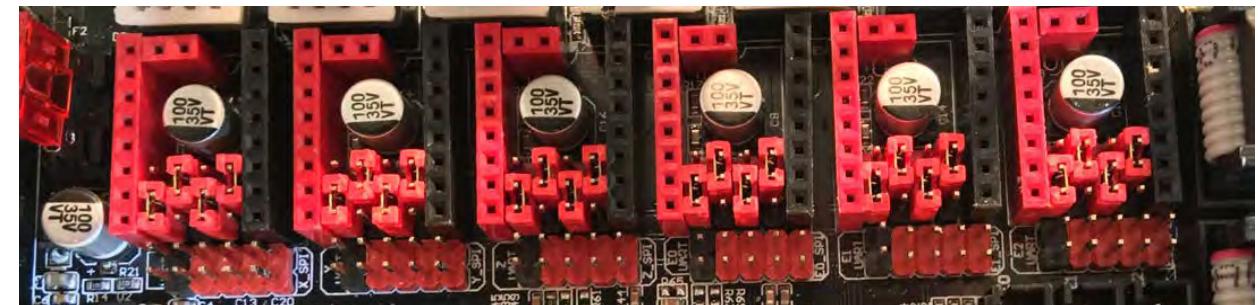
Stand-alone Mode

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.

1 / 32

| | | | | |
|--------|---|-----|-----|-------|
| ENABLE | - | - | - | +VMOT |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | MS0 |
| SLEEP | - | 9 | 7 | 2A |
| STEP | D | 9 | 8 | 7 |
| DIR | D | - | 8 | - |
| | - | - | - | GND |
| | - | - | - | - |

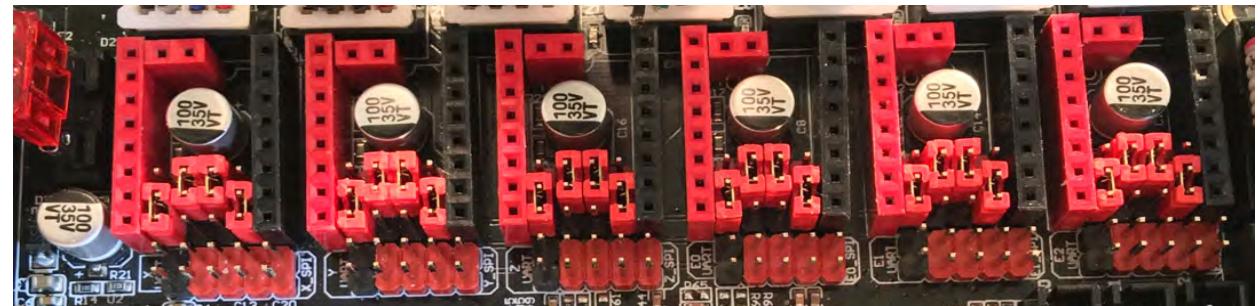
Note: The "D" jumper MUST be SET!



1 / 64

| | | | | |
|--------|---|-----|-----|-------|
| ENABLE | - | - | - | +VMOT |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | MS0 |
| SLEEP | - | 9 | 8 | - |
| STEP | D | 9 | 8 | 7 |
| DIR | D | - | - | 7 |
| | - | - | - | - |
| | - | - | - | - |

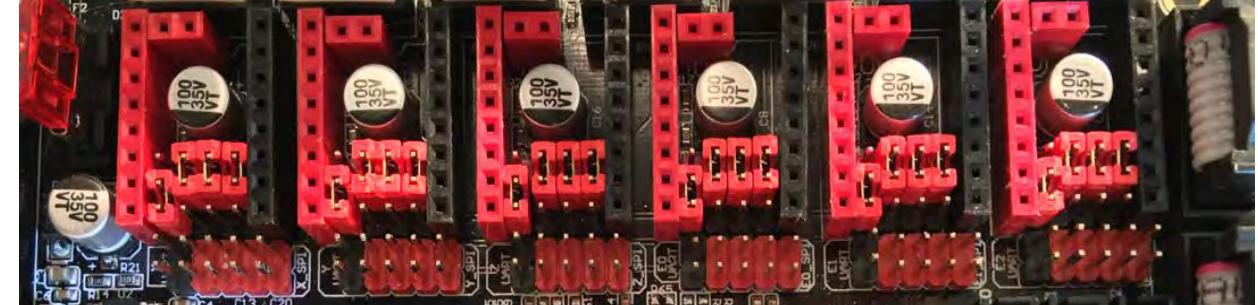
Note: The "D" jumper MUST be SET!



1 / 128

| | | | | |
|--------|---|-----|-----|-------|
| ENABLE | - | - | - | +VMOT |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | 1A |
| MS3 | - | - | - | 1B |
| RESET | - | MS2 | MS1 | MS0 |
| SLEEP | - | 9 | 8 | 7 |
| STEP | D | 9 | 8 | 7 |
| DIR | D | - | - | - |
| | - | - | - | - |
| | - | - | - | - |

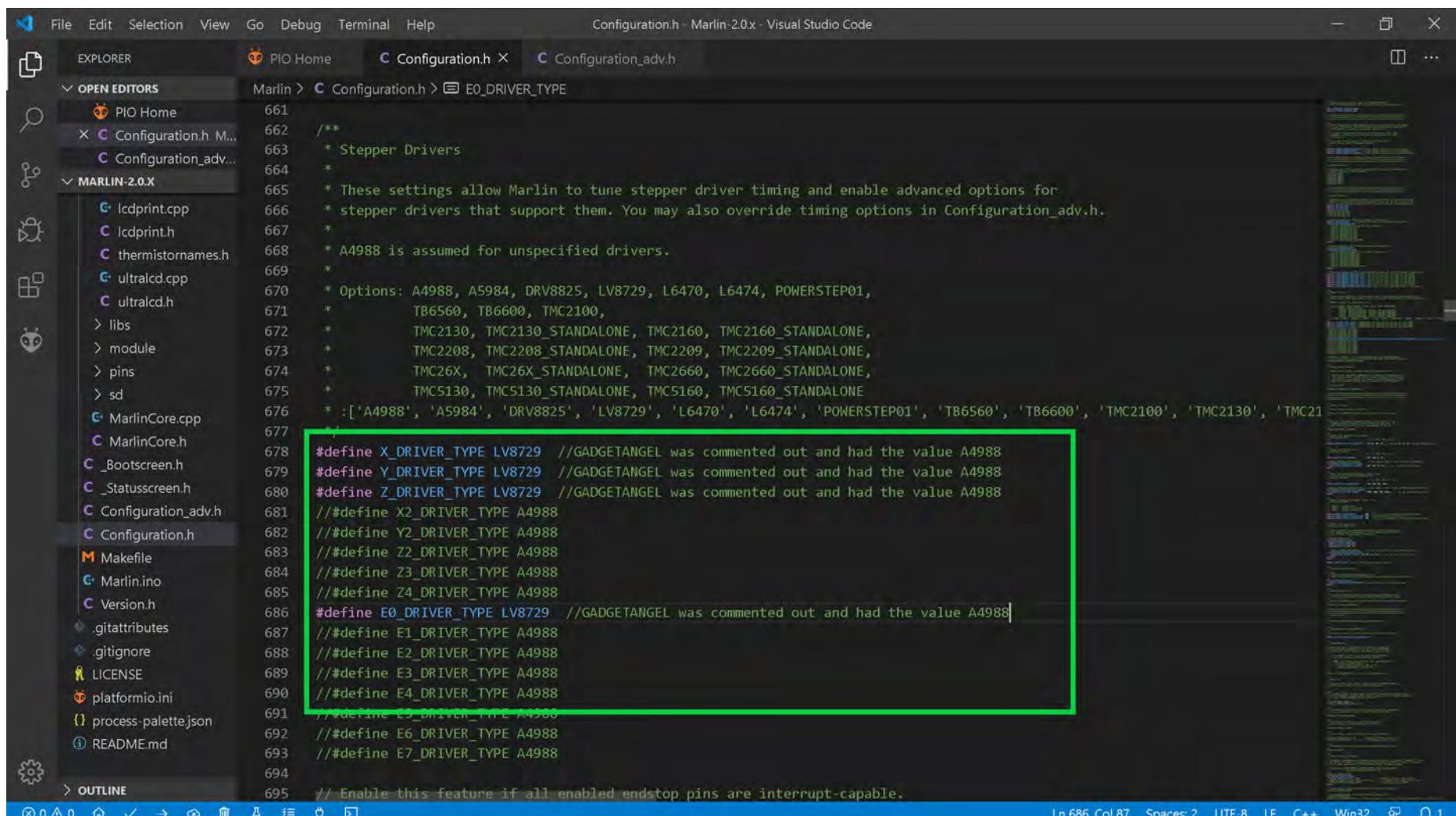
Note: The "D" jumper MUST be SET!



The (latest release of) Marlin Setup for FYSETC S6128 V1.1 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for FYSETC S6128 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using FYSETC S6128 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use FYSETC S6128 drivers. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
- The S6128 is a drop in replacement for the LV8729. Since Marlin does not have an option for S6128 we will use the LV8729 option.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the following snippet of C++ code:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * T86560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130', 'TMC5160']
676 */
677
# define X_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
# define Y_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
# define Z_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
//#define X2_DRIVER_TYPE A4988
//#define Y2_DRIVER_TYPE A4988
//#define Z2_DRIVER_TYPE A4988
//#define Z3_DRIVER_TYPE A4988
//#define Z4_DRIVER_TYPE A4988
# define E0_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988
//#define E1_DRIVER_TYPE A4988
//#define E2_DRIVER_TYPE A4988
//#define E3_DRIVER_TYPE A4988
# define E4_DRIVER_TYPE A4988
//#define E5_DRIVER_TYPE A4988
//#define E6_DRIVER_TYPE A4988
//#define E7_DRIVER_TYPE A4988
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

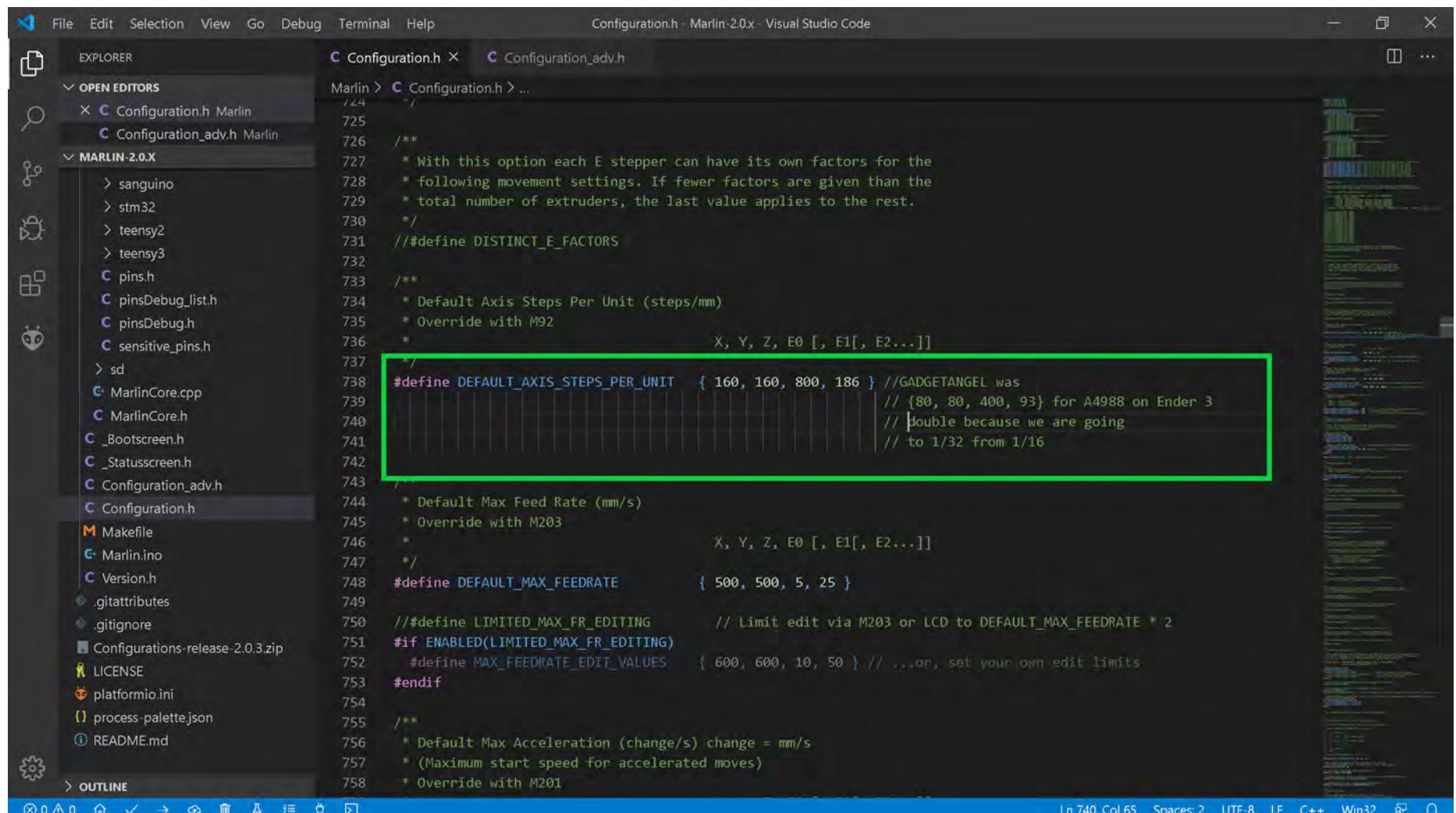
```

A green rectangular box highlights the line `# define E0_DRIVER_TYPE LV8729 //GADGETANGEL was commented out and had the value A4988`. This indicates that the driver type for axis 0 has been changed from the default A4988 to the FYSETC S6128 driver type LV8729. The rest of the driver configuration lines for other axes (X, Y, Z, E1-E7) are also shown, with their comments removed.

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC S6128 V1.1 Drivers

- We are changing from A4988 stepper motor drivers on the Ender 3 to S6128 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following line of code:

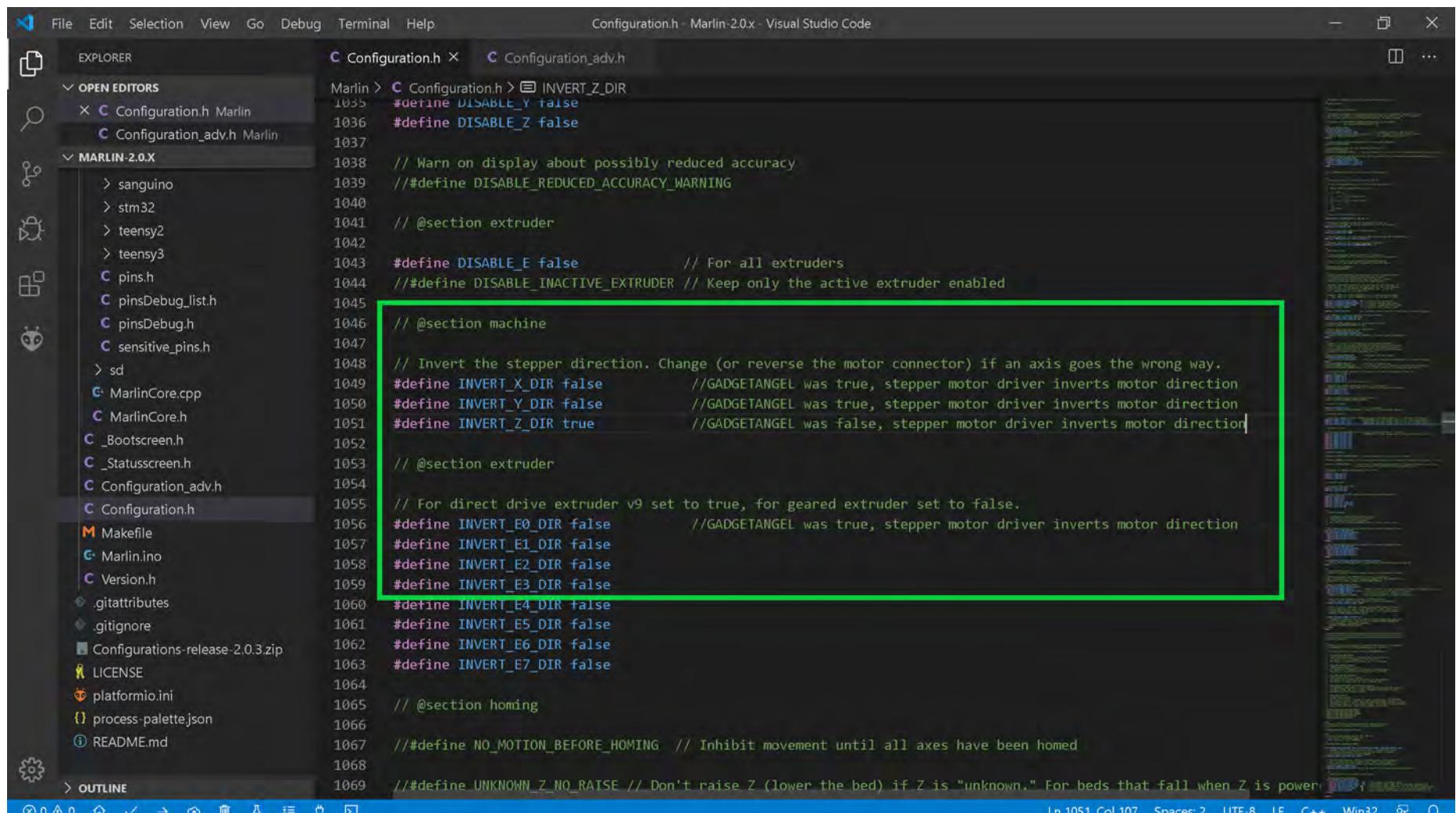
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// Double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom indicates: Ln 740, Col 65, Spaces: 2, UTF-8, LF, C++, Win32.

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC S6128 V1.1 Drivers

- Since the A4988 driver is what my Ender 3 used, but, now I want to use S6128 drivers, I must invert the stepper motor direction because the S6128 or LV8729 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the S6128 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as show in the **GREEN** box below



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > INVERT_Z_DIR
  Configuration.h Marlin
  Configuration_adv.h Marlin
MARLIN-2.0.X
  sanguino
  stm32
  teensy2
  teensy3
  pins.h
  pinsDebug_list.h
  pinsDebug.h
  sensitive_pins.h
  sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  Configurations-release-2.0.3.zip
  LICENSE
  platformio.ini
  process-palette.json
  README.md
  OUTLINE
Ln 1051, Col 107  Spaces: 2  UTF-8  LF  C++  Win32  ⚡  ⌂

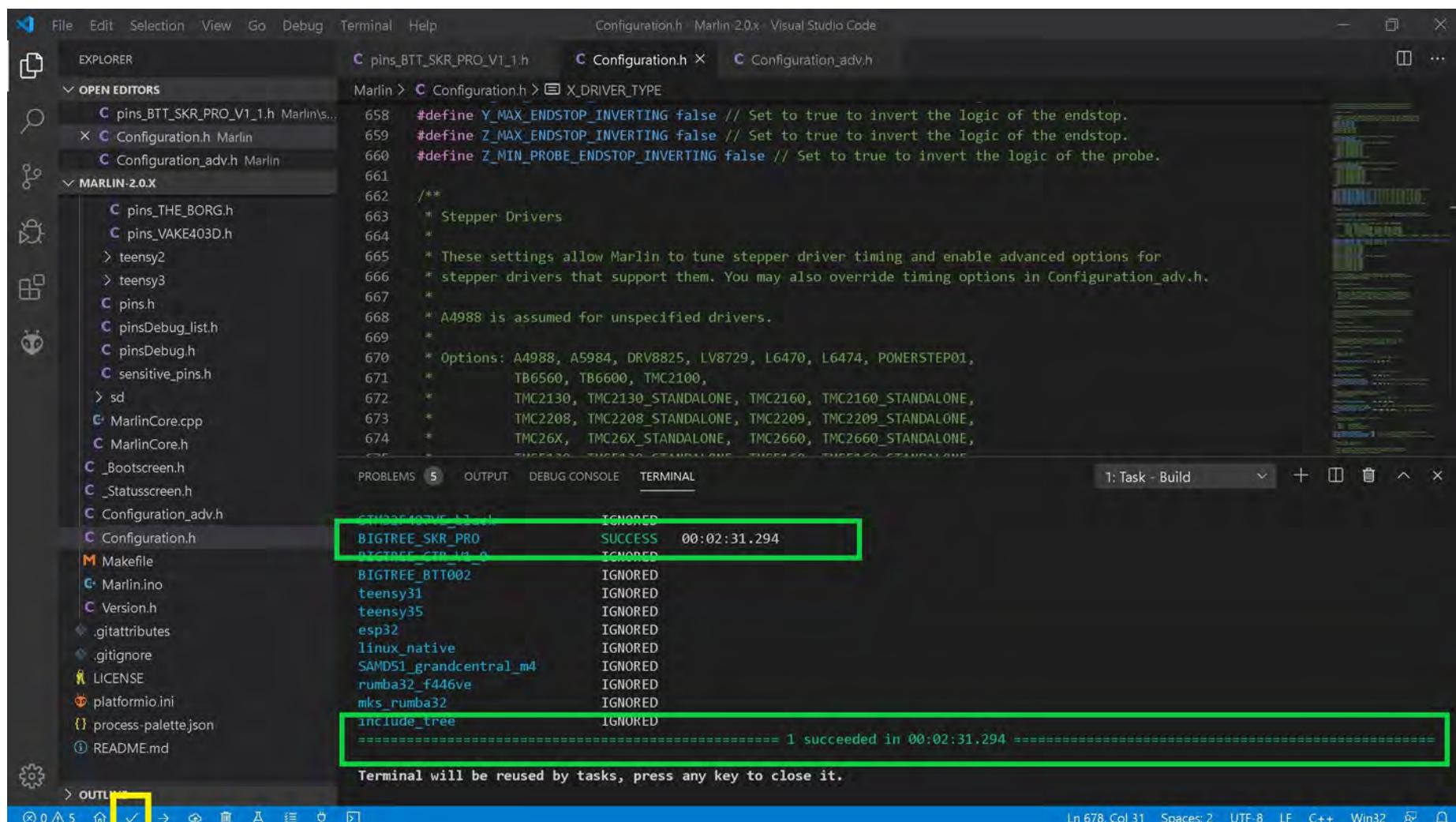
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false          // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered up

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC S6128 V1.1 Drivers

- The end of Marlin setup for FYSETC S6128 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows files like Configuration.h, pins_BTT_SKR_PRO_V1_1.h, and Configuration_adv.h.
- Terminal:** Displays the build log:

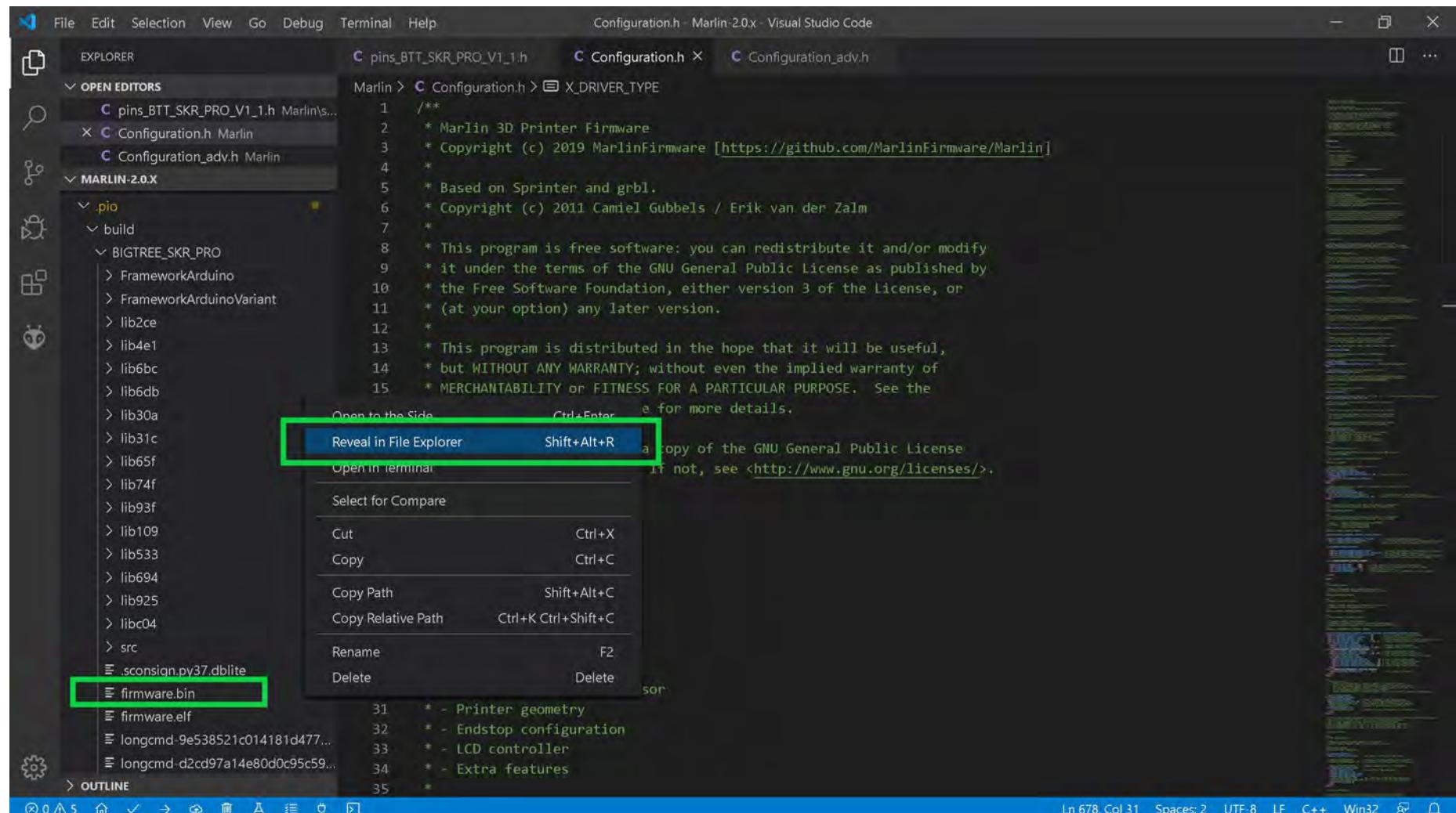

```
==== 1 succeeded in 00:02:31.294 ====
Terminal will be reused by tasks, press any key to close it.
```
- Output:** Shows build status for various boards:

| Board | Status | Time |
|------------------------|---------|--------------|
| BIGTREE_SKR_PRO | SUCCESS | 00:02:31.294 |
| BIGTREE_CTP_12_0 | IGNORED | |
| BIGTREE_BTT002 | IGNORED | |
| teensy31 | IGNORED | |
| teensy35 | IGNORED | |
| esp32 | IGNORED | |
| linux_native | IGNORED | |
| SAMD51_grandcentral_m4 | IGNORED | |
| rumba32_f446ve | IGNORED | |
| mks_rumba32 | IGNORED | |
| include_tree | IGNORED | |

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for FYSETC S6128 V1.1 Drivers

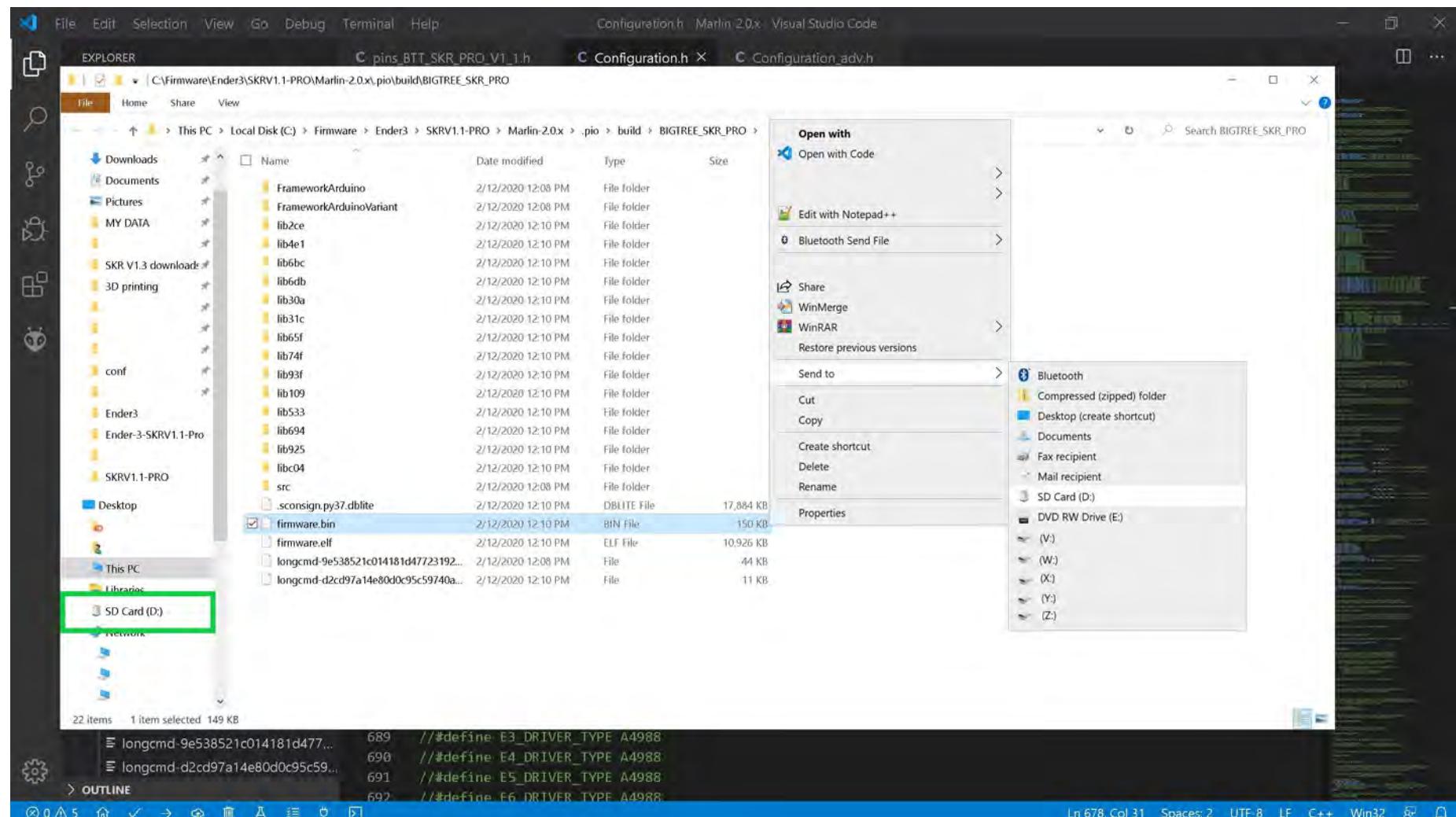
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC S6128 V1.1 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



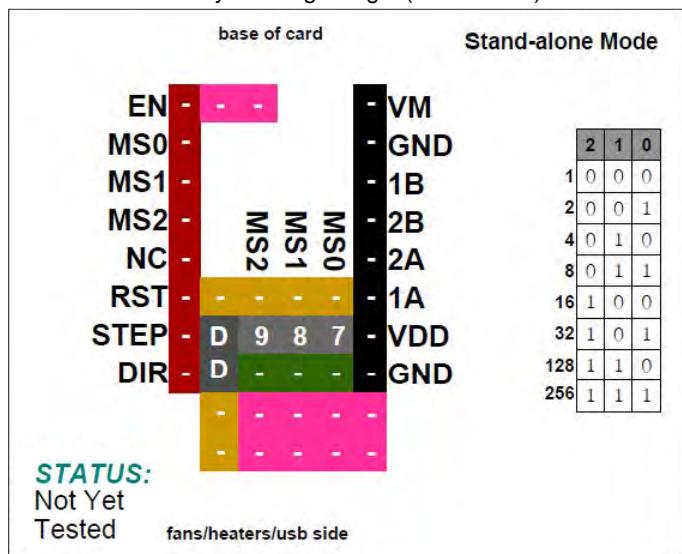
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

| base of card | | | Stand-alone Mode | | |
|-------------------|-----|-----|-----------------------|-----|-----|
| EN | - | - | VM | GND | |
| MS0 | - | - | 1B | | |
| MS1 | - | - | 2B | | |
| MS2 | MS2 | MS1 | MS0 | 2A | |
| NC | - | - | - | 1A | |
| RST | - | - | - | - | VDD |
| STEP | D | 9 | 8 | 7 | GND |
| DIR | D | - | - | - | |
| STATUS: | | | | | |
| Not Yet Tested | | | fans/heaters/usb side | | |

FYSETC ST820

Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|---|------|------|---|-----------------|
| FYSETC ST820 | Low | Low | Low | Full step | 2 Phase |
| Maximum 256 Subdivision | Low | Low | High | Half step | 1-2 Phase |
| 45V DC 1.5A (peak) | Low | High | Low | 1/4 step | W1-2 Phase |
| | Low | High | High | 1/8 step | 2W1-2 Phase |
| | High | Low | Low | 1/16 step | 4W1-2 Phase |
| | High | Low | High | 1/32 step | 8W1-2 Phase |
| | High | High | Low | 1/128 step | 16W1-2 Phase |
| | High | High | High | 1/256 step | 32W1-2 Phase |
| Driving Current Calculation Formula $V_{DD} = 3.3V \text{ or } 5V \text{ DC}$ $R_S(\text{Typical Sense Resistor}) = 0.15\Omega$ | $I_{MAX} = V_{ref} * \left(\frac{V_{DD}}{5} \right) * \frac{1}{R_S}$ | | | $V_{ref} = I_{MAX} * \left(\frac{5}{V_{DD}} \right) * R_S$ | |

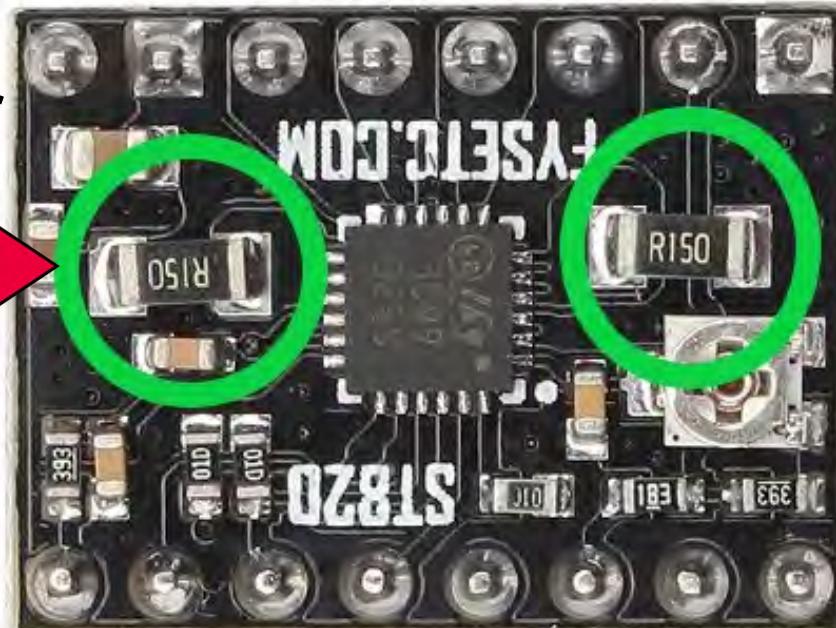


FYSETC ST820

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN



Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>

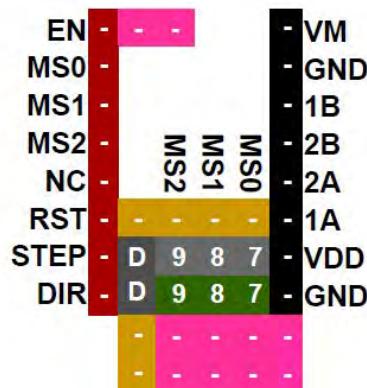


- $R_s = R050$ is 0.05 Ohms
- $R_s = R068$ is 0.068 Ohms
- $R_s = R100$ is 0.1 Ohms
- $R_s = R150$ is 0.15 Ohms
- $R_s = R200$ is 0.2 Ohms
- $R_s = R220$ is 0.22 Ohms

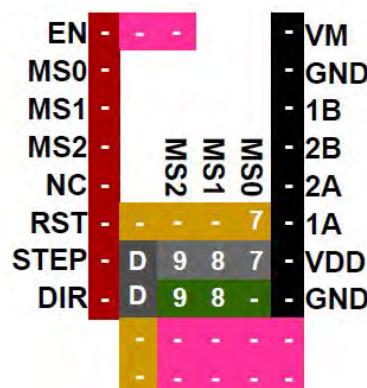
FYSETC ST820

Stand-alone Mode

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.



STEP

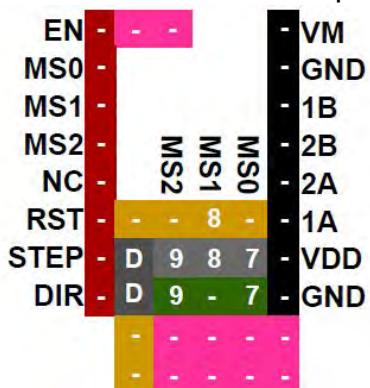


1 / 2

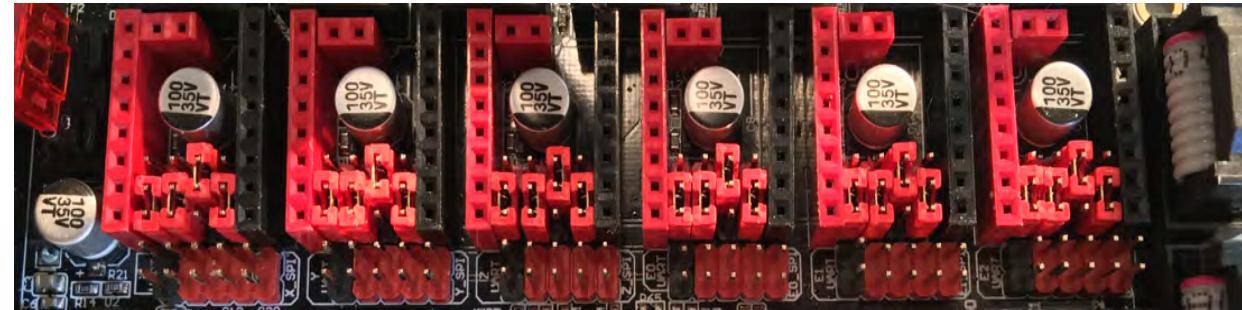
FYSETC ST820

Stand-alone Mode

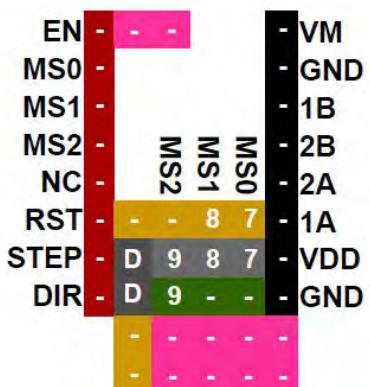
Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.



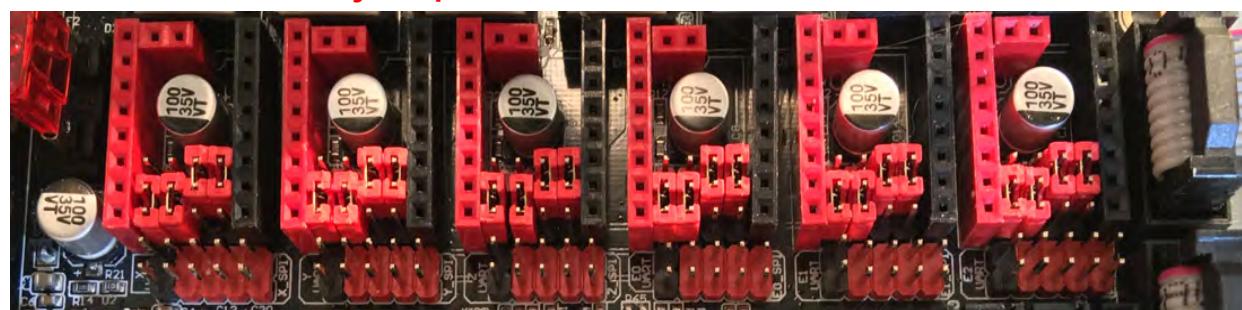
Note: The "D" jumper MUST be SET!



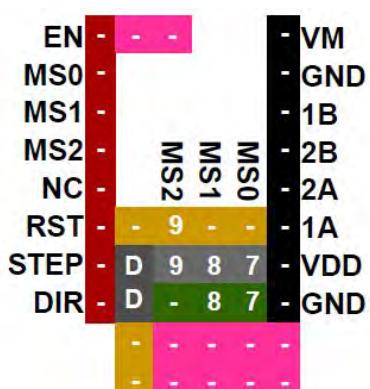
1 / 4



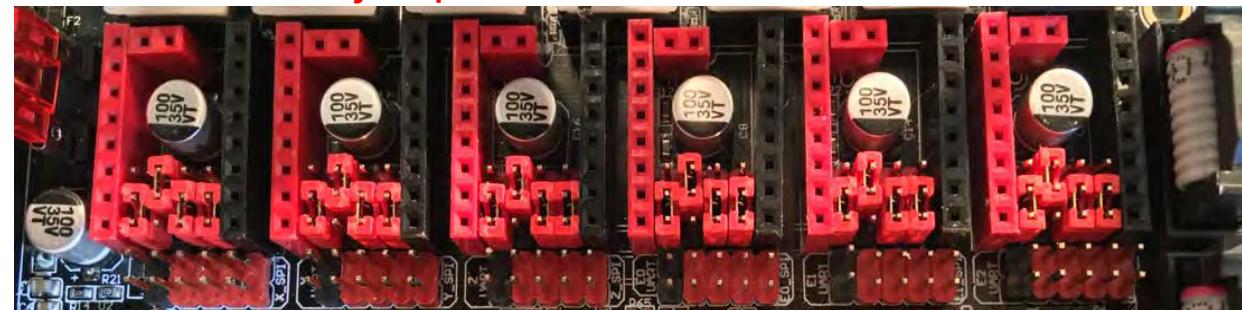
Note: The "D" jumper MUST be SET!



1 / 8



Note: The "D" jumper MUST be SET!



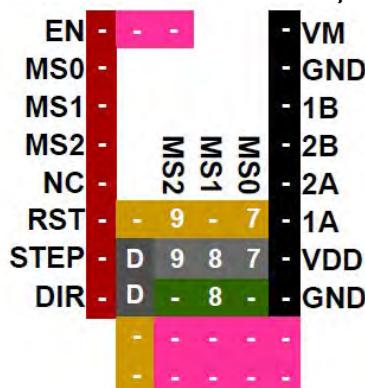
1 / 16

FYSETC ST820

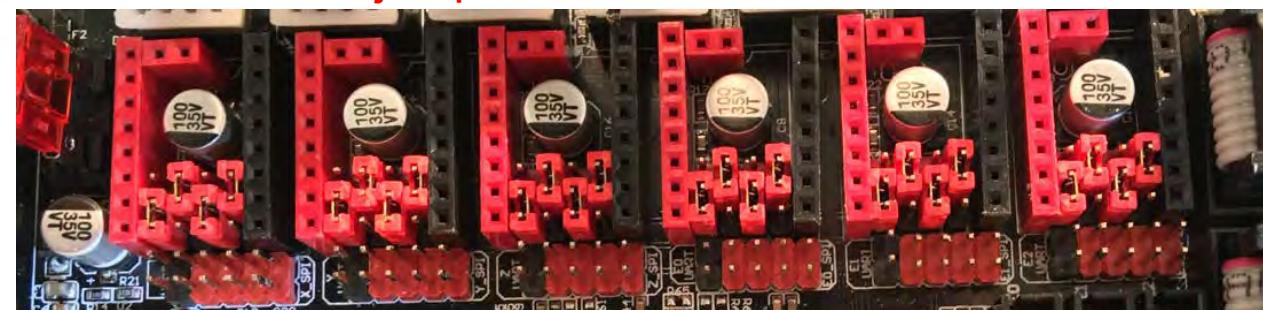
Stand-alone Mode

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.

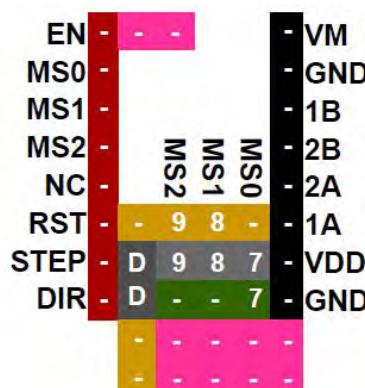
1 / 32



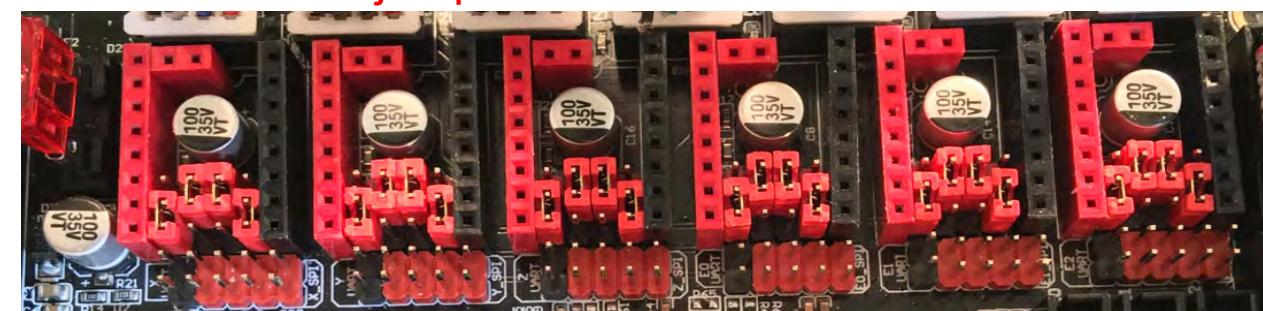
Note: The "D" jumper MUST be SET!



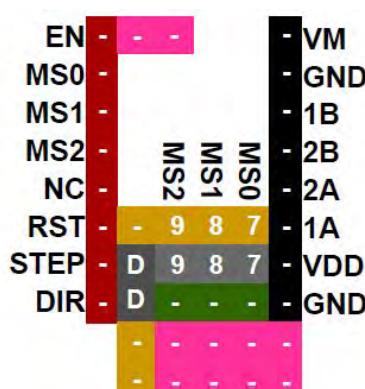
1 / 128



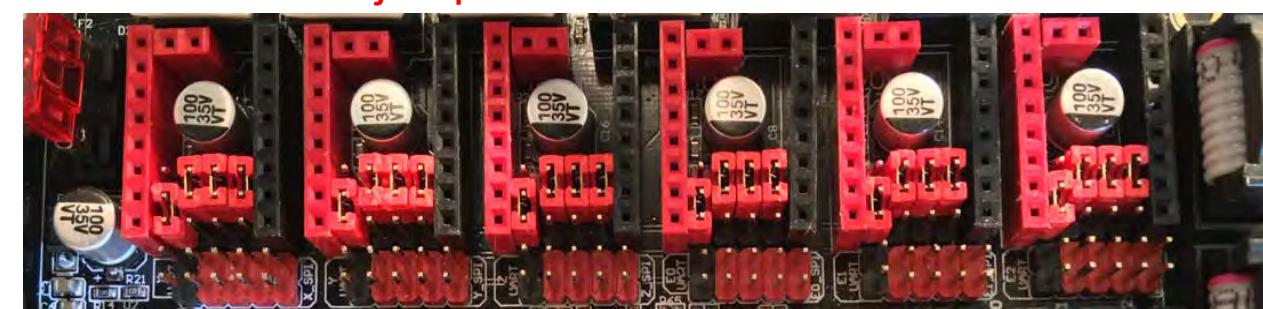
Note: The "D" jumper MUST be SET!



1 / 256



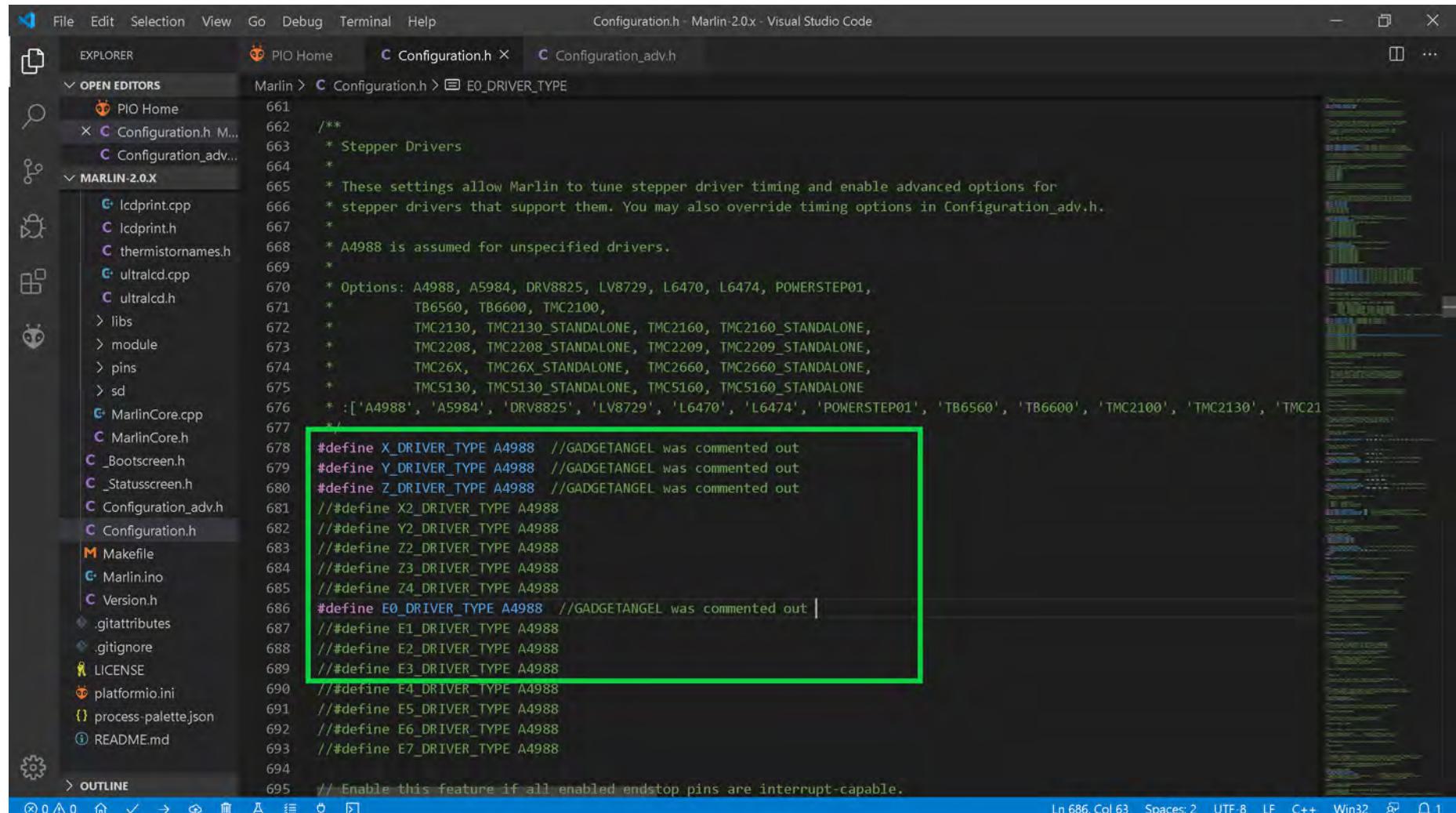
Note: The "D" jumper MUST be SET!



The (latest release of) Marlin Setup for FYSETC ST820 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for FYSETC ST820 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using FYSETC ST820 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use FYSETC ST820 drivers. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
- The **ST820** is a drop in replacement for the **A4988**. Since Marlin does not have an option for **ST820** we will use the **A4988** option.



```

File Edit Selection View Go Debug Terminal Help
Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h
Marlin > Configuration.h > E0_DRIVER_TYPE

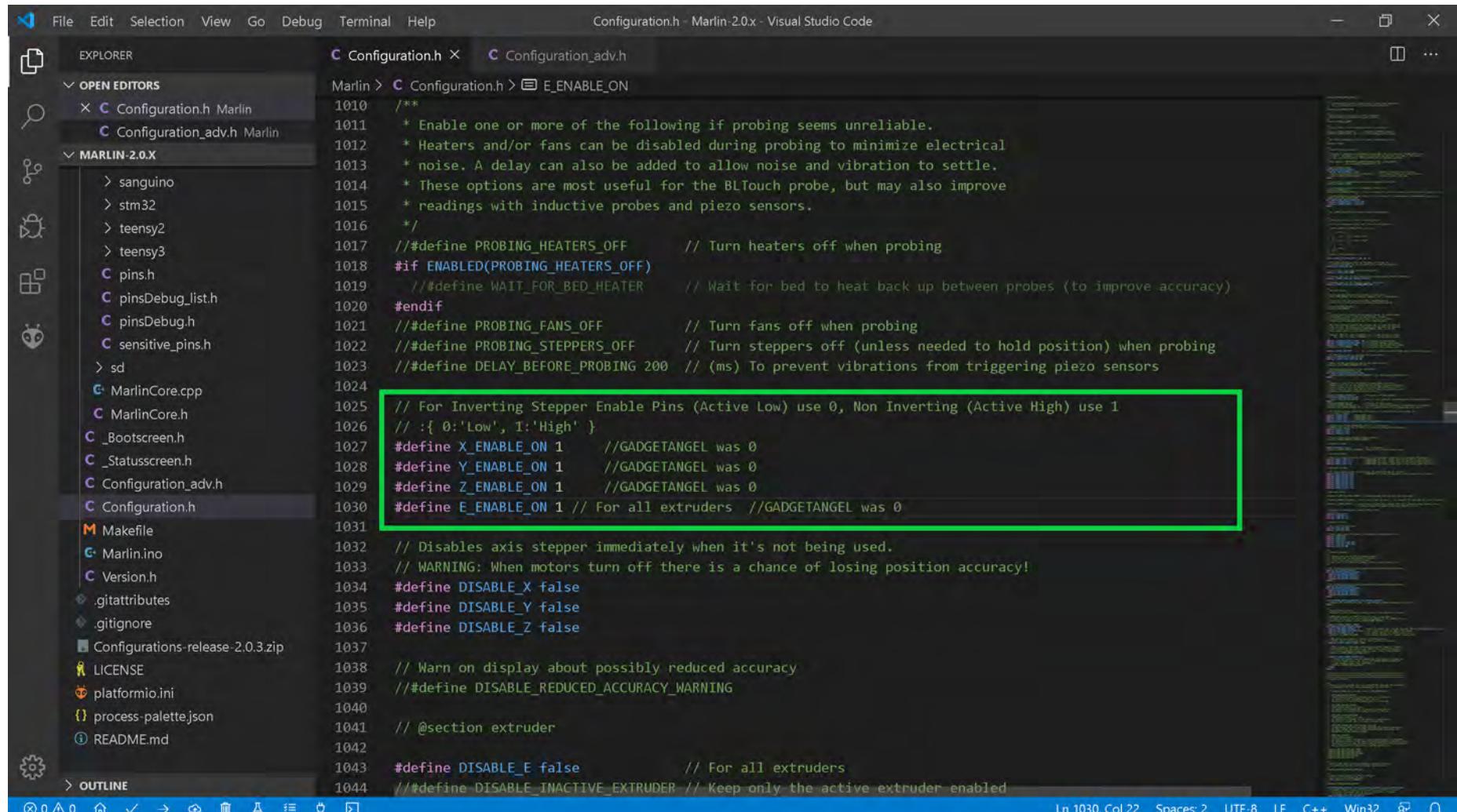
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130', 'TMC5160']
676 */
677 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
678 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
679 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
680 //##define X2_DRIVER_TYPE A4988
681 //##define Y2_DRIVER_TYPE A4988
682 //##define Z2_DRIVER_TYPE A4988
683 //##define Z3_DRIVER_TYPE A4988
684 //##define Z4_DRIVER_TYPE A4988
685 //##define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out |
686 //##define E1_DRIVER_TYPE A4988
687 //##define E2_DRIVER_TYPE A4988
688 //##define E3_DRIVER_TYPE A4988
689 //##define E4_DRIVER_TYPE A4988
690 //##define E5_DRIVER_TYPE A4988
691 //##define E6_DRIVER_TYPE A4988
692 //##define E7_DRIVER_TYPE A4988
693
694 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC ST820 Drivers

- In the Marlin firmware, the ST820 drivers needs an ACTIVE HIGH for the stepper motor driver's enable pin, so set "X_ENABLE_ON" to 1, "Y_ENABLE_ON" to 1, "Z_ENABLE_ON" to 1 and "E_ENABLE_ON" to 1, as seen in the **GREEN** box below.



Configuration.h - Marlin-2.0.x - Visual Studio Code

```

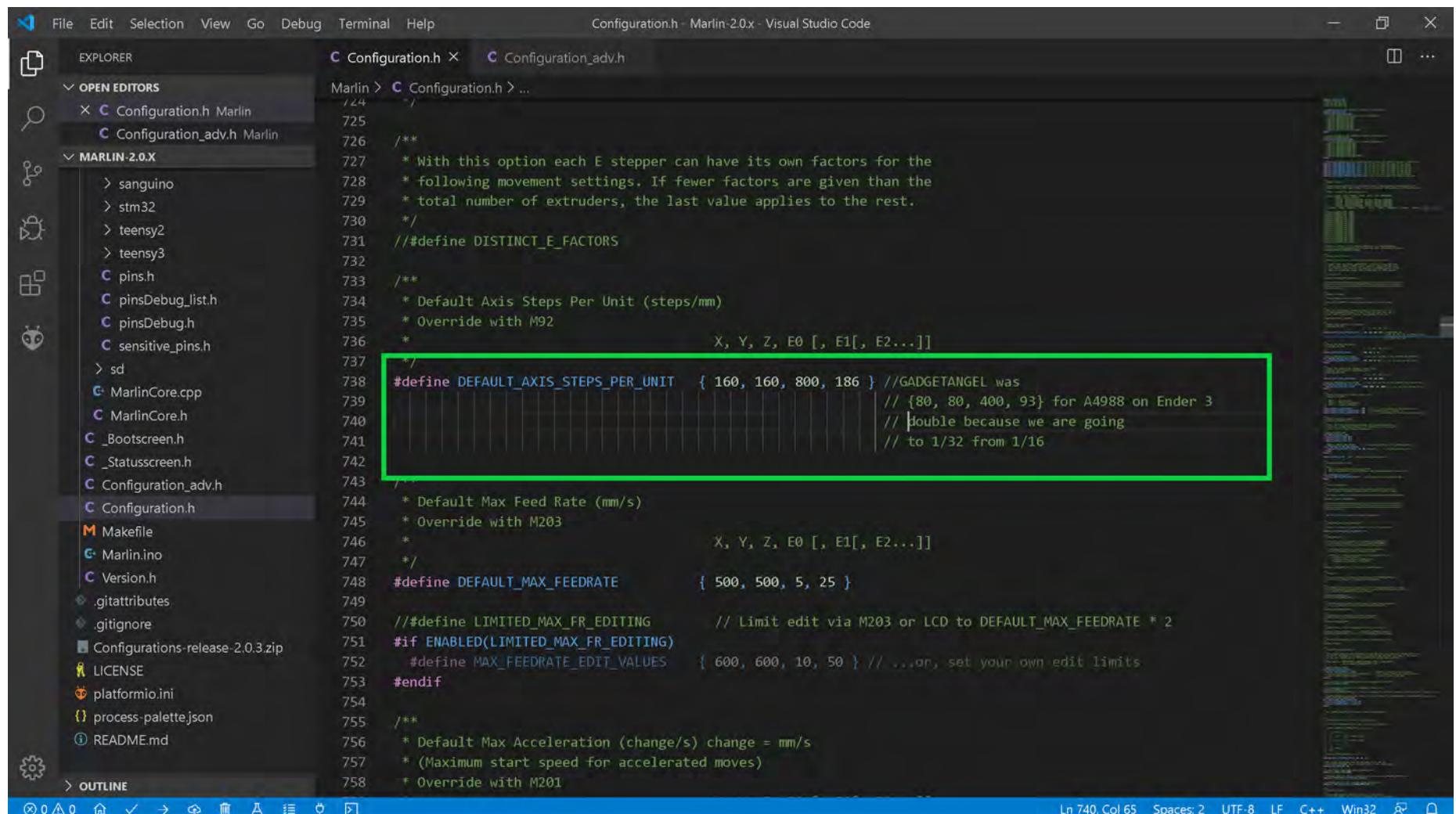
1010 /**
1011 * Enable one or more of the following if probing seems unreliable.
1012 * Heaters and/or fans can be disabled during probing to minimize electrical
1013 * noise. A delay can also be added to allow noise and vibration to settle.
1014 * These options are most useful for the BLTouch probe, but may also improve
1015 * readings with inductive probes and piezo sensors.
1016 */
1017 // #define PROBING_HEATERS_OFF // Turn heaters off when probing
1018 #if ENABLED(PROBING_HEATERS_OFF)
1019 // #define WAIT_FOR_BED_HEATER // Wait for bed to heat back up between probes (to improve accuracy)
1020 #endif
1021 // #define PROBING_FANS_OFF // Turn fans off when probing
1022 // #define PROBING_STEPPERS_OFF // Turn steppers off (unless needed to hold position) when probing
1023 // #define DELAY_BEFORE_PROBING 200 // (ms) To prevent vibrations from triggering piezo sensors
1024
1025 // For Inverting Stepper Enable Pins (Active Low) use 0, Non Inverting (Active High) use 1
1026 // :{ 0:'Low', 1:'High' }
1027 #define X_ENABLE_ON 1 // GADGETANGEL was 0
1028 #define Y_ENABLE_ON 1 // GADGETANGEL was 0
1029 #define Z_ENABLE_ON 1 // GADGETANGEL was 0
1030 #define E_ENABLE_ON 1 // For all extruders // GADGETANGEL was 0
1031
1032 // Disables axis stepper immediately when it's not being used.
1033 // WARNING: When motors turn off there is a chance of losing position accuracy!
1034 #define DISABLE_X false
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC ST820 Drivers

- We are changing from A4988 stepper motor drivers on the Ender 3 to FYSETC ST820 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following line of code:

```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// Double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom indicates: Ln 740, Col 65, Spaces: 2, UTF-8, LF, C++, Win32.

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC ST820 Drivers

- **Optional Step:** I found conflicting information on the ST820 driver. Some sources say you will need to change the motor direction others say you may not. So I provide the below information in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring instead of the Marlin firmware, here is a link on how to change the motor direction via the wiring (look for section labeled "Motor moving the wrong direction") https://reprap.org/wiki/Stepper_wiring. Other people prefer to change the motor direction in the Marlin firmware. **So if you want or need to** change the motor direction in Marlin, then if the axis' setting you will be using the ST820 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below

```
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin 2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS Configuration.h Configuration_adv.h
Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered
```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC ST820 Drivers

- The end of Marlin setup for FYSETC ST820 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x Visual Studio Code

EXPLORER OPEN EDITORS Marlin > Configuration.h > X_DRIVER_TYPE

MARLIN-2.0.X

C pins_BTT_SKR_PRO_V1_1.h Marlin\...
C Configuration.h Marlin
C Configuration_adv.h Marlin

C pins_THE_BORG.h
C pins_VAKE403D.h
> teensy2
> teensy3
C pins.h
C pinsDebug.list.h
C pinsDebug.h
C sensitive_pins.h
> sd
C MarlinCore.cpp
C MarlinCore.h
C _Bootscreen.h
C _Statusscreen.h
C Configuration_adv.h
C Configuration.h
M Makefile
C Marlin.ino
C Version.h
.gitattributes
.gitignore
LICENSE
platformio.ini
process-palette.json
README.md

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: Task - Build + ×

| CTH2540TVE_11_1 | IGNORED | |
|------------------------|---------|--------------|
| BIGTREE_SKR_PRO | SUCCESS | 00:02:31.294 |
| BIGTREE_CTC_12_0 | IGNORED | |
| BIGTREE_BT002 | IGNORED | |
| teensy31 | IGNORED | |
| teensy35 | IGNORED | |
| esp32 | IGNORED | |
| linux_native | IGNORED | |
| SAMD51_grandcentral_m4 | IGNORED | |
| rumba32_f446ve | IGNORED | |
| mks_rumba32 | IGNORED | |
| include_tree | IGNORED | |

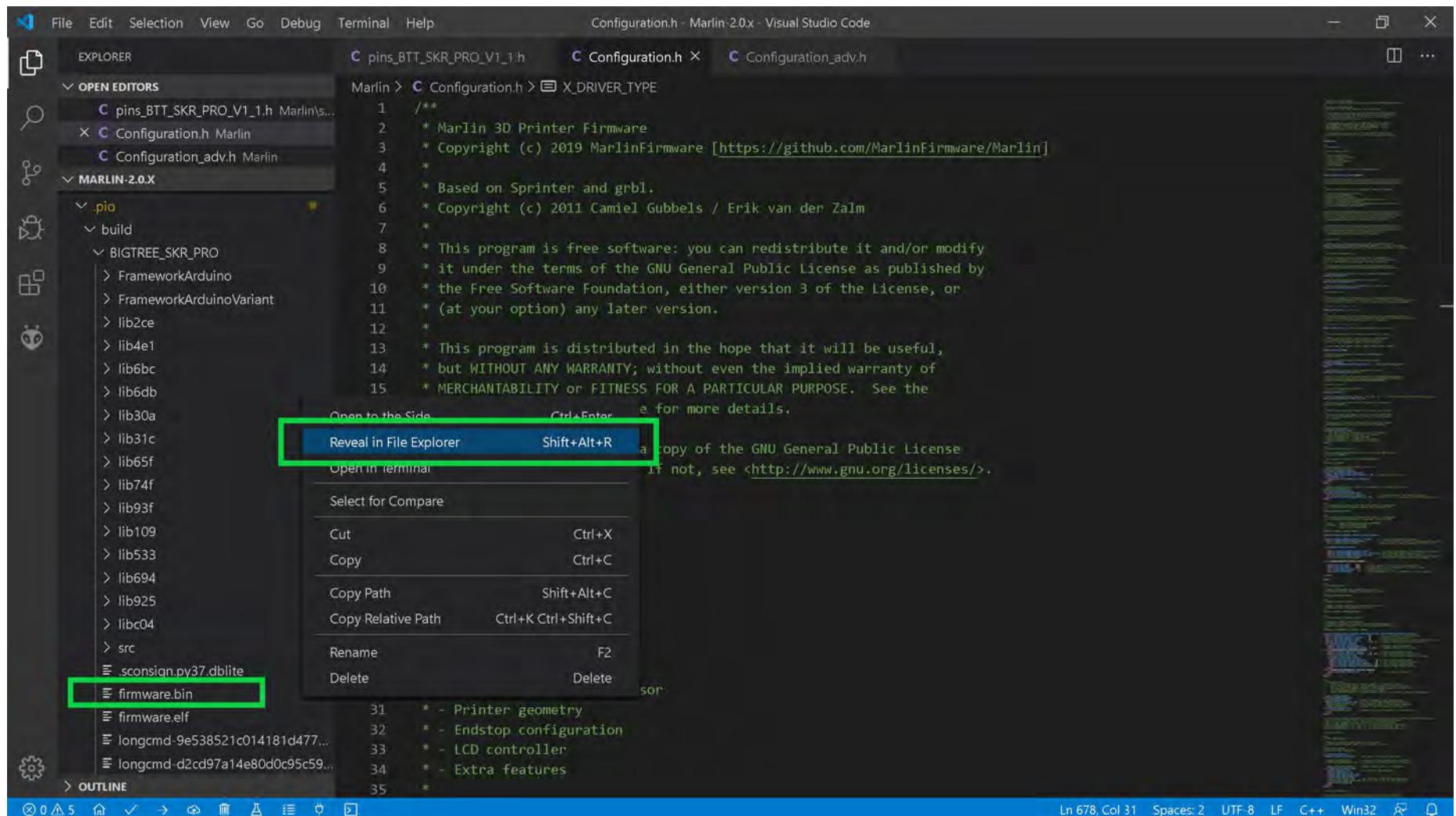
===== 1 succeeded in 00:02:31.294 =====

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for FYSETC ST820 Drivers

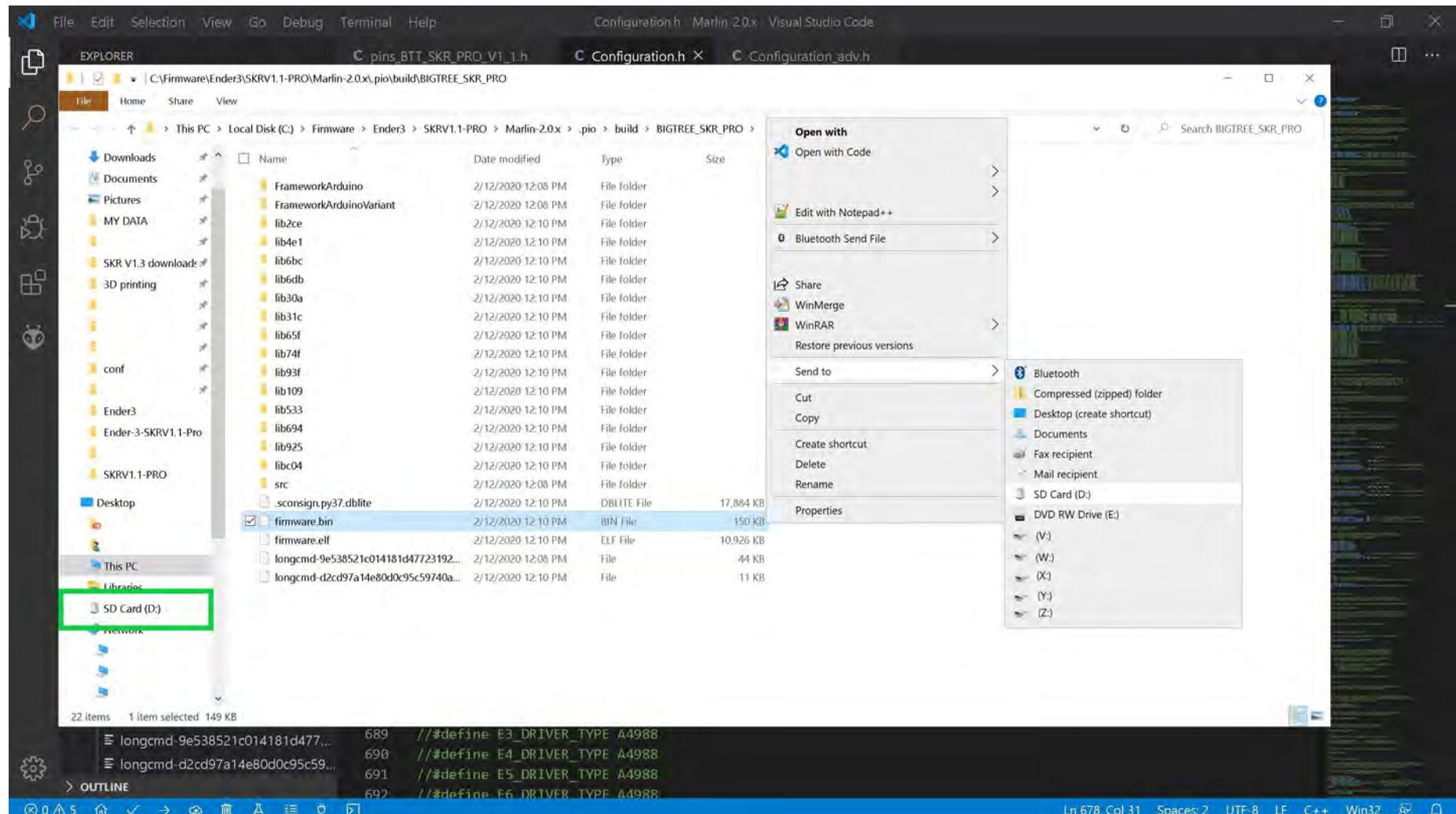
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



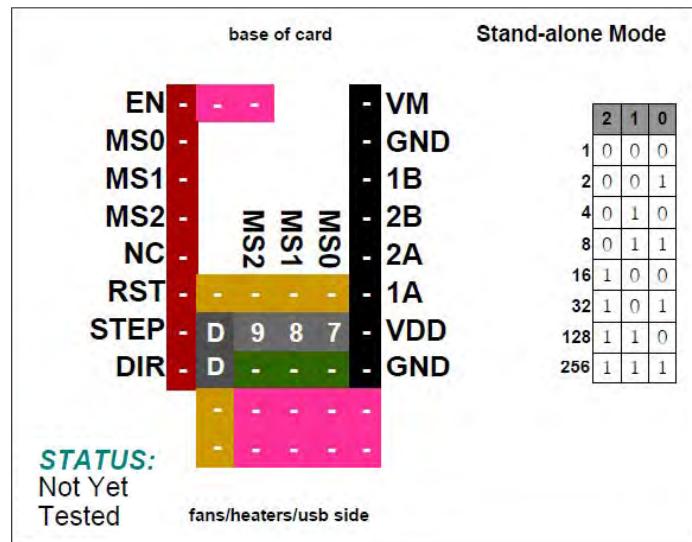
- Go to the next page.

The (latest release of) Marlin Setup for FYSETC ST820 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



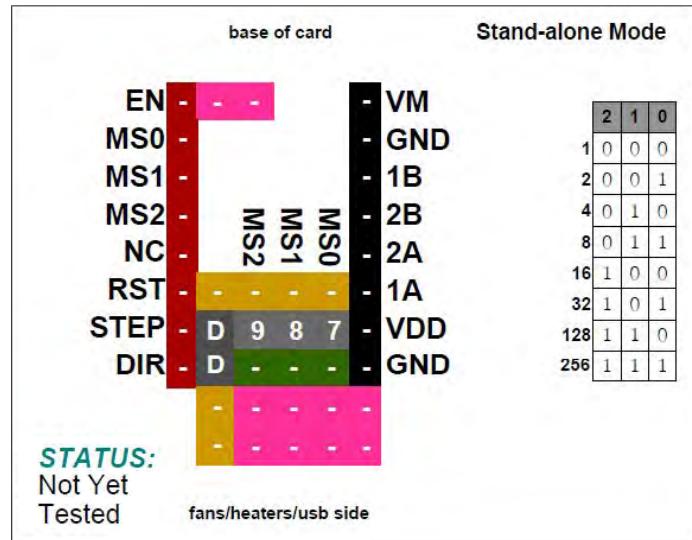
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.



BIQU ST820

Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|---|------------|---|-----------------------------|------------------------|
| | Low | Low | Low | Full step | 2 Phase |
|  BIQU® ST820 | Low | Low | High | Half step | 1-2 Phase |
| Maximum 256 Subdivision | Low | High | Low | 1/4 step | W1-2 Phase |
| 45V DC | Low | High | High | 1/8 step | 2W1-2 Phase |
| 1.5A (peak) | High | Low | Low | 1/16 step | 4W1-2 Phase |
| | High | Low | High | 1/32 step | 8W1-2 Phase |
| | High | High | Low | 1/128 step | 16W1-2 Phase |
| | High | High | High | 1/256 step | 32W1-2 Phase |
| Driving Current Calculation Formula | $I_{MAX} = V_{ref} * \left(\frac{V_{DD}}{5}\right) * \frac{1}{R_S}$ | | $V_{ref} = I_{MAX} * \left(\frac{5}{V_{DD}}\right) * R_S$ | | |
| $V_{DD} = 3.3\text{ V or }5\text{ V DC}$ R_S (Typical Sense Resistor) = 0.15Ω | | | | | |

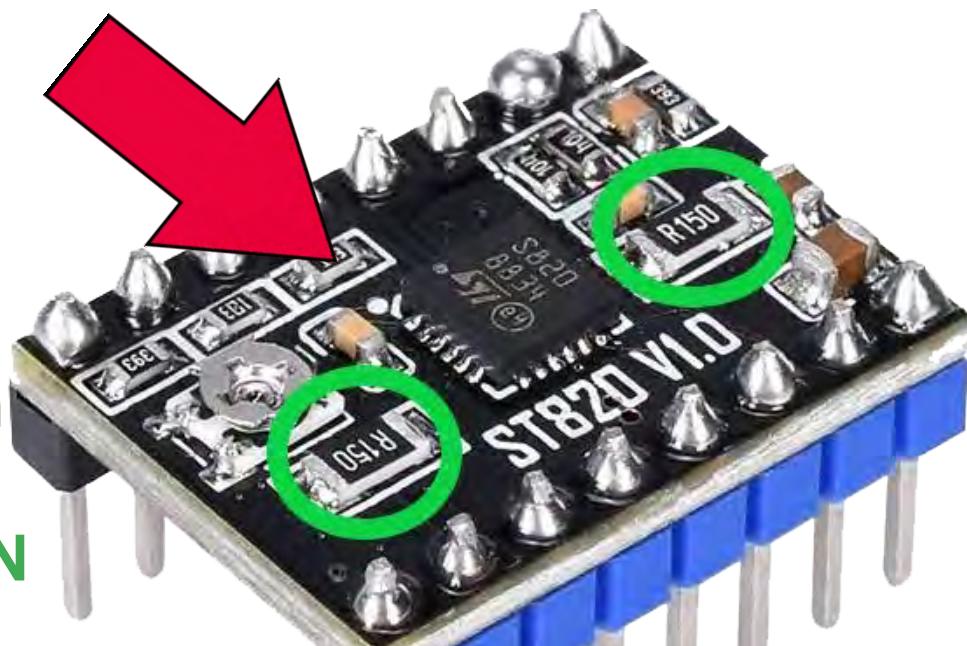


BIQU ST820

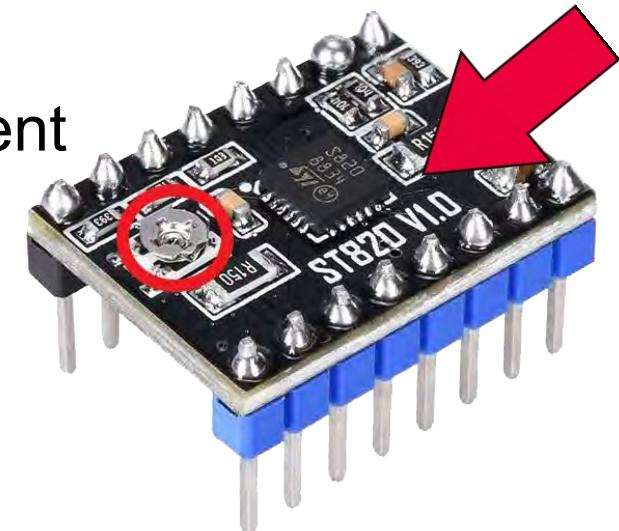
Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN



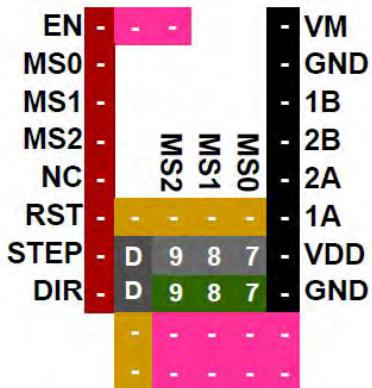
Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>



- $R_s = R050$ is 0.05 Ohms
- $R_s = R068$ is 0.068 Ohms
- $R_s = R100$ is 0.1 Ohms
- $R_s = R150$ is 0.15 Ohms
- $R_s = R200$ is 0.2 Ohms
- $R_s = R220$ is 0.22 Ohms

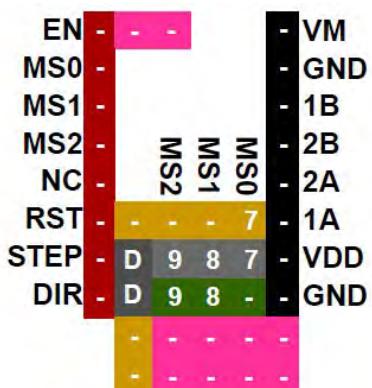
BIQU ST820**Stand-alone Mode**

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.



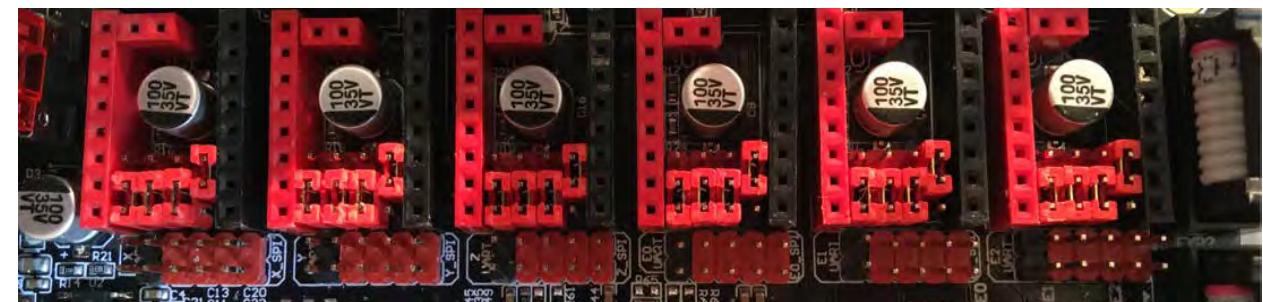
STEP

Note: The "D" jumper MUST be SET!



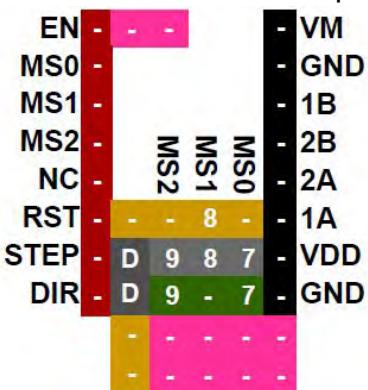
1 / 2

Note: The "D" jumper MUST be SET!



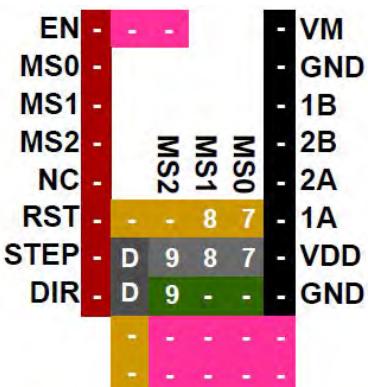
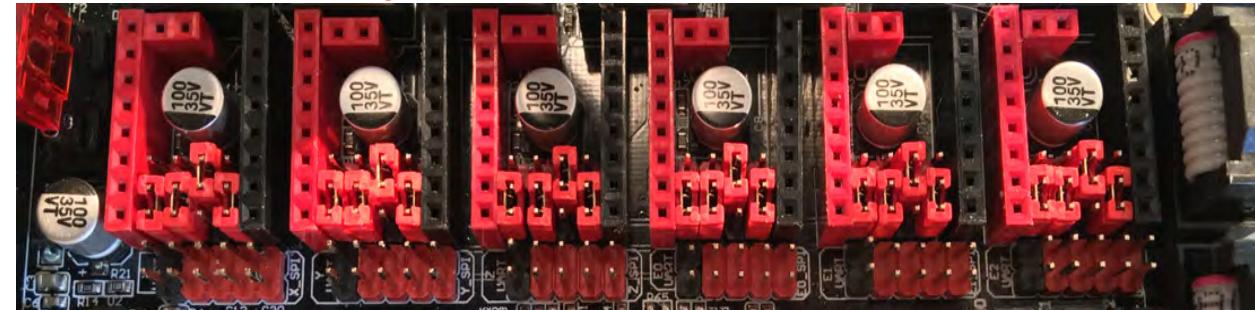
BIQU ST820**Stand-alone Mode**

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.



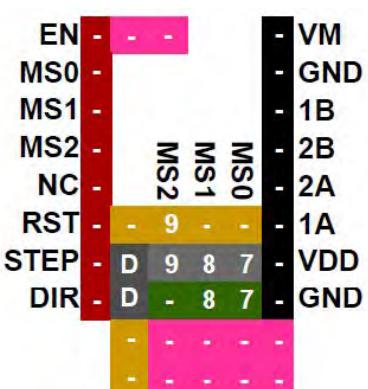
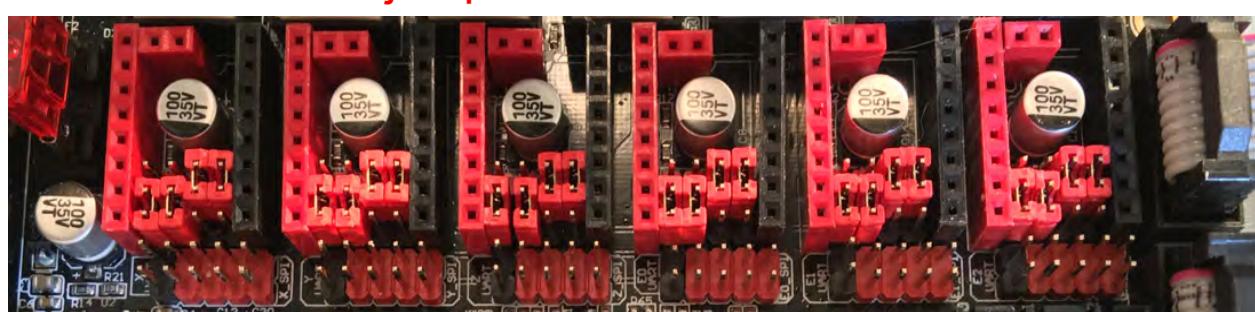
1 / 4

Note: The "D" jumper MUST be SET!



1 / 8

Note: The "D" jumper MUST be SET!



1 / 16

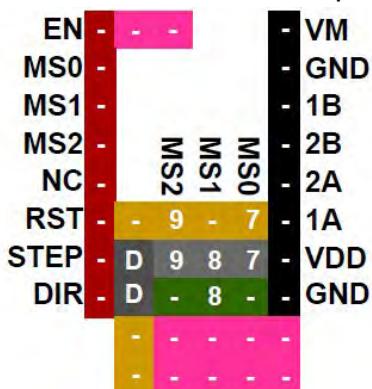
Note: The "D" jumper MUST be SET!



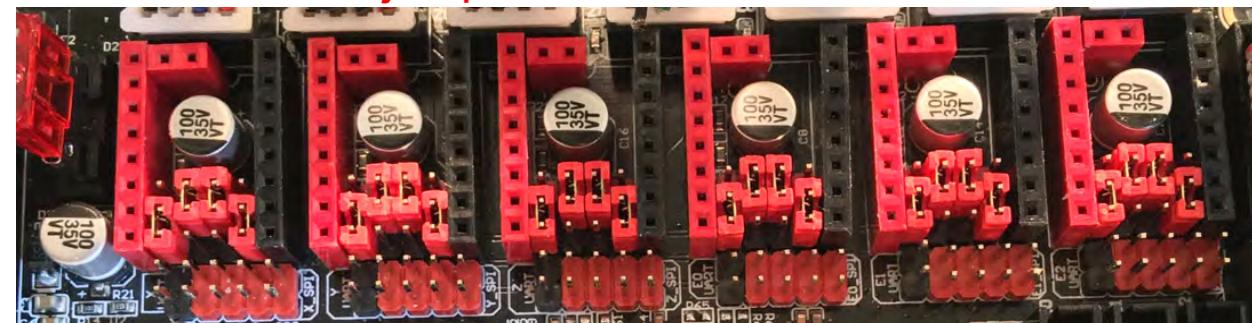
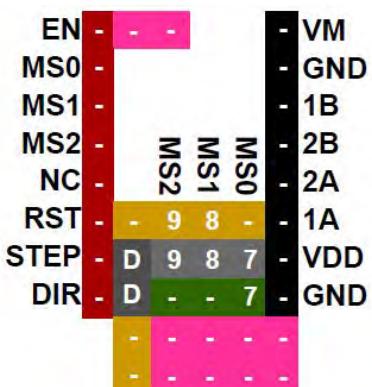
BIQU ST820**Stand-alone Mode**

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.

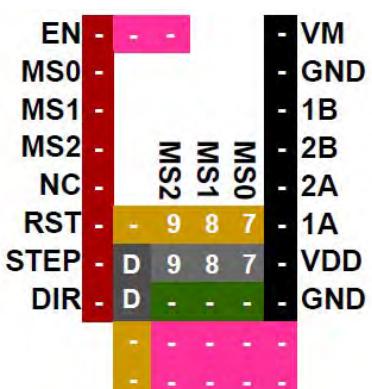
1 / 32



1 / 128



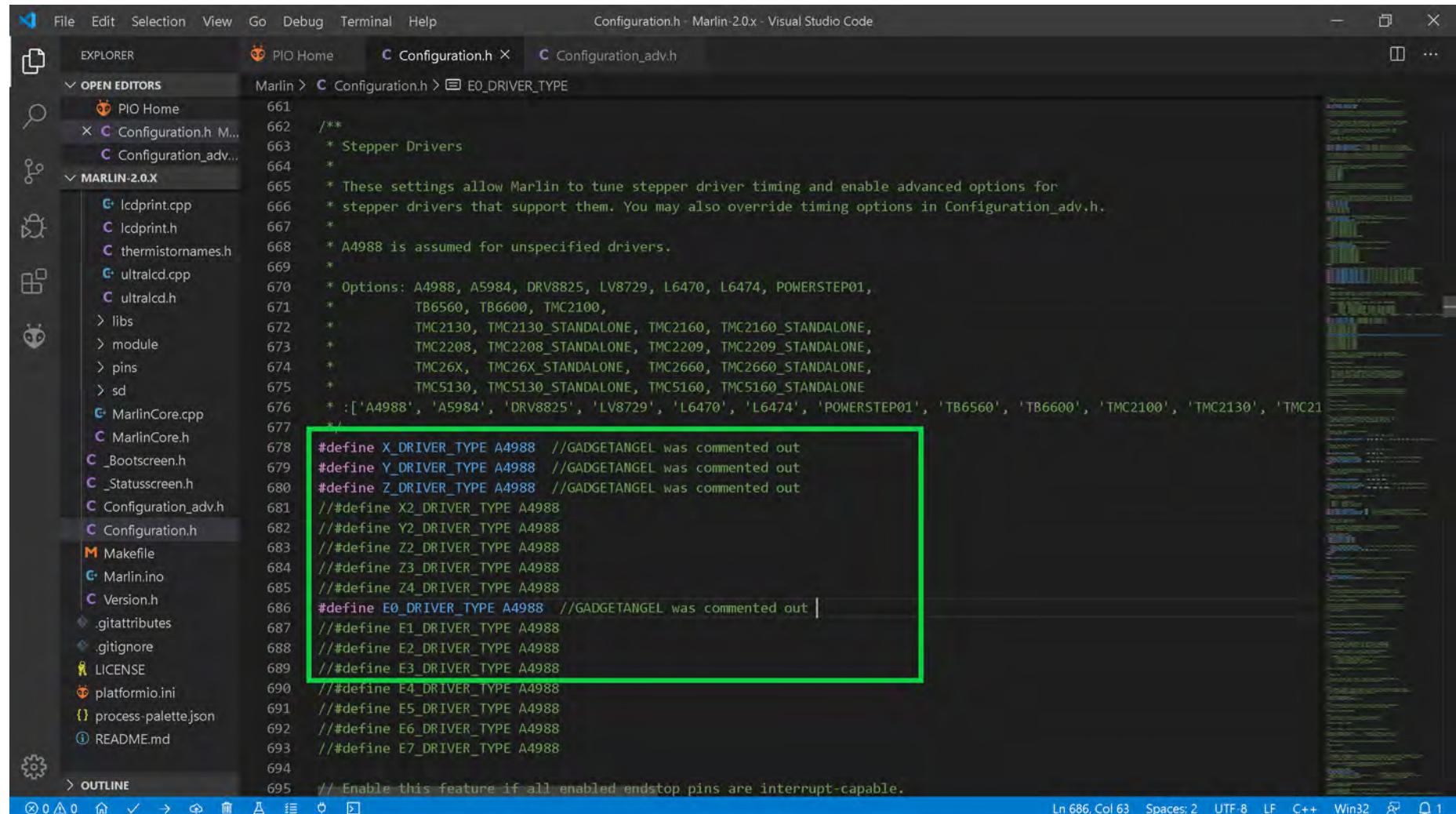
1 / 256



The (latest release of) Marlin Setup for BIQU ST820 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU ST820 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using BIQU ST820 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use BIQU ST820 drivers. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
- The **ST820 is a drop in replacement for the A4988**. Since Marlin does not have an option for ST820 we will use the A4988 option.



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following snippet of C++ code:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160',
676 *           'TMC2208', 'TMC2209', 'TMC26X', 'TMC2660', 'TMC5130', 'TMC5160'],
677 */
678 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
679 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
680 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
681 //##define X2_DRIVER_TYPE A4988
682 //##define Y2_DRIVER_TYPE A4988
683 //##define Z2_DRIVER_TYPE A4988
684 //##define Z3_DRIVER_TYPE A4988
685 //##define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out |
687 //##define E1_DRIVER_TYPE A4988
688 //##define E2_DRIVER_TYPE A4988
689 //##define E3_DRIVER_TYPE A4988
690 //##define E4_DRIVER_TYPE A4988
691 //##define E5_DRIVER_TYPE A4988
692 //##define E6_DRIVER_TYPE A4988
693 //##define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

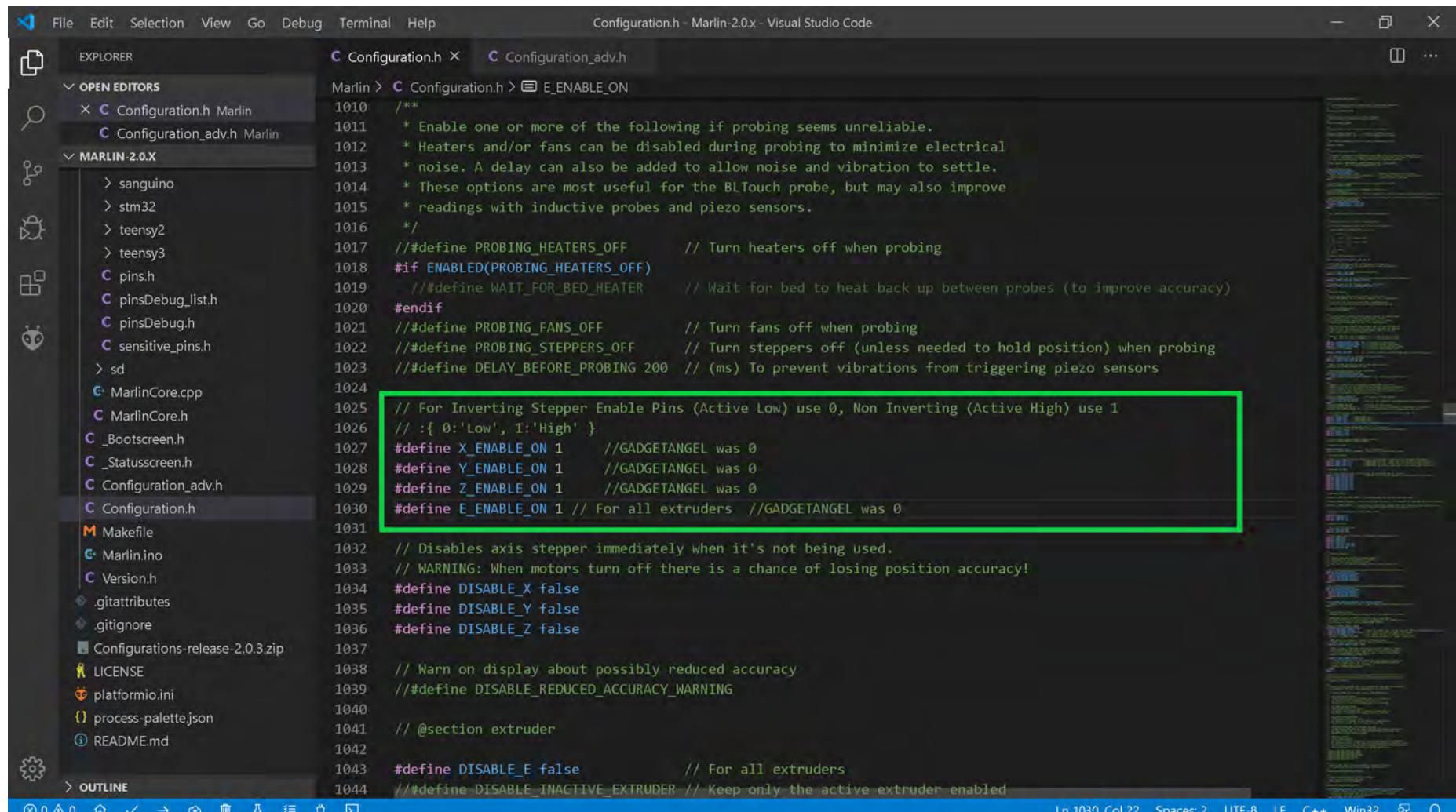
```

A green rectangular box highlights the section of code from line 678 to line 686, which defines the driver type for each axis (X, Y, Z, and E0). The line `#define E0_DRIVER_TYPE A4988` is preceded by a vertical bar character, indicating it was previously commented out.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU ST820 Drivers

- In the Marlin firmware, the ST820 drivers needs an ACTIVE HIGH for the stepper motor driver's enable pin, so set "X_ENABLE_ON" to 1, "Y_ENABLE_ON" to 1, "Z_ENABLE_ON" to 1 and "E_ENABLE_ON" to 1, as seen in the **GREEN** box below.



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E_ENABLE_ON
  Configuration.h Marlin
  Configuration_adv.h Marlin
MARLIN-2.0.X
  sanguino
  stm32
  teensy2
  teensy3
  pins.h
  pinsDebug.list.h
  pinsDebug.h
  sensitive_pins.h
  sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  Configurations-release 2.0.3.zip
  LICENSE
  platformio.ini
  process-palette.json
  README.md
OUTLINE

1010 /**
1011  * Enable one or more of the following if probing seems unreliable.
1012  * Heaters and/or fans can be disabled during probing to minimize electrical
1013  * noise. A delay can also be added to allow noise and vibration to settle.
1014  * These options are most useful for the BLTouch probe, but may also improve
1015  * readings with inductive probes and piezo sensors.
1016 */
1017 // #define PROBING_HEATERS_OFF // Turn heaters off when probing
1018 #if ENABLED(PROBING_HEATERS_OFF)
1019   // #define WAIT_FOR_BED_HEATER // Wait for bed to heat back up between probes (to improve accuracy)
1020 #endif
1021 // #define PROBING_FANS_OFF // Turn fans off when probing
1022 // #define PROBING_STEPPERS_OFF // Turn steppers off (unless needed to hold position) when probing
1023 // #define DELAY_BEFORE_PROBING 200 // (ms) To prevent vibrations from triggering piezo sensors
1024
1025 // For Inverting Stepper Enable Pins (Active Low) use 0, Non Inverting (Active High) use 1
1026 // :{ 0:'Low', 1:'High' }
1027 #define X_ENABLE_ON 1 // GADGETANGEL was 0
1028 #define Y_ENABLE_ON 1 // GADGETANGEL was 0
1029 #define Z_ENABLE_ON 1 // GADGETANGEL was 0
1030 #define E_ENABLE_ON 1 // For all extruders // GADGETANGEL was 0
1031
1032 // Disables axis stepper immediately when it's not being used.
1033 // WARNING: When motors turn off there is a chance of losing position accuracy!
1034 #define DISABLE_X false
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled

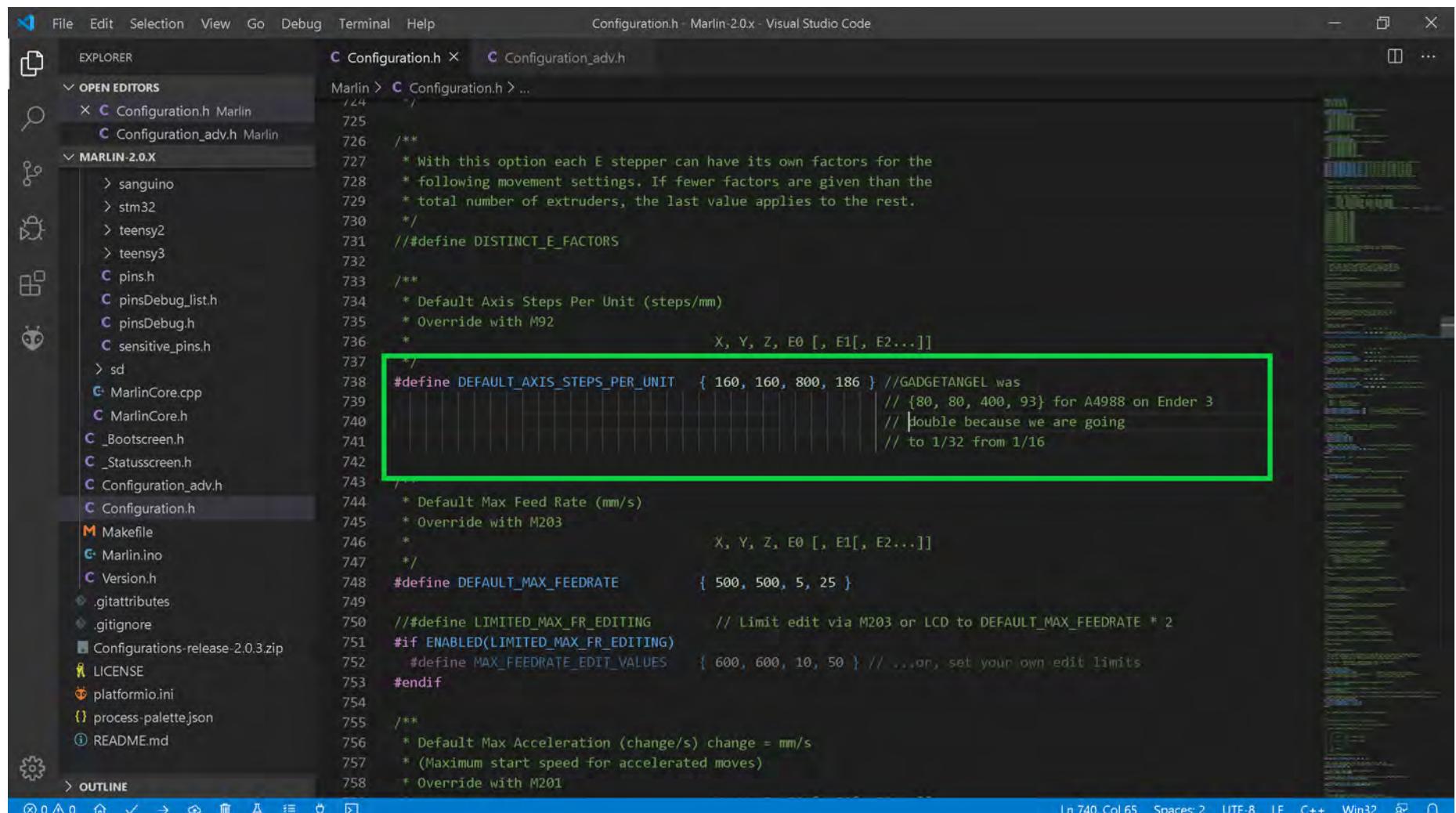
```

Ln 1030, Col 22 Spaces:2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU ST820 Drivers

- Since we are changing from A4988 stepper motor drivers on the Ender 3 to BIQU ST820 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the GREEN box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin configuration header. A green rectangular box highlights the following line of code:

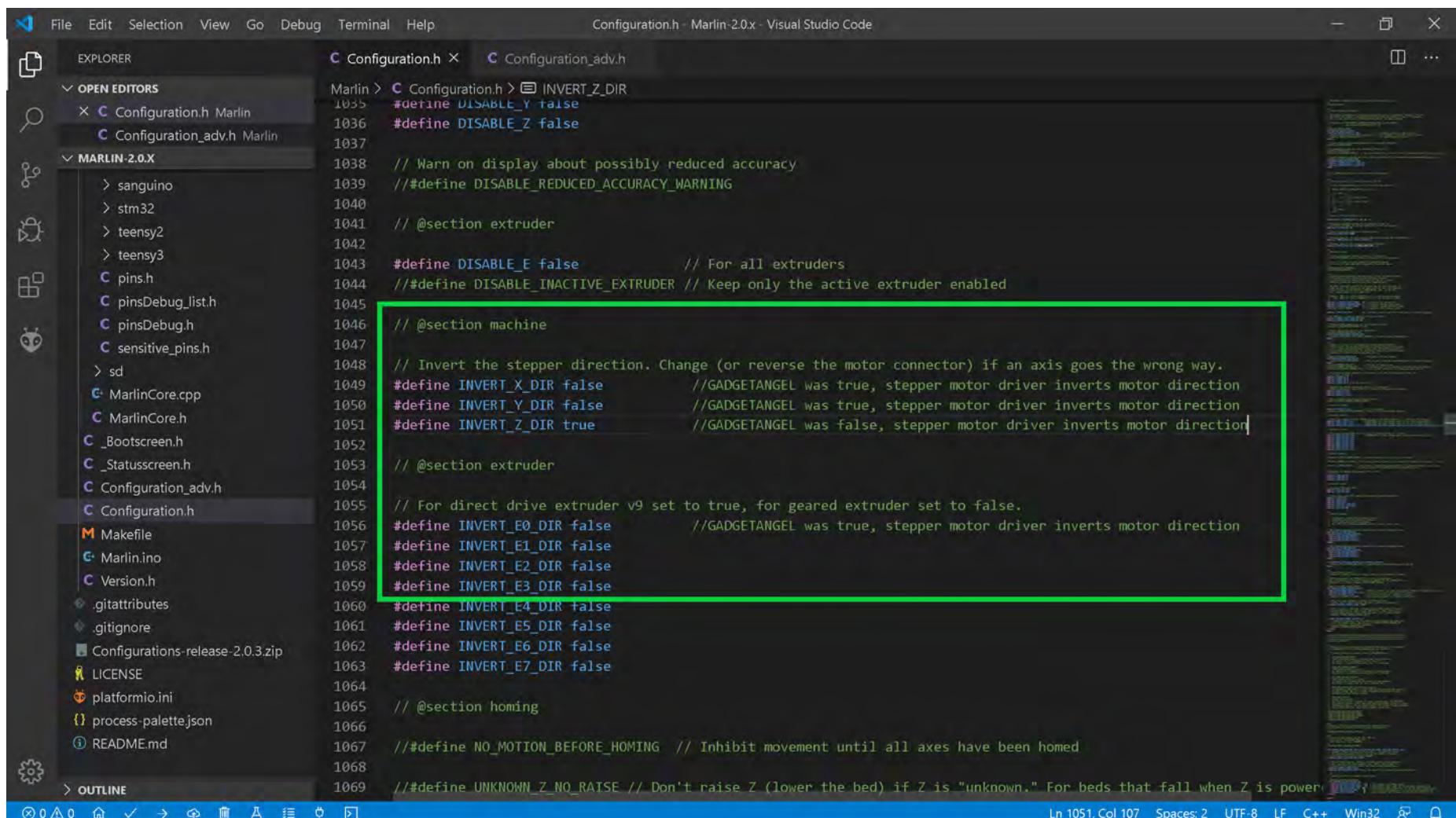
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// Double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom right indicates: Ln 740, Col 65, Spaces:2, UTF-8, LF, C++, Win32.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU ST820 Drivers

- **Optional Step:** I found conflicting information on the ST820 driver. Some sources say you will need to change the motor direction others say you may not. So I provide, the below information, in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring instead of the Marlin firmware, here is a link on how to change the motor direction via the wiring (look for section labeled "Motor moving the wrong direction") https://reprap.org/wiki/Stepper_wiring. Other people prefer to change the motor direction in the Marlin firmware. **So if you want or need to change the motor direction in Marlin**, then if the axis' setting you will be using the ST820 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following snippet of C++ code:

```

1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

A green rectangular box highlights the following lines of code:

```

1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction

```

The status bar at the bottom right of the code editor shows: Ln 1051, Col 107, Spaces: 2, UTF-8, LF, C++, Win32.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU ST820 Drivers

- The end of Marlin setup for BIQU ST820 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

The screenshot shows the Visual Studio Code interface with the Marlin repository open. The left sidebar shows the file structure under 'OPEN EDITORS' and 'MARLIN-2.0.X'. The main editor area displays the 'Configuration.h' file with code related to endstop inversion and stepper driver timing. Below the editor is a terminal window showing the build process:

```

CTM20E40TVE_1.1      IGNORED
BIGTREE_SKR_PRO        SUCCESS 00:02:31.294
BIGTREE_ST8_1.0        IGNORED
BIGTREE_BTT002         IGNORED
teensy31               IGNORED
teensy35               IGNORED
esp32                  IGNORED
linux_native            IGNORED
SAMD51_grandcentral_m4 IGNORED
rumba32_f446ve          IGNORED
mks_rumba32             IGNORED
include_tree             IGNORED
=====
===== 1 succeeded in 00:02:31.294 =====

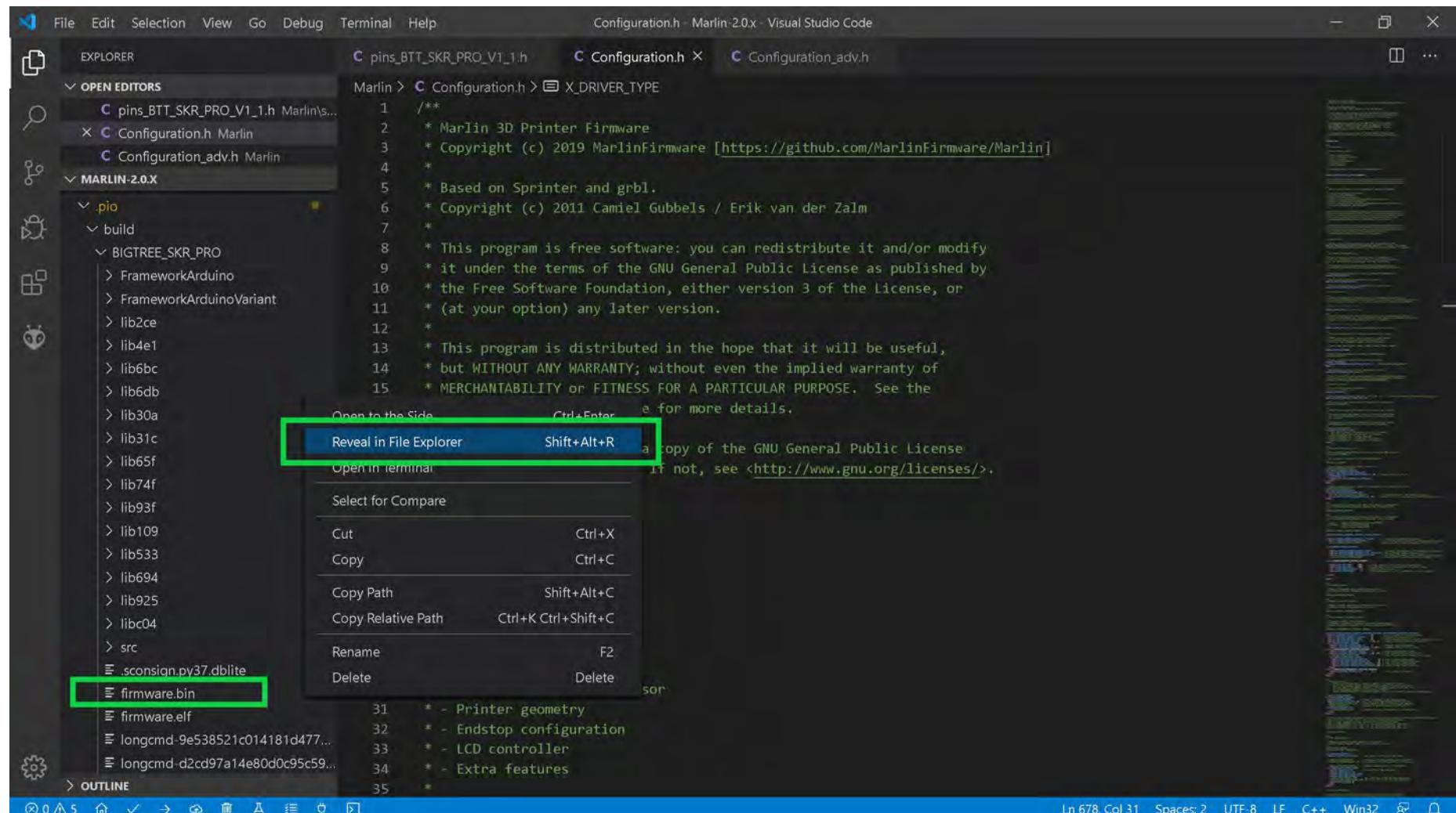
```

The terminal output is highlighted with a green box. At the bottom of the terminal, a message says "Terminal will be reused by tasks, press any key to close it." A yellow box highlights the checkmark icon in the bottom-left corner of the terminal tab bar.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU ST820 Drivers

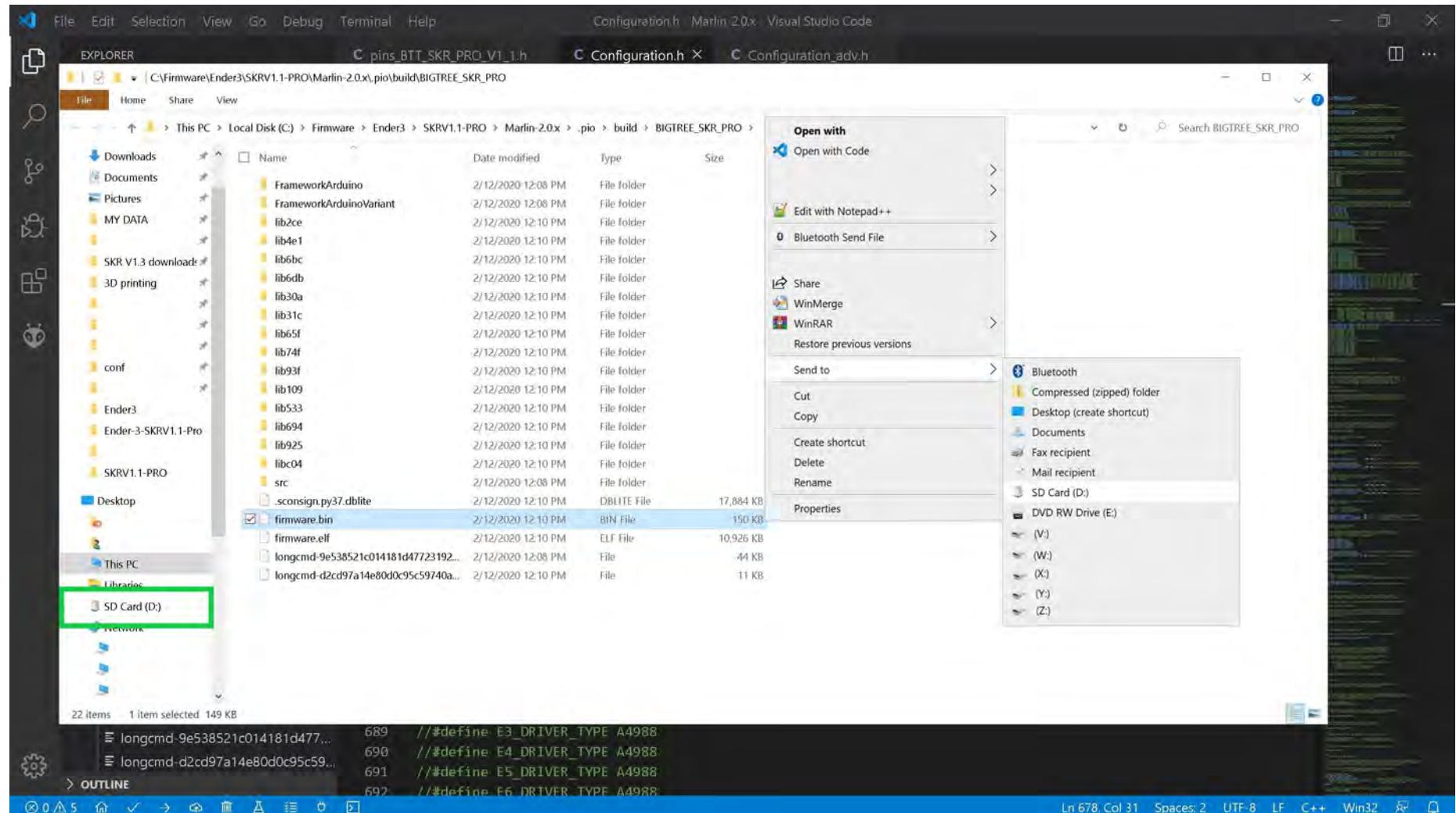
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



- Go to the next page.

The (latest release of) Marlin Setup for BIQU ST820 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



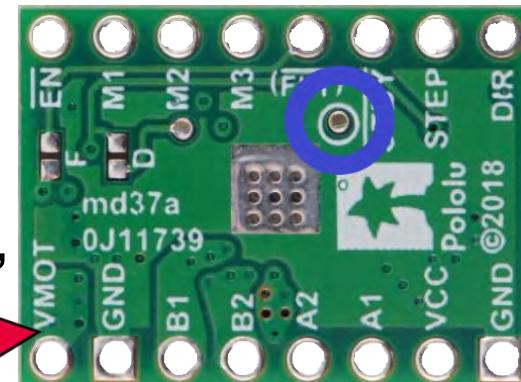
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

| | base of card | Stand-alone Mode |
|---------|-----------------------|------------------|
| ENABLE | - - - | VMOT |
| MODE1 | - | GND |
| MODE2 | - | B1 |
| MODE3 | - | B2 |
| FAULT | - - - | A2 |
| STBY | - - - | A1 |
| STEP | D 9 8 7 | VCC |
| DIR | D - - | GND |
| STATUS: | Not Yet Tested | |
| | fans/heaters/usb side | |

POLOLU ST820 (STSPIN820)

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} .

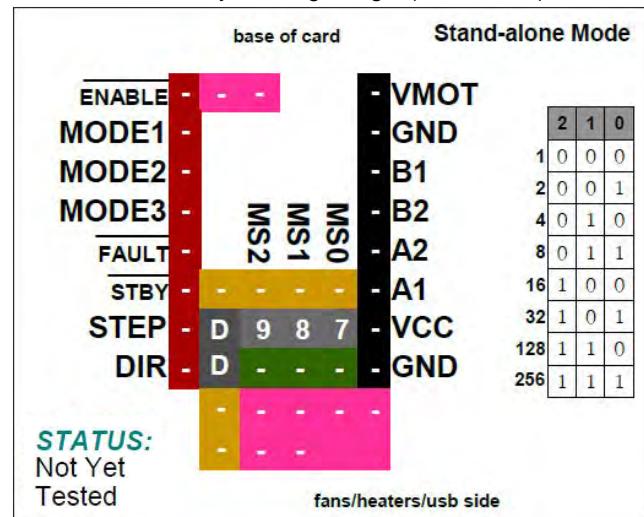
Note: "V_{ref} Test point" location is on the bottom of the driver board, as shown in BLUE



| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|--|------|------|------|----------------------|-----------------|
| Pololu ST820 | Low | Low | Low | Full step | 2 Phase |
| Maximum 256 Subdivision | Low | Low | High | Half step | 1-2 Phase |
| 45V DC | Low | High | Low | 1/4 step | W1-2 Phase |
| 1.5A (peak) | Low | High | High | 1/8 step | 2W1-2 Phase |
| Driving Current Calculation Formula | High | Low | Low | 1/16 step | 4W1-2 Phase |
| R_S (Typical Sense Resistor)= 0.2Ω | High | Low | High | 1/32 step | 8W1-2 Phase |
| | High | High | Low | 1/128 step | 16W1-2 Phase |
| | High | High | High | 1/256 step | 32W1-2 Phase |

$$I_{MAX} = V_{ref} * \frac{1}{R_S}$$

$$V_{ref} = I_{MAX} * R_S$$

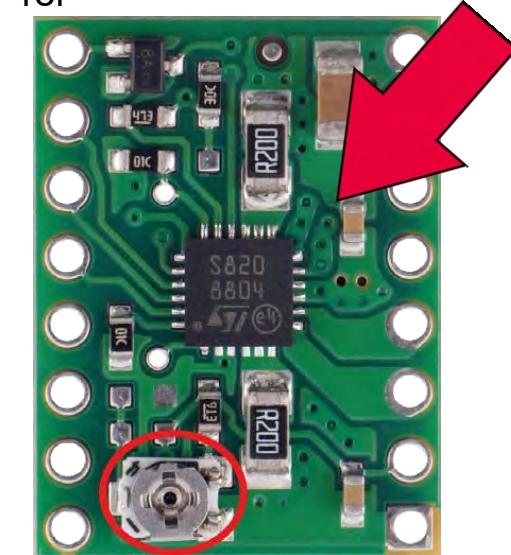
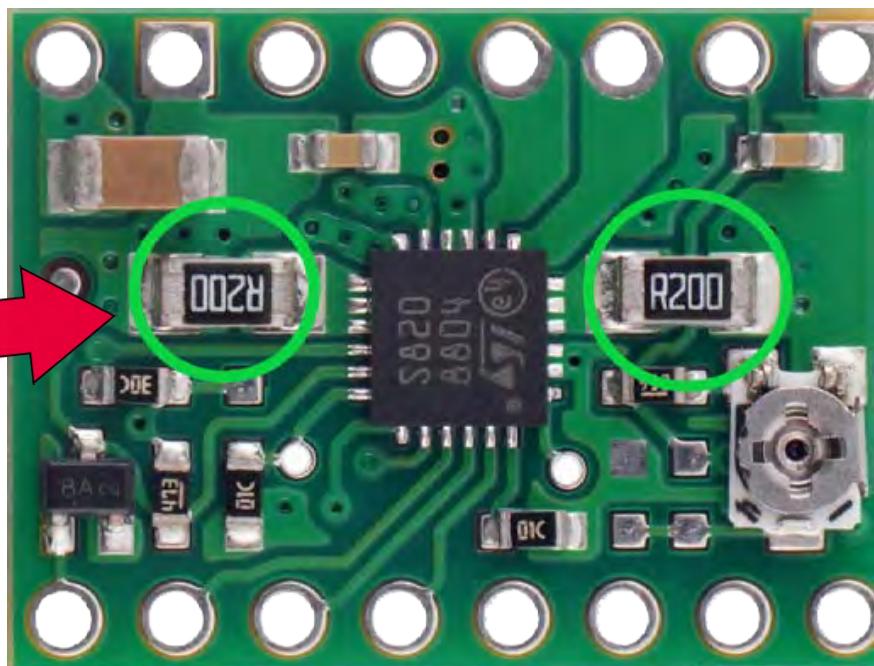


POLOLU ST820 (STSPIN820)

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN

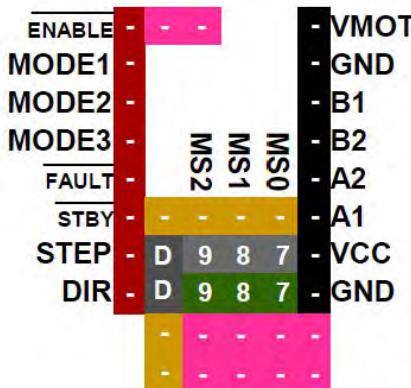


- $R_s = R050$ is 0.05 Ohms
- $R_s = R068$ is 0.068 Ohms
- $R_s = R100$ is 0.1 Ohms
- $R_s = R150$ is 0.15 Ohms
- $R_s = R200$ is 0.2 Ohms
- $R_s = R220$ is 0.22 Ohms

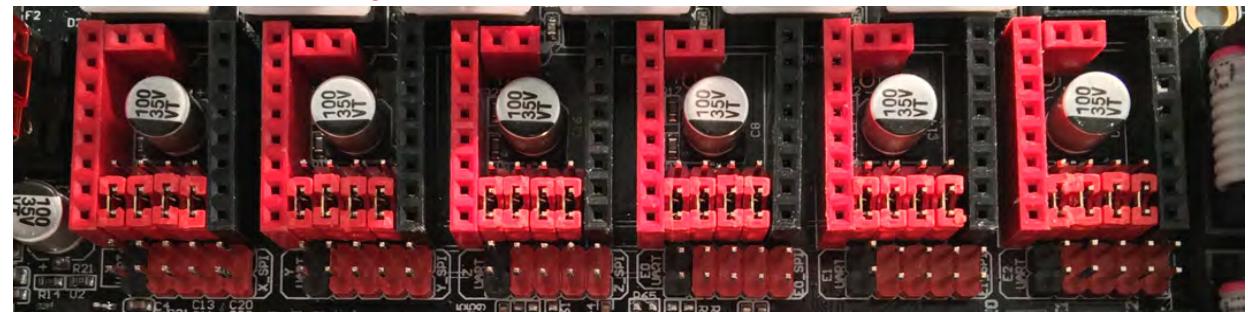
POLOLU ST820 (STSPIN820)

Stand-alone Mode

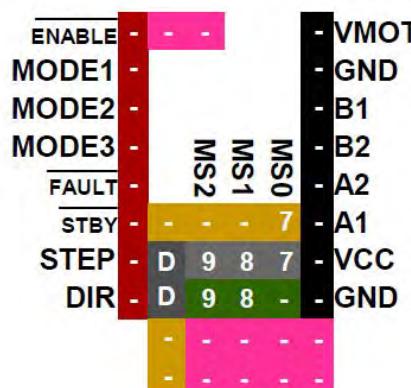
Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.



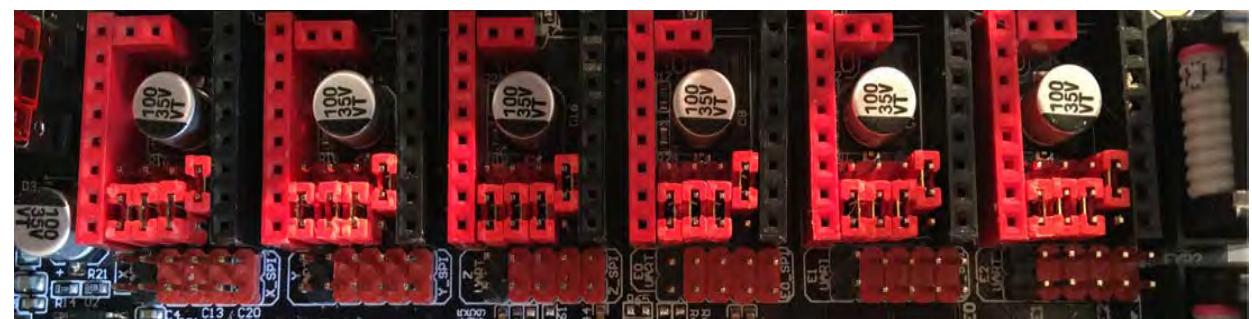
Note: The "D" jumper MUST be SET!



STEP



Note: The "D" jumper MUST be SET!

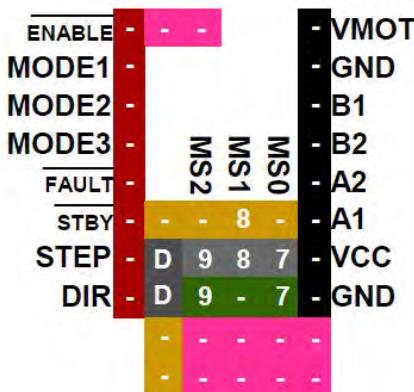


1 / 2

POLOLU ST820 (STSPIN820)

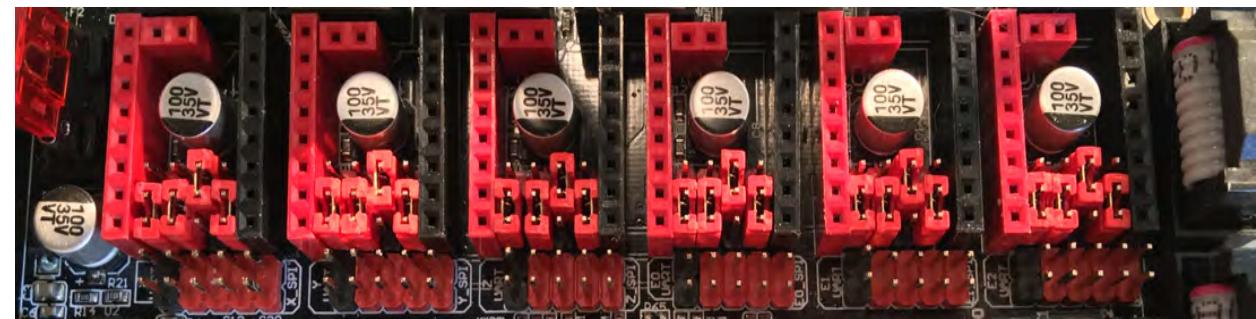
Stand-alone Mode

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.

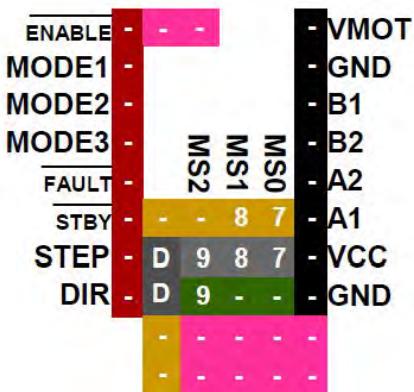


1 / 4

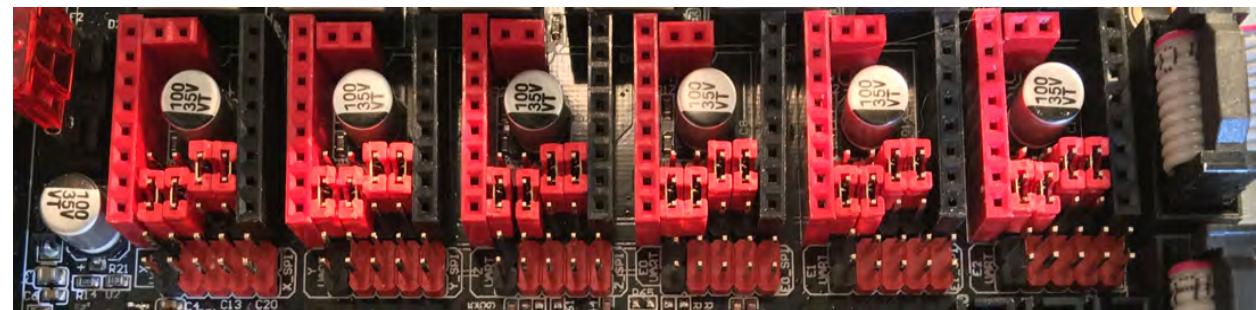
Note: The "D" jumper MUST be SET!



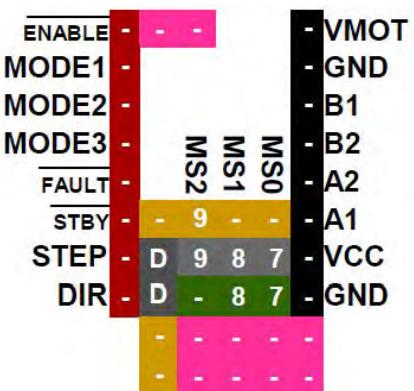
1 / 8



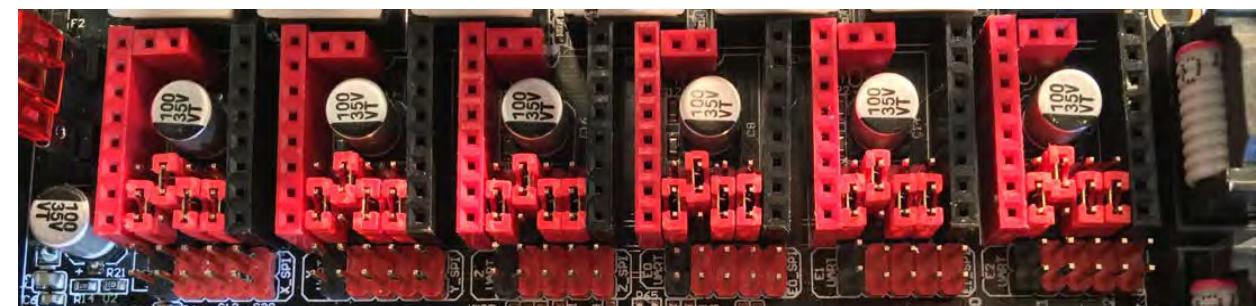
Note: The "D" jumper MUST be SET!



1 / 16



Note: The "D" jumper MUST be SET!



POLOLU ST820 (STSPIN820)

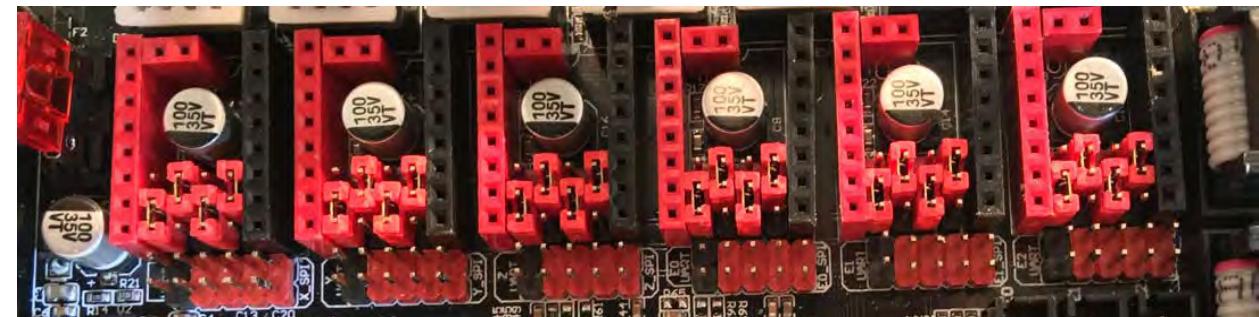
Stand-alone Mode

Important: This driver has special requirements in the Configuration and Configuration_adv.h. Also, this driver requires constant cooling the moment any motor is used, or it will switch on and off.

| | | | | |
|--------|---|-----|-----|------|
| ENABLE | - | - | - | VMOT |
| MODE1 | - | - | - | GND |
| MODE2 | - | - | - | B1 |
| MODE3 | - | - | - | B2 |
| FAULT | - | MS2 | MS1 | A2 |
| STBY | - | 9 | 7 | A1 |
| STEP | D | 9 | 8 | VCC |
| DIR | D | - | 8 | GND |

1 / 32

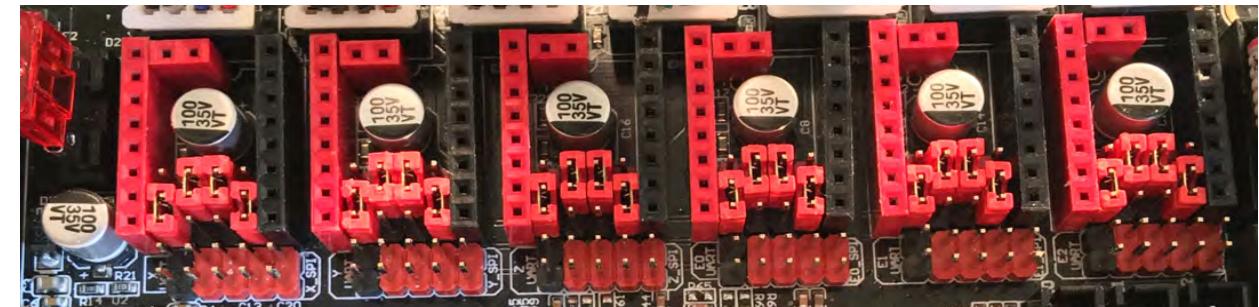
Note: The "D" jumper MUST be SET!



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| | | | | |
|--------|---|-----|-----|------|
| ENABLE | - | - | - | VMOT |
| MODE1 | - | - | - | GND |
| MODE2 | - | - | - | B1 |
| MODE3 | - | - | - | B2 |
| FAULT | - | MS2 | MS1 | A2 |
| STBY | - | 9 | 8 | A1 |
| STEP | D | 9 | 8 | VCC |
| DIR | D | - | 7 | GND |

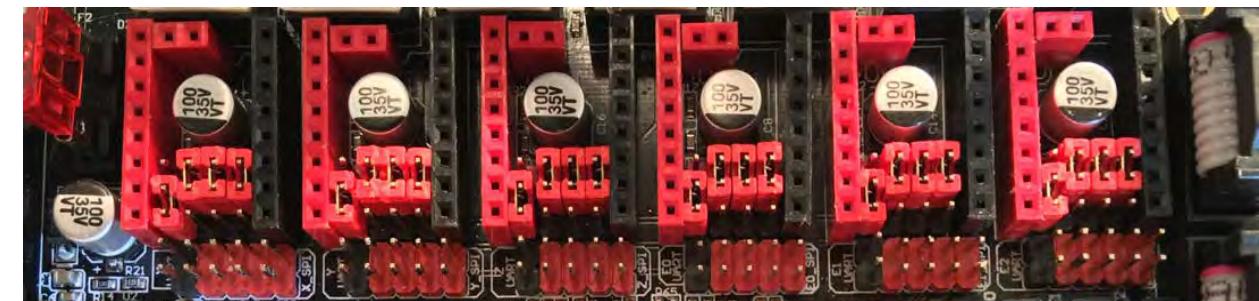
Note: The "D" jumper MUST be SET!



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| | | | | |
|--------|---|-----|-----|------|
| ENABLE | - | - | - | VMOT |
| MODE1 | - | - | - | GND |
| MODE2 | - | - | - | B1 |
| MODE3 | - | - | - | B2 |
| FAULT | - | MS2 | MS1 | A2 |
| STBY | - | 9 | 8 | A1 |
| STEP | D | 9 | 8 | VCC |
| DIR | D | - | - | GND |

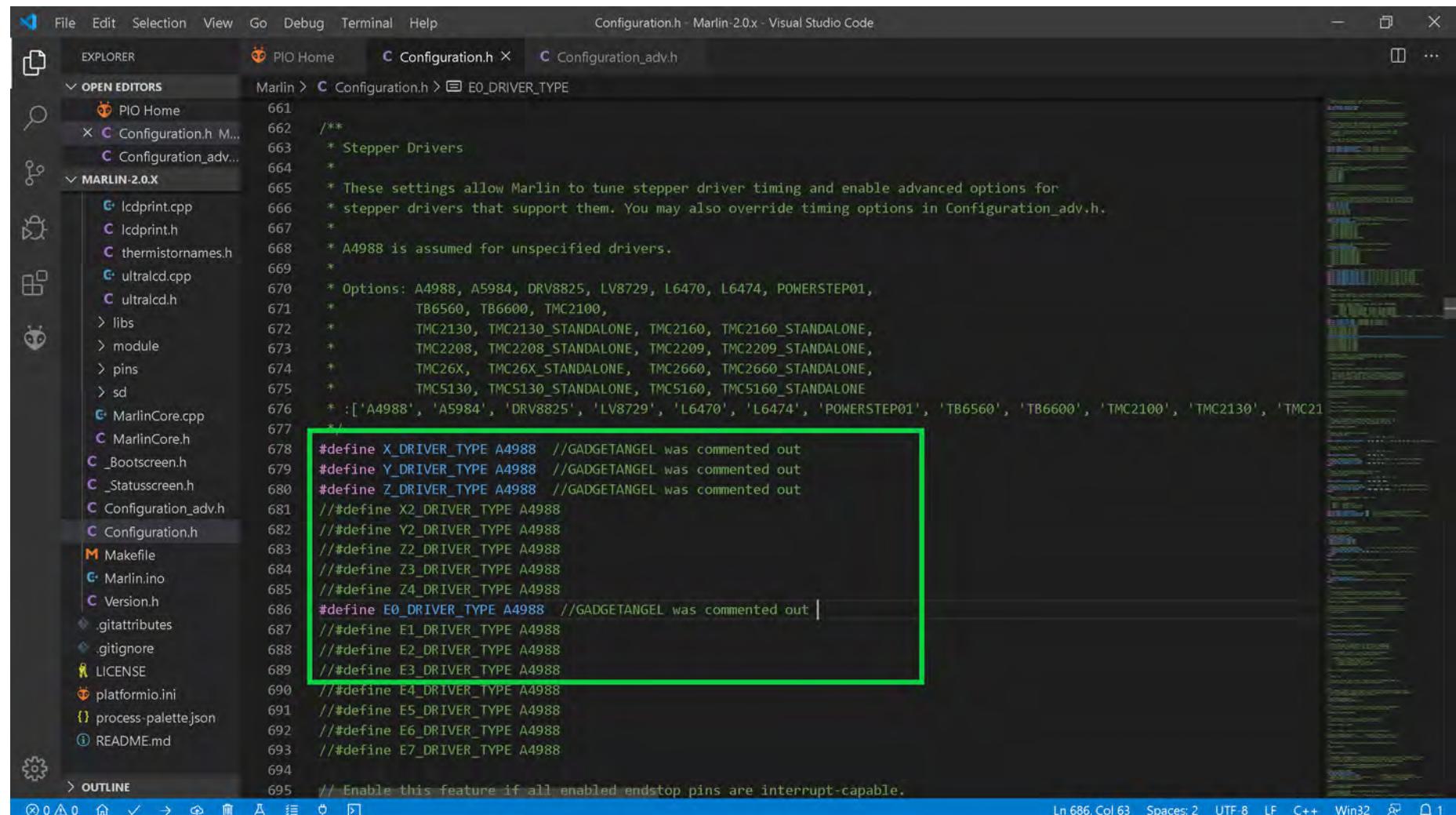
Note: The "D" jumper MUST be SET!



The (latest release of) Marlin Setup for POLOLU ST820 (STSPIN820) Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for POLOLU ST820 (STSPIN820) stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using POLOLU ST820 (STSPIN820) drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use POLOLU ST820 (STSPIN820) drivers. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
- The ST820 is a drop in replacement for the A4988. Since Marlin does not have an option for ST820 we will use the A4988 option.



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following snippet of code, which is highlighted with a green box:

```

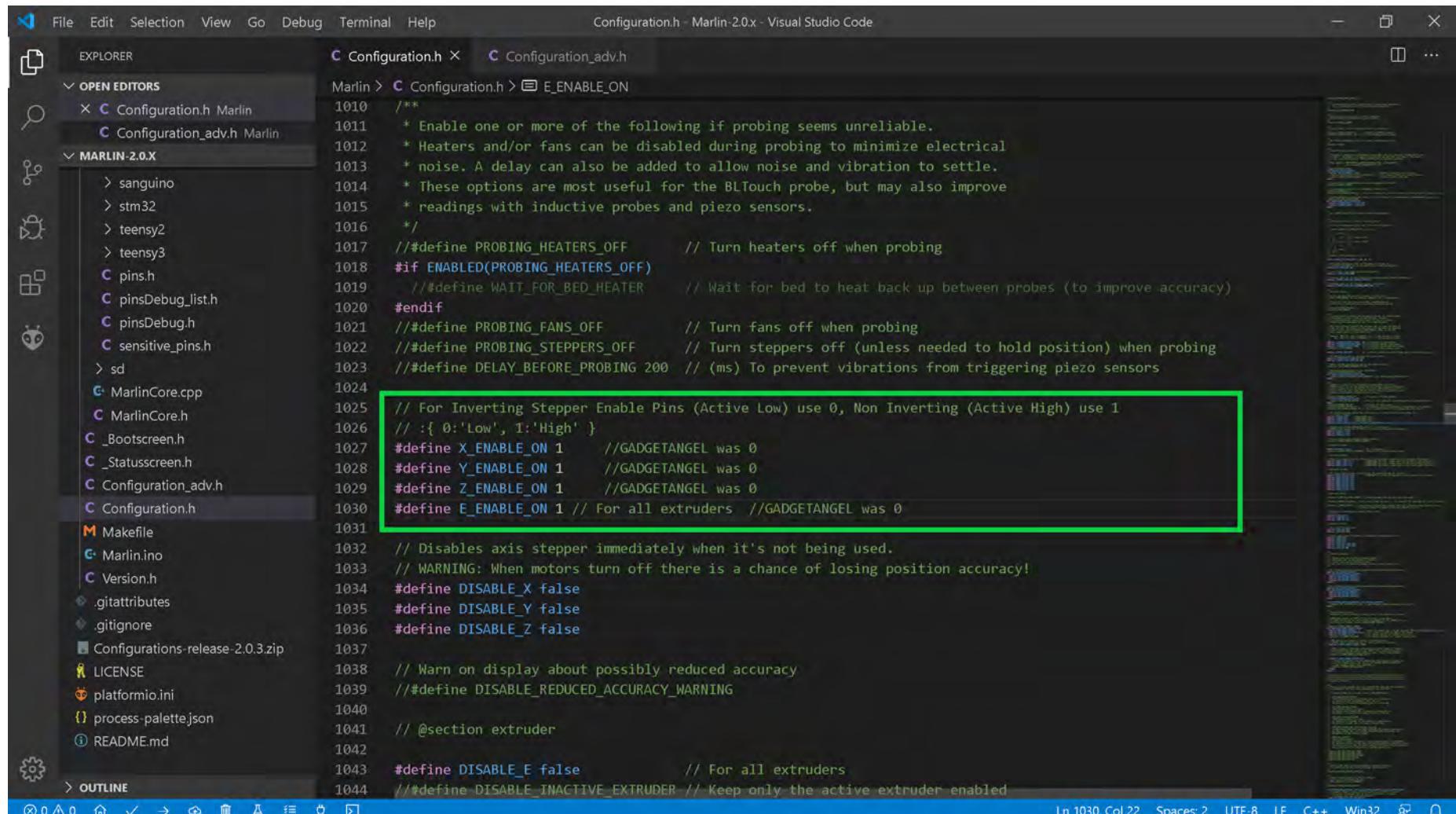
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160',
676 * 'TMC2208', 'TMC2208_STANDALONE', 'TMC2209', 'TMC2209_STANDALONE',
677 * 'TMC26X', 'TMC26X_STANDALONE', 'TMC2660', 'TMC2660_STANDALONE',
678 * 'TMC5130', 'TMC5130_STANDALONE', 'TMC5160', 'TMC5160_STANDALONE']
679 */
680 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
681 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
682 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
683 //#define X2_DRIVER_TYPE A4988
684 //#define Y2_DRIVER_TYPE A4988
685 //#define Z2_DRIVER_TYPE A4988
686 //#define Z3_DRIVER_TYPE A4988
687 //#define Z4_DRIVER_TYPE A4988
688 #define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out
689 //#define E1_DRIVER_TYPE A4988
690 //#define E2_DRIVER_TYPE A4988
691 //#define E3_DRIVER_TYPE A4988
692 //#define E4_DRIVER_TYPE A4988
693 //#define E5_DRIVER_TYPE A4988
694 //#define E6_DRIVER_TYPE A4988
695 //#define E7_DRIVER_TYPE A4988
696
697 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU ST820 (STSPIN820) Drivers

- In the Marlin firmware, the ST820 drivers needs an ACTIVE HIGH for the stepper motor driver's enable pin, so set "X_ENABLE_ON" to 1, "Y_ENABLE_ON" to 1, "Z_ENABLE_ON" to 1 and "E_ENABLE_ON" to 1, as seen in the **GREEN** box below.



Configuration.h - Marlin-2.0x - Visual Studio Code

```

File Edit Selection View Go Debug Terminal Help
EXPLORER Configuration.h Configuration_adv.h
Marlin > Configuration.h > E_ENABLE_ON
1010 /**
1011 * Enable one or more of the following if probing seems unreliable.
1012 * Heaters and/or fans can be disabled during probing to minimize electrical
1013 * noise. A delay can also be added to allow noise and vibration to settle.
1014 * These options are most useful for the BLTouch probe, but may also improve
1015 * readings with inductive probes and piezo sensors.
1016 */
1017 //#define PROBING_HEATERS_OFF // Turn heaters off when probing
1018 #if ENABLED(PROBING_HEATERS_OFF)
1019   // #define WAIT_FOR_BED_HEATER // Wait for bed to heat back up between probes (to improve accuracy)
1020 #endif
1021 //#define PROBING_FANS_OFF // Turn fans off when probing
1022 //#define PROBING_STEPPERS_OFF // Turn steppers off (unless needed to hold position) when probing
1023 //#define DELAY_BEFORE_PROBING 200 // (ms) To prevent vibrations from triggering piezo sensors
1024
1025 // For Inverting Stepper Enable Pins (Active Low) use 0, Non Inverting (Active High) use 1
1026 // :{ 0:'Low', 1:'High' }
1027 #define X_ENABLE_ON 1 //GADGETANGEL was 0
1028 #define Y_ENABLE_ON 1 //GADGETANGEL was 0
1029 #define Z_ENABLE_ON 1 //GADGETANGEL was 0
1030 #define E_ENABLE_ON 1 // For all extruders //GADGETANGEL was 0
1031
1032 // Disables axis stepper immediately when it's not being used.
1033 // WARNING: When motors turn off there is a chance of losing position accuracy!
1034 #define DISABLE_X false
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 //#define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false // For all extruders
1044 //#define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled

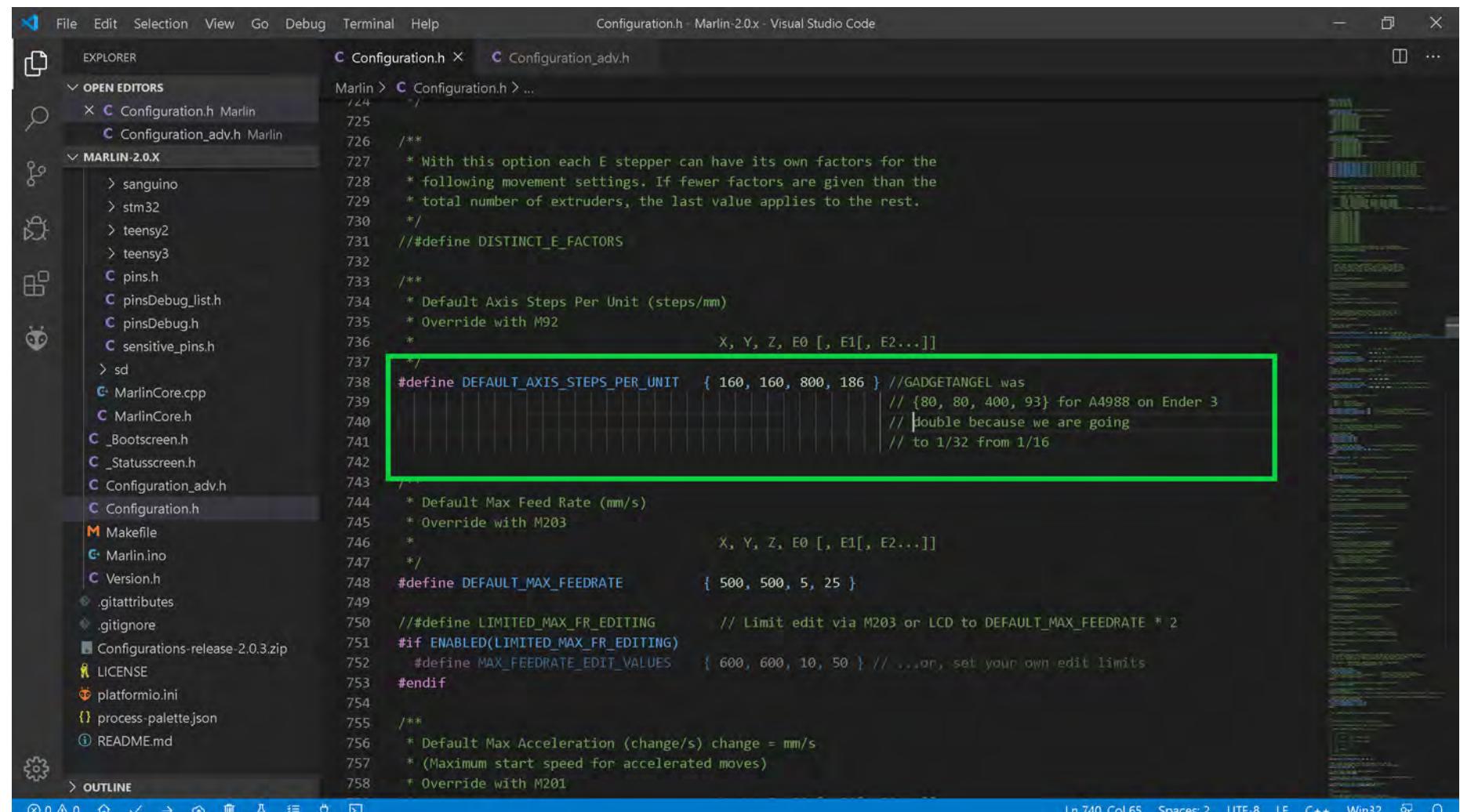
```

Ln 1030, Col 22 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU ST820 (STSPIN820) Drivers

- Since we are changing from A4988 stepper motor drivers on the Ender 3 to POLOLU ST820 (STSPIN820) stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the line:

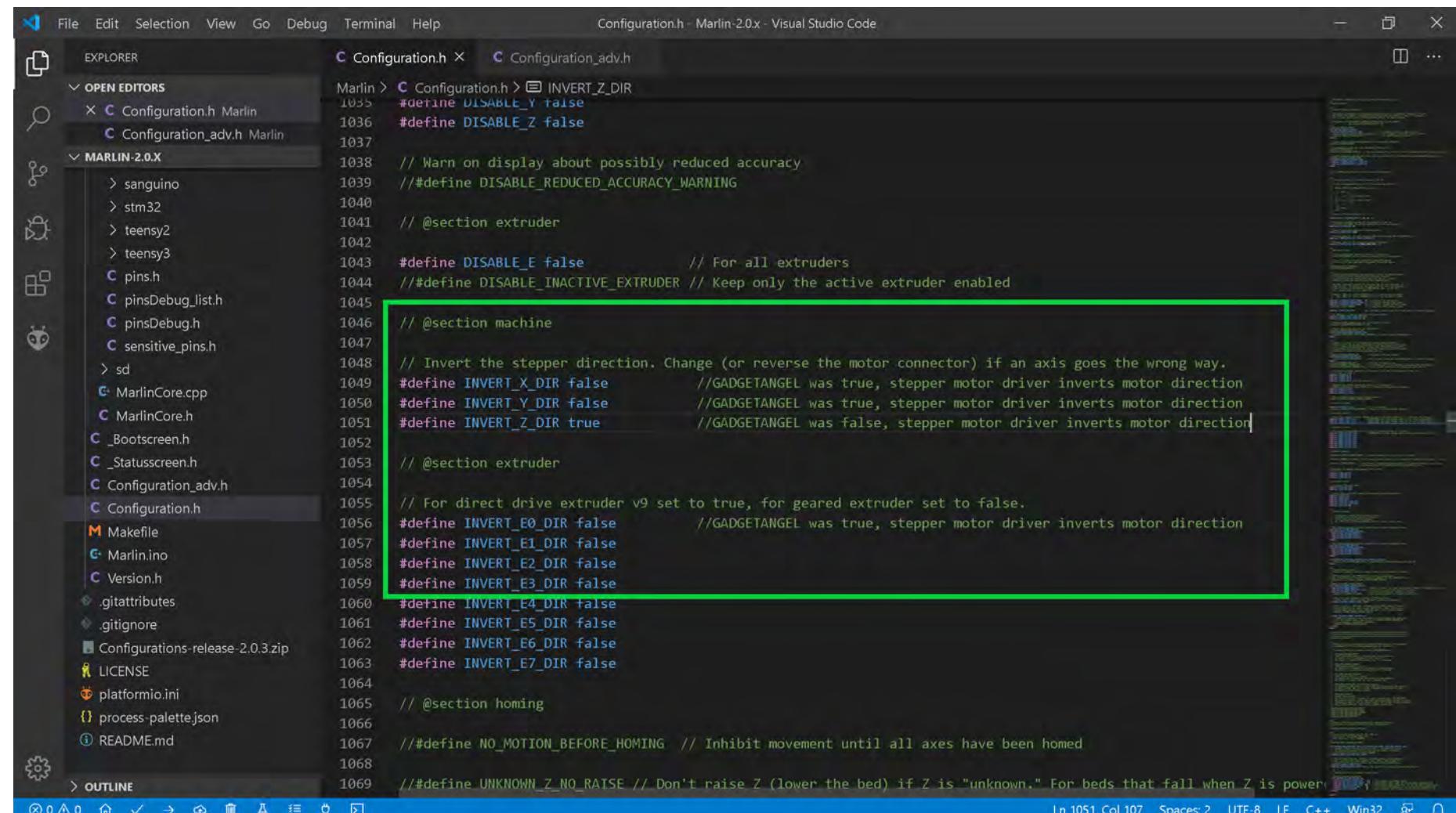
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// double because we are going
// to 1/32 from 1/16
```

The 'EXPLORER' sidebar on the left shows the project structure, including files like 'Configuration.h' and 'Configuration_adv.h' under the 'MARLIN-2.0.X' folder. The status bar at the bottom indicates the code is at line 740, column 65, with 2 spaces, in UTF-8 encoding, for C++ on Win32.

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU ST820 (STSPIN820) Drivers

- **Optional Step:** I found conflicting information on the ST820 driver. Some sources say you will need to change the motor direction others say you may not. So I provide the below information in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring instead of the Marlin firmware, here is a link on how to change the motor direction via the wiring (look for section labeled "Motor moving the wrong direction") https://reprap.org/wiki/Stepper_wiring. Other people prefer to change the motor direction in the Marlin firmware. **So if you want or need to change the motor direction in Marlin**, then if the axis' setting you will be using the ST820 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



Configuration.h - Marlin-2.0.x - Visual Studio Code

```

File Edit Selection View Go Debug Terminal Help
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > INVERT_Z_DIR
  Configuration.h Marlin 1035 #define DISABLE_Y false
  Configuration_adv.h Marlin 1036 #define DISABLE_Z false
  1037
  // Warn on display about possibly reduced accuracy
  1038 // #define DISABLE_REDUCED_ACCURACY_WARNING
  1039
  // @section extruder
  1040
  1041 #define DISABLE_E false          // For all extruders
  1042 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
  1043
  1044 // @section machine
  1045
  1046 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
  1047 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
  1048 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
  1049 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
  1050
  1051 // @section extruder
  1052
  1053 // For direct drive extruder v9 set to true, for geared extruder set to false.
  1054
  1055 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
  1056 #define INVERT_E1_DIR false
  1057 #define INVERT_E2_DIR false
  1058 #define INVERT_E3_DIR false
  1059 #define INVERT_E4_DIR false
  1060 #define INVERT_E5_DIR false
  1061 #define INVERT_E6_DIR false
  1062 #define INVERT_E7_DIR false
  1063
  1064 // @section homing
  1065
  1066 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
  1067
  1068 // #define UNKNOWN_Z_NO_RATSE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered
  1069

```

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU ST820 (STSPIN820) Drivers

- The end of Marlin setup for POLOLU ST820 (STSPIN820) drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

The screenshot shows the Visual Studio Code interface with the Marlin repository open. The left sidebar shows the project structure with files like Configuration.h, pins_BTT_SKR_PRO_V1_1.h, and Configuration_adv.h. The main editor area displays the Configuration.h file with code related to stepper drivers and endstops. The bottom right terminal window shows the build process:

```

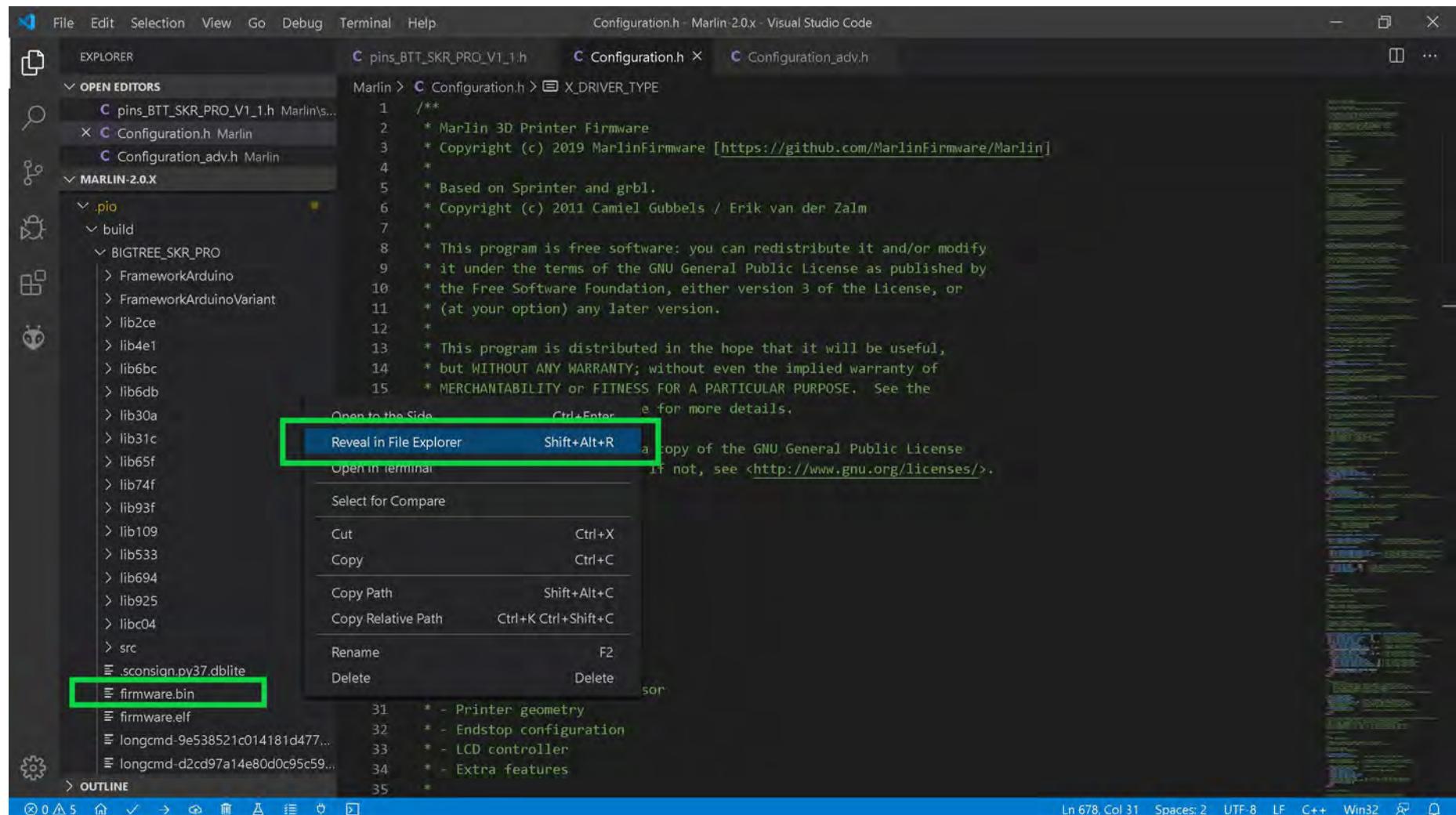
  BIGTREE_SKR_PRO          SUCCESS  00:02:31.294
  BIGTREE_CTP_11_0          IGNORED
  BIGTREE_BTT002            IGNORED
  teensy31                  IGNORED
  teensy35                  IGNORED
  esp32                      IGNORED
  linux_native               IGNORED
  SAMD51_grandcentral_m4   IGNORED
  rumba32_f446ve             IGNORED
  mks_rumba32                IGNORED
  include_tree                IGNORED
=====
===== 1 succeeded in 00:02:31.294 =====
  
```

The terminal message indicates 1 success in 00:02:31.294. A yellow box highlights the checkmark icon in the terminal toolbar, and a green box highlights the terminal output showing the successful build message.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for POLOLU ST820 (STSPIN820) Drivers

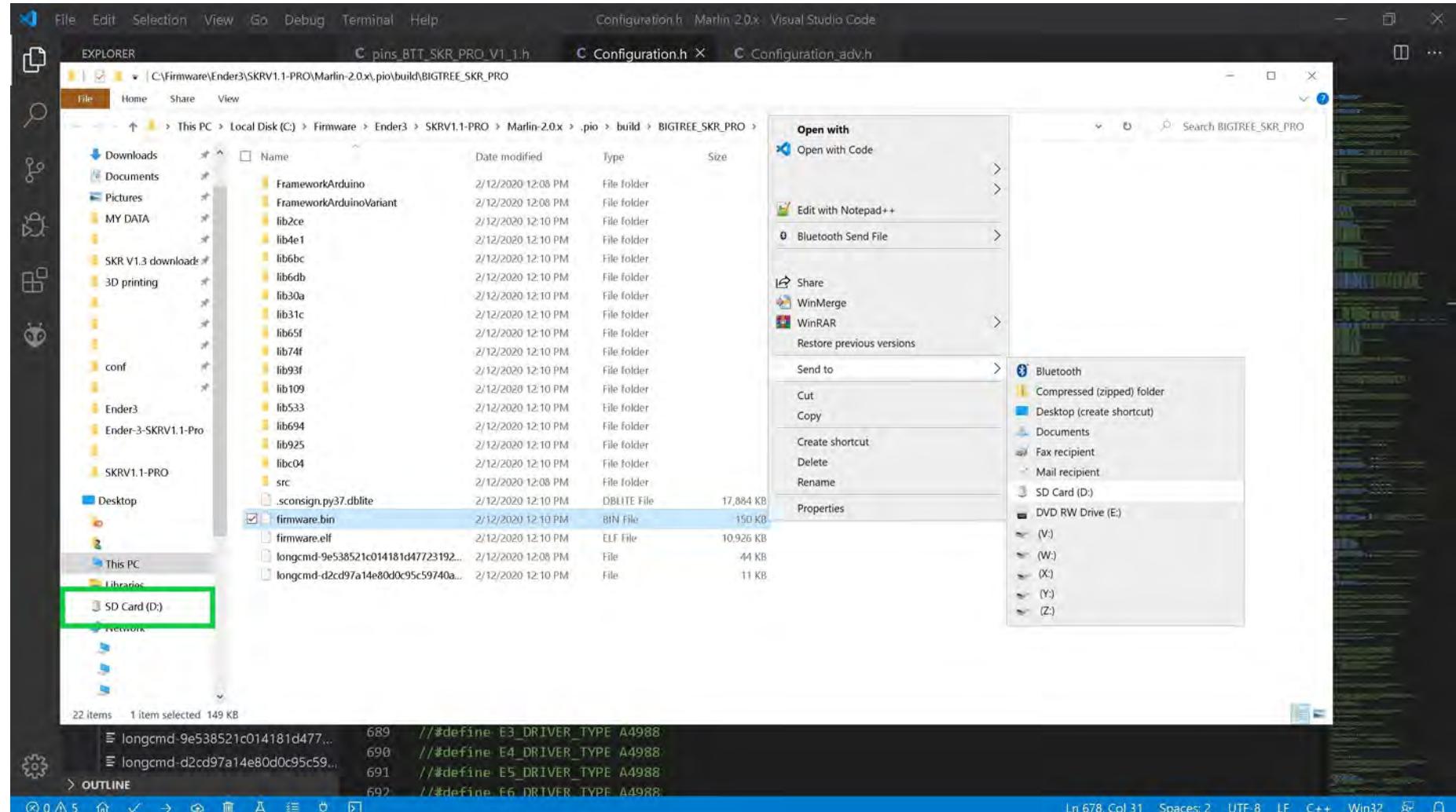
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



- Go to the next page.

The (latest release of) Marlin Setup for POLOLU ST820 (STSPIN820) Drivers

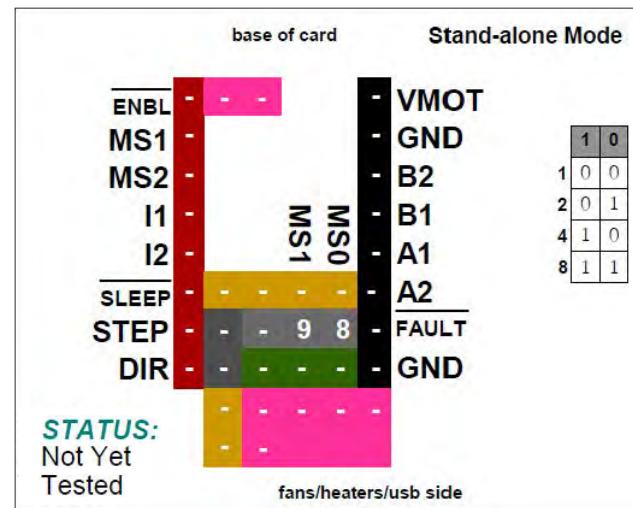
- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



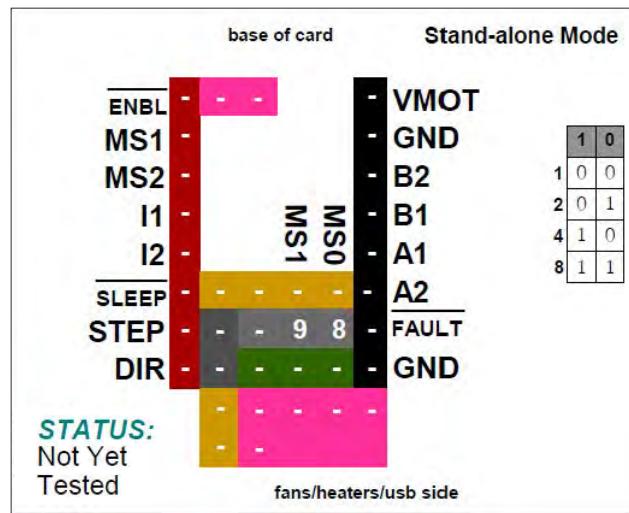
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

POLOLU MP6500

Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.



| Driver Chip | MS1 | MS0 | Microstep Resolution | Excitation Mode |
|---|---------------------------|------|---------------------------------|-----------------|
| Pololu MP6500 Maximum 8 Subdivision 35V DC 2.5A (peak) | Low | Low | Full step | 2 Phase |
| | Low | High | Half (1/2) step | 1-2 Phase |
| | High | Low | Quarter (1/4) step | W1-2 Phase |
| | High | High | Eighth (1/8) step | 2W1-2 Phase |
| Driving Current Calculation Formula | $I_{MAX} = V_{ref} * 3.5$ | | $V_{ref} = \frac{I_{MAX}}{3.5}$ | |

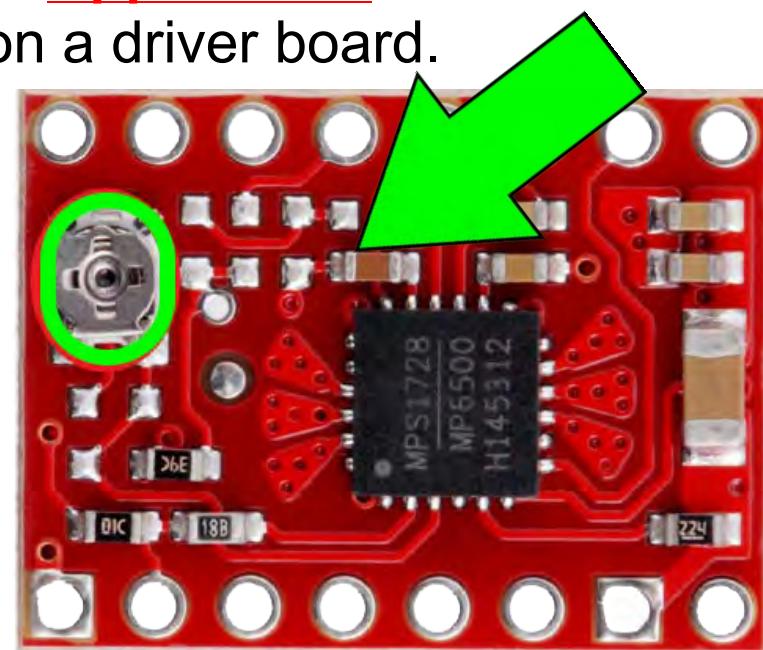
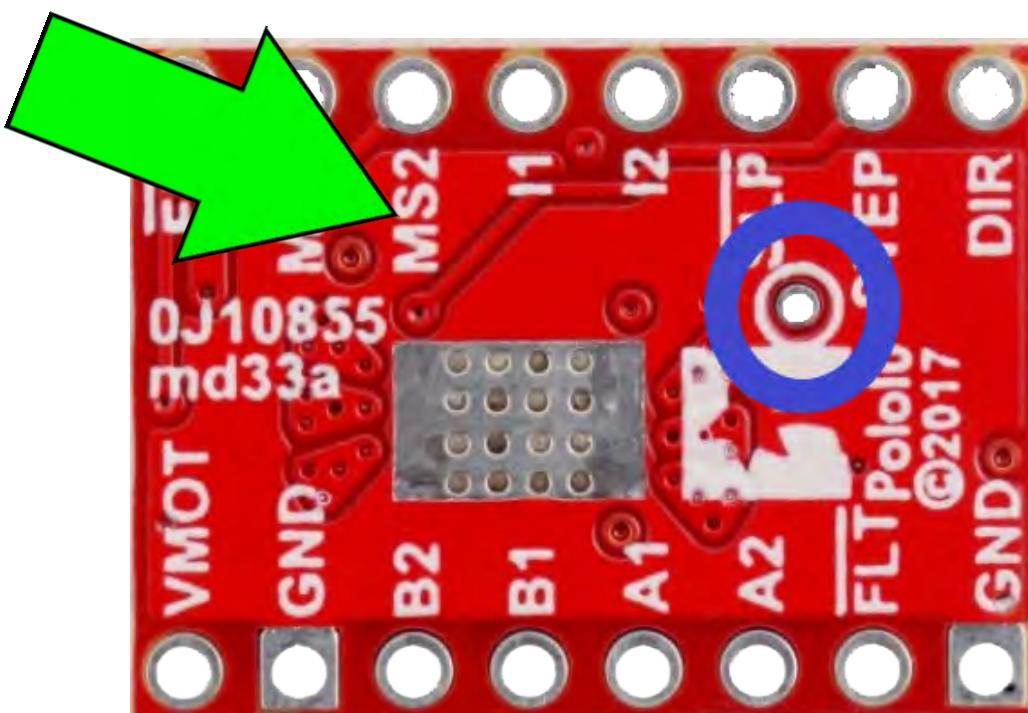


POLOLU MP6500

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board (or use the board's " V_{ref} Test point") to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: " V_{ref} Test point" location is on the bottom of the driver board, as shown in **BLUE**



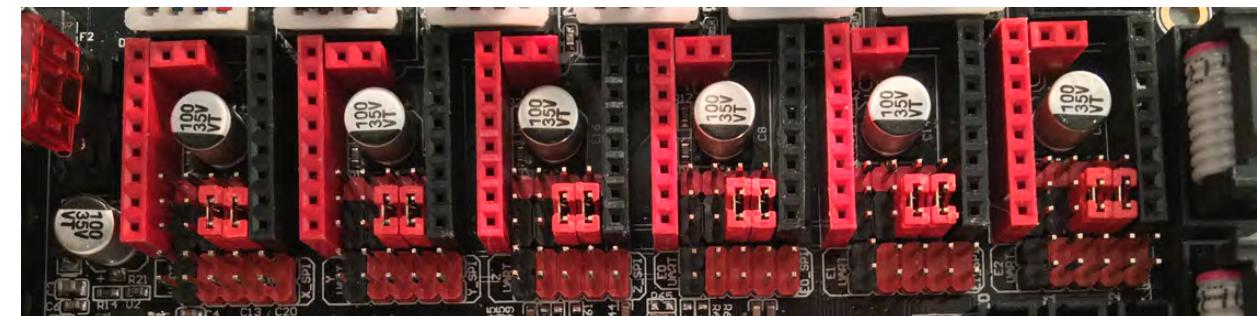
Note: MP6500 driver board does not use external current sense resistors (R_s).

POLOLU MP6500

Stand-alone Mode

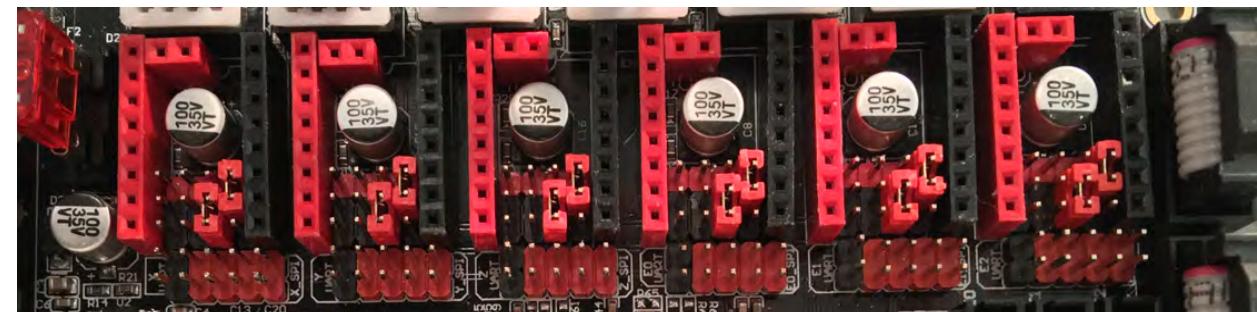
STEP

| | | | | |
|-------|---|---|-----|-------|
| ENBL | - | - | - | VMOT |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | B2 |
| I1 | - | - | - | B1 |
| I2 | - | - | - | A1 |
| SLEEP | - | - | - | A2 |
| STEP | - | - | 9 8 | FAULT |
| DIR | - | - | 9 8 | GND |
| | - | - | - | - |



1 / 2

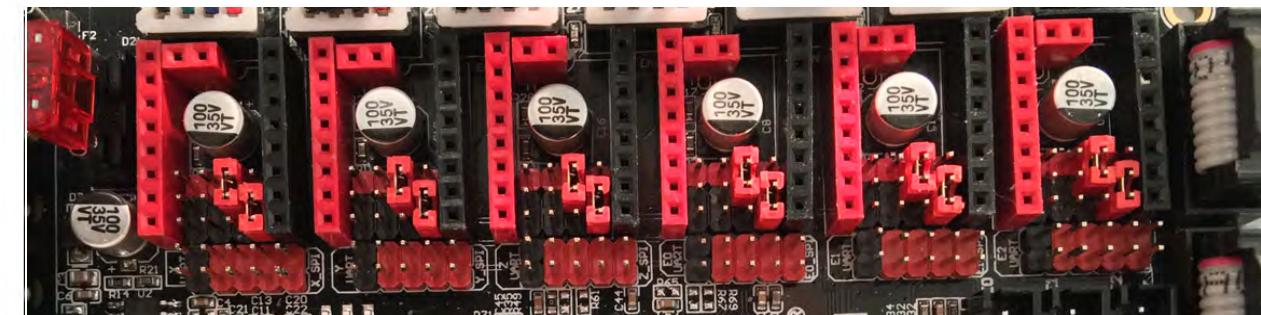
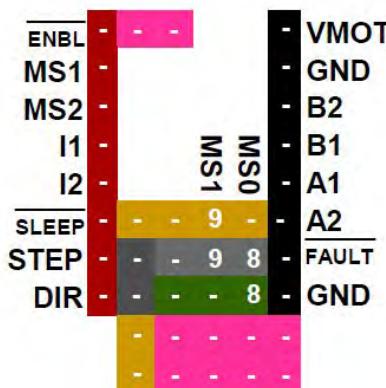
| | | | | |
|-------|---|---|-----|-------|
| ENBL | - | - | - | VMOT |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | B2 |
| I1 | - | - | - | B1 |
| I2 | - | - | - | A1 |
| SLEEP | - | - | - | A2 |
| STEP | - | - | 9 8 | FAULT |
| DIR | - | - | 9 - | GND |
| | - | - | - | - |



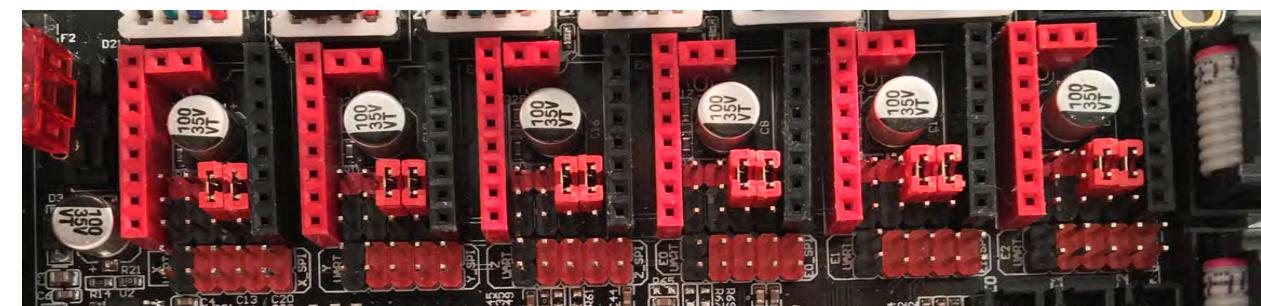
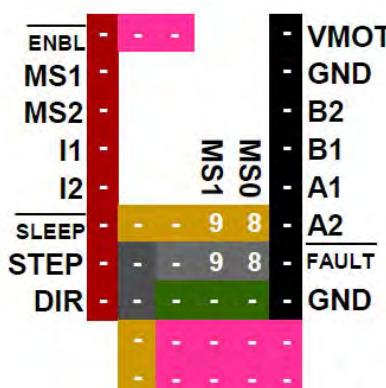
POLOLU MP6500

Stand-alone Mode

1 / 4



1 / 8



The (latest release of) Marlin Setup for POLOLU MP6500 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for POLOLU MP6500 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using POLOLU MP6500 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use POLOLU MP6500 drivers. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
- The **POLOLU MP6500 is a drop in replacement for the A4988. Since Marlin does not have an option for POLOLU MP6500 we will use the A4988 as the driver type.**

```

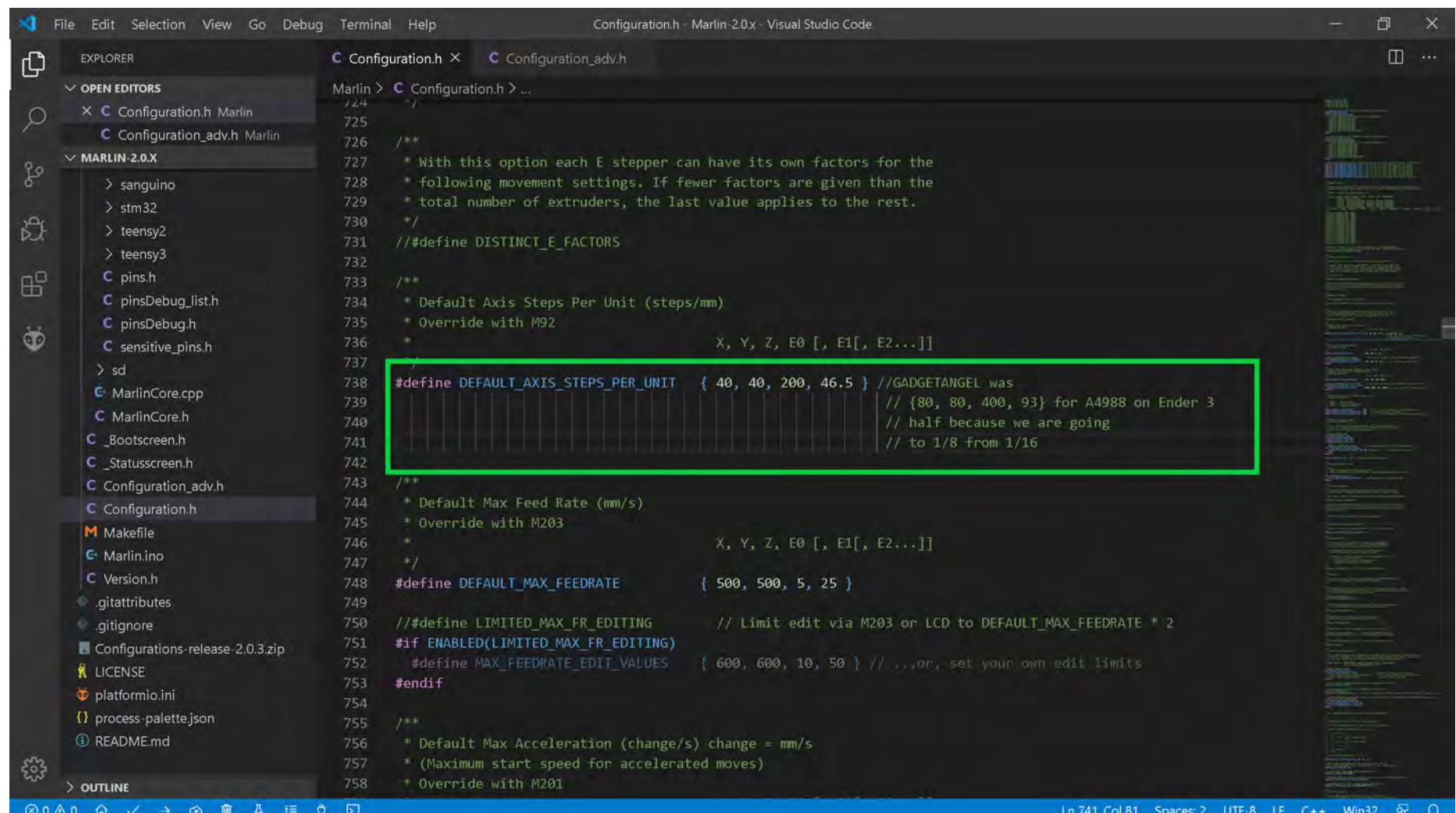
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER PIO Home Configuration.h Configuration_adv.h
Marlin > Configuration.h > E0_DRIVER_TYPE
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC2660', 'TMC5130', 'TMC5160']
676 */
677 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
678 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
679 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
680 //##define X2_DRIVER_TYPE A4988
681 //##define Y2_DRIVER_TYPE A4988
682 //##define Z2_DRIVER_TYPE A4988
683 //##define Z3_DRIVER_TYPE A4988
684 //##define Z4_DRIVER_TYPE A4988
685 //##define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out |
686 #define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out
687 //##define E1_DRIVER_TYPE A4988
688 //##define E2_DRIVER_TYPE A4988
689 //##define E3_DRIVER_TYPE A4988
690 //##define E4_DRIVER_TYPE A4988
691 //##define E5_DRIVER_TYPE A4988
692 //##define E6_DRIVER_TYPE A4988
693 //##define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.
Ln 686, Col 63 Spaces: 2 UTF-8 LF C++ Win32 ⌂ 1

```

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU MP6500 Drivers

- Since we are changing from A4988 stepper motor drivers on the Ender 3 to for POLOLU MP6500 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/8 stepping. So we are cutting our STEPS in half. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16.** So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {40, 40, 200, 46.5}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the line:

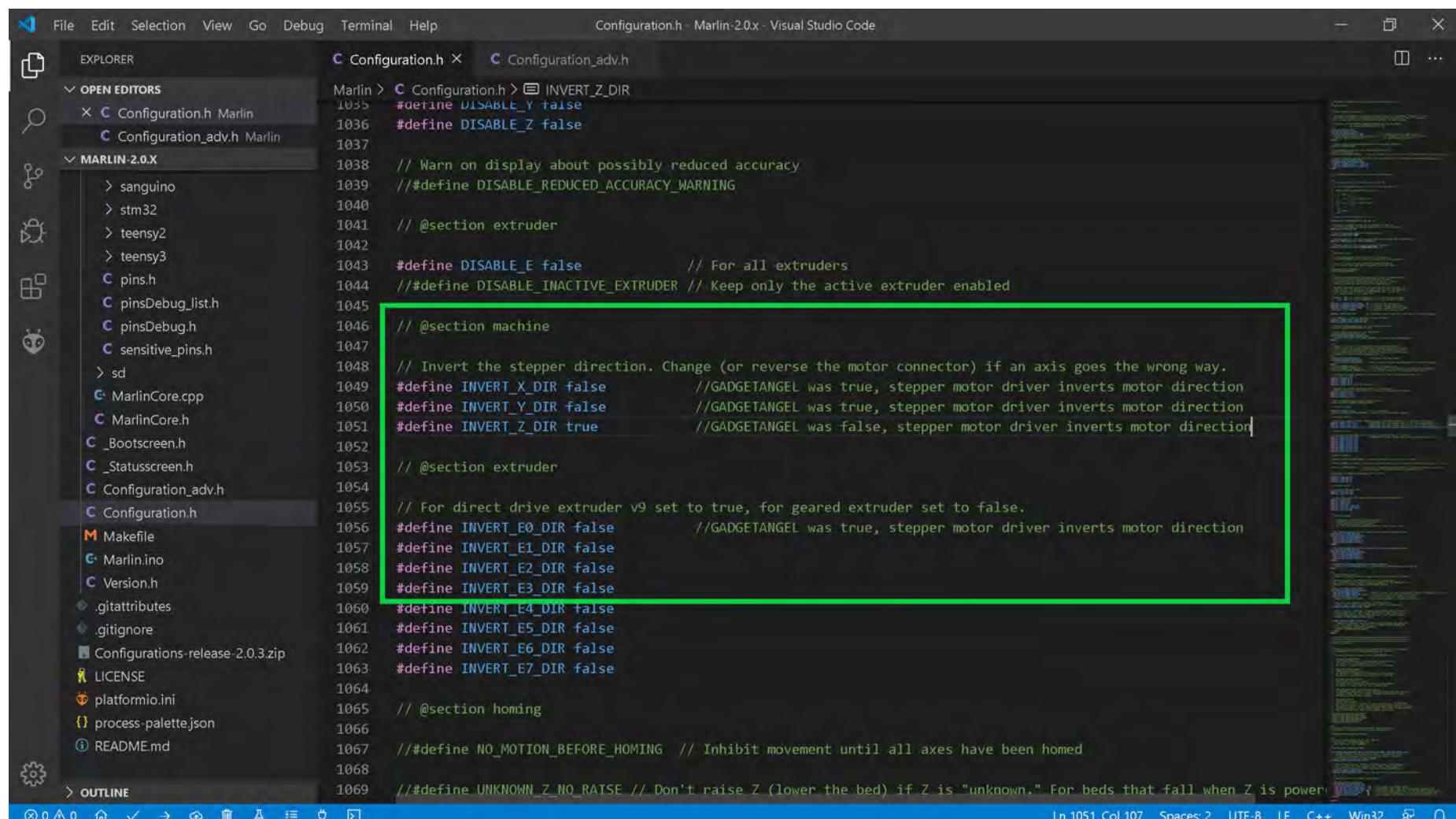
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 40, 40, 200, 46.5 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// half because we are going
// to 1/8 from 1/16
```

The code editor's status bar at the bottom right shows: Ln 741, Col 81 Spaces:2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU MP6500 Drivers

- **Optional Step:** I cannot find information on the POLOLU MP6500 driver's impact on motor direction. So I provide the below information in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring instead of the Marlin firmware, here is a link on how to change the motor direction via the wiring (look for section labeled "Motor moving the wrong direction") https://reprap.org/wiki/Stepper_wiring. Other people prefer to change the motor direction in the Marlin firmware. **So if you want or need to change the motor direction in Marlin**, then if the axis' setting you will be using the MP6500 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



Configuration.h - Marlin-2.0.x - Visual Studio Code

```

File Edit Selection View Go Debug Terminal Help
EXPLORER Configuration.h Configuration_adv.h
Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU MP6500 Drivers

- The end of Marlin setup for POLOLU MP6500 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

The screenshot shows the Visual Studio Code interface with the Marlin 2.0.x repository open. The left sidebar displays the project structure, including files like pins_BTT_SKR_PRO_V1_1.h, Configuration.h, Configuration_adv.h, and Makefile. The main editor area shows the Configuration.h file with code related to endstop inversion. The bottom right corner features a terminal window showing the output of a build command for BIGTREETECH_V1_0, which completed successfully in 00:02:31.294.

```
#define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.  
#define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.  
#define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.  
  
/*  
 * Stepper Drivers  
 *  
 * These settings allow Marlin to tune stepper driver timing and enable advanced options for  
 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.  
 *  
 * A4988 is assumed for unspecified drivers.  
 *  
 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,  
 * TB6560, TB6600, TMC2100,  
 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,  
 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,  
 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,  
 * TMC2660_STANDALONE, TMC2660_STANDALONE, TMC2660_STANDALONE  
 */
```

| | BIGTREETECH_V1_0 | IGNORED | |
|--|------------------------|---------|--------------|
| | BIGTREETECH_V1_0 | SUCCESS | 00:02:31.294 |
| | BIGTREETECH_V1_0 | IGNORED | |
| | BIGTREE_BTT002 | IGNORED | |
| | teensy31 | IGNORED | |
| | teensy35 | IGNORED | |
| | esp32 | IGNORED | |
| | linux_native | IGNORED | |
| | SAMD51_grandcentral_m4 | IGNORED | |
| | rumba32_f446ve | IGNORED | |
| | mks_rumba32 | IGNORED | |
| | include_tree | IGNORED | |

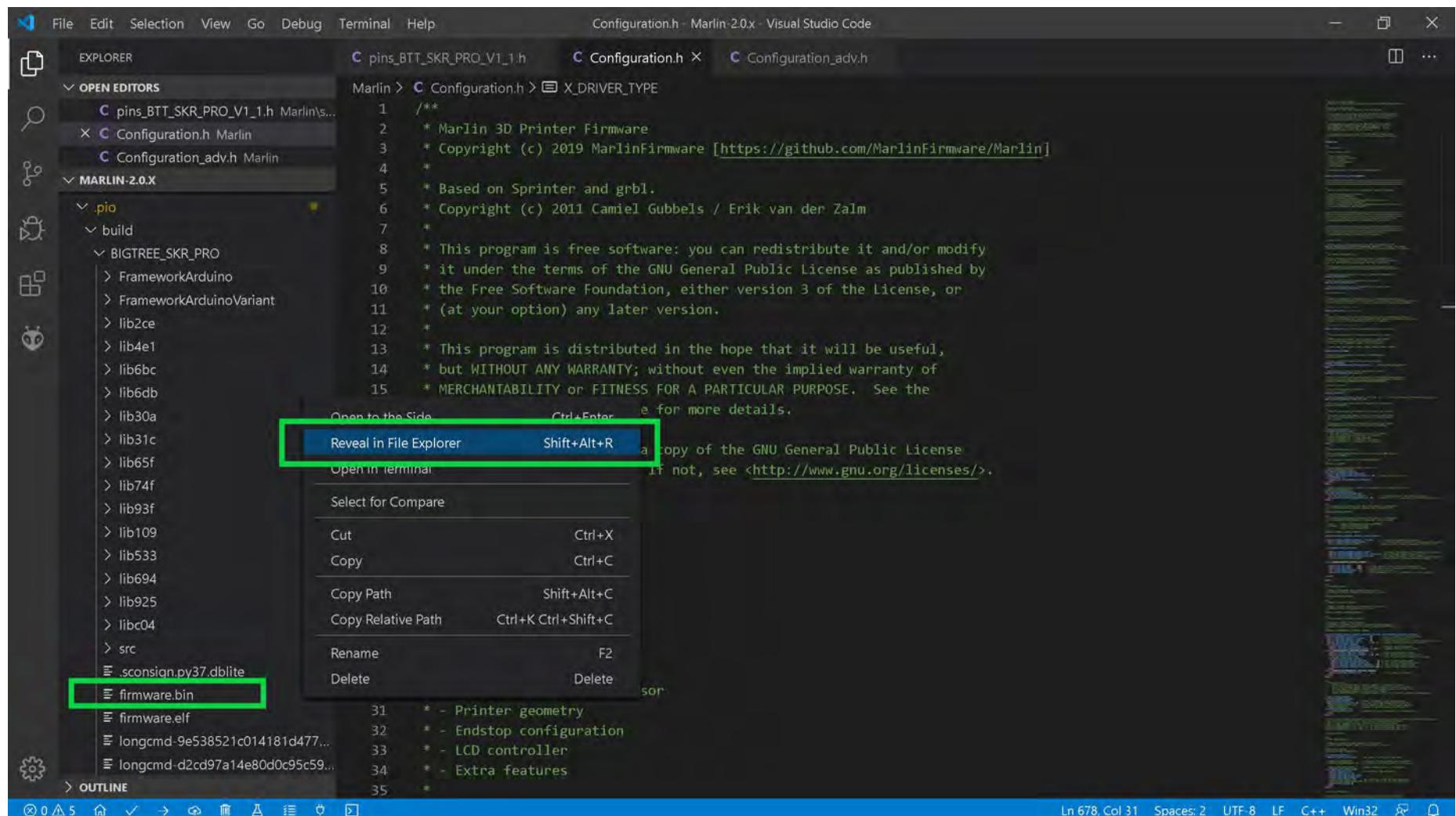
```
===== 1 succeeded in 00:02:31.294 =====
```

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for POLOLU MP6500 Drivers

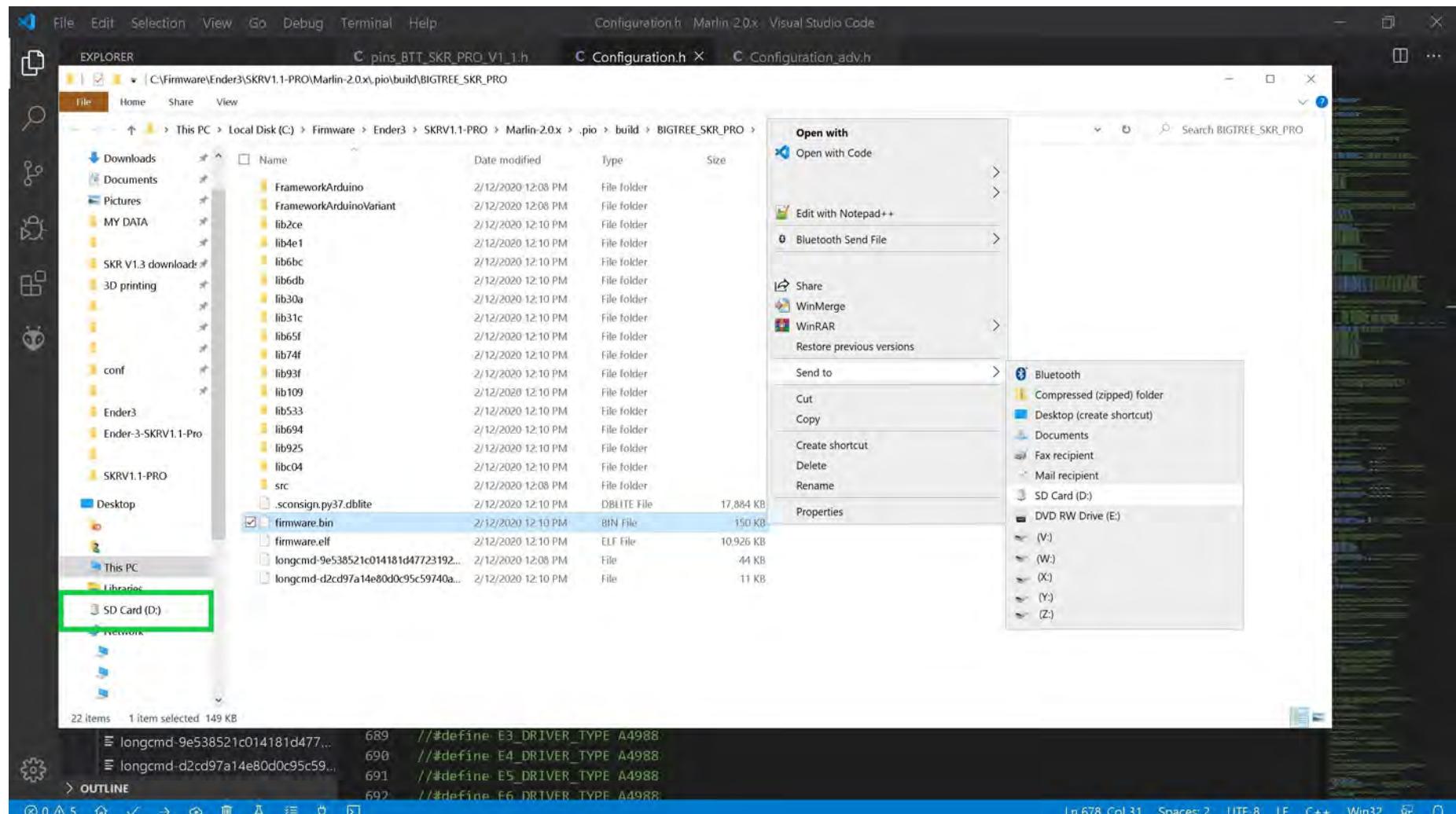
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



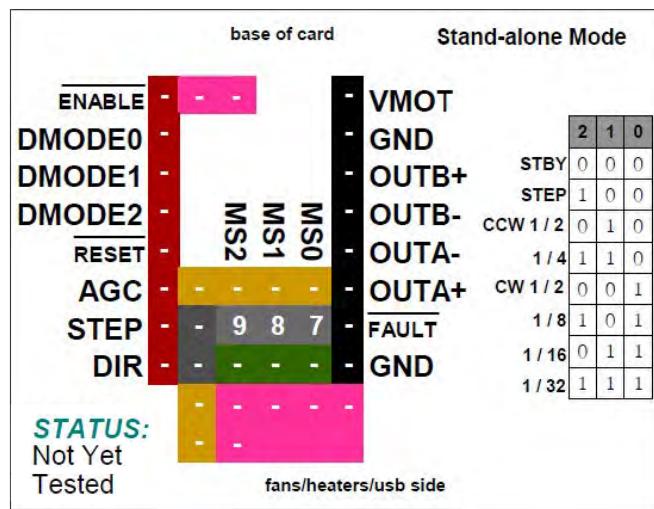
- Go to the next page.

The (latest release of) Marlin Setup for POLOLU MP6500 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



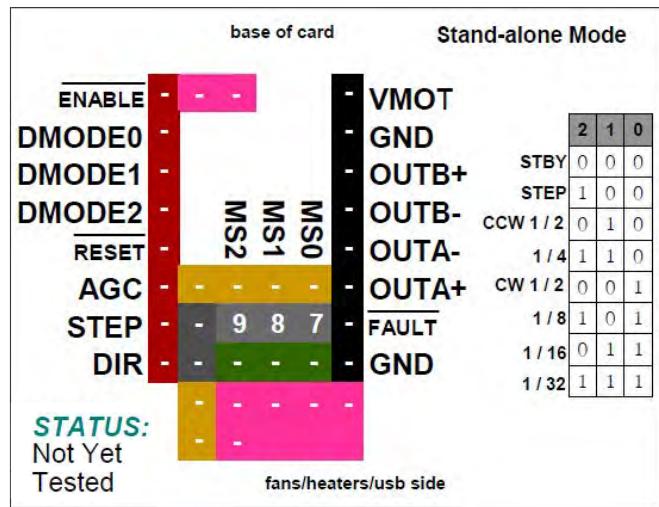
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.



POLOLU TB67S249FTG

Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution |
|-------------------------------------|----------------------------|------|------|----------------------------------|
| Pololu TB67S249FTG | Low | Low | Low | Standby mode (outputs disabled) |
| Maximum 32 Subdivision | High | Low | Low | Full step |
| 47V DC 4.5A (peak) | Low | High | Low | Non-circular half step ("a") |
| | High | High | Low | 1/4 step |
| | Low | Low | High | Circular half step ("b") |
| | High | Low | High | 1/8 step |
| | Low | High | High | 1/16 step |
| | High | High | High | 1/32 step |
| Driving Current Calculation Formula | $I_{MAX} = V_{ref} * 1.25$ | | | $V_{ref} = \frac{I_{MAX}}{1.25}$ |

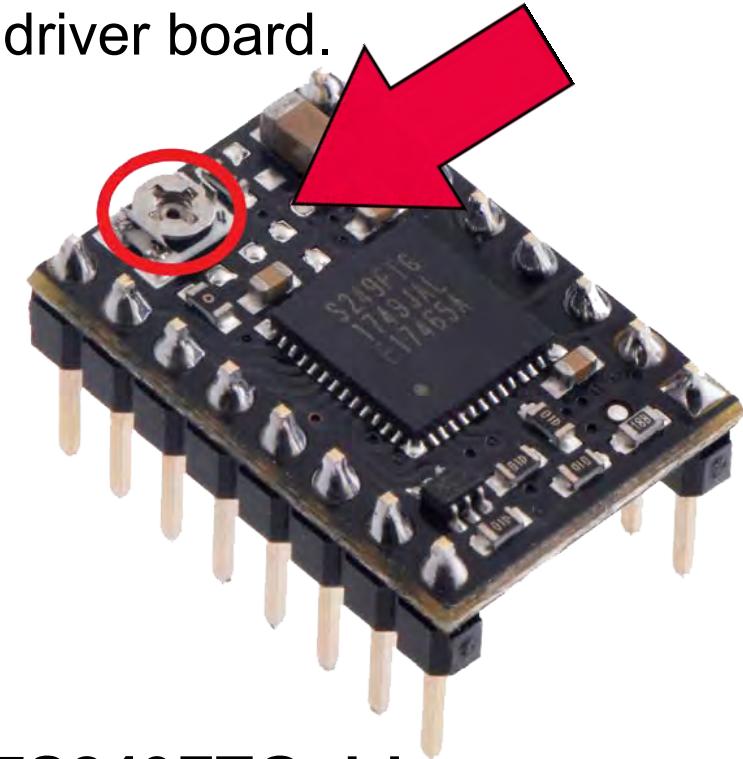
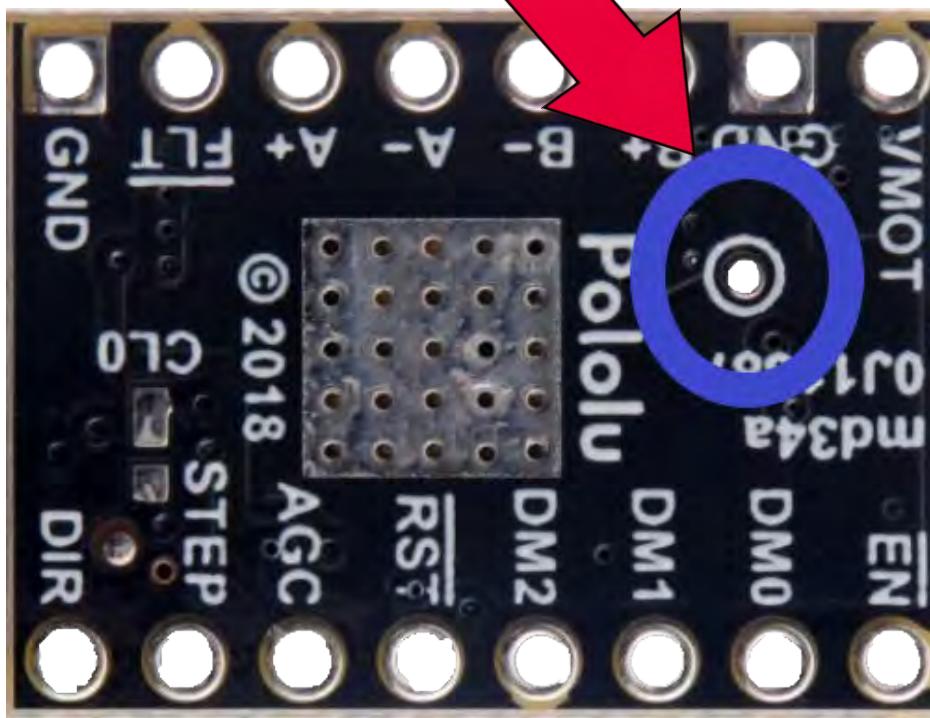


POLOLU TB67S249FTG

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board (or use the board's " V_{ref} Test point") to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: " V_{ref} Test point" location is on the Bottom of the driver board, as shown in **BLUE**



Note: TB67S249FTG driver board does not use external current sense resistors (R_s).

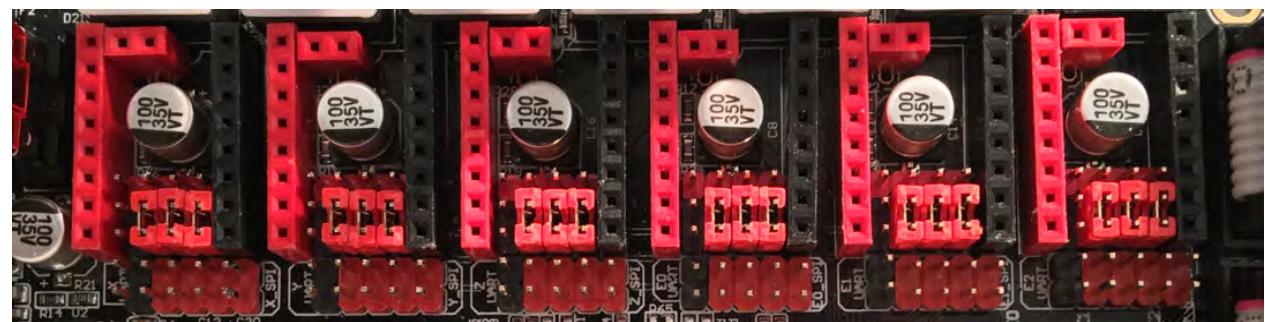
POLOLU TB67S249FTG

Stand-alone Mode

Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

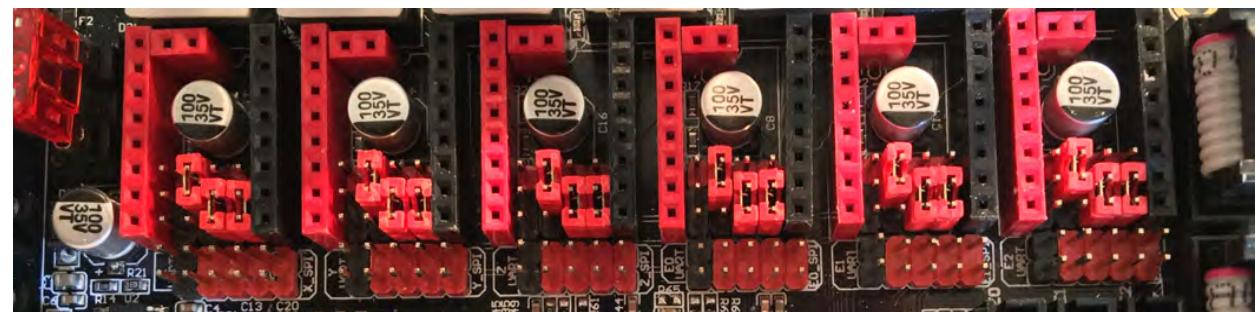
| | | | | |
|--------|---|-----|-----|-------|
| ENABLE | | | | VMOT |
| DMODE0 | | | | GND |
| DMODE1 | | | | OUTB+ |
| DMODE2 | | MS2 | MS1 | OUTB- |
| RESET | | MS0 | | OUTA- |
| AGC | | | | OUTA+ |
| STEP | 9 | 8 | 7 | FAULT |
| DIR | 9 | 8 | 7 | GND |

Stand By



| | | | | |
|--------|---|-----|-----|-------|
| ENABLE | | | | VMOT |
| DMODE0 | | | | GND |
| DMODE1 | | | | OUTB+ |
| DMODE2 | | MS2 | MS1 | OUTB- |
| RESET | | MS0 | | OUTA- |
| AGC | 9 | | | OUTA+ |
| STEP | 9 | 8 | 7 | FAULT |
| DIR | | 8 | 7 | GND |

STEP



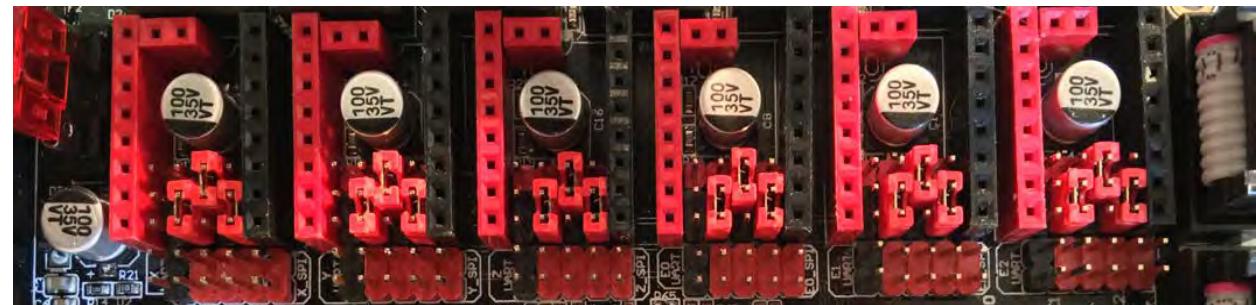
POLOLU TB67S249FTG

Stand-alone Mode

Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

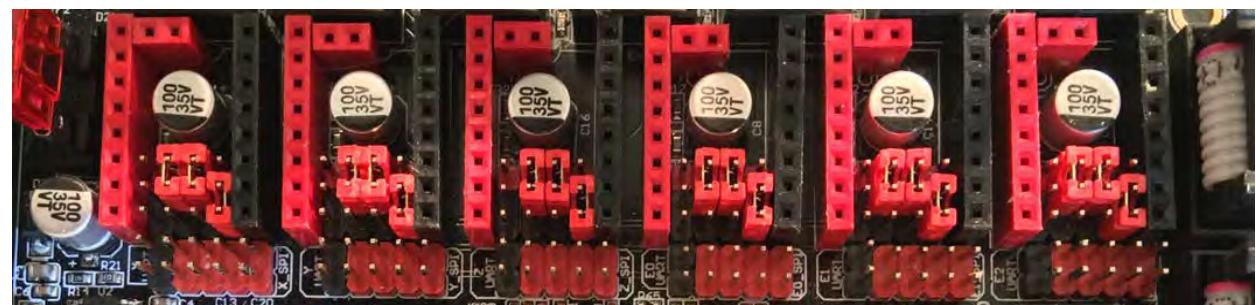
| | | | | |
|---------|---|-----|-----|-------|
| ENABLE | - | - | - | VMOT |
| D MODE0 | - | - | - | GND |
| D MODE1 | - | - | - | OUTB+ |
| D MODE2 | - | MS2 | MS1 | OUTB- |
| RESET | - | MS0 | - | OUTA- |
| AGC | - | - | 8 | OUTA+ |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | - | 7 |
| | - | - | - | GND |

CCW 1 / 2



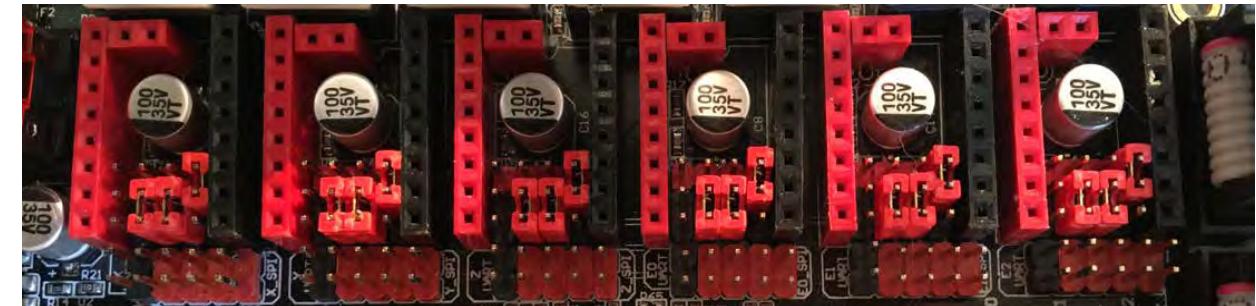
| | | | | |
|---------|---|-----|-----|-------|
| ENABLE | - | - | - | VMOT |
| D MODE0 | - | - | - | GND |
| D MODE1 | - | - | - | OUTB+ |
| D MODE2 | - | MS2 | MS1 | OUTB- |
| RESET | - | MS0 | - | OUTA- |
| AGC | - | - | 9 | OUTA+ |
| STEP | - | 8 | - | 7 |
| DIR | - | 9 | - | 7 |
| | - | - | - | GND |

1 / 4



| | | | | |
|---------|---|-----|-----|-------|
| ENABLE | - | - | - | VMOT |
| D MODE0 | - | - | - | GND |
| D MODE1 | - | - | - | OUTB+ |
| D MODE2 | - | MS2 | MS1 | OUTB- |
| RESET | - | MS0 | - | OUTA- |
| AGC | - | - | - | OUTA+ |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | 8 | - |
| | - | - | - | GND |

CW 1 / 2

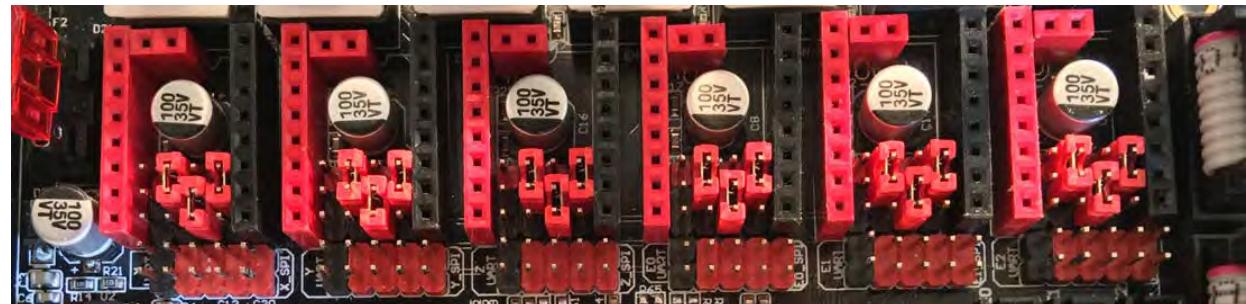


POLOLU TB67S249FTG

Stand-alone Mode

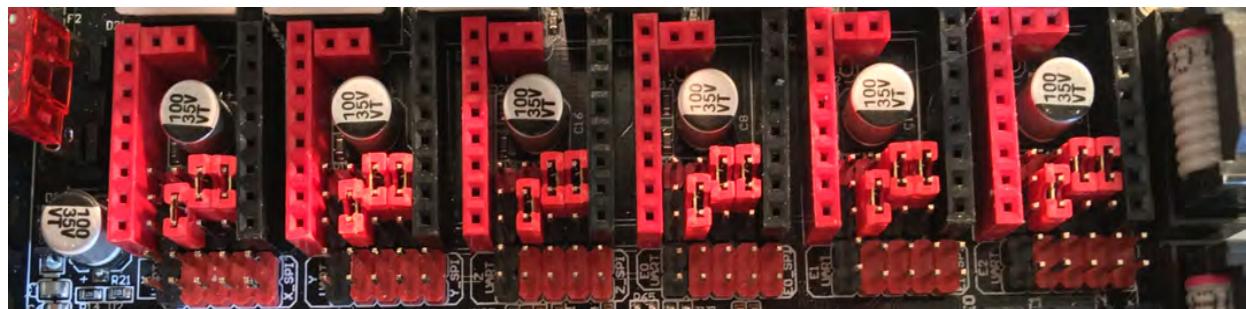
Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

| | | | | |
|--------|---|-------------------|---|-------|
| ENABLE | - | - | - | VMOT |
| DMODE0 | - | - | - | GND |
| DMODE1 | - | - | - | OUTB+ |
| DMODE2 | - | MS2 MS1 MS0 | - | OUTB- |
| RESET | - | - | - | OUTA- |
| AGC | - | 9 - 7 | - | OUTA+ |
| STEP | - | 9 8 7 | - | FAULT |
| DIR | - | - | 8 | - |
| | | | | GND |



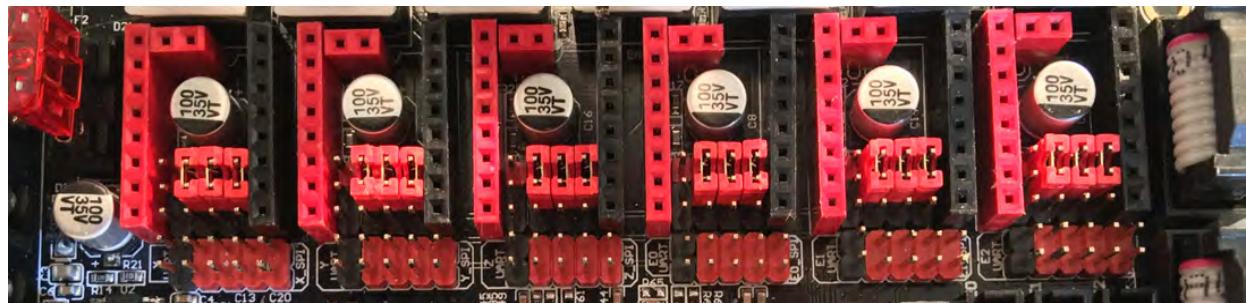
1 / 8

| | | | | |
|--------|---|-------------------|--------|-------|
| ENABLE | - | - | - | VMOT |
| DMODE0 | - | - | - | GND |
| DMODE1 | - | - | - | OUTB+ |
| DMODE2 | - | MS2 MS1 MS0 | - | OUTB- |
| RESET | - | - | - | OUTA- |
| AGC | - | - | 8 7 | OUTA+ |
| STEP | - | 9 8 7 | - | FAULT |
| DIR | - | 9 | - | - |
| | | | | GND |



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| | | | | |
|--------|---|-------------------|-------------|-------|
| ENABLE | - | - | - | VMOT |
| DMODE0 | - | - | - | GND |
| DMODE1 | - | - | - | OUTB+ |
| DMODE2 | - | MS2 MS1 MS0 | - | OUTB- |
| RESET | - | - | - | OUTA- |
| AGC | - | - | 9 8 7 | OUTA+ |
| STEP | - | 9 8 7 | - | FAULT |
| DIR | - | - | - | GND |
| | | | | |



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The (latest release of) Marlin Setup for POLOLU TB67S249FTG Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for POLOLU TB67S249FTG stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using POLOLU TB67S249FTG drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use POLOLU TB67S249FTG drivers. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
 - The **POLOLU TB67S249FTG** is a drop in replacement for the A4988. Since Marlin does not have an option for POLOLU TB67S249FTG we will use the A4988 as the driver type.

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h

OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE

MARLIN-2.0.X

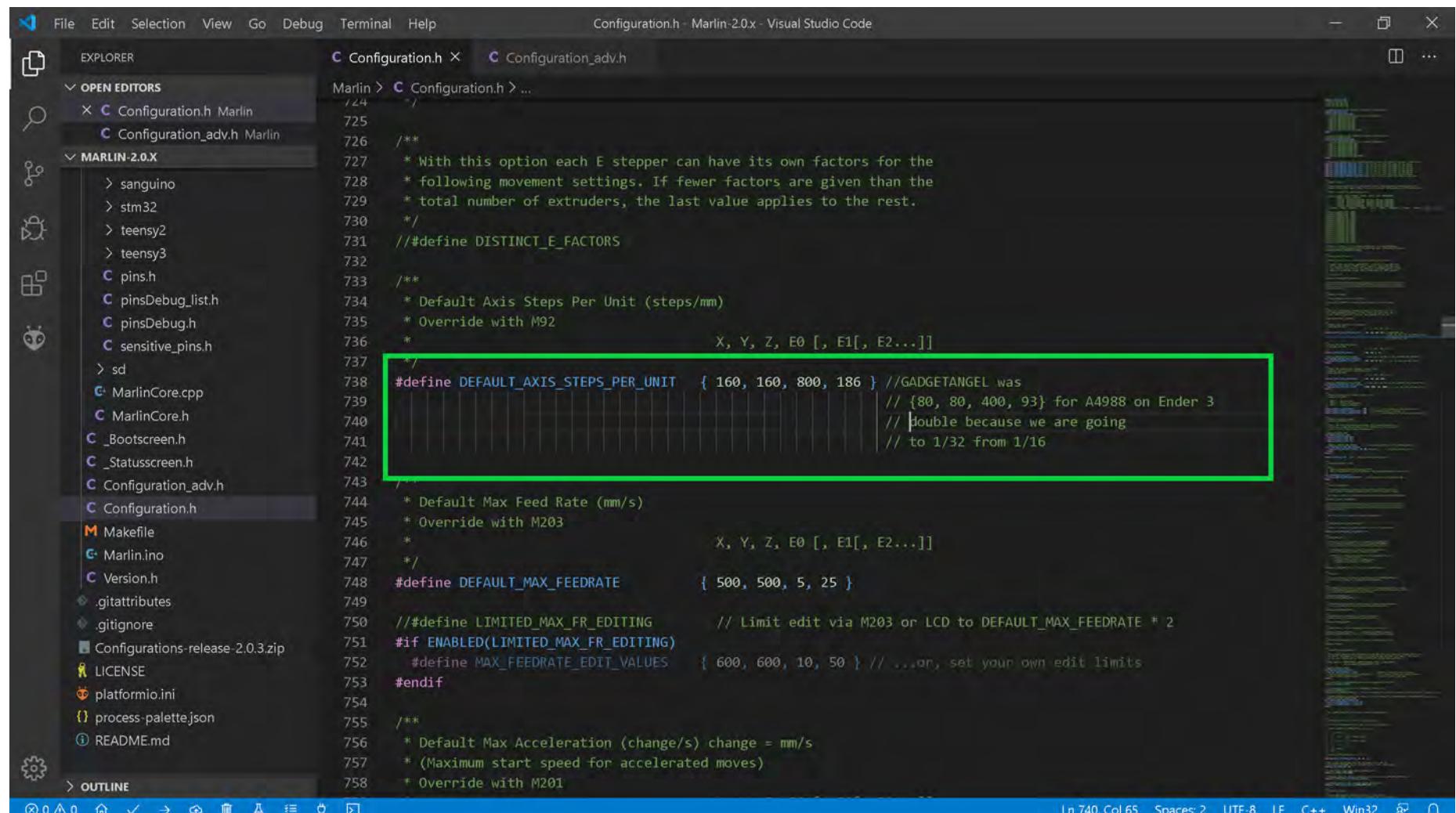
Lcdprint.cpp Lcdprint.h thermistornames.h ultralcd.cpp ultralcd.h libs module pins sd MarlinCore.cpp MarlinCore.h _Bootscreen.h _Statusscreen.h Configuration_adv.h Makefile Marlin.ino Version.h .gitattributes .gitignore LICENSE platformio.ini process-palette.json README.md

```
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC2660', 'TMC5130', 'TMC5160']
676 */
677
678 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
679 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
680 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out |
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.
```

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU TB67S249FTG Drivers

- Since we are changing from A4988 stepper motor drivers on the Ender 3 to for POLOLU TB67S249FTG stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16.** So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin MARLIN-2.0.X sanguino stm32 teensy2 teensy3 pins.h pinsDebug_list.h pinsDebug.h sensitive_pins.h sd MarlinCore.cpp MarlinCore.h _Bootscreen.h _Statusscreen.h Configuration_adv.h Configuration.h Makefile Marlin.ino Version.h .gitattributes .gitignore Configurations-release-2.0.3.zip LICENSE platformio.ini process-palette.json README.md OUTLINE

```

Configuration.h x Configuration.h x Configuration_adv.h x
Marlin > Configuration.h > ...
724
725
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 *
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } // GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // double because we are going
741 // to 1/32 from 1/16
742
743 /**
744 * Default Max Feed Rate (mm/s)
745 * Override with M203
746 *
747 */
748 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }
749
750 // #define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
751 #if ENABLED(LIMITED_MAX_FR_EDITING)
752 #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ...on, set your own edit limits
753 #endif
754
755 /**
756 * Default Max Acceleration (change/s) change = mm/s
757 * (Maximum start speed for accelerated moves)
758 * Override with M201

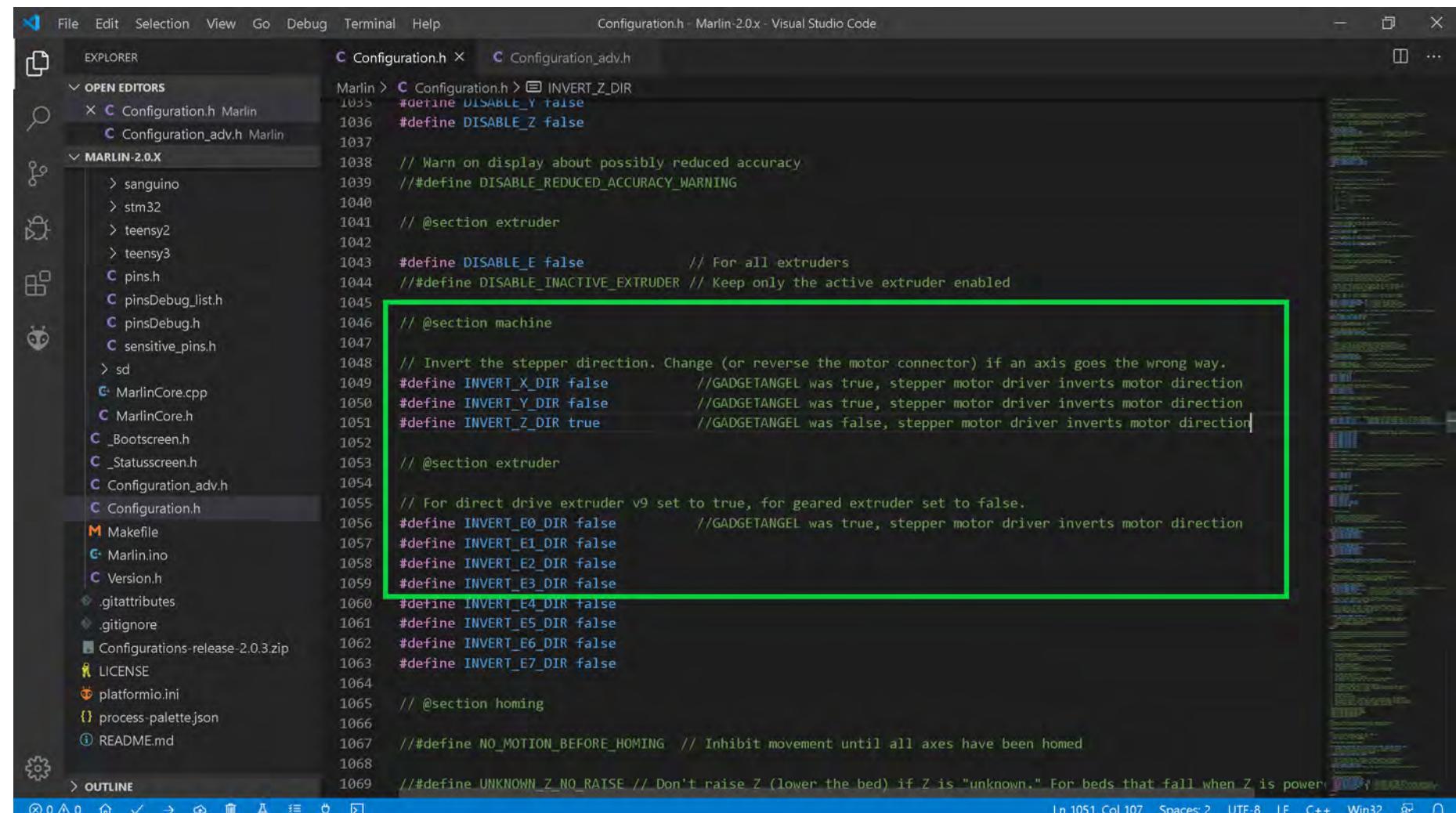
```

Ln 740, Col 65 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU TB67S249FTG Drivers

- **Optional Step:** I cannot find information on the POLOLU TB67S249FTG driver's impact on motor direction. So I provide the below information in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring instead of the Marlin firmware, here is a link on how to change the motor direction via the wiring (look for section labeled "Motor moving the wrong direction") https://reprap.org/wiki/Stepper_wiring. Other people prefer to change the motor direction in the Marlin firmware. **So if you want or need to change the motor direction in Marlin**, then if the axis' setting you will be using the TB67S249FTG driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following code block, which defines the direction of the stepper motors:

```

#define INVERT_X_DIR false           // GADGETANGEL was true, stepper motor driver inverts motor direction
#define INVERT_Y_DIR false           // GADGETANGEL was true, stepper motor driver inverts motor direction
#define INVERT_Z_DIR true            // GADGETANGEL was false, stepper motor driver inverts motor direction

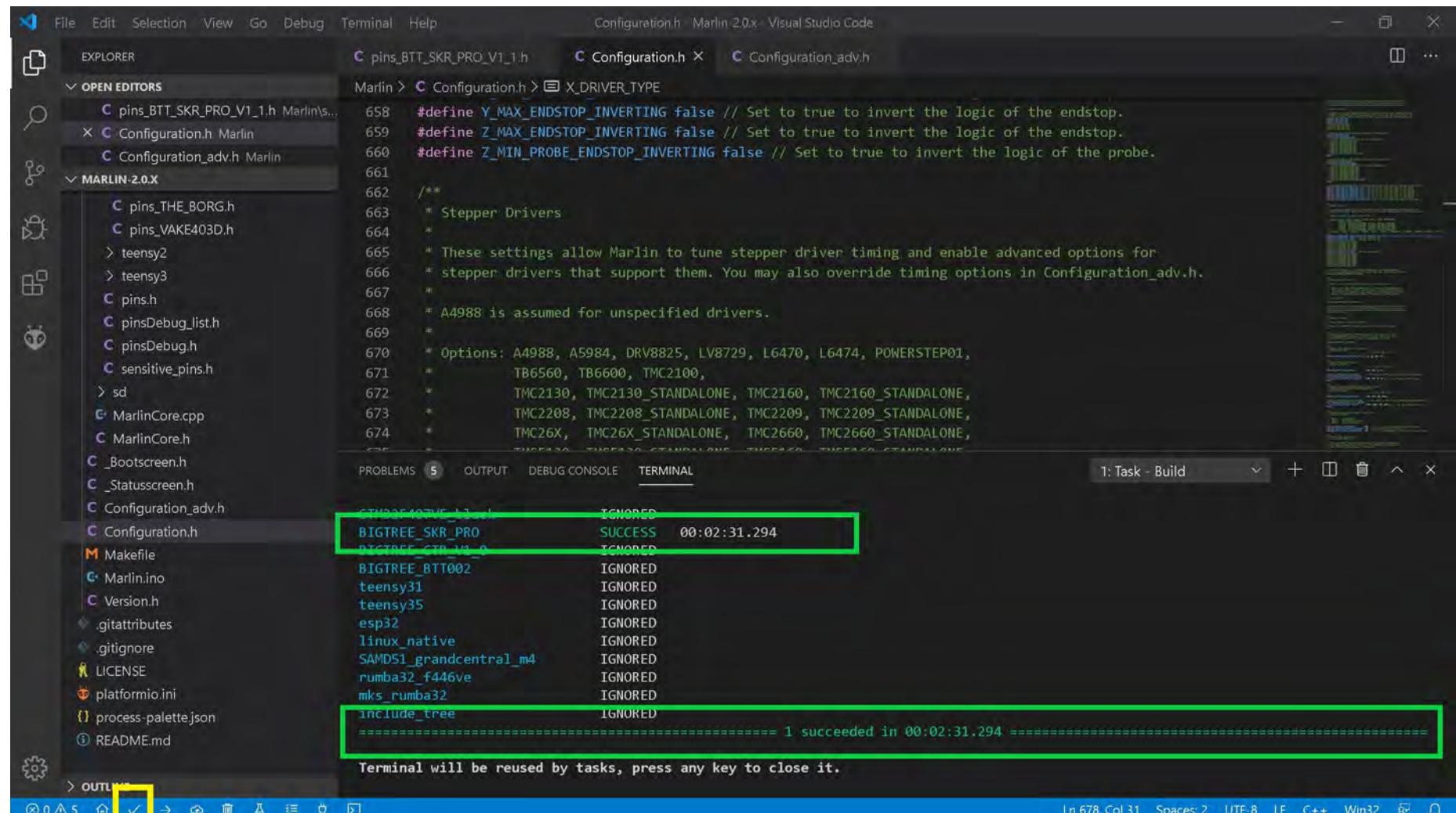
```

The rest of the file contains various #define statements and comments related to Marlin configuration.

- Go to the next page.

The (latest release of) Marlin Setup for POLOLU TB67S249FTG Drivers

- The end of Marlin setup for POLOLU TB67S249FTG drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows files like Configuration.h, pins_BTT_SKR_PRO_V1_1.h, Configuration_adv.h, and MarlinCore.cpp.
- Terminal:** Displays the build log for "Task - Build".
- Output:** Shows the terminal output, which includes the following text highlighted in green boxes:

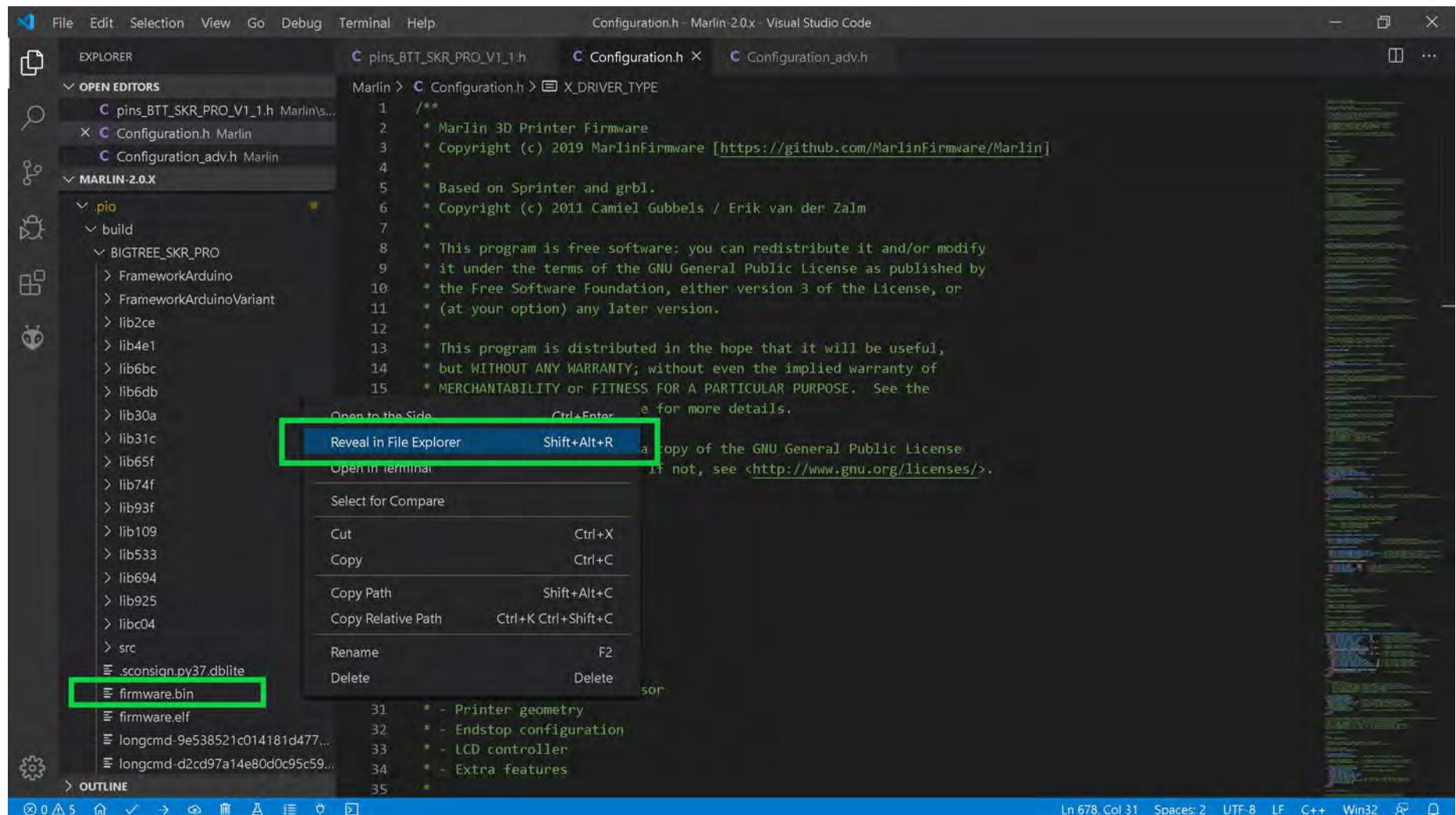

```

      BIGTREETECH_SKR_V1_1_I          IGNORED
      BIGTREETECH_SKR_PRO              SUCCESS 00:02:31.294
      BIGTREETECH_SKR_V1_0              IGNORED
      BIGTREETECH_BTT002               IGNORED
      teensy31                         IGNORED
      teensy35                         IGNORED
      esp32                            IGNORED
      linux_native                      IGNORED
      SAMD51_grandcentral_m4           IGNORED
      rumba32_f446ve                    IGNORED
      mks_rumba32                       IGNORED
      include_tree                      IGNORED
      ===== 1 succeeded in 00:02:31.294 =====
      
```
- Bottom Status Bar:** Shows "Ln 678, Col 31" and other system information.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for POLOLU TB67S249FTG Drivers

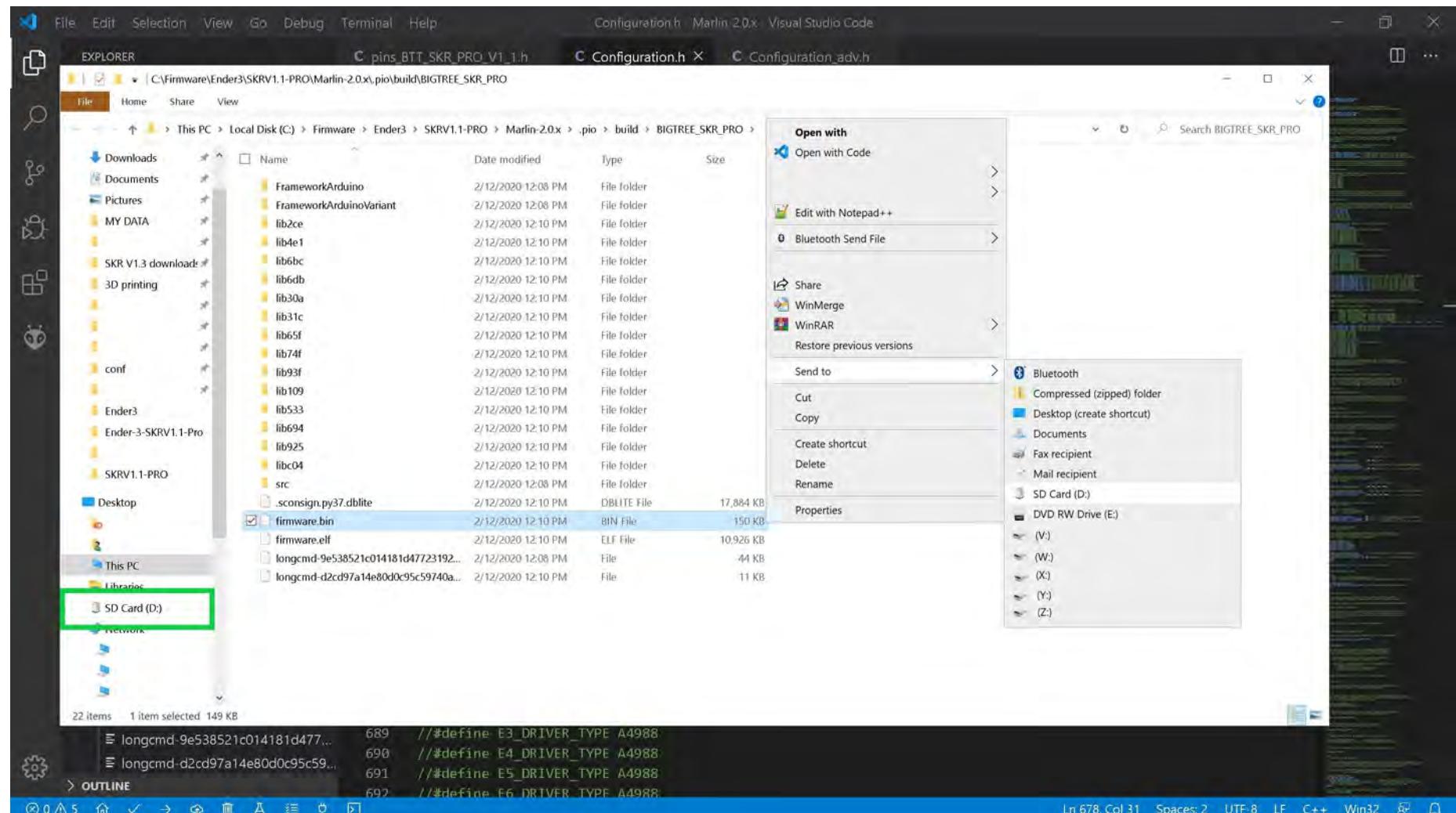
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



- Go to the next page.

The (latest release of) Marlin Setup for POLOLU TB67S249FTG Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

BIQU S109

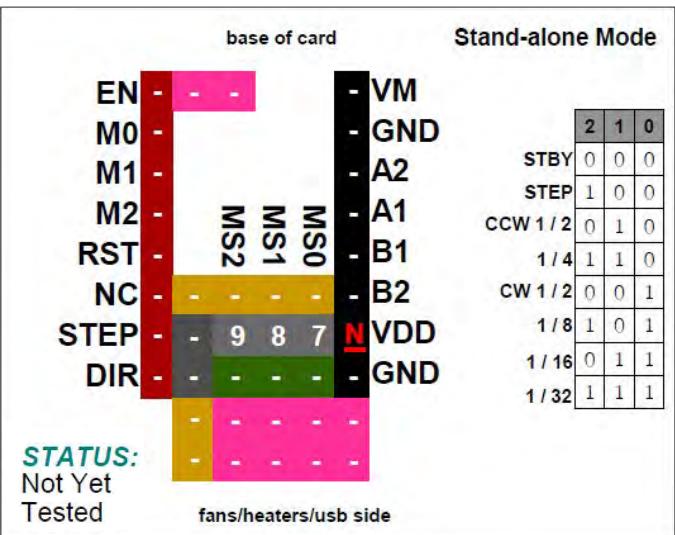
| base of card | | Stand-alone Mode |
|-----------------------|-----|------------------|
| EN | - | VM |
| M0 | - | GND |
| M1 | - | A2 |
| M2 | - | A1 |
| RST | MS2 | B1 |
| NC | MS1 | B2 |
| STEP | MS0 | VDD |
| DIR | - | GND |
| STATUS: | | |
| Not Yet Tested | | |
| fans/heaters/usb side | | |

| | | | |
|---------|---|---|---|
| STBY | 2 | 1 | 0 |
| STEP | 0 | 0 | 0 |
| CCW 1/2 | 1 | 0 | 0 |
| 1/4 | 0 | 1 | 0 |
| CW 1/2 | 1 | 1 | 0 |
| 1/8 | 0 | 0 | 1 |
| 1/16 | 1 | 0 | 1 |
| 1/32 | 0 | 1 | 1 |
| | 1 | 1 | 1 |

Note: V_{DD} is an Output (N), *on a 3.3 V MCU like SKR PRO V1.1 the V_{DD} must be disconnected!!*

Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution |
|--|---|------|------|---|
|  S109 | Low | Low | Low | Standby mode (outputs disabled) |
| | High | Low | Low | Full step |
| | Low | High | Low | Non-circular half step ("a") |
| | High | High | Low | 1/4 step |
| | Low | Low | High | Circular half step ("b") |
| | High | Low | High | 1/8 step |
| | Low | High | High | 1/16 step |
| | High | High | High | 1/32 step |
| Driving Current Calculation Formula $V_{DD} = 5 \text{ V DC}$ | $I_{MAX} = V_{ref} * \left(\frac{V_{DD}}{5}\right) * \frac{1}{(5 * R_S)}$ | | | $V_{ref} = I_{MAX} * \left(\frac{5}{V_{DD}}\right) * (5 * R_S)$ |
| R_S (Typical Sense Resistor) = 0.1Ω | | | | |

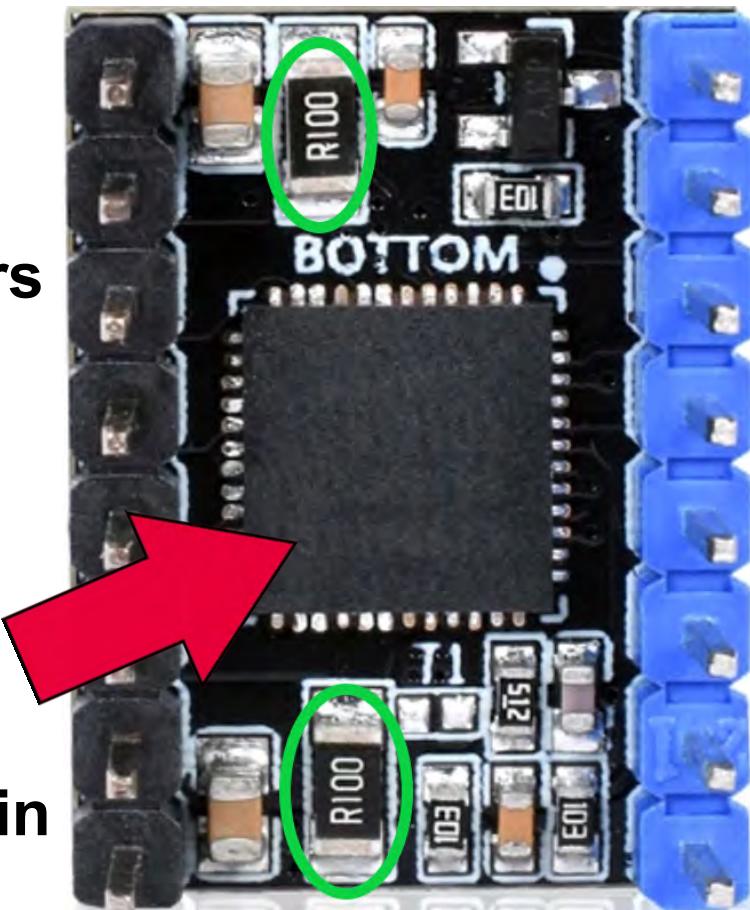


BIQU S109

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board. V_{DD} is an Output (N), **on a 3.3 V MCU like SKR PRO V1.1 the V_{DD} must be disconnected!**

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN



- $R_s = R050$ is 0.05 Ohms
- $R_s = R068$ is 0.068 Ohms
- $R_s = R100$ is 0.1 Ohms
- $R_s = R150$ is 0.15 Ohms
- $R_s = R200$ is 0.2 Ohms
- $R_s = R220$ is 0.22 Ohms



Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>

BIQU S109

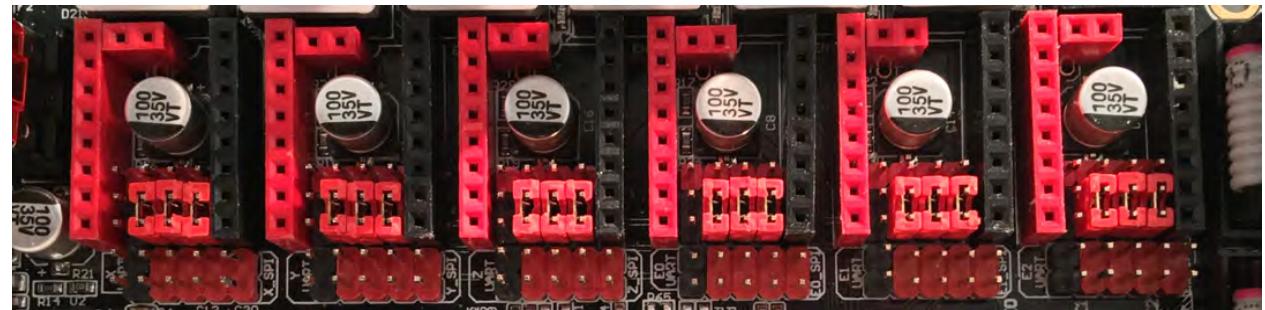
Stand-alone Mode

Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| M0 | - | - | - | GND |
| M1 | - | - | - | A2 |
| M2 | - | - | - | A1 |
| RST | - | MS2 | MS1 | MS0 |
| NC | - | - | - | - |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | 8 | 7 |

Stand By

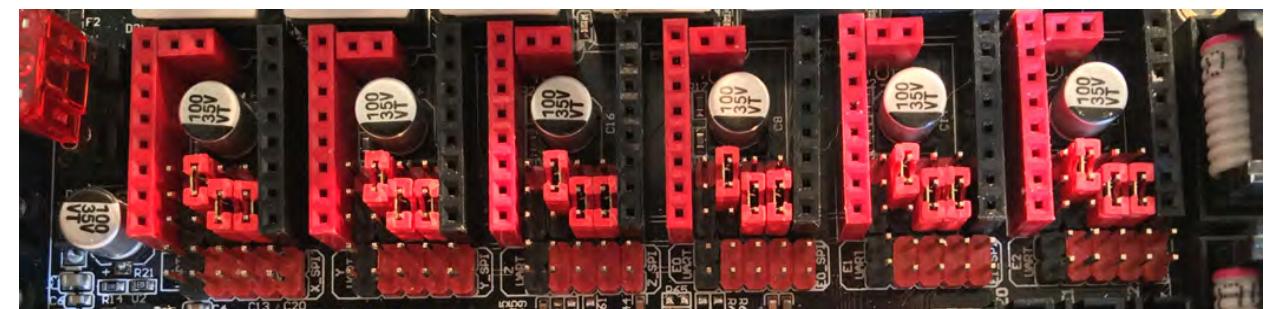
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| M0 | - | - | - | GND |
| M1 | - | - | - | A2 |
| M2 | - | - | - | A1 |
| RST | - | MS2 | MS1 | MS0 |
| NC | - | 9 | - | - |
| STEP | - | 9 | 8 | 7 |
| DIR | - | - | 8 | 7 |

STEP

Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



BQU S109

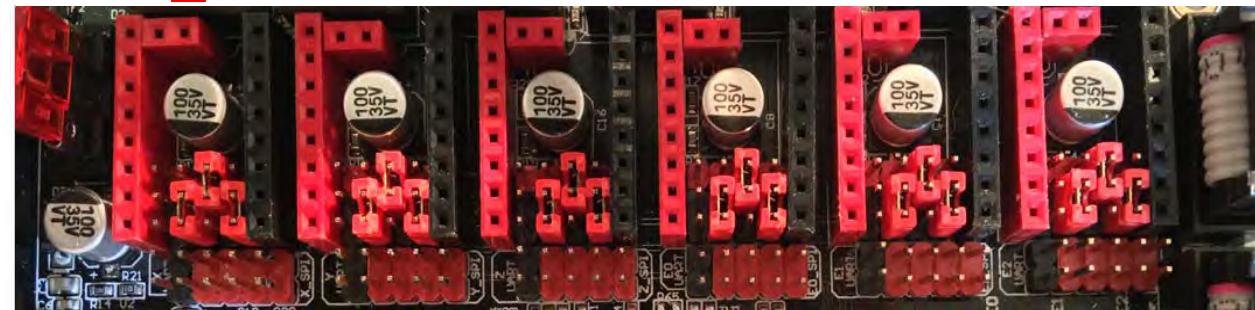
Stand-alone Mode

Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| M0 | - | - | - | GND |
| M1 | - | - | - | A2 |
| M2 | - | - | - | A1 |
| RST | - | MS2 | MS1 | MS0 |
| NC | - | - | 8 | - |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | - | 7 |
| | - | - | - | GND |

CCW 1 / 2

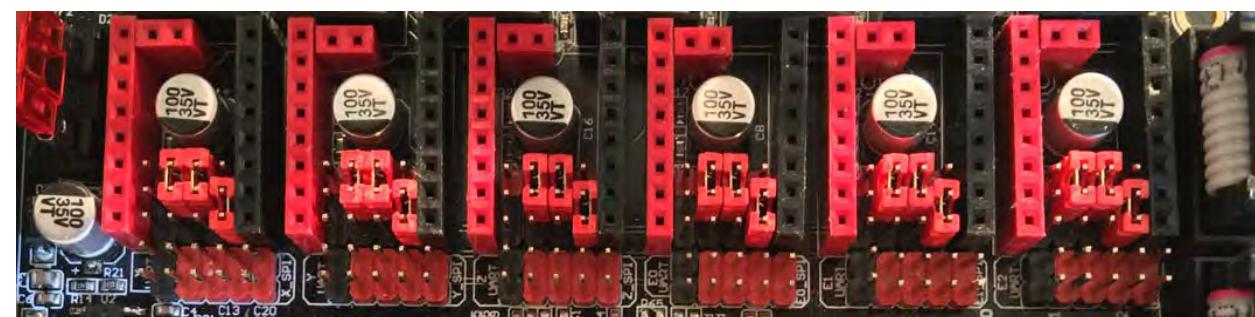
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| M0 | - | - | - | GND |
| M1 | - | - | - | A2 |
| M2 | - | MS2 | MS1 | MS0 |
| RST | - | - | - | - |
| NC | - | 9 | 8 | - |
| STEP | - | 9 | 8 | 7 |
| DIR | - | - | - | 7 |
| | - | - | - | GND |

1 / 4

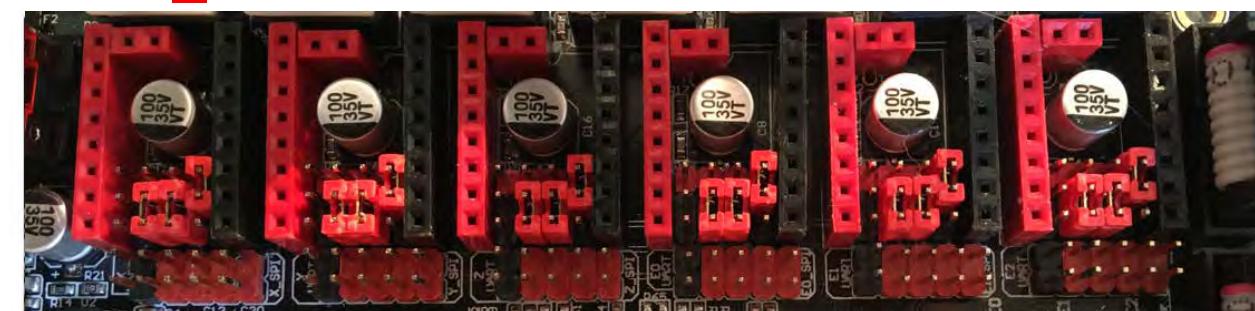
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| M0 | - | - | - | GND |
| M1 | - | - | - | A2 |
| M2 | - | MS2 | MS1 | MS0 |
| RST | - | - | - | - |
| NC | - | - | 7 | - |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | 8 | - |
| | - | - | - | GND |

CW 1 / 2

Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



BQU S109

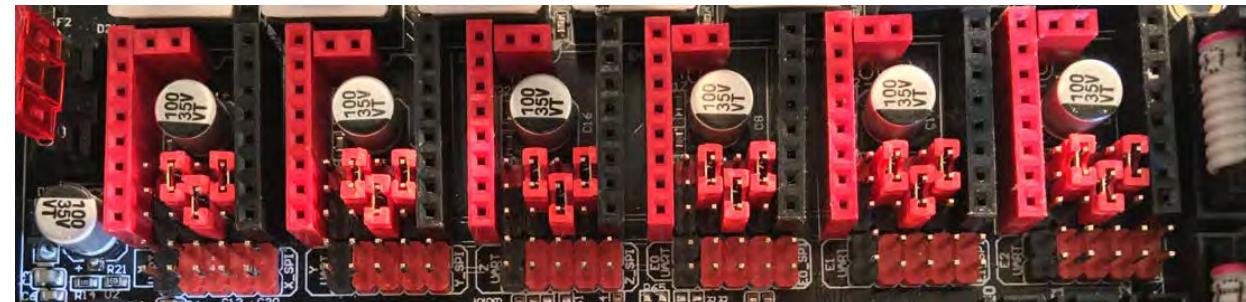
Stand-alone Mode

| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| M0 | - | - | - | GND |
| M1 | - | - | - | A2 |
| M2 | - | - | - | A1 |
| RST | - | MS2 | MS1 | MS0 |
| NC | - | 9 | 7 | 8 |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 8 | - | GND |

1 / 8

Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

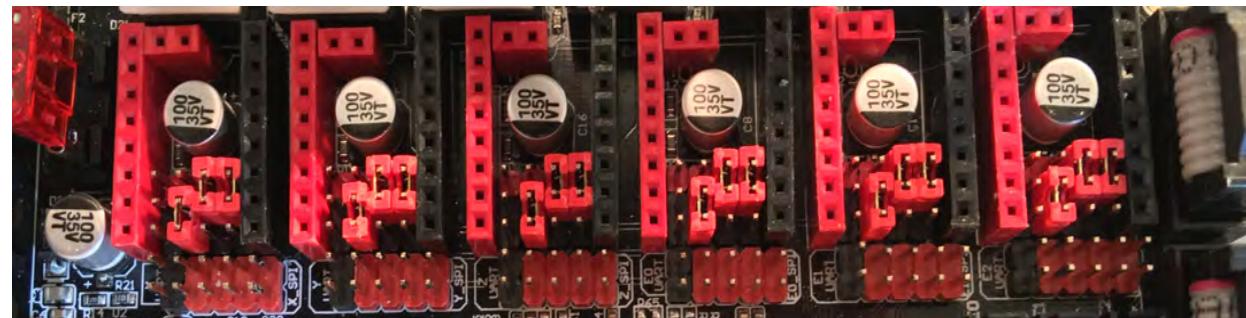
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| M0 | - | - | - | GND |
| M1 | - | - | - | A2 |
| M2 | - | MS2 | MS1 | MS0 |
| RST | - | 8 | 7 | 9 |
| NC | - | 8 | 7 | 9 |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | - | GND |

1 / 16

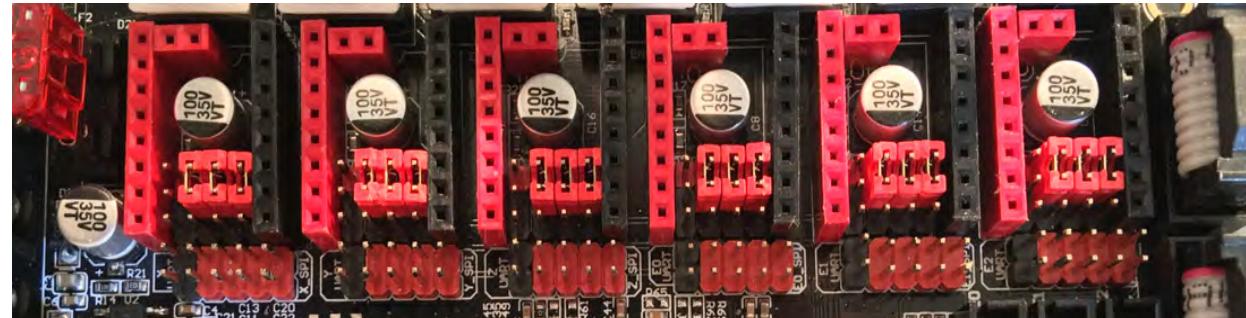
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| M0 | - | - | - | GND |
| M1 | - | - | - | A2 |
| M2 | - | MS2 | MS1 | MS0 |
| RST | - | 9 | 8 | 7 |
| NC | - | 9 | 8 | 7 |
| STEP | - | 9 | 8 | 7 |
| DIR | - | 9 | - | GND |

1 / 32

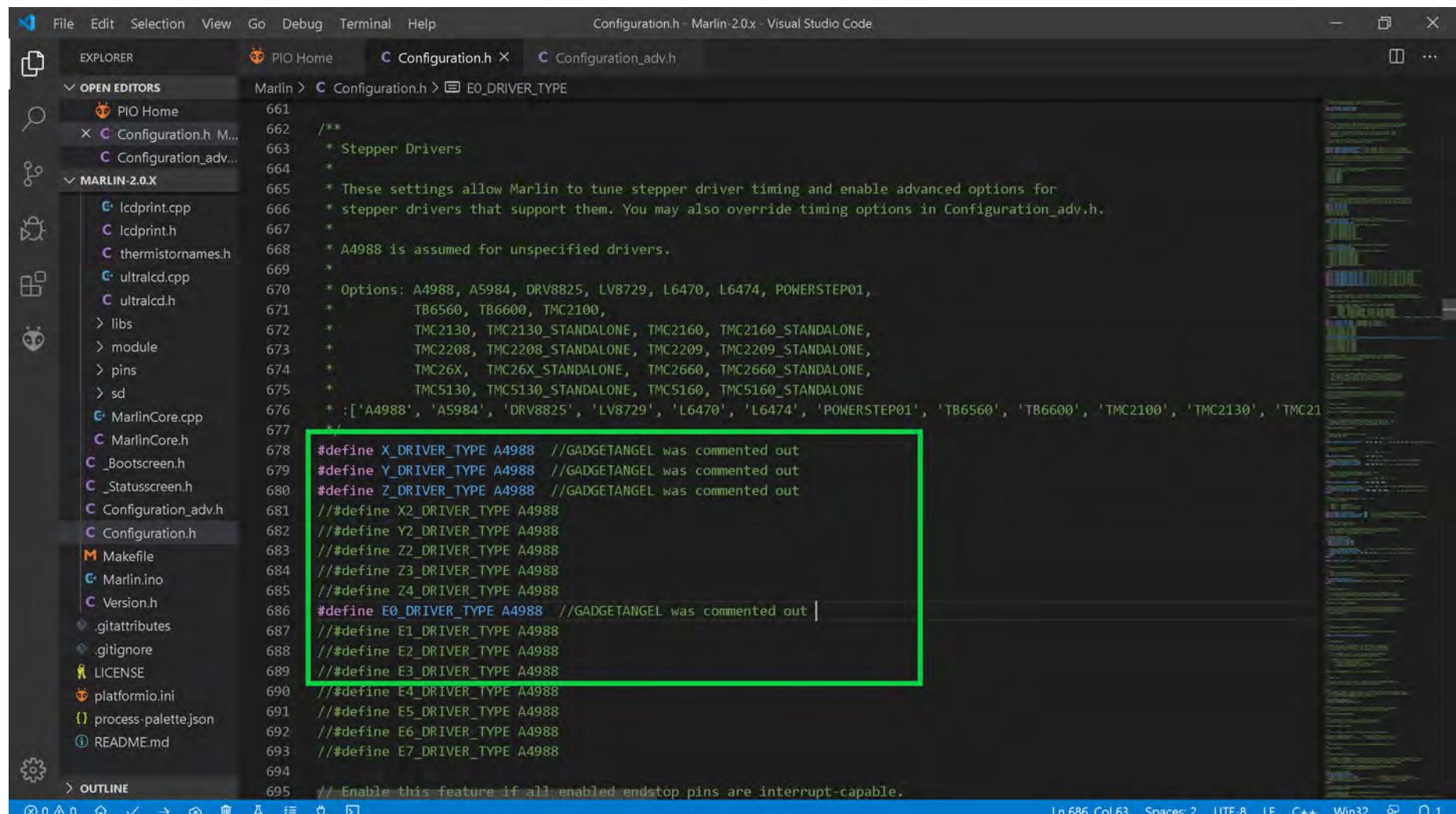
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



The (latest release of) Marlin Setup for BIQU S109 Drivers

NOTE: [Go to Appendix C](#), and then come back here for the changes to Marlin for BIQU S109 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using BIQU S109 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use BIQU S109 drivers. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
- The **BIQU S109 is a drop in replacement for the A4988. Since Marlin does not have an option for BIQU S109 we will use the A4988 as the driver type.**



The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Title Bar:** Configuration.h - Marlin-2.0.x - Visual Studio Code.
- Explorer:** Shows the project structure under 'OPEN EDITORS' and 'MARLIN-2.0.X'. The 'Configuration.h' file is selected.
- Code Editor:** Displays the 'Configuration.h' file content. A green box highlights the section from line 678 to line 895, which defines driver types for various axes (X, Y, Z, E0-E7). The highlighted code includes comments indicating they were commented out by GADGETANGEL.
- Status Bar:** Line 686, Col 63, Spaces: 2, UTF-8, LF, C++, Win32, 1.

```

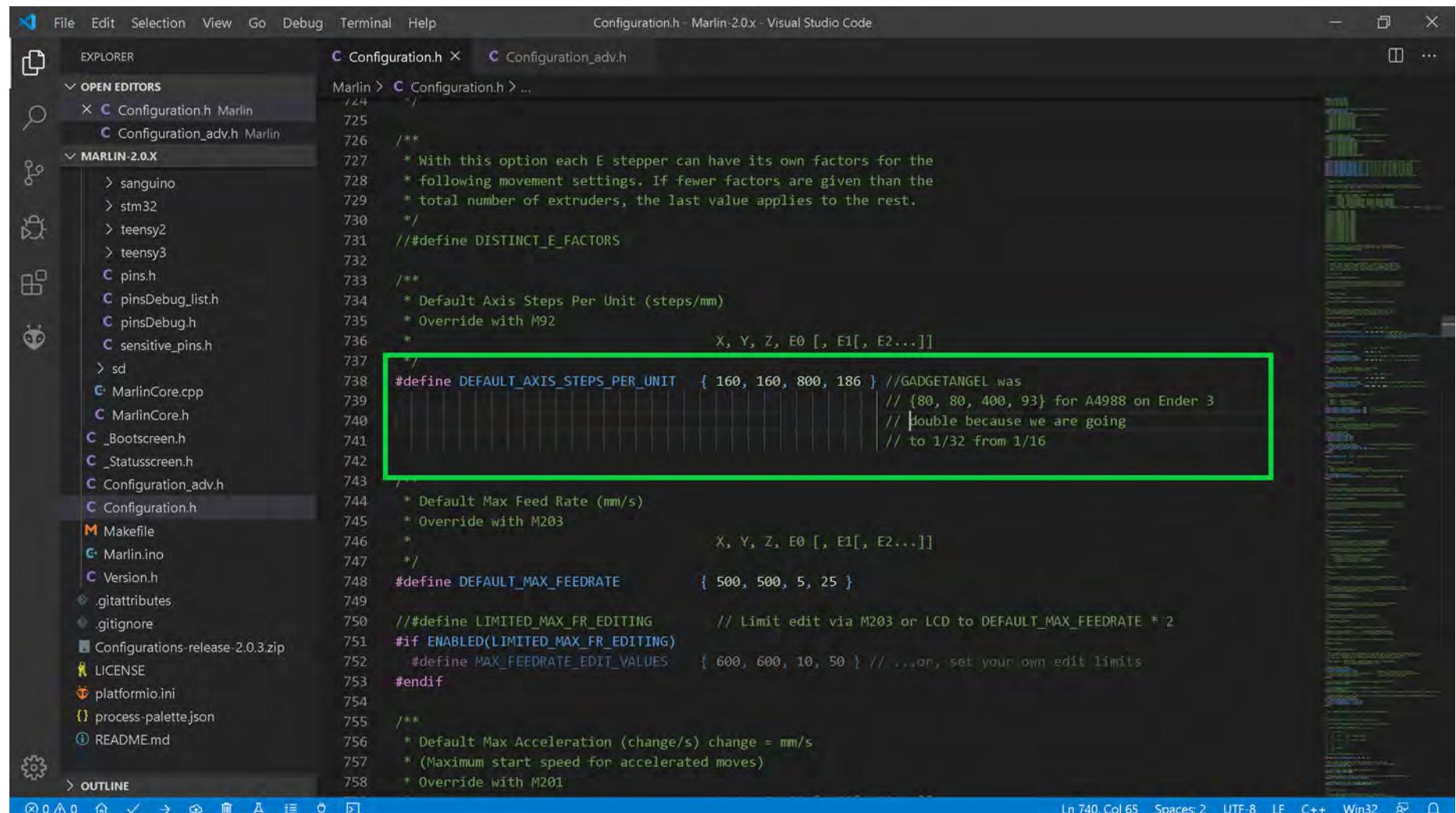
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 *           TB6560, TB6600, TMC2100,
672 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
676 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160',
677 *
678 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
679 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
680 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out |
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU S109 Drivers

- Since we are changing from A4988 stepper motor drivers on the Ender 3 to for BIQU S109 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following line of code:

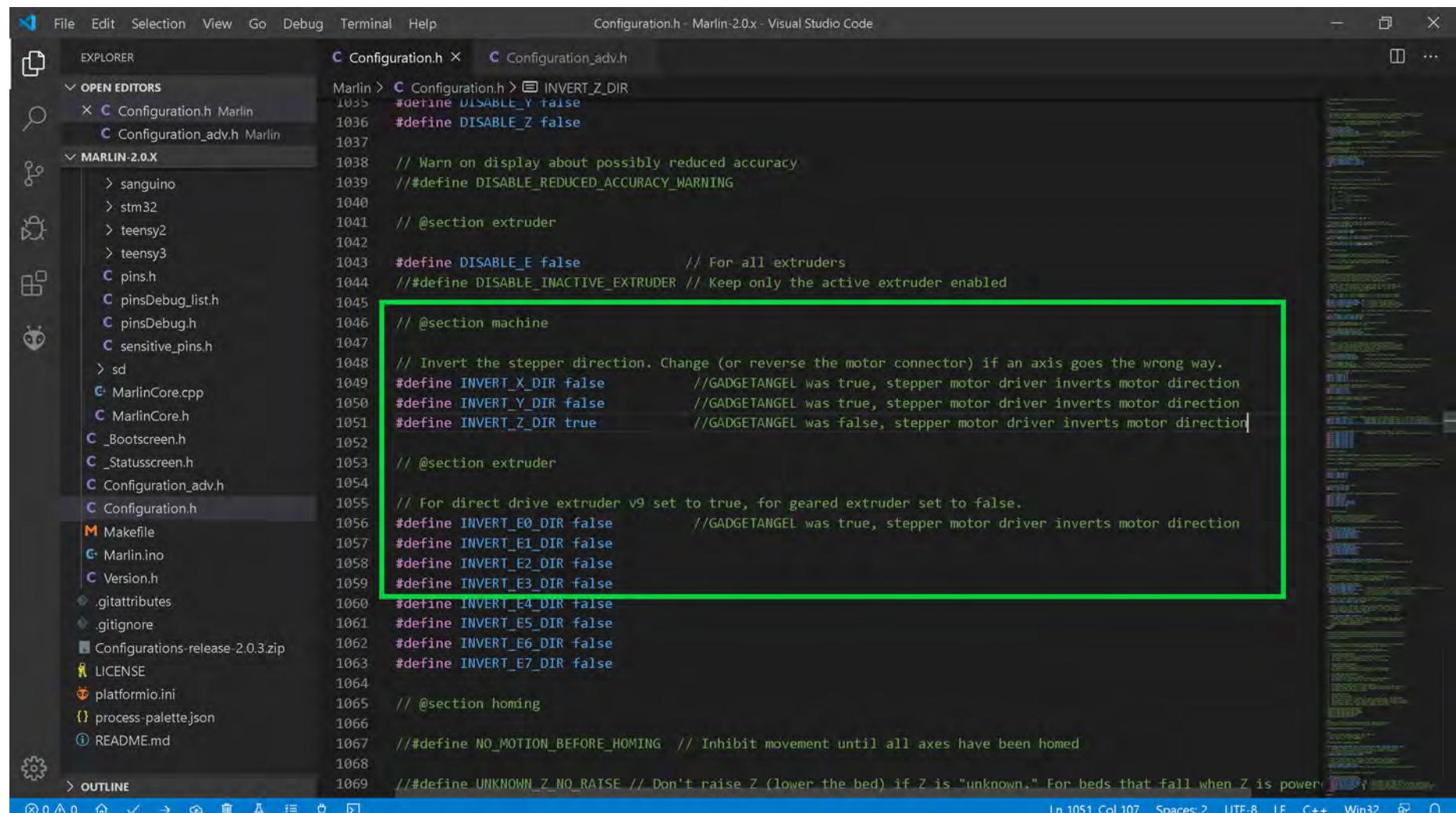
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom right shows: Ln 740, Col 65, Spaces: 2, UTF-8, LF, C++, Win32.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU S109 Drivers

- **Optional Step:** I cannot find information on the BIQU S109 driver's impact on motor direction. So I provide the below information in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring instead of the Marlin firmware, here is a link on how to change the motor direction via the wiring (look for section labeled "Motor moving the wrong direction") https://reprap.org/wiki/Stepper_wiring. Other people prefer to change the motor direction in the Marlin firmware. **So if you want or need to change the motor direction in Marlin**, then if the axis' setting you will be using the S109 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



```

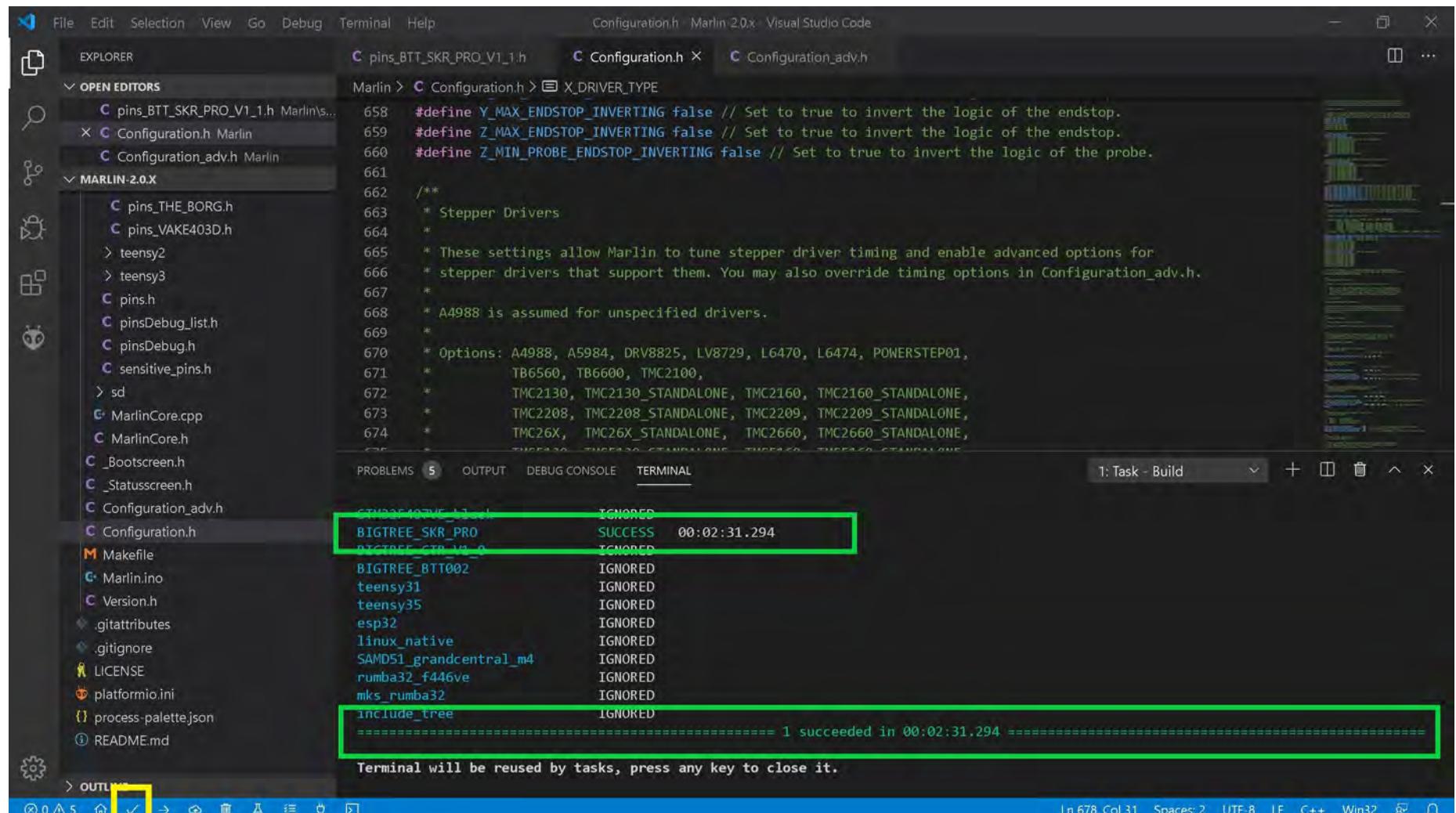
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > INVERT_Z_DIR
  Configuration.h Marlin 1035 #define DISABLE_Y false
  Configuration_adv.h Marlin 1036 #define DISABLE_Z false
MARLIN-2.0.X 1037
  sanguino
  > stm32
  > teensy2
  > teensy3
  pins.h
  pinsDebug_list.h
  pinsDebug.h
  sensitive_pins.h
  > sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  Configurations-release-2.0.3.zip
  LICENSE
  platformio.ini
  process-palette.json
  README.md
OUTLINE
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false          // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RATSE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered
Ln 1051, Col 107  Spaces:2  UTF-8  LF  C++  Win32  ⚡  🔍

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU S109 Drivers

- The end of Marlin setup for BIQU S109 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows files like Configuration.h, pins_BTT_SKR_PRO_V1_1.h, Configuration_adv.h, and MarlinCore.cpp.
- Terminal:** Displays the build log for "Task - Build".
- Output:** Shows the status of various build configurations.

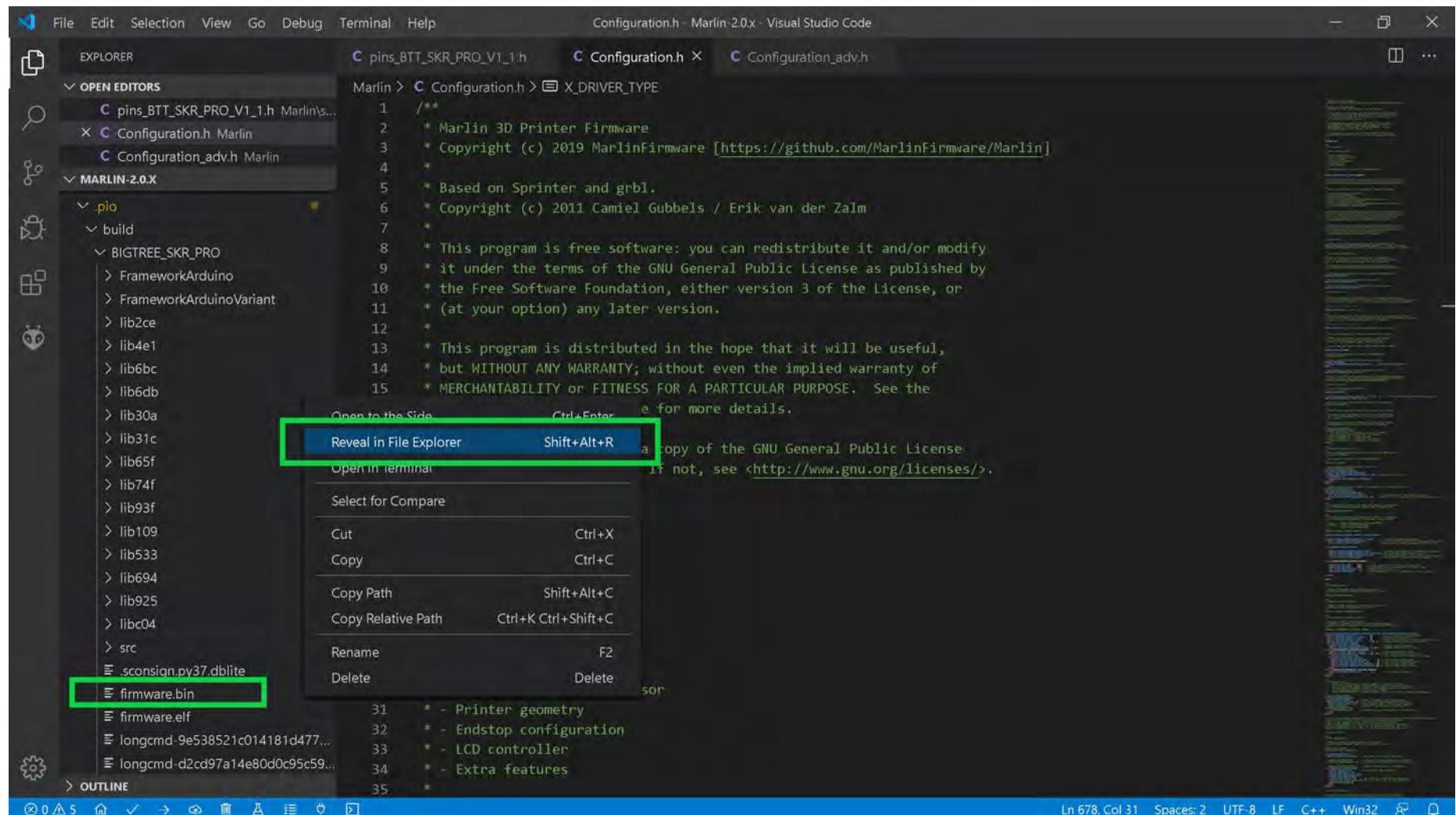
```

Configuration.h Marlin 2.0.x Visual Studio Code
pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h
Marlin > Configuration.h > X_DRIVER_TYPE
658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
661
662 /**
663 * Stepper Drivers
664 *
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 * TMC2225, TMC2225_STANDALONE, TMC2610, TMC2610_STANDALONE
1: Task - Build
  +  -  ×
  S OUTPUT DEBUG CONSOLE TERMINAL
  BIGTREE_SKR_PRO SUCCESS 00:02:31.294
  BIGTREE_CTC_11_0 IGNORED
  BIGTREE_BTT002 IGNORED
  teensy31 IGNORED
  teensy35 IGNORED
  esp32 IGNORED
  linux_native IGNORED
  SAMD51_grandcentral_m4 IGNORED
  rumba32_f446ve IGNORED
  mks_rumba32 IGNORED
  include_tree IGNORED
  ===== 1 succeeded in 00:02:31.294 =====
Terminal will be reused by tasks, press any key to close it.
Ln 678, Col 31 Spaces: 2 UTF-8 LF C++ Win32 ⚡ 🔍
  
```

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU S109 Drivers

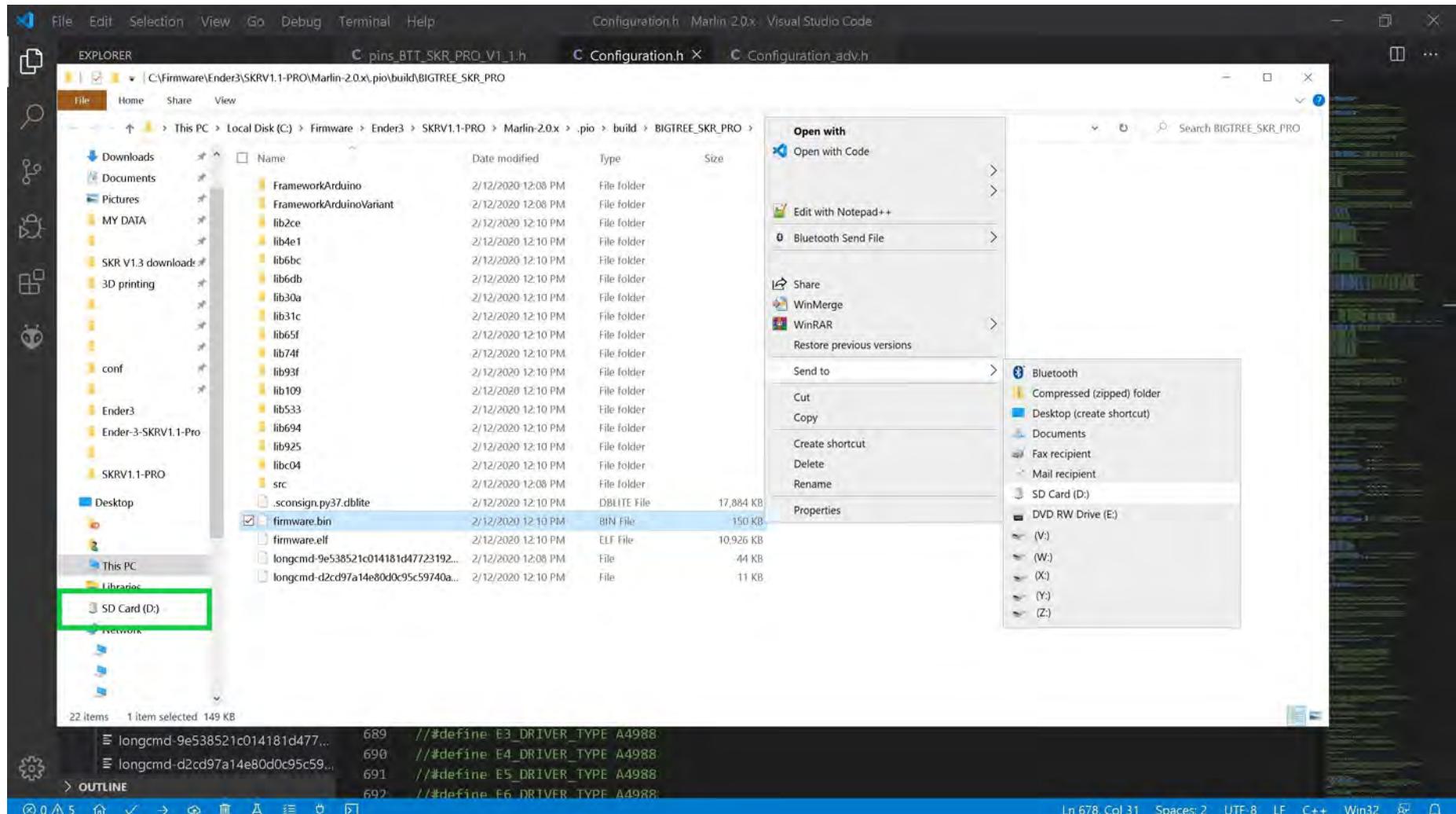
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



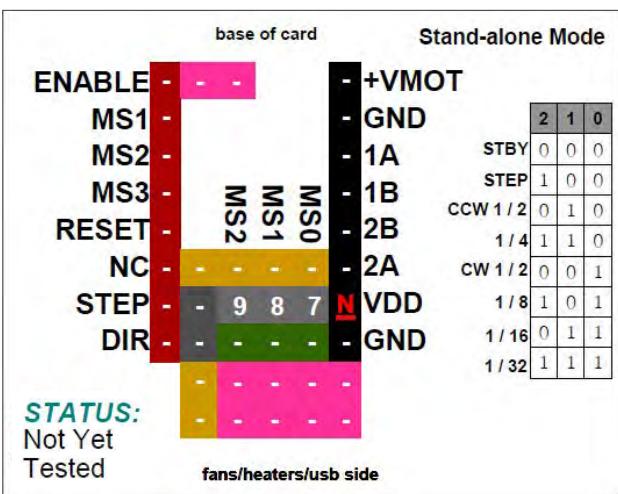
- Go to the next page.

The (latest release of) Marlin Setup for BIQU S109 Drivers

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

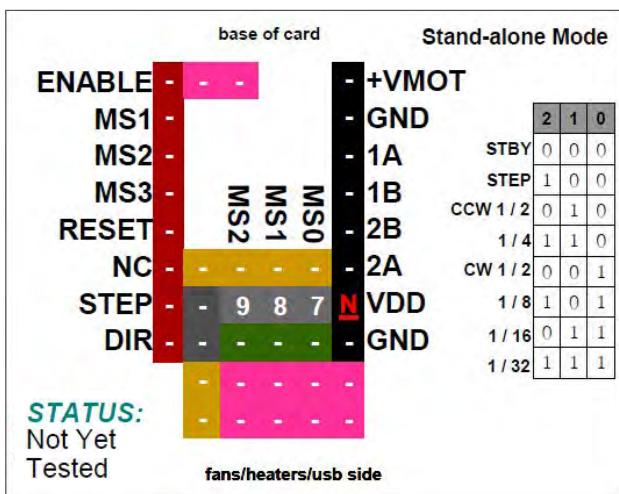


FYSETC S109

Note: V_{DD} is an Output (**N**), *on a 3.3 V MCU like SKR PRO V1.1 the V_{DD} must be disconnected!!*

Note: See the next page for information about location of the current sense resistors and how to set V_{ref} on the stepper motor driver board.

| Driver Chip | MS2 | MS1 | MS0 | Microstep Resolution |
|---|---|------|---|---------------------------------|
| FYSETC | Low | Low | Low | Standby mode (outputs disabled) |
| S109 | High | Low | Low | Full step |
| Maximum 32 Subdivision | Low | High | Low | Non-circular half step ("a") |
| 50V DC 4A (peak) | High | High | Low | 1/4 step |
| Driving Current Calculation Formula | Low | Low | High | Circular half step ("b") |
| $V_{DD} = 5 \text{ V DC}$ | High | Low | High | 1/8 step |
| R_S (Typical Sense Resistor) = 0.1Ω | Low | High | High | 1/16 step |
| | High | High | High | 1/32 step |
| Driving Current Calculation Formula | $I_{MAX} = V_{ref} * \left(\frac{V_{DD}}{5}\right) * \frac{1}{(5 * R_S)}$ | | $V_{ref} = I_{MAX} * \left(\frac{5}{V_{DD}}\right) * (5 * R_S)$ | |
| $V_{DD} = 5 \text{ V DC}$ | | | | |
| R_S (Typical Sense Resistor) = 0.1Ω | | | | |

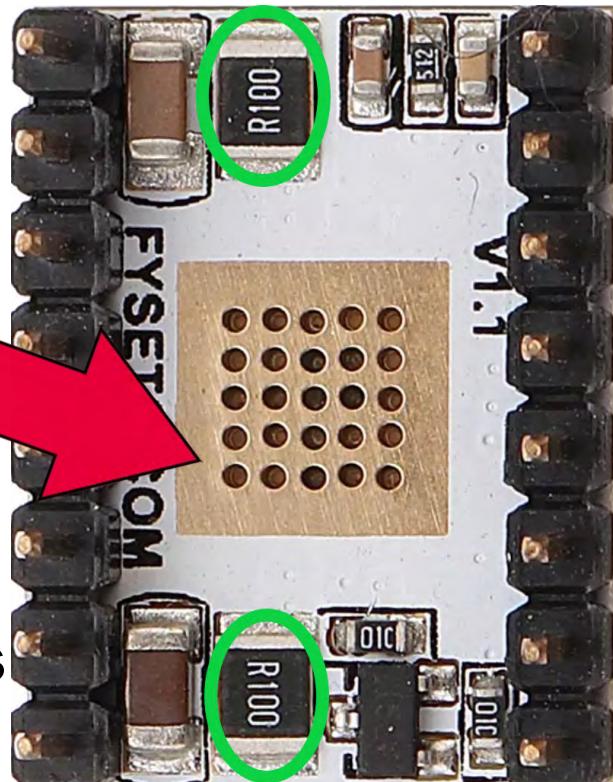


FYSETC S109

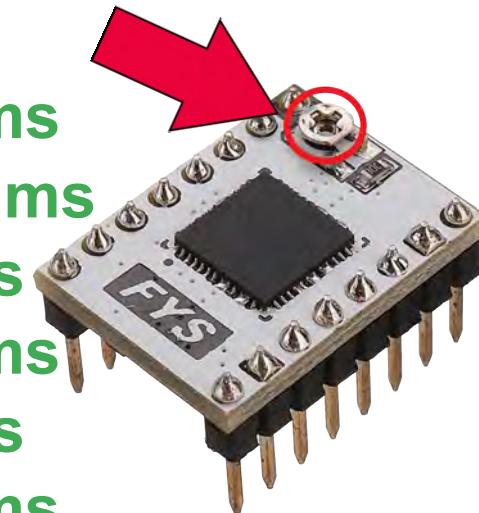
Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board. V_{DD} is an Output (N), on a 3.3 V MCU like SKR PRO V1.1 the V_{DD} must be disconnected!

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN



- $R_s = R050$ is 0.05 Ohms
- $R_s = R068$ is 0.068 Ohms
- $R_s = R100$ is 0.1 Ohms
- $R_s = R150$ is 0.15 Ohms
- $R_s = R200$ is 0.2 Ohms
- $R_s = R220$ is 0.22 Ohms



Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>

FYSETC S109

Stand-alone Mode

Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

| | | | |
|--------|---|-------|-------|
| ENABLE | - | - | +VMOT |
| MS1 | - | - | GND |
| MS2 | - | - | 1A |
| MS3 | - | MS1 | 1B |
| RESET | - | MS2 | 2B |
| NC | - | - | 2A |
| STEP | - | 9 8 7 | VDD |
| DIR | - | 9 8 7 | GND |

Stand By

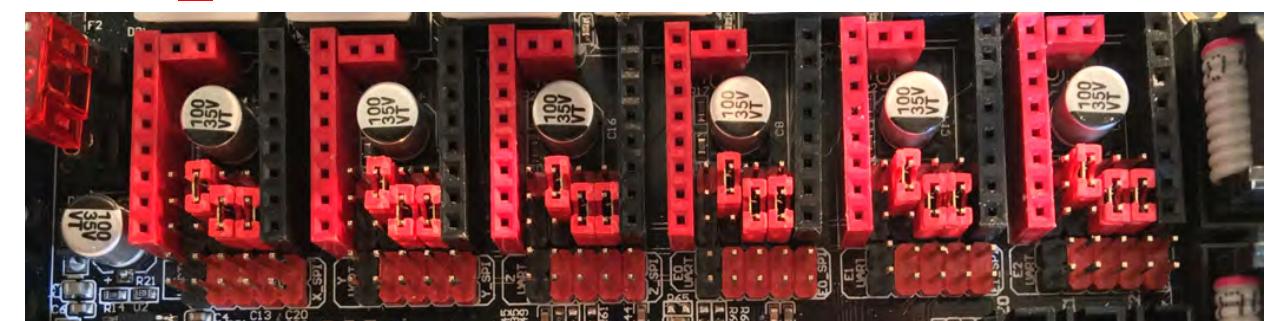
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | |
|--------|---|-------|-------|
| ENABLE | - | - | +VMOT |
| MS1 | - | - | GND |
| MS2 | - | - | 1A |
| MS3 | - | MS1 | 1B |
| RESET | - | MS2 | 2B |
| NC | - | 9 | 2A |
| STEP | - | 9 8 7 | VDD |
| DIR | - | 8 7 | GND |

STEP

Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



FYSETC S109

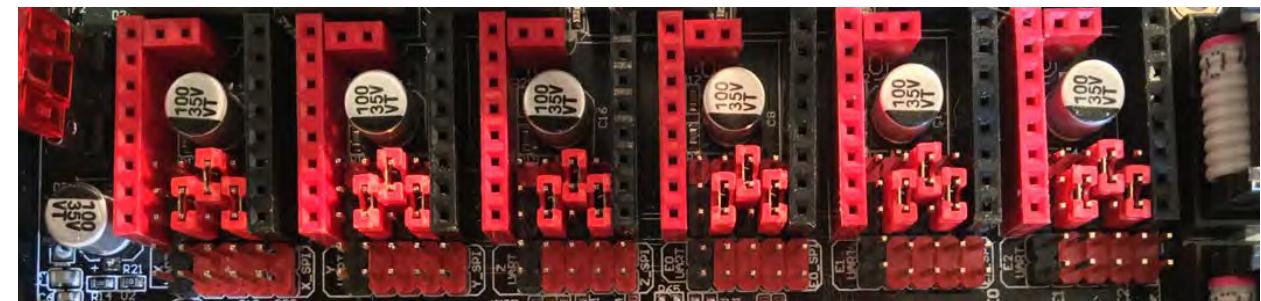
Stand-alone Mode

Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

| | | | |
|--------|-----|-----|-------|
| ENABLE | - | - | +VMOT |
| MS1 | - | - | GND |
| MS2 | - | - | 1A |
| MS3 | - | - | 1B |
| RESET | MS2 | MS1 | MS0 |
| NC | - | 8 | - |
| STEP | - | 9 | 8 7 N |
| DIR | - | 9 | 7 GND |
| | - | - | - |

CCW 1 / 2

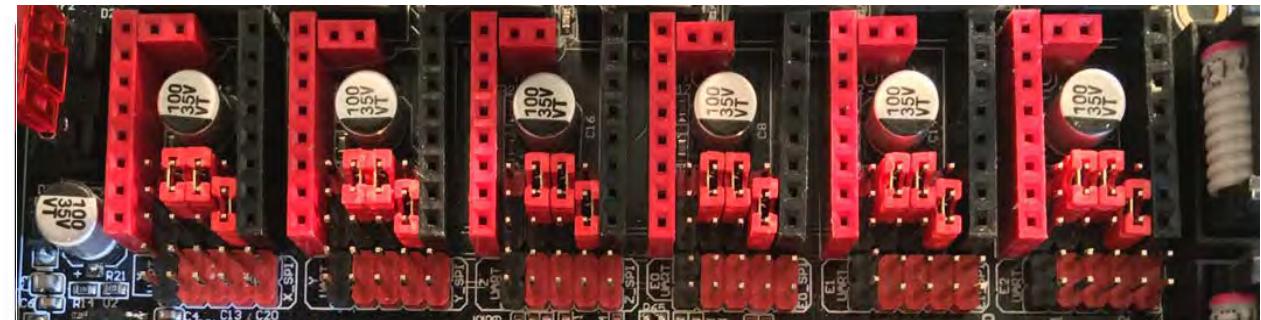
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | |
|--------|-----|-----|-------|
| ENABLE | - | - | +VMOT |
| MS1 | - | - | GND |
| MS2 | - | - | 1A |
| MS3 | - | - | 1B |
| RESET | MS2 | MS1 | MS0 |
| NC | - | 9 | 8 - |
| STEP | - | 9 | 8 7 N |
| DIR | - | - | 7 GND |
| | - | - | - |

1 / 4

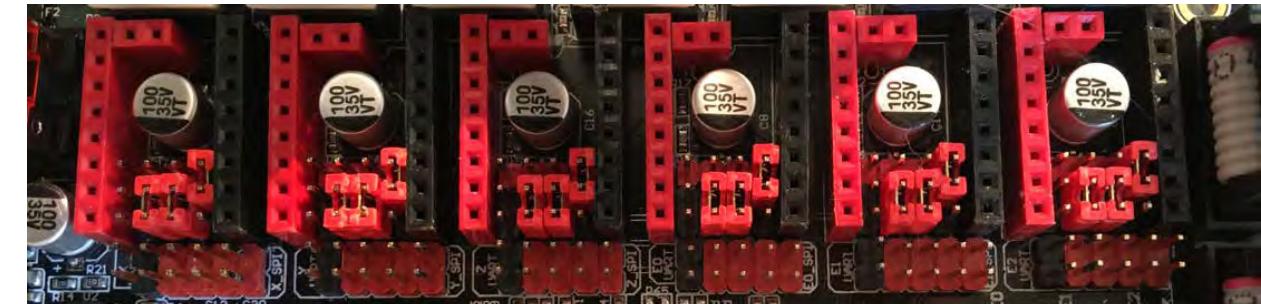
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | |
|--------|-----|-----|-------|
| ENABLE | - | - | +VMOT |
| MS1 | - | - | GND |
| MS2 | - | - | 1A |
| MS3 | - | - | 1B |
| RESET | MS2 | MS1 | MS0 |
| NC | - | - | 7 - |
| STEP | - | 9 | 8 7 N |
| DIR | - | 9 | 8 - |
| | - | - | - |

CW 1 / 2

Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



FYSETC S109

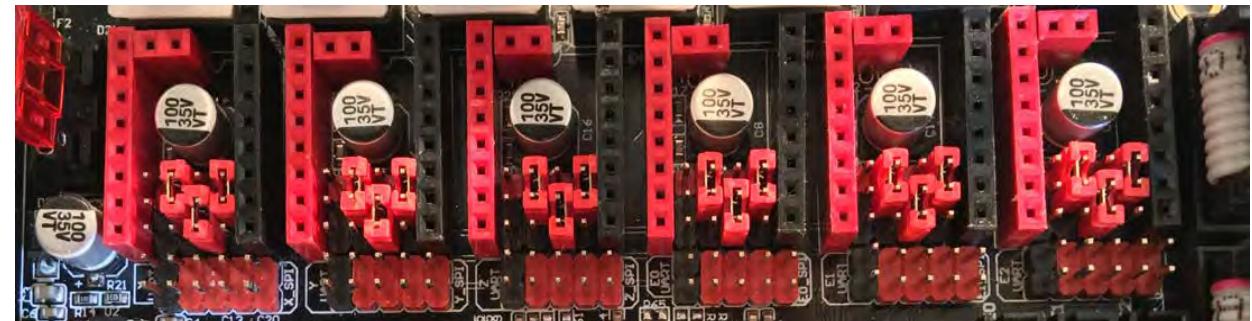
Stand-alone Mode

Note: 'Circular half step ("b")' means "clockwise (CW) motor direction with half step resolution". 'Non-circular half step ("a")' means "counterclockwise (CCW) motor direction with half step resolution".

| | | | |
|--------|---|-----|-------|
| ENABLE | - | - | +VMOT |
| MS1 | - | - | GND |
| MS2 | - | - | 1A |
| MS3 | - | - | 1B |
| RESET | - | MS2 | MS0 |
| NC | - | 9 | 7 |
| STEP | - | 9 | 8 |
| DIR | - | 7 | VDD |
| | - | - | GND |
| | - | - | - |

1 / 8

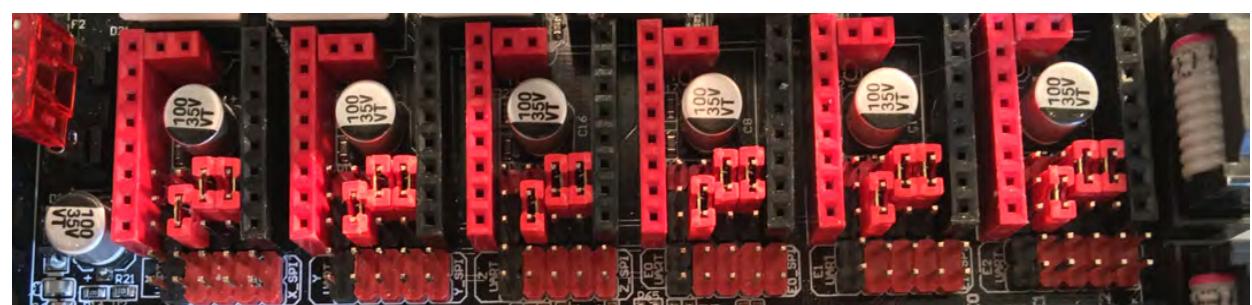
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | |
|--------|---|-----|-------|
| ENABLE | - | - | +VMOT |
| MS1 | - | - | GND |
| MS2 | - | - | 1A |
| MS3 | - | - | 1B |
| RESET | - | MS2 | MS0 |
| NC | - | 8 | 7 |
| STEP | - | 9 | 8 |
| DIR | - | 7 | VDD |
| | - | - | GND |
| | - | - | - |

1 / 16

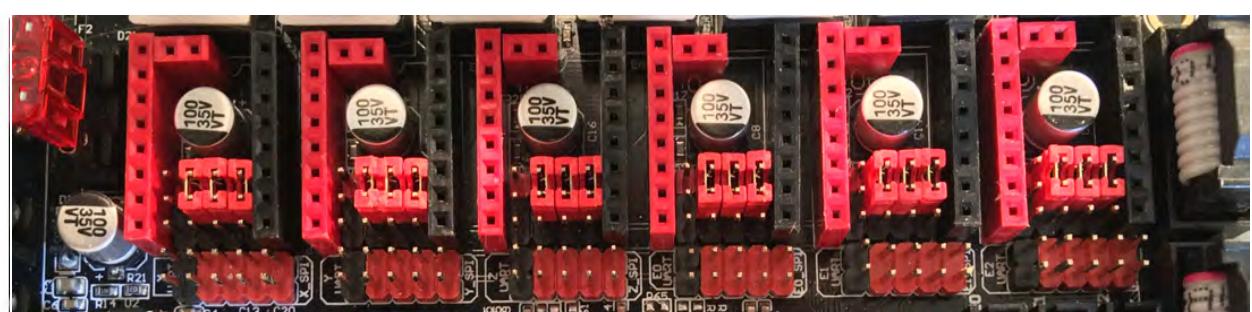
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



| | | | |
|--------|---|-----|-------|
| ENABLE | - | - | +VMOT |
| MS1 | - | - | GND |
| MS2 | - | - | 1A |
| MS3 | - | - | 1B |
| RESET | - | MS2 | MS0 |
| NC | - | 9 | 8 |
| STEP | - | 9 | 8 |
| DIR | - | 7 | VDD |
| | - | - | GND |
| | - | - | - |

1 / 32

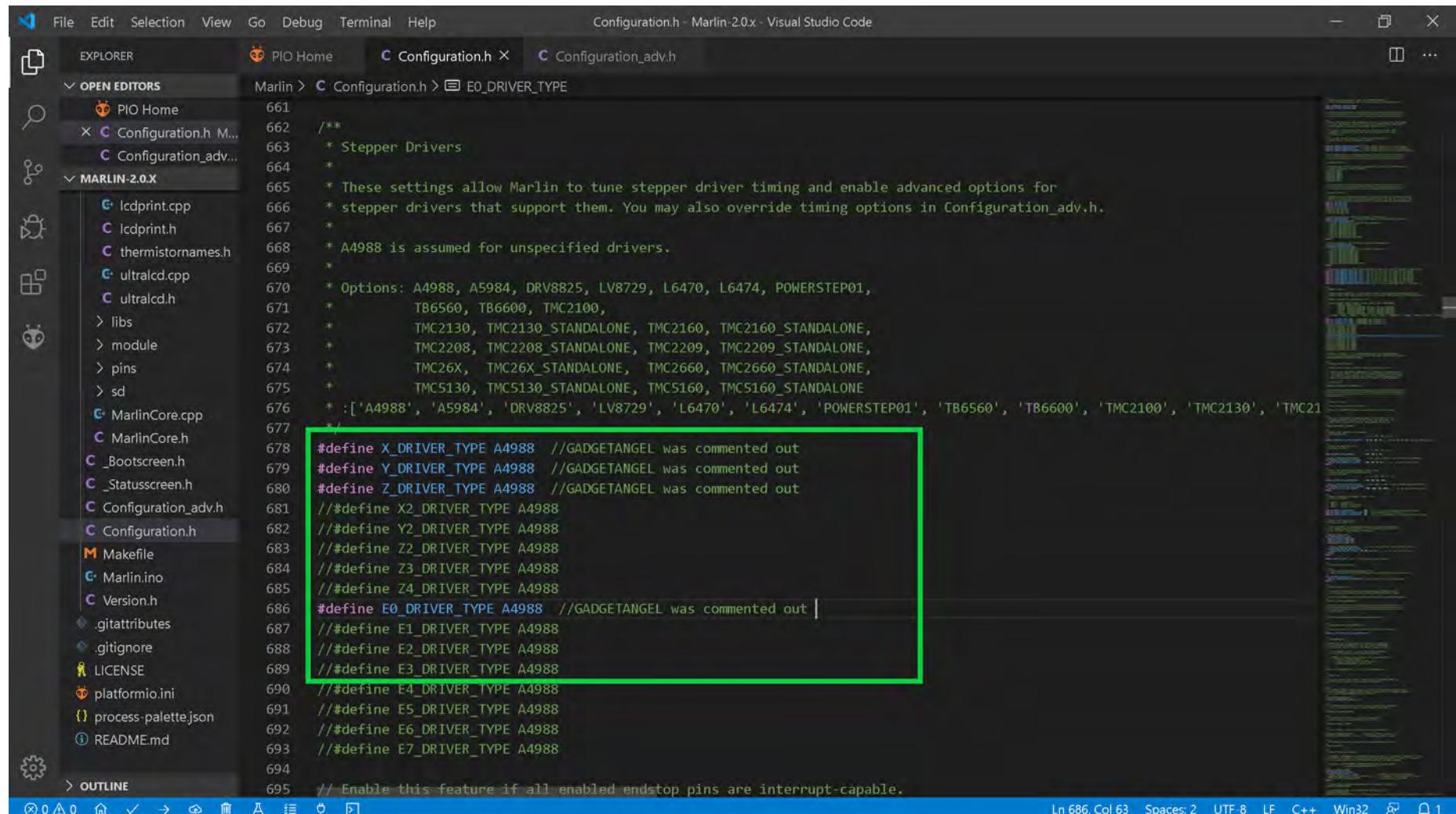
Note: N, on a 3.3 V MCU, like SKR PRO V1.1, **MUST** be disconnected!



The (latest release of) Marlin Setup for FYSETC S109 Drivers

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for FYSETC S109 stepper motor drivers.

- Change the stepper motor drivers so that Marlin knows you are using FYSETC S109 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use FYSETC S109 drivers. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
- The FYSETC S109 is a drop in replacement for the A4988. Since Marlin does not have an option for FYSETC S109 we will use the A4988 as the driver type.



```

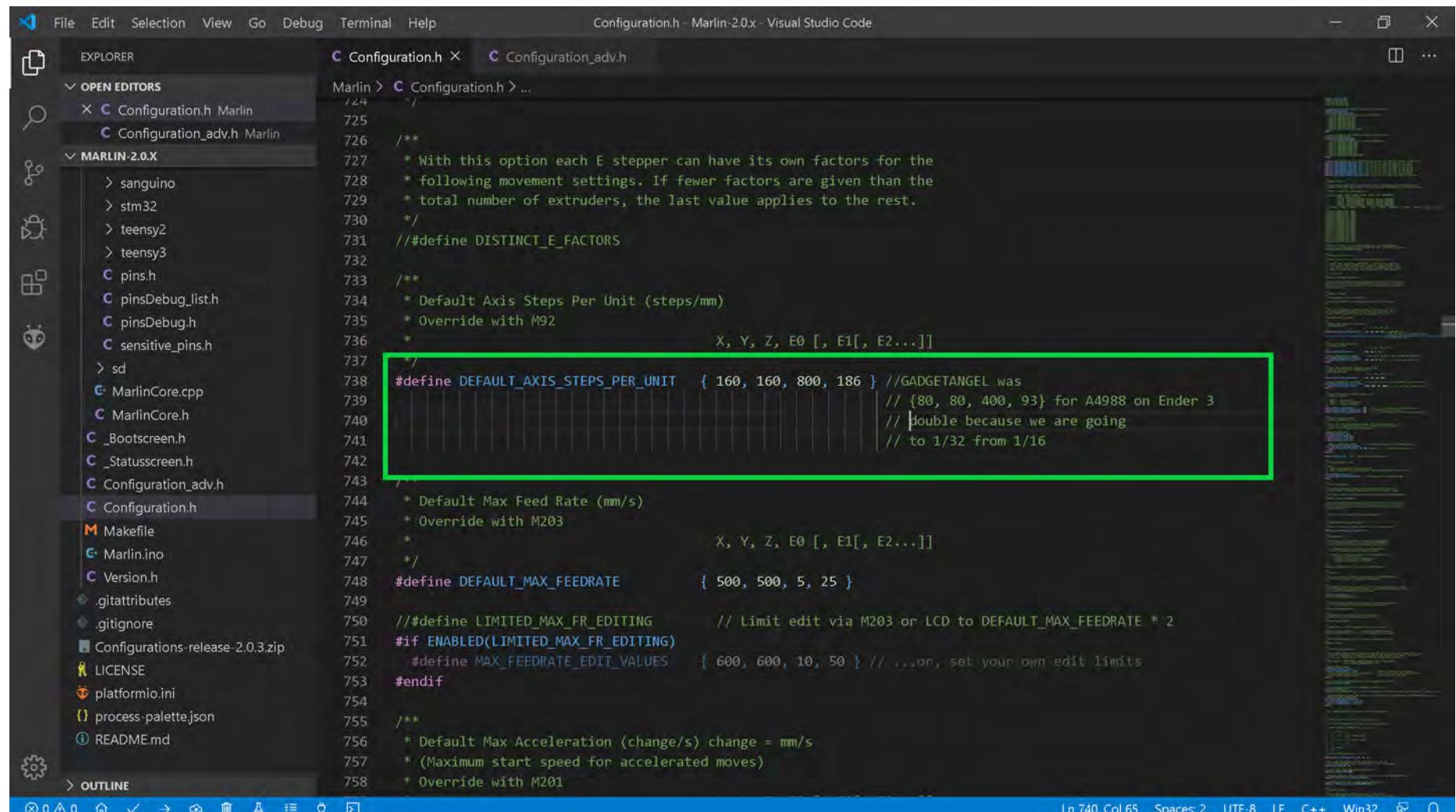
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
  PIO Home
  Configuration.h M...
  Configuration_adv...
MARLIN-2.0.X
  Lcdprint.cpp
  Lcdprint.h
  thermistornames.h
  ultralcd.cpp
  ultralcd.h
  libs
  module
  pins
  sd
  MarlinCore.cpp
  MarlinCore.h
  Bootscreen.h
  Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  LICENSE
  platformio.ini
  process-palette.json
  README.md
OUTLINE
Ln 686 Col 63 Spaces: 2 UTF-8 LF C++ Win32 ⌂ 1
  661 /**
  662 * Stepper Drivers
  663 *
  664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
  665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
  666 * A4988 is assumed for unspecified drivers.
  667 *
  668 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
  669 *           TB6560, TB6600, TMC2100,
  670 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
  671 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
  672 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
  673 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
  674 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160',
  675 *           'TMC2208', 'TMC2209', 'TMC2660', 'TMC5130', 'TMC5160']
  676 */
  677
  678 #define X_DRIVER_TYPE A4988 //GADGETANGEL was commented out
  679 #define Y_DRIVER_TYPE A4988 //GADGETANGEL was commented out
  680 #define Z_DRIVER_TYPE A4988 //GADGETANGEL was commented out
  681 //#define X2_DRIVER_TYPE A4988
  682 //#define Y2_DRIVER_TYPE A4988
  683 //#define Z2_DRIVER_TYPE A4988
  684 //#define Z3_DRIVER_TYPE A4988
  685 //#define Z4_DRIVER_TYPE A4988
  686 #define E0_DRIVER_TYPE A4988 //GADGETANGEL was commented out
  687 //#define E1_DRIVER_TYPE A4988
  688 //#define E2_DRIVER_TYPE A4988
  689 //#define E3_DRIVER_TYPE A4988
  690 //#define E4_DRIVER_TYPE A4988
  691 //#define E5_DRIVER_TYPE A4988
  692 //#define E6_DRIVER_TYPE A4988
  693 //#define E7_DRIVER_TYPE A4988
  694
  695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC S109 Drivers

- Since we are changing from A4988 stepper motor drivers on the Ender 3 to for FYSETC S109 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following line of code:

```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom right shows: Ln 740, Col 65, Spaces: 2, UTF-8, LF, C++, Win32.

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC S109 Drivers

- **Optional Step:** I cannot find information on the FYSETC S109 driver's impact on motor direction. So I provide the below information in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring instead of the Marlin firmware, here is a link on how to change the motor direction via the wiring (look for section labeled "Motor moving the wrong direction") https://reprap.org/wiki/Stepper_wiring. Other people prefer to change the motor direction in the Marlin firmware. **So if you want or need to** change the motor direction in Marlin, then if the axis' setting you will be using the S109 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below

```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > INVERT_Z_DIR
  Configuration.h Marlin 1035 #define DISABLE_Y false
  Configuration_adv.h Marlin 1036 #define DISABLE_Z false
  1037
  1038 // Warn on display about possibly reduced accuracy
  1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
  1040
  1041 // @section extruder
  1042
  1043 #define DISABLE_E false          // For all extruders
  1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
  1045
  1046 // @section machine
  1047
  1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
  1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
  1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
  1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
  1052
  1053 // @section extruder
  1054
  1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
  1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
  1057 #define INVERT_E1_DIR false
  1058 #define INVERT_E2_DIR false
  1059 #define INVERT_E3_DIR false
  1060 #define INVERT_E4_DIR false
  1061 #define INVERT_E5_DIR false
  1062 #define INVERT_E6_DIR false
  1063 #define INVERT_E7_DIR false
  1064
  1065 // @section homing
  1066
  1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
  1068
  1069 // #define UNKNOWN_Z_NO_RATSE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC S109 Drivers

- The end of Marlin setup for FYSETC S109 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x Visual Studio Code

EXPLORER OPEN EDITORS MARLIN-2.0.X

C pins_BTT_SKR_PRO_V1_1.h C Configuration.h X Configuration_adv.h

Marlin > C Configuration.h > X_DRIVER_TYPE

658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.

661
662 */**
663 * Stepper Drivers
664 *
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, PONERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,

PROBLEMS 5 OUTPUT DEBUG CONSOLE TERMINAL 1: Task - Build

| | |
|-------------------------|----------------------|
| STM32F103VC_L1.h | IGNORED |
| BIGTREETREE_SKR_PRO | SUCCESS 00:02:31.294 |
| BIGTREETREE_SKR_V1_0 | IGNORED |
| BIGTREETREE_BTT002 | IGNORED |
| teensy31 | IGNORED |
| teensy35 | IGNORED |
| esp32 | IGNORED |
| linux_native | IGNORED |
| SAMDS11_grandcentral_m4 | IGNORED |
| rumba32_f446ve | IGNORED |
| mks_rumba32 | IGNORED |
| include_tree | IGNORED |

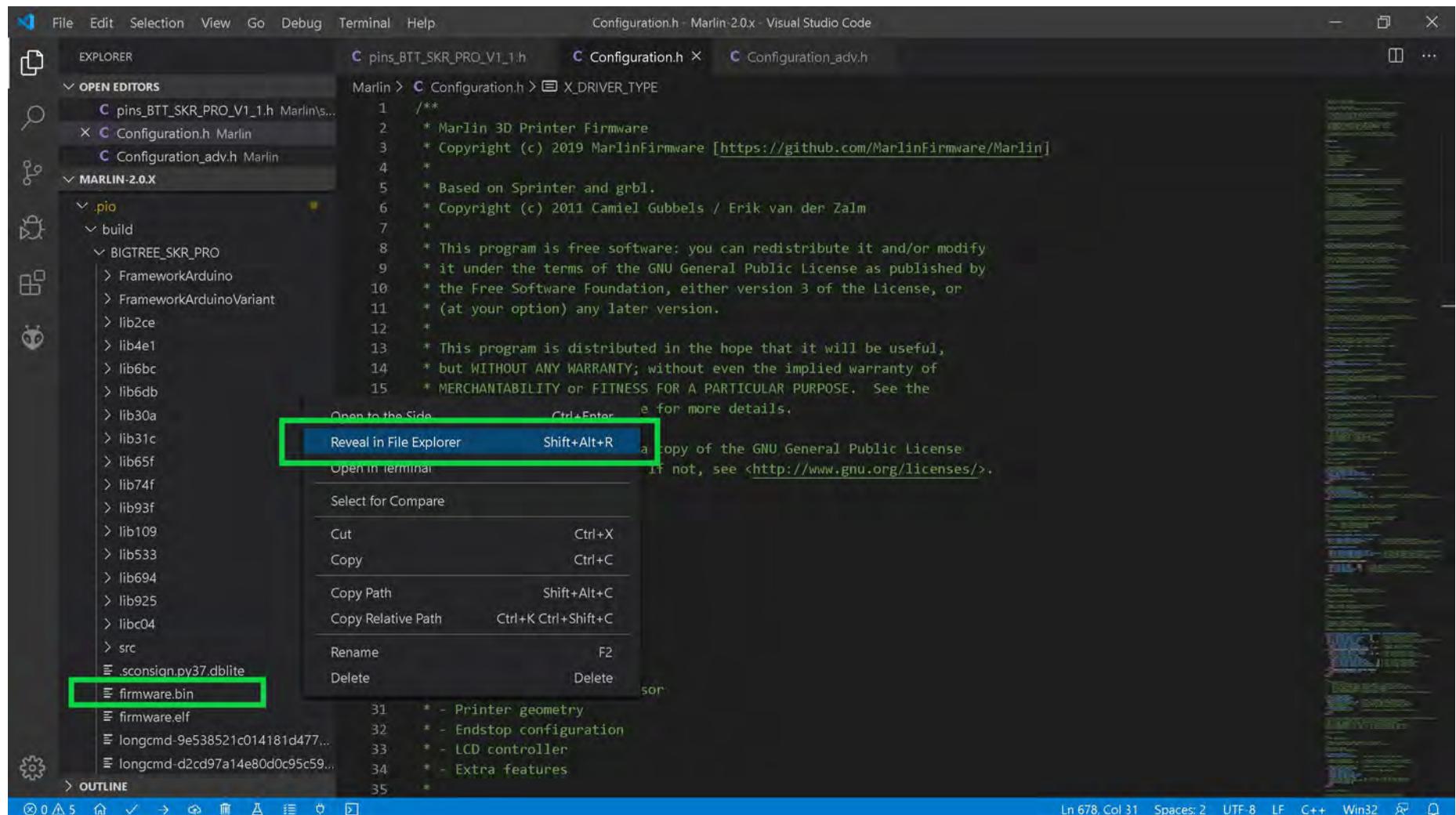
===== 1 succeeded in 00:02:31.294 =====

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for FYSETC S109 Drivers

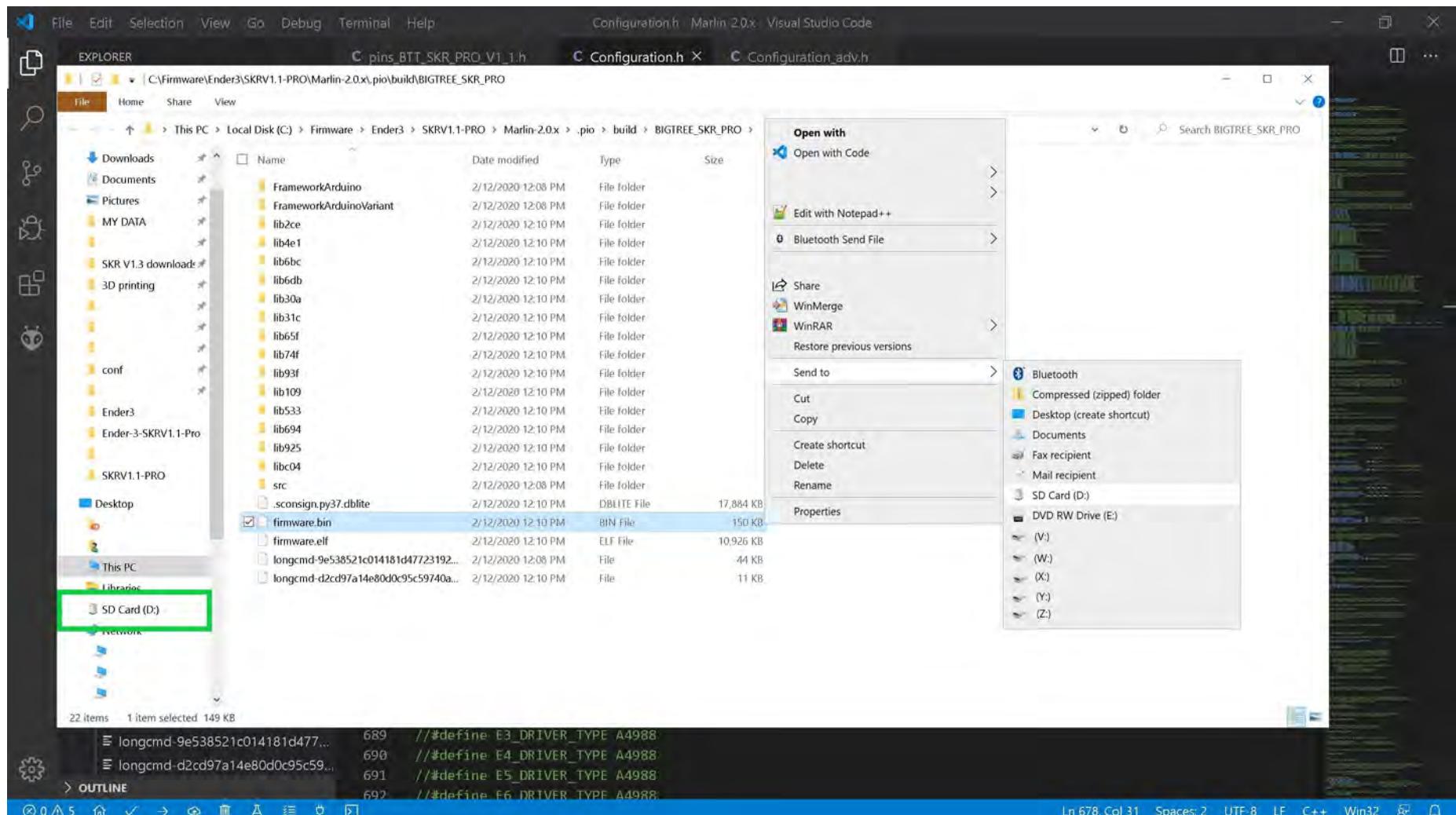
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer window.



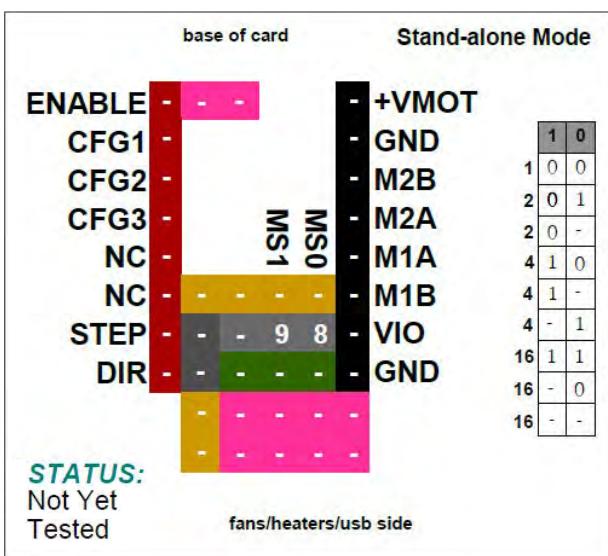
- Go to the next page.

The (latest release of) Marlin Setup for FYSETC S109 Drivers

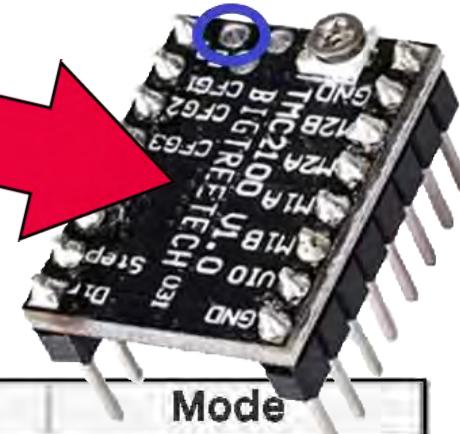
- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



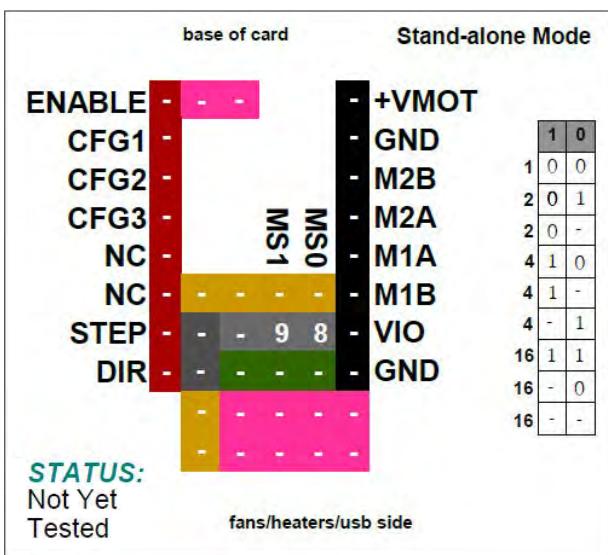
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

**BIQU TMC2100**Stand-alone Mode

NOTE: Use the potentiometer (POT) on the top of the board or use the "V_{ref} Test point" location, as shown in BLUE, to adjust your driver board's V_{ref}



| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|---|---|------|--------|---|-------------|
| BIQU® TMC2100 Stand Alone Mode Maximum 16 Subdivision 46V DC 2.5A (peak) | GND | GND | 1 | NONE | spreadCycle |
| | GND | VIO | 1 / 2 | NONE | spreadCycle |
| | GND | OPEN | 1 / 2 | 1 / 256 | spreadCycle |
| | VIO | GND | 1 / 4 | NONE | spreadCycle |
| | VIO | OPEN | 1 / 4 | 1 / 256 | spreadCycle |
| | OPEN | VIO | 1 / 4 | 1 / 256 | stealthChop |
| | VIO | VIO | 1 / 16 | NONE | spreadCycle |
| | OPEN | GND | 1 / 16 | 1 / 256 | spreadCycle |
| | OPEN | OPEN | 1 / 16 | 1 / 256 | stealthChop |
| Driving Current Calculation Formula | $I_{MAX} = V_{ref}$ | | | $V_{ref} = I_{MAX}$ | |
| R_S (Typical Sense Resistor) = 0.11Ω | See Appendix B #1. Use 50% to 90% as shown below: $I_{MAX} = I_{MAX} * 0.90$ | | | See Appendix B #1. Use 50% to 90% as shown below: $V_{ref} = V_{ref} * 0.90$ | |



BIQU TMC2100

Stand-alone Mode

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board (or use the board's " V_{ref} Test point" to set your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

To learn more, please watch this [YouTube video done by Teaching Tech](#) and check out this link on the [TMC2100 Driver](#)

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN

- $R_s = R050$ is 0.05 Ohms
- $R_s = R068$ is 0.068 Ohms
- $R_s = R100$ is 0.1 Ohms
- $R_s = R150$ is 0.15 Ohms
- $R_s = R200$ is 0.2 Ohms
- $R_s = R220$ is 0.22 Ohms



Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>

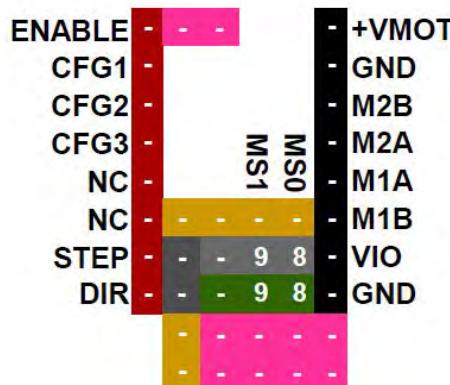
BIQU TMC2100

Stand-alone Mode

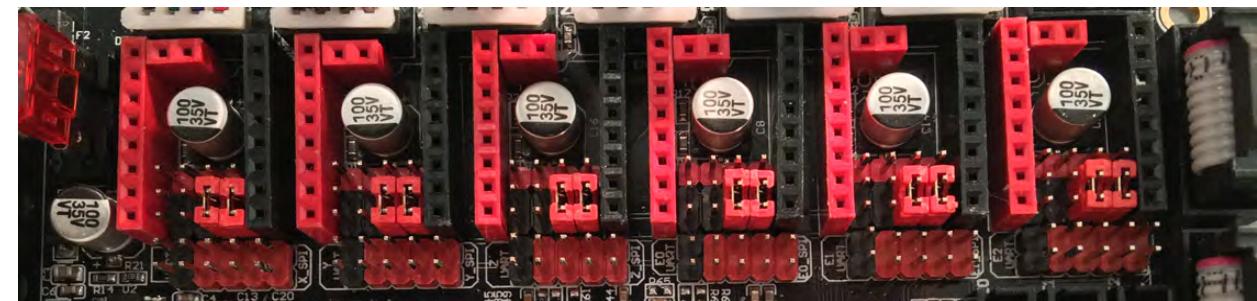
Stand-alone Mode

STEPInterpolation: **none**

SpreadCycle



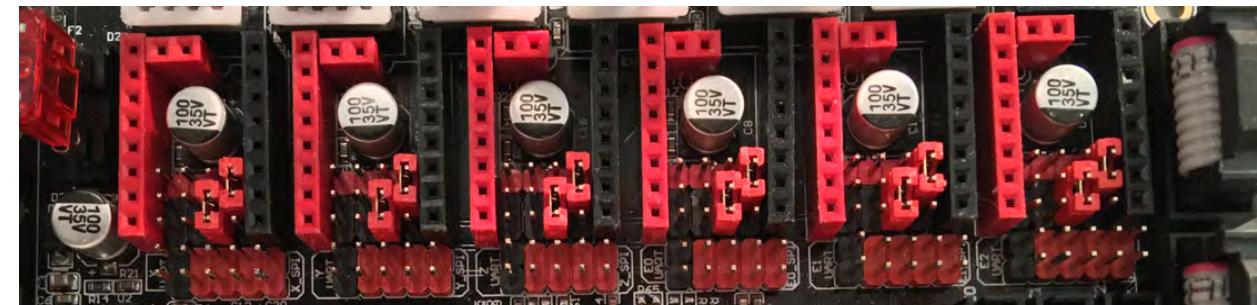
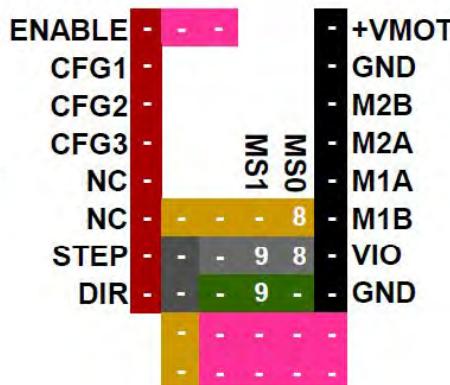
Stand-alone Mode



Stand-alone Mode

1 / 2Interpolation: **none**

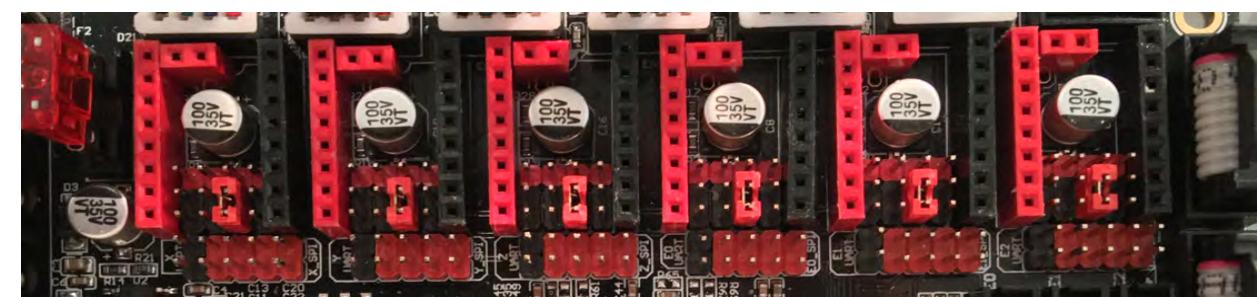
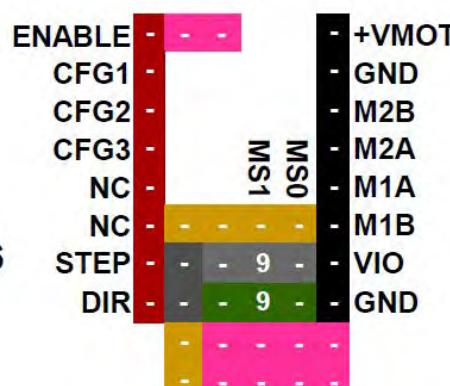
SpreadCycle



Stand-alone Mode

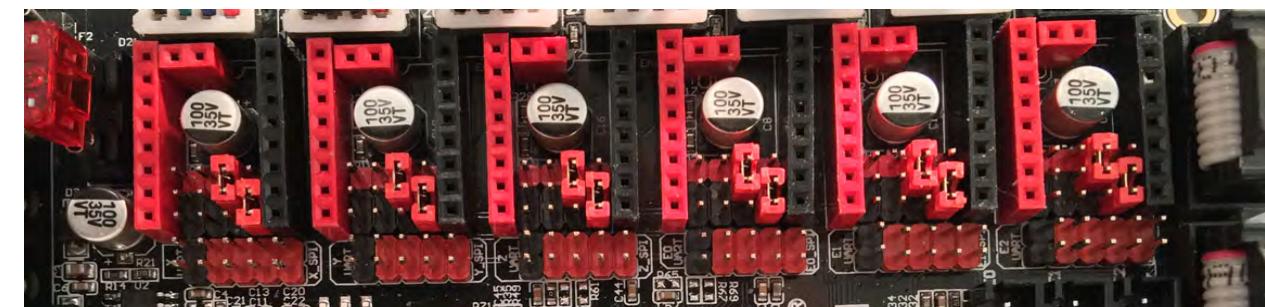
1 / 2Interpolation: **1/256**

SpreadCycle

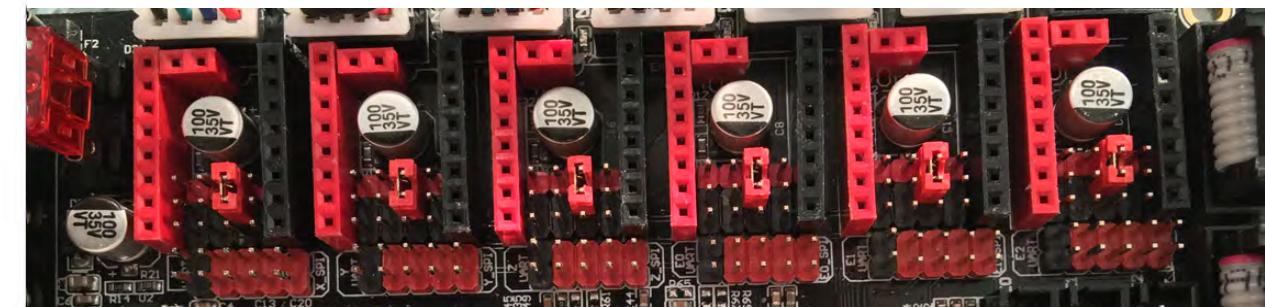


BIQU TMC2100**Stand-alone Mode**

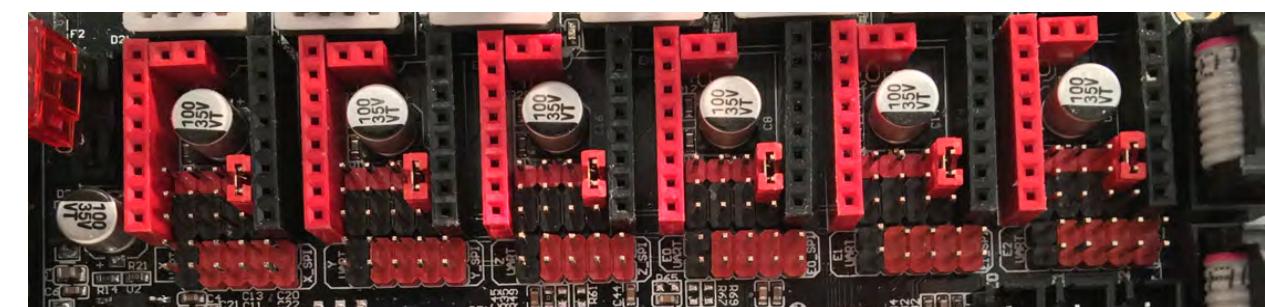
| | | | | |
|---------------------|--------|-----|-----|-------|
| Stand-alone Mode | ENABLE | - | - | +VMOT |
| 1 / 4 | CFG1 | - | - | GND |
| Interpolation: none | CFG2 | - | - | M2B |
| SpreadCycle | CFG3 | - | - | M2A |
| | NC | MS1 | MS0 | M1A |
| | NC | - | 9 | M1B |
| | STEP | - | 9 8 | VIO |
| | DIR | - | 8 | GND |



| | | | | |
|----------------------|--------|-----|-----|-------|
| Stand-alone Mode | ENABLE | - | - | +VMOT |
| 1 / 4 | CFG1 | - | - | GND |
| Interpolation: 1/256 | CFG2 | - | - | M2B |
| SpreadCycle | CFG3 | - | - | M2A |
| | NC | MS1 | MS0 | M1A |
| | NC | - | 9 | M1B |
| | STEP | - | 9 | VIO |
| | DIR | - | - | GND |



| | | | | |
|----------------------|--------|-----|-----|-------|
| Stand-alone Mode | ENABLE | - | - | +VMOT |
| 1 / 4 | CFG1 | - | - | GND |
| Interpolation: 1/256 | CFG2 | - | - | M2B |
| StealthChop | CFG3 | - | - | M2A |
| | NC | MS1 | MS0 | M1A |
| | NC | - | 8 | M1B |
| | STEP | - | 8 | VIO |
| | DIR | - | - | GND |



BIQU TMC2100

Stand-alone Mode

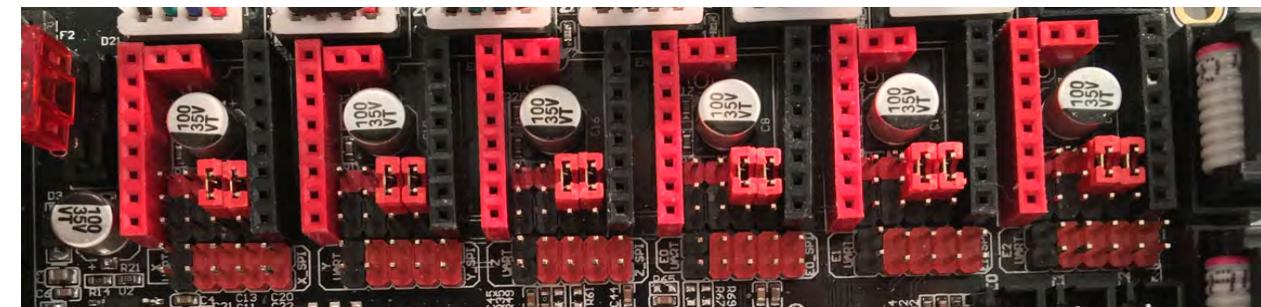
Stand-alone Mode

1 / 16

Interpolation: none

SpreadCycle

| | | | |
|--------|-----|-----|-------|
| ENABLE | [] | [] | +VMOT |
| CFG1 | [] | [] | - GND |
| CFG2 | [] | [] | - M2B |
| CFG3 | [] | [] | - M2A |
| NC | [] | MS1 | - M1A |
| NC | [] | MS0 | - M1B |
| STEP | [] | 9 8 | - VIO |
| DIR | [] | [] | - GND |



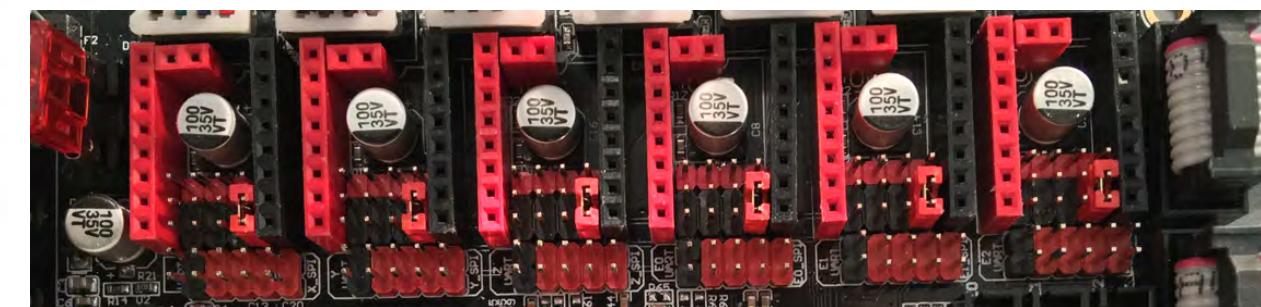
Stand-alone Mode

1 / 16

Interpolation: 1/256

SpreadCycle

| | | | |
|--------|-----|-----|-------|
| ENABLE | [] | [] | +VMOT |
| CFG1 | [] | [] | - GND |
| CFG2 | [] | [] | - M2B |
| CFG3 | [] | [] | - M2A |
| NC | [] | MS1 | - M1A |
| NC | [] | MS0 | - M1B |
| STEP | [] | 8 | - VIO |
| DIR | [] | 8 | - GND |



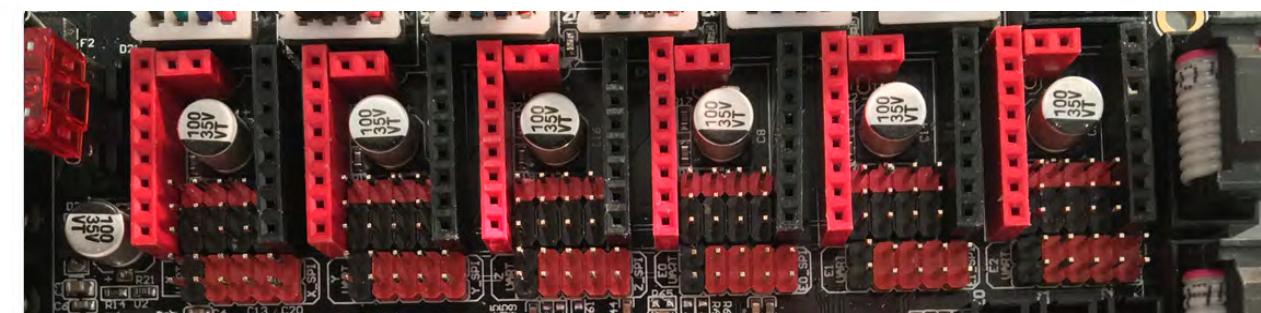
Stand-alone Mode

1 / 16

Interpolation: 1/256

StealthChop

| | | | |
|--------|-----|-----|-------|
| ENABLE | [] | [] | +VMOT |
| CFG1 | [] | [] | - GND |
| CFG2 | [] | [] | - M2B |
| CFG3 | [] | [] | - M2A |
| NC | [] | MS1 | - M1A |
| NC | [] | MS0 | - M1B |
| STEP | [] | [] | - VIO |
| DIR | [] | [] | - GND |



The (latest release of) Marlin Setup for BIQU TMC2100 Drivers in Stand-alone Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2100 stepper motor drivers in stand-alone mode.

- Change the stepper motor drivers so that Marlin knows you are using BIQU TMC2100 drivers in stand-alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use BIQU TMC2100 drivers in stand-alone mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Title Bar:** Configuration.h - Marlin-2.0.x - Visual Studio Code.
- Left Sidebar (EXPLORER):** Shows the project structure under "OPEN EDITORS" and "MARLIN-2.0.X". The "Configuration.h" file is selected.
- Central Area:** The code editor displays the "Configuration.h" file. A green box highlights the section starting at line 661, which defines driver types for various axes and the extruder.
- Right Sidebar:** Shows the "PROBLEMS" and "OUTPUT" tabs.

```
Marlin > C Configuration.h > E0_DRIVER_TYPE
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
676 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC2660', 'TMC5130', 'TMC5160']
677 */
678 #define X_DRIVER_TYPE TMC2100 //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE TMC2100 //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE TMC2100 //GADGETANGEL was commented out and had the value A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2100 //GADGETANGEL was commented out and had the value A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2100 Drivers in Stand-alone Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to for BIQU TMC2100 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as shown in the GREEN box below.

The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the following snippet:

```

    /**
     * Default Axis Steps Per Unit (steps/mm)
     * Override with M92
     *
     * X, Y, Z, E0 [, E1[, E2...]]
     */
#define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// want 1/4 steps, so divide each number by 4 since going from
// 1/16 to 1/4 steps

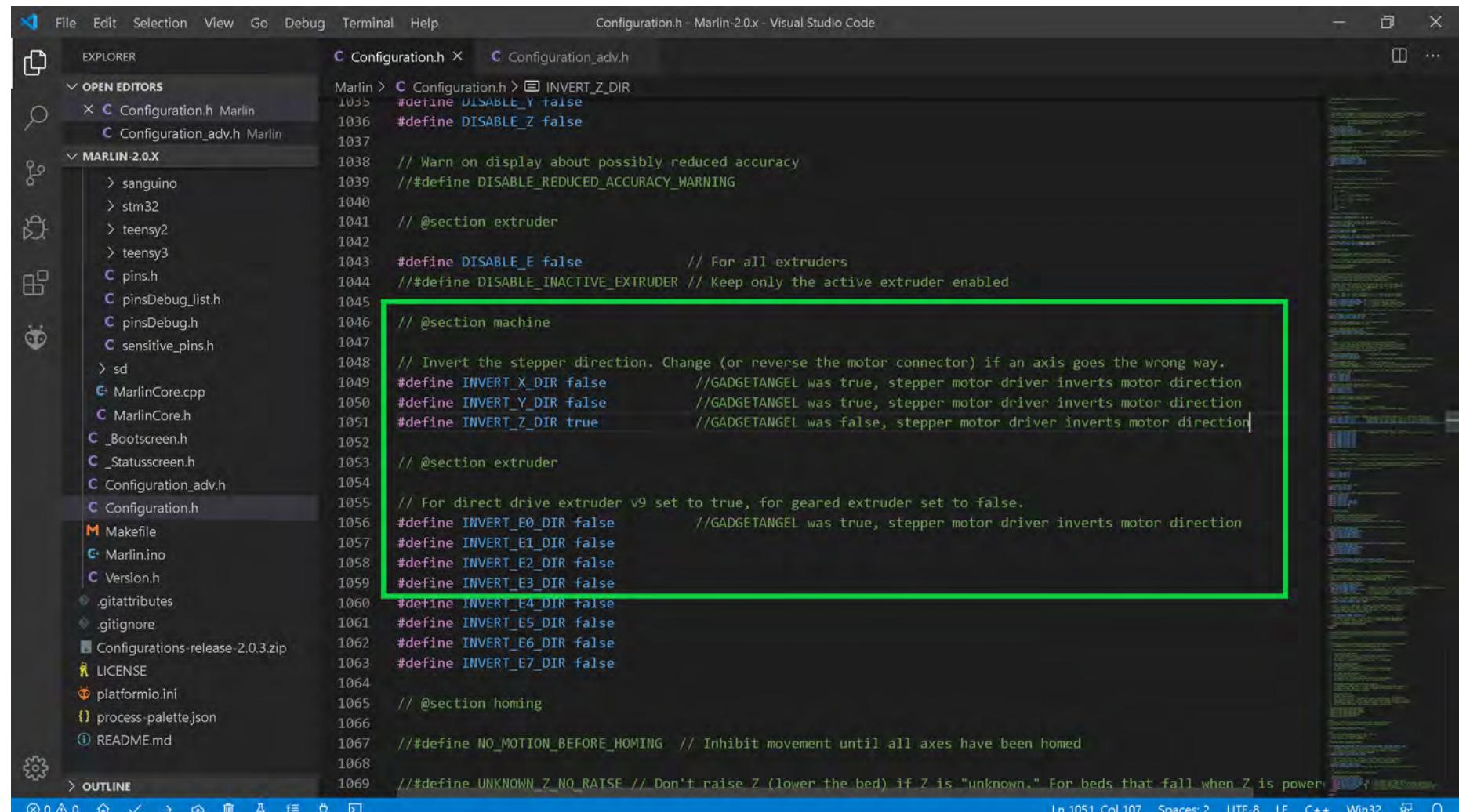
```

The line `#define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 }` is highlighted with a green rectangular box. The code editor's status bar at the bottom right shows 'Ln 738, Col 62'.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2100 Drivers in Stand-alone Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2100 drivers, I must invert the stepper motor direction because the TMC2100 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2100 driver on was "true" change it to "false", as shown in the GREEN box below. If the setting was "false", now set it to "true", as show in the GREEN box below



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor has a dark theme. On the left is the Explorer sidebar showing project files like 'Configuration.h', 'Configuration_adv.h', 'MarlinCore.cpp', etc. The main editor area shows the following code snippet:

```

1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 //##define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 //##define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        //GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        //GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         //GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       //GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 //##define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 //##define UNKNOWN_Z_NO_RATSE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

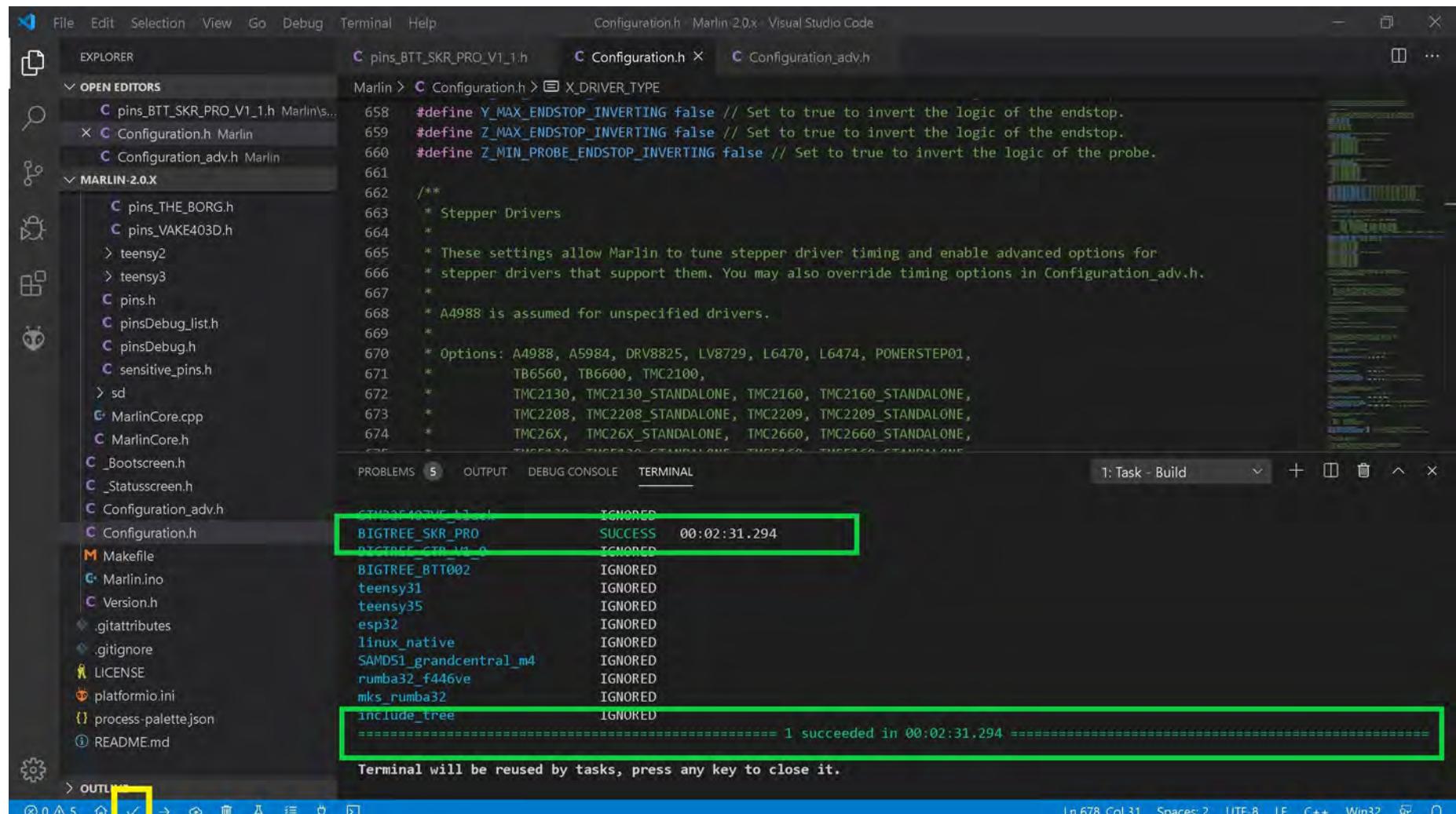
```

A green rectangular box highlights the section of code from line 1048 to line 1059, which defines the inverting of stepper directions for each axis (E0-E7). The code indicates that GADGETANGEL was true for the X and Y axes, while Z was false.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2100 Drivers in Stand-alone Mode

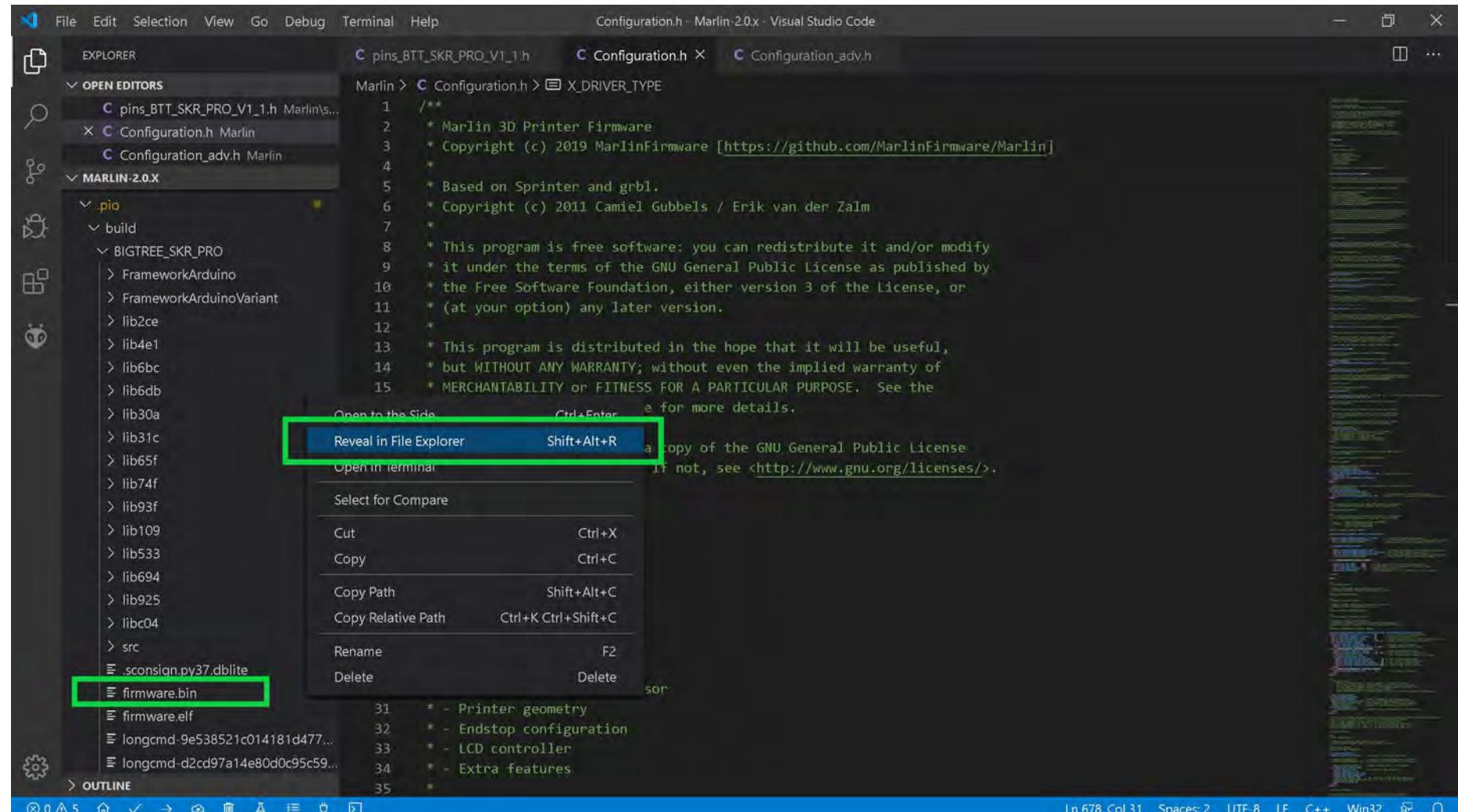
- The end of Marlin setup for BIQU TMC2100 drivers in stand-alone mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2100 Drivers in Stand-alone Mode

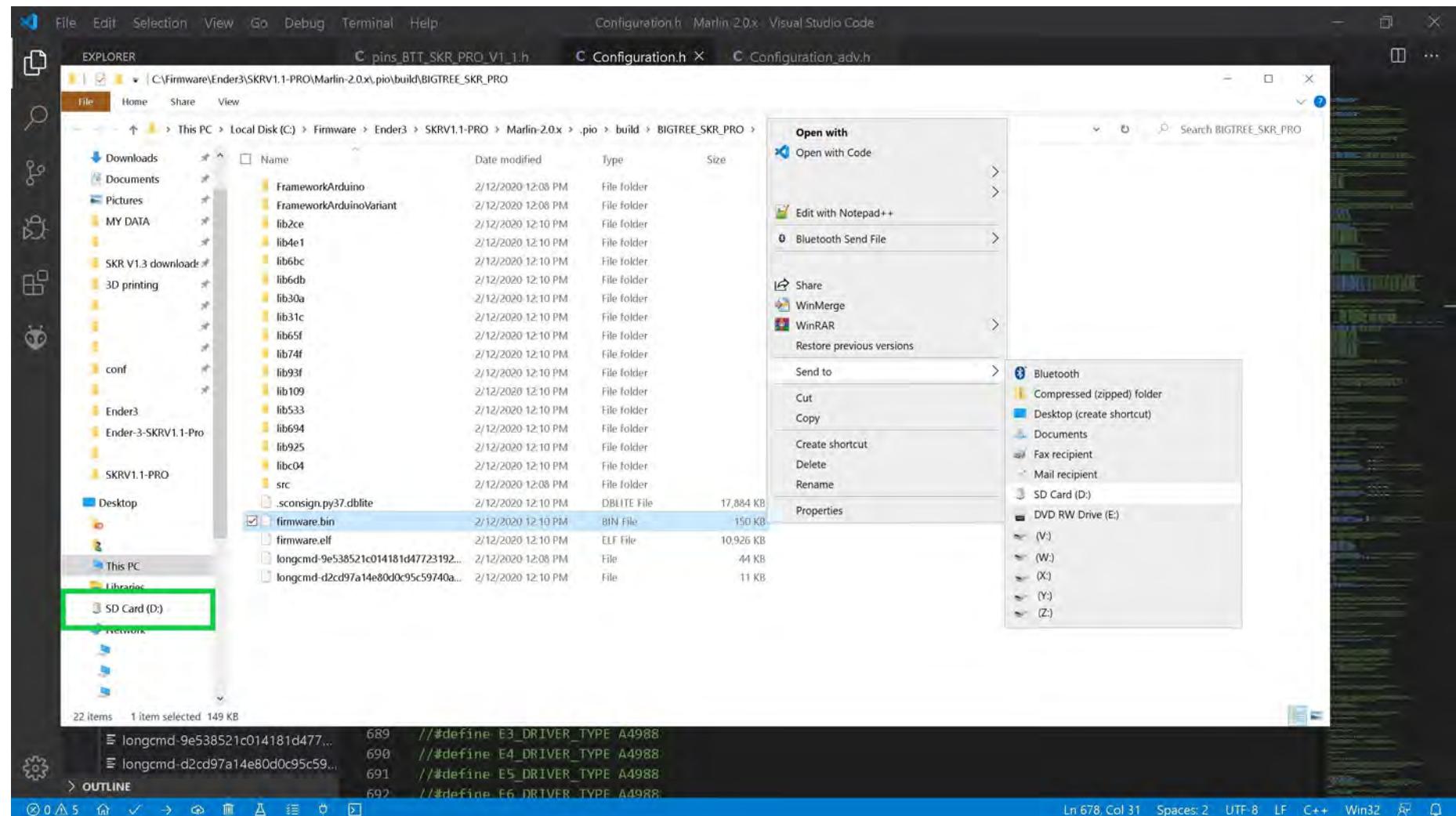
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



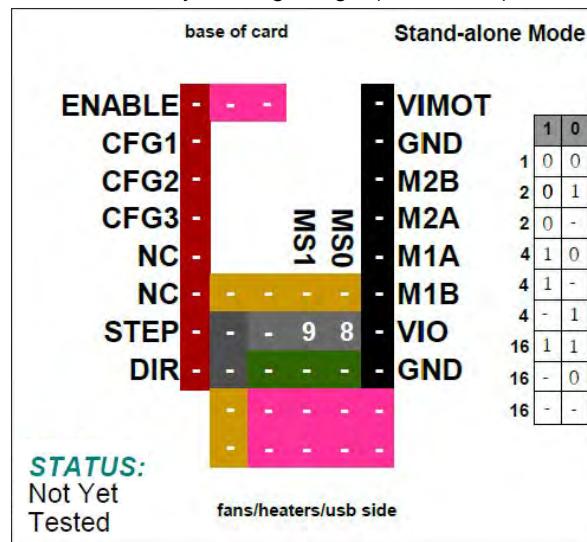
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2100 Drivers in Stand-alone Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



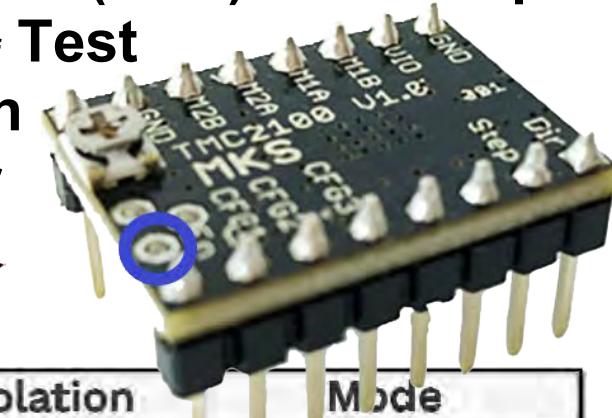
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.



MKS TMC2100

Stand-alone Mode

NOTE: Use the potentiometer (POT) on the top of the board or use the "V_{ref} Test point" location, as shown in BLUE, to adjust your driver board's V_{ref}



| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|---|------|------|--------|---------------|-------------|
| Makerbase TMC2100 Stand Alone Mode Maximum 16 Subdivision 46V DC 2.5A (peak) | GND | GND | 1 | NONE | spreadCycle |
| | GND | VIO | 1 / 2 | NONE | spreadCycle |
| | GND | OPEN | 1 / 2 | 1 / 256 | spreadCycle |
| | VIO | GND | 1 / 4 | NONE | spreadCycle |
| | VIO | OPEN | 1 / 4 | 1 / 256 | spreadCycle |
| | OPEN | VIO | 1 / 4 | 1 / 256 | stealthChop |
| | VIO | VIO | 1 / 16 | NONE | spreadCycle |
| | OPEN | GND | 1 / 16 | 1 / 256 | spreadCycle |
| | OPEN | OPEN | 1 / 16 | 1 / 256 | stealthChop |

Driving Current Calculation Formula
 R_S (Typical Sense Resistor) = 0.11Ω

$$I_{MAX} = V_{ref}$$

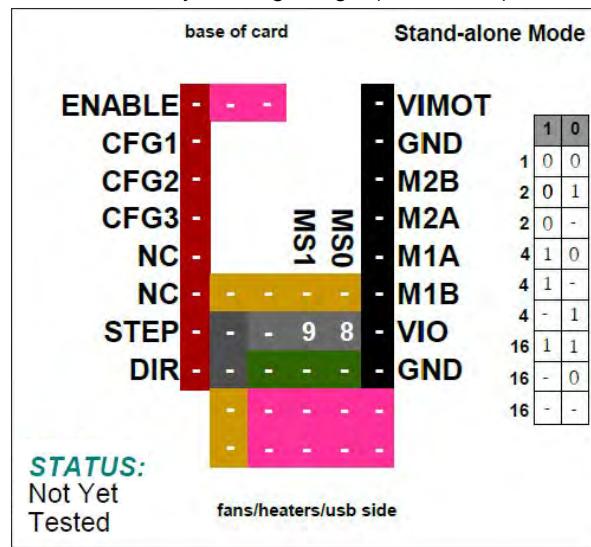
See Appendix B #1. Use 50% to 90% as shown below:

$$I_{MAX} = I_{MAX} * 0.90$$

$$V_{ref} = I_{MAX}$$

See Appendix B #1. Use 50% to 90% as shown below:

$$V_{ref} = V_{ref} * 0.90$$



MKS TMC2100

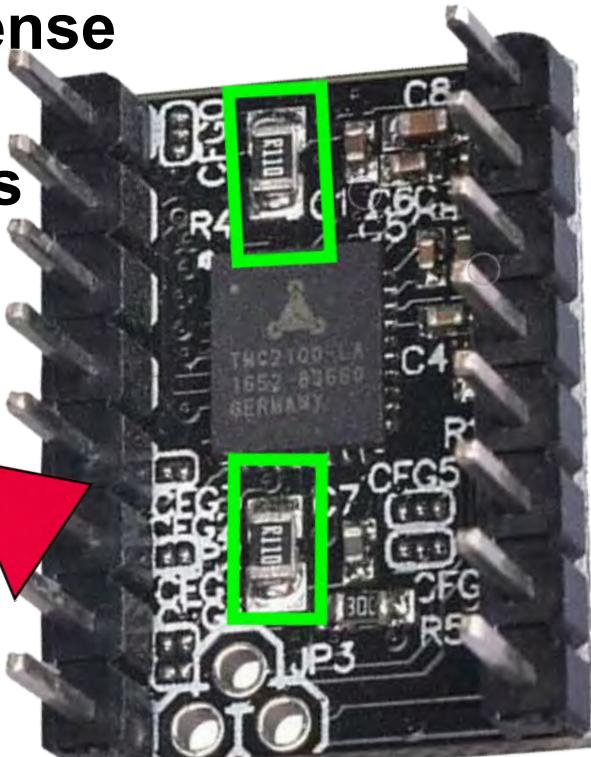
Stand-alone Mode

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board (or use the board's " V_{ref} Test point" to set your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.

To learn more, please watch this [YouTube video](#) done by Teaching Tech and check out this link on the [TMC2100 Driver](#)

Note: Check your current sense resistors (R_s) values on the driver board, as shown in GREEN



$R_s = R050$ is 0.05 Ohms

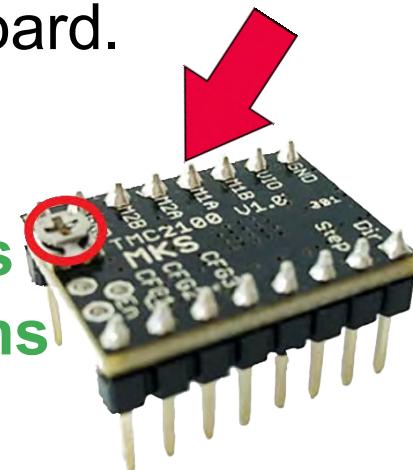
$R_s = R068$ is 0.068 Ohms

$R_s = R100$ is 0.1 Ohms

$R_s = R150$ is 0.15 Ohms

$R_s = R200$ is 0.2 Ohms

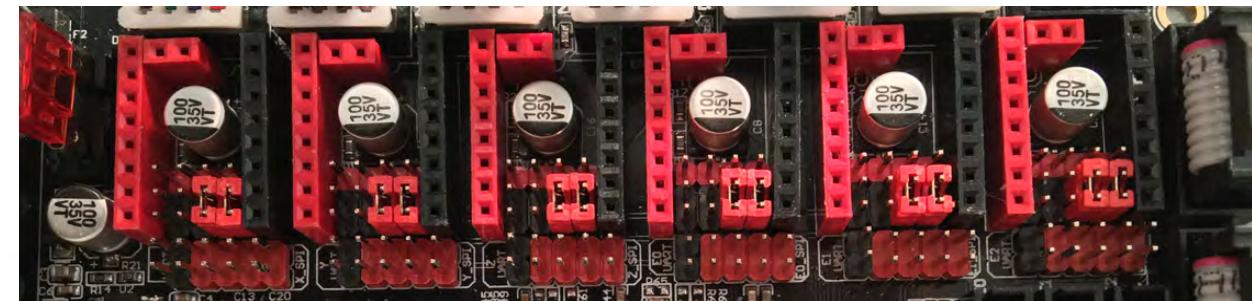
$R_s = R220$ is 0.22 Ohms



Note: See this video about current sense resistors (R_s) and their possible locations:
<https://youtu.be/8wk1elugv5A>

MKS TMC2100**Stand-alone Mode**

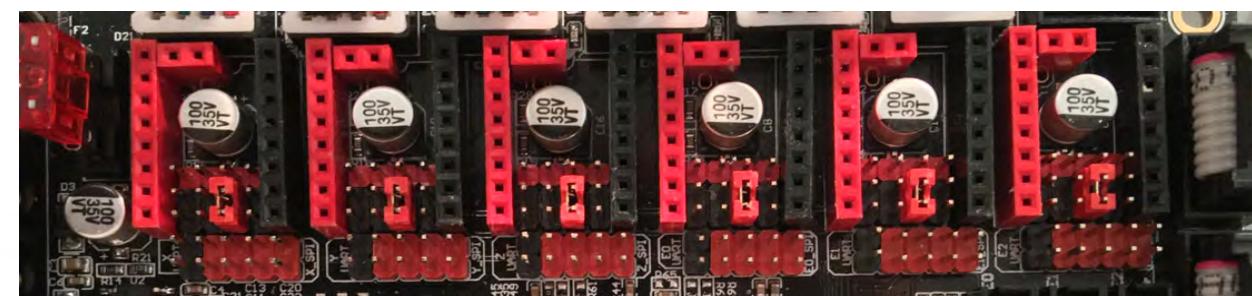
| | | | | |
|----------------------------|--------|---|-----|-------|
| Stand-alone Mode | ENABLE | - | - | VIMOT |
| | CFG1 | - | - | GND |
| | CFG2 | - | - | M2B |
| | CFG3 | - | - | M2A |
| | NC | - | MS1 | M1A |
| Interpolation: none | NC | - | MS0 | M1B |
| SpreadCycle | STEP | - | 9 8 | VIO |
| | DIR | - | 9 8 | GND |

Stand-alone Mode

| | | | | |
|----------------------------|--------|---|-----|-------|
| Stand-alone Mode | ENABLE | - | - | VIMOT |
| | CFG1 | - | - | GND |
| | CFG2 | - | - | M2B |
| | CFG3 | - | - | M2A |
| | NC | - | MS1 | M1A |
| Interpolation: none | NC | - | MS0 | M1B |
| SpreadCycle | STEP | - | 9 8 | VIO |
| | DIR | - | 9 - | GND |



| | | | | |
|-----------------------------|--------|---|-----|-------|
| Stand-alone Mode | ENABLE | - | - | VIMOT |
| | CFG1 | - | - | GND |
| | CFG2 | - | - | M2B |
| | CFG3 | - | - | M2A |
| | NC | - | MS1 | M1A |
| Interpolation: 1/256 | NC | - | MS0 | M1B |
| SpreadCycle | STEP | - | 9 - | VIO |
| | DIR | - | 9 - | GND |



MKS TMC2100**Stand-alone Mode****Stand-alone Mode**

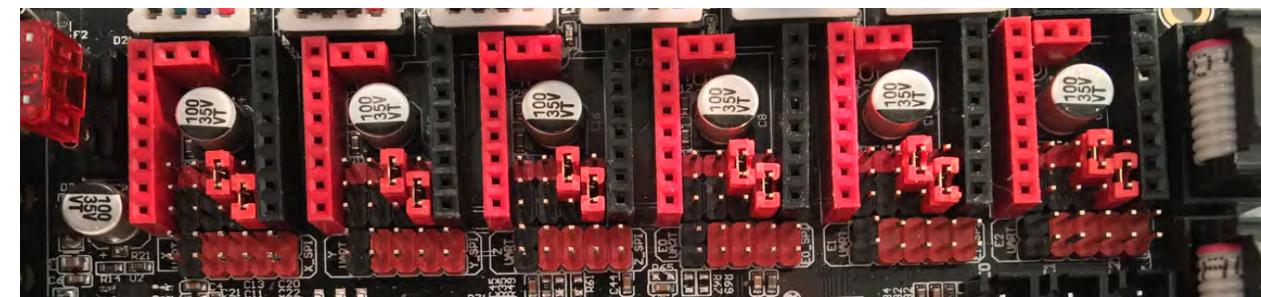
Stand-alone Mode

1 / 4

Interpolation: **none**

SpreadCycle

| | ENABLE | | VIMOT |
|------------------|--------|------------|-------|
| Stand-alone Mode | CFG1 | | GND |
| | CFG2 | | M2B |
| | CFG3 | MS0 MS1 | M2A |
| | NC | | M1A |
| | NC | 9 | M1B |
| | STEP | 9 8 | VIO |
| | DIR | 8 | GND |



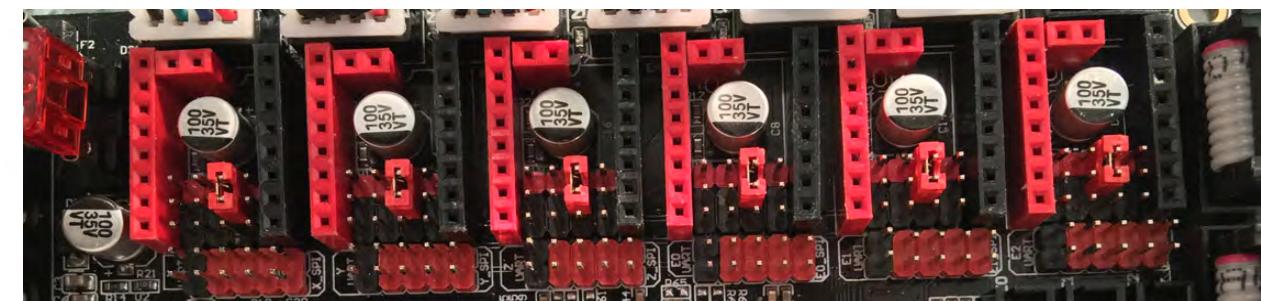
Stand-alone Mode

1 / 4

Interpolation: **1/256**

SpreadCycle

| | ENABLE | | VIMOT |
|------------------|--------|------------|-------|
| Stand-alone Mode | CFG1 | | GND |
| | CFG2 | | M2B |
| | CFG3 | MS0 MS1 | M2A |
| | NC | | M1A |
| | NC | 9 | M1B |
| | STEP | 9 | VIO |
| | DIR | | GND |



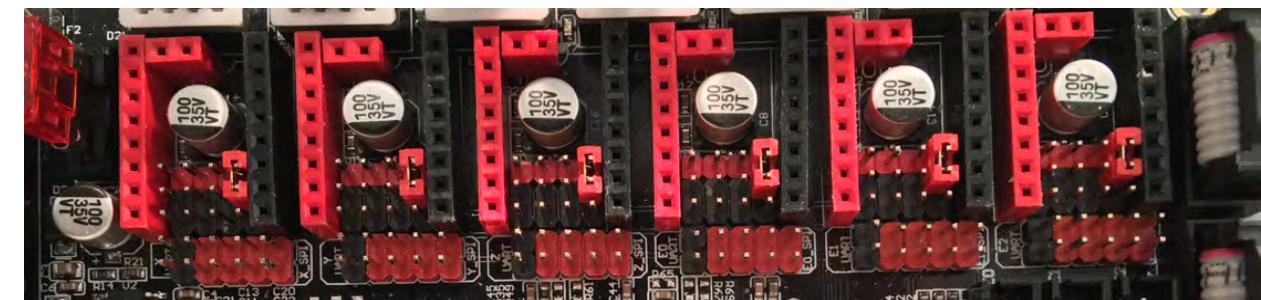
Stand-alone Mode

1 / 4

Interpolation: **1/256**

StealthChop

| | ENABLE | | VIMOT |
|------------------|--------|------------|-------|
| Stand-alone Mode | CFG1 | | GND |
| | CFG2 | | M2B |
| | CFG3 | MS0 MS1 | M2A |
| | NC | | M1A |
| | NC | 8 | M1B |
| | STEP | 8 | VIO |
| | DIR | | GND |



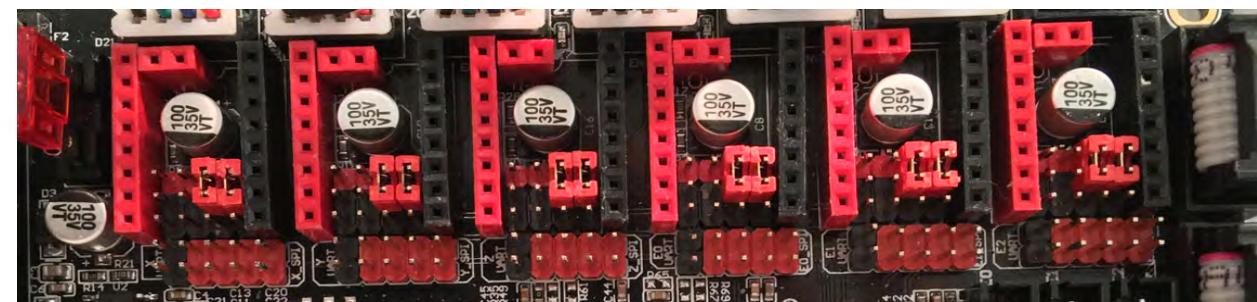
MKS TMC2100**Stand-alone Mode**

Stand-alone Mode

1 / 16Interpolation: **none**

SpreadCycle

| | | | | |
|--------|-----|-----|-----|-------|
| ENABLE | [] | [] | - | VIMOT |
| CFG1 | [] | [] | - | GND |
| CFG2 | [] | [] | - | M2B |
| CFG3 | [] | [] | - | M2A |
| NC | [] | MS1 | MS0 | M1A |
| NC | [] | 9 | 8 | M1B |
| STEP | [] | 9 | 8 | VIO |
| DIR | [] | [] | [] | GND |

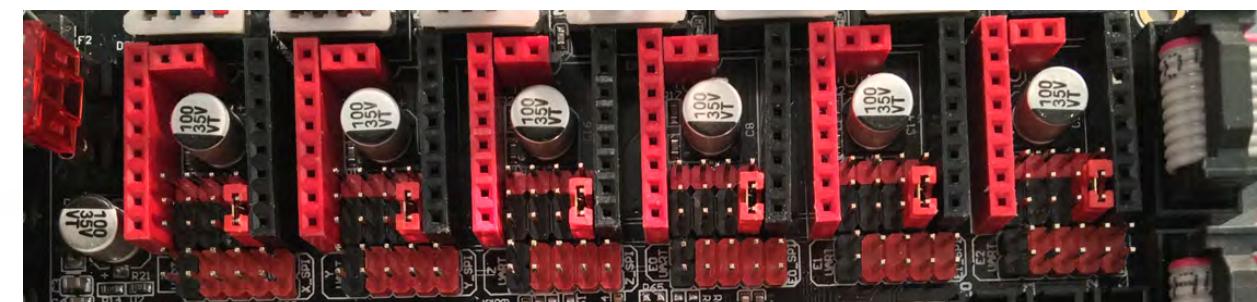


Stand-alone Mode

1 / 16Interpolation: **1/256**

SpreadCycle

| | | | | |
|--------|-----|-----|-----|-------|
| ENABLE | [] | [] | - | VIMOT |
| CFG1 | [] | [] | - | GND |
| CFG2 | [] | [] | - | M2B |
| CFG3 | [] | [] | - | M2A |
| NC | [] | MS1 | MS0 | M1A |
| NC | [] | [] | [] | M1B |
| STEP | [] | [] | 8 | VIO |
| DIR | [] | [] | 8 | GND |

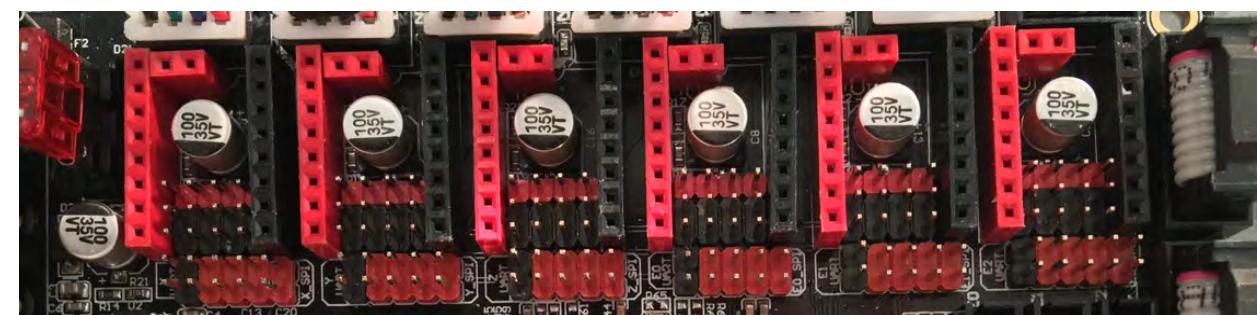


Stand-alone Mode

1 / 16Interpolation: **1/256**

StealthChop

| | | | | |
|--------|-----|-----|-----|-------|
| ENABLE | [] | [] | - | VIMOT |
| CFG1 | [] | [] | - | GND |
| CFG2 | [] | [] | - | M2B |
| CFG3 | [] | [] | - | M2A |
| NC | [] | MS1 | MS0 | M1A |
| NC | [] | [] | [] | M1B |
| STEP | [] | [] | [] | VIO |
| DIR | [] | [] | [] | GND |

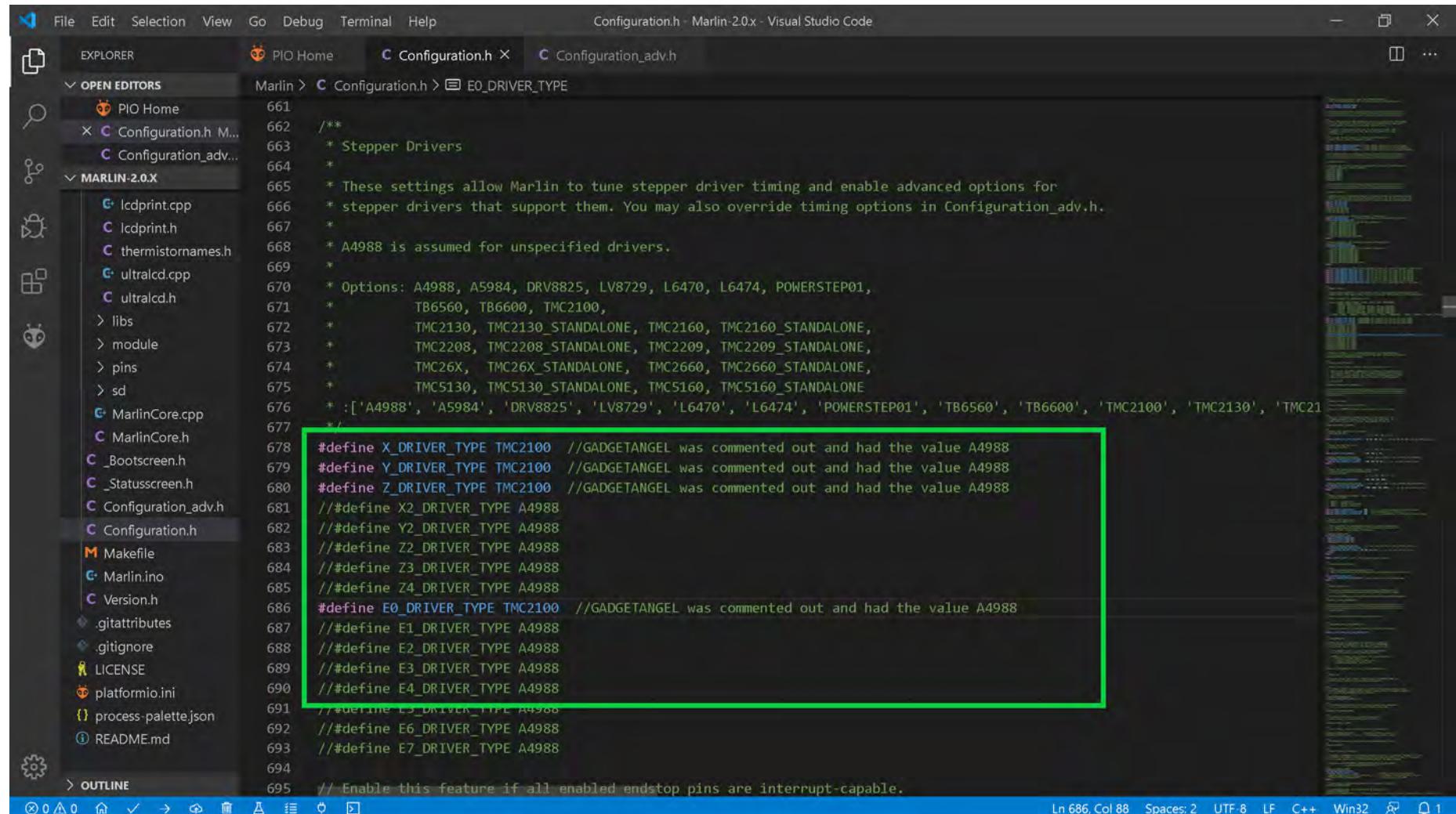


The (latest release of) Marlin Setup for MKS TMC2100 Drivers in Stand-alone Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for MKS

TMC2100 stepper motor drivers in stand-alone mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2100 drivers in stand-alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2100 drivers in stand-alone mode. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the following driver type definitions:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2660']
676 */
677 #define X_DRIVER_TYPE TMC2100 //GADGETANGEL was commented out and had the value A4988
678 #define Y_DRIVER_TYPE TMC2100 //GADGETANGEL was commented out and had the value A4988
679 #define Z_DRIVER_TYPE TMC2100 //GADGETANGEL was commented out and had the value A4988
680 //##define X2_DRIVER_TYPE A4988
681 //##define Y2_DRIVER_TYPE A4988
682 //##define Z2_DRIVER_TYPE A4988
683 //##define Z3_DRIVER_TYPE A4988
684 //##define Z4_DRIVER_TYPE A4988
685 //##define E1_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2100 //GADGETANGEL was commented out and had the value A4988
687 //##define E1_DRIVER_TYPE A4988
688 //##define E2_DRIVER_TYPE A4988
689 //##define E3_DRIVER_TYPE A4988
690 //##define E4_DRIVER_TYPE A4988
691 //##define E5_DRIVER_TYPE A4988
692 //##define E6_DRIVER_TYPE A4988
693 //##define E7_DRIVER_TYPE A4988
694 // Enable this feature if all enabled endstop pins are interrupt-capable.
695

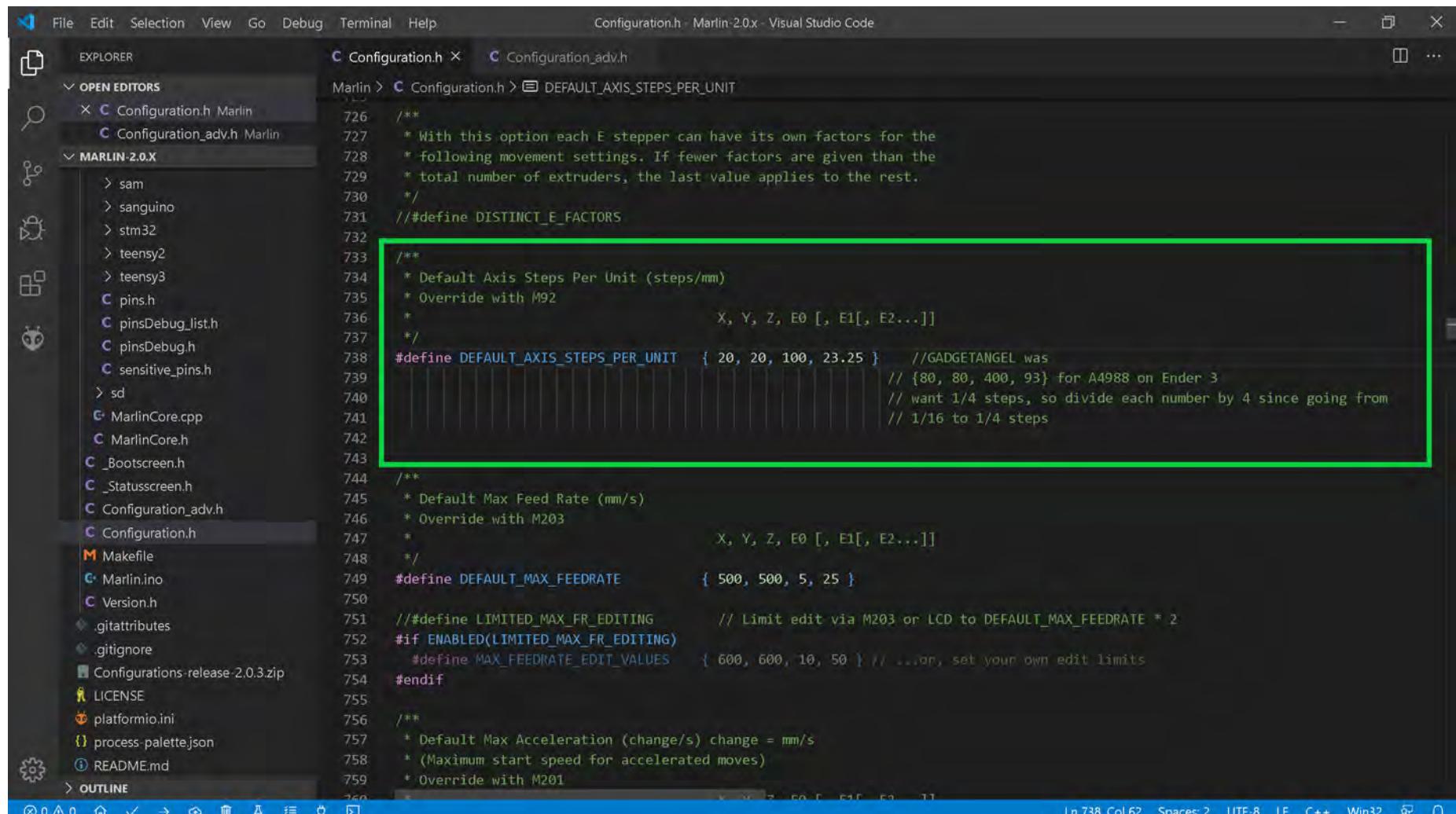
```

A green rectangular box highlights the driver type definitions for X, Y, Z, and E0 axes, specifically the lines starting with '#define' and containing 'TMC2100' or 'A4988'. The status bar at the bottom right shows 'Ln 686, Col 88' and other file details.

- Go to the next page.

The (latest release of) Marlin Setup for MKS TMC2100 Drivers in Stand-alone Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to MKS TMC2100 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as seen in the GREEN box below.



```

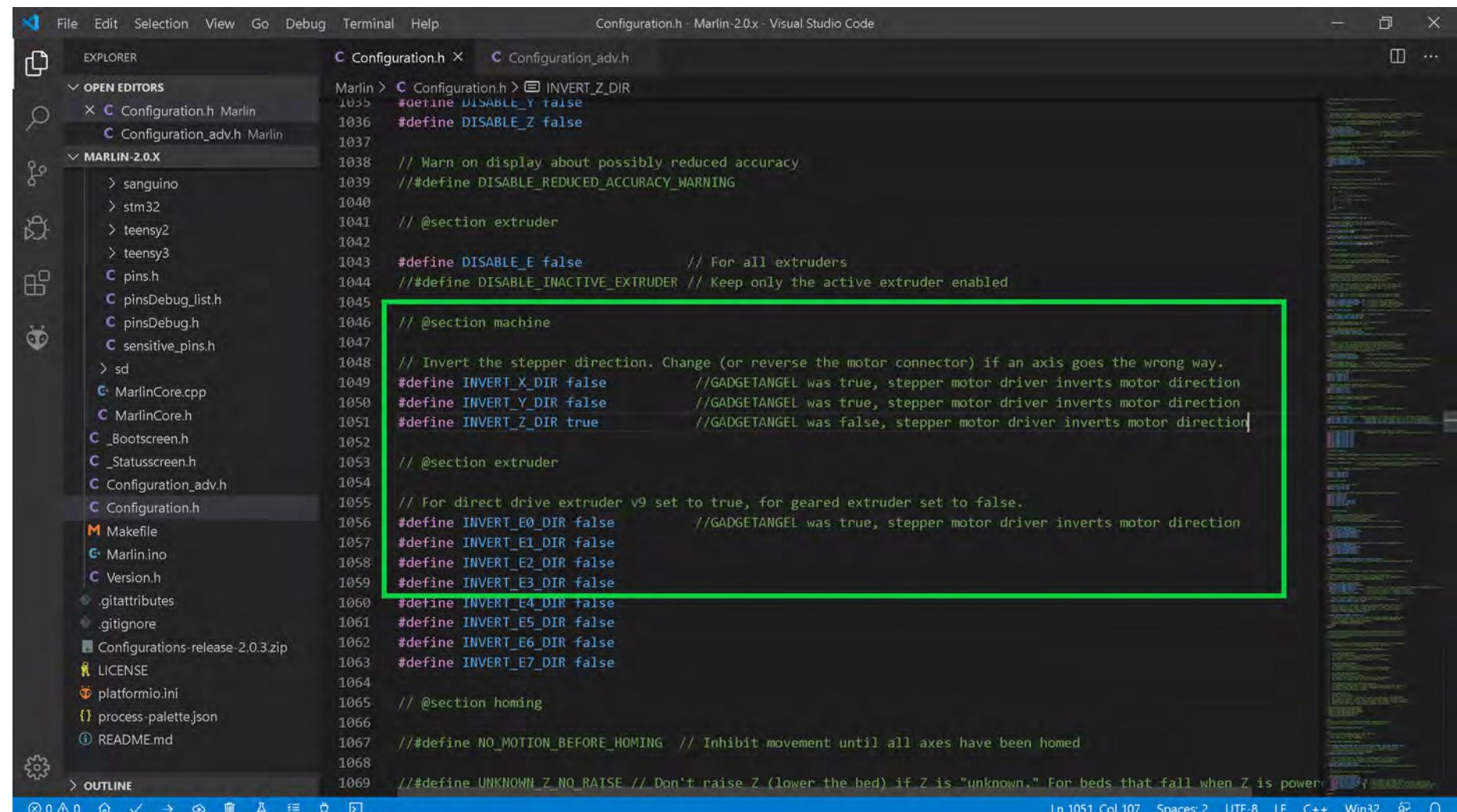
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin 2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin Configuration.h DEFAULT_AXIS_STEPS_PER_UNIT
sam
sanguino
stm32
teensy2
teensy3
pins.h
pinsDebug_list.h
pinsDebug.h
sensitive_pins.h
sd
MarlinCore.cpp
MarlinCore.h
_Bootscreen.h
_Statusscreen.h
Configuration_adv.h
Configuration.h
Makefile
Marlin.ino
Version.h
.gitattributes
.gitignore
Configurations-release-2.0.3.zip
LICENSE
platformio.ini
process-palette.json
README.md
OUTLINE
Ln 738, Col 62 Spaces: 2 UTF-8 LF C++ Win32
    726 /**
    727 * With this option each E stepper can have its own factors for the
    728 * following movement settings. If fewer factors are given than the
    729 * total number of extruders, the last value applies to the rest.
    730 */
    731 //#define DISTINCT_E_FACTORS
    732 /**
    733 * Default Axis Steps Per Unit (steps/mm)
    734 * Override with M92
    735 *
    736 X, Y, Z, E0 [, E1[, E2...]]
    737 */
    738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 } //GADGETANGEL was
    739 // {80, 80, 400, 93} for A4988 on Ender 3
    740 // want 1/4 steps, so divide each number by 4 since going from
    741 // 1/16 to 1/4 steps
    742 /**
    743 * Default Max Feed Rate (mm/s)
    744 * Override with M203
    745 *
    746 X, Y, Z, E0 [, E1[, E2...]]
    747 */
    748 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }
    749 /**
    750 * Define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
    751 */
    752 #if ENABLED(LIMITED_MAX_FR_EDITING)
    753 #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ...or, set your own edit limits
    754#endif
    755 /**
    756 * Default Max Acceleration (change/s) change = mm/s
    757 * (Maximum start speed for accelerated moves)
    758 */
    759 * Override with M201
    760 */

```

- Go to the next page.

The (latest release of) Marlin Setup for MKS TMC2100 Drivers in Stand-alone Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2100 drivers, I must invert the stepper motor direction because the TMC2100 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2100 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as show in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following snippet of C++ code:

```

Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

A green rectangular box highlights the line `#define INVERT_Z_DIR true`, indicating that the setting for the Z-axis stepper motor direction has been changed from its original value.

- Go to the next page.

The (latest release of) Marlin Setup for MKS TMC2100 Drivers in Stand-alone Mode

- The end of Marlin setup for MKS TMC2100 drivers in stand-alone mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x - Visual Studio Code

EXPLORER

OPEN EDITORS

MARLIN-2.0.X

pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h

Marlin > Configuration.h > X_DRIVER_TYPE

```
658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.  
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.  
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.  
661  
662 /*  
663 * Stepper Drivers  
664 *  
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for  
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.  
667 *  
668 * A4988 is assumed for unspecified drivers.  
669 *  
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, PONERSTEP01,  
671 * TB6560, TB6600, TMC2100,  
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,  
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,  
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,  
675 * TMC2660_STANDALONE, TMC2660_STANDALONE, TMC2660_STANDALONE, TMC2660_STANDALONE
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

1: Task - Build

| TMC2209_STANDALONE | IGNORED | |
|------------------------|---------|--------------|
| BIGTREE_SKR_PRO | SUCCESS | 00:02:31.294 |
| TMC2660_STANDALONE | IGNORED | |
| BIGTREE_BTT002 | IGNORED | |
| teensy31 | IGNORED | |
| teensy35 | IGNORED | |
| esp32 | IGNORED | |
| linux_native | IGNORED | |
| SAMD51_grandcentral_m4 | IGNORED | |
| rumba32_f446ve | IGNORED | |
| mks_rumba32 | IGNORED | |
| include_tree | IGNORED | |

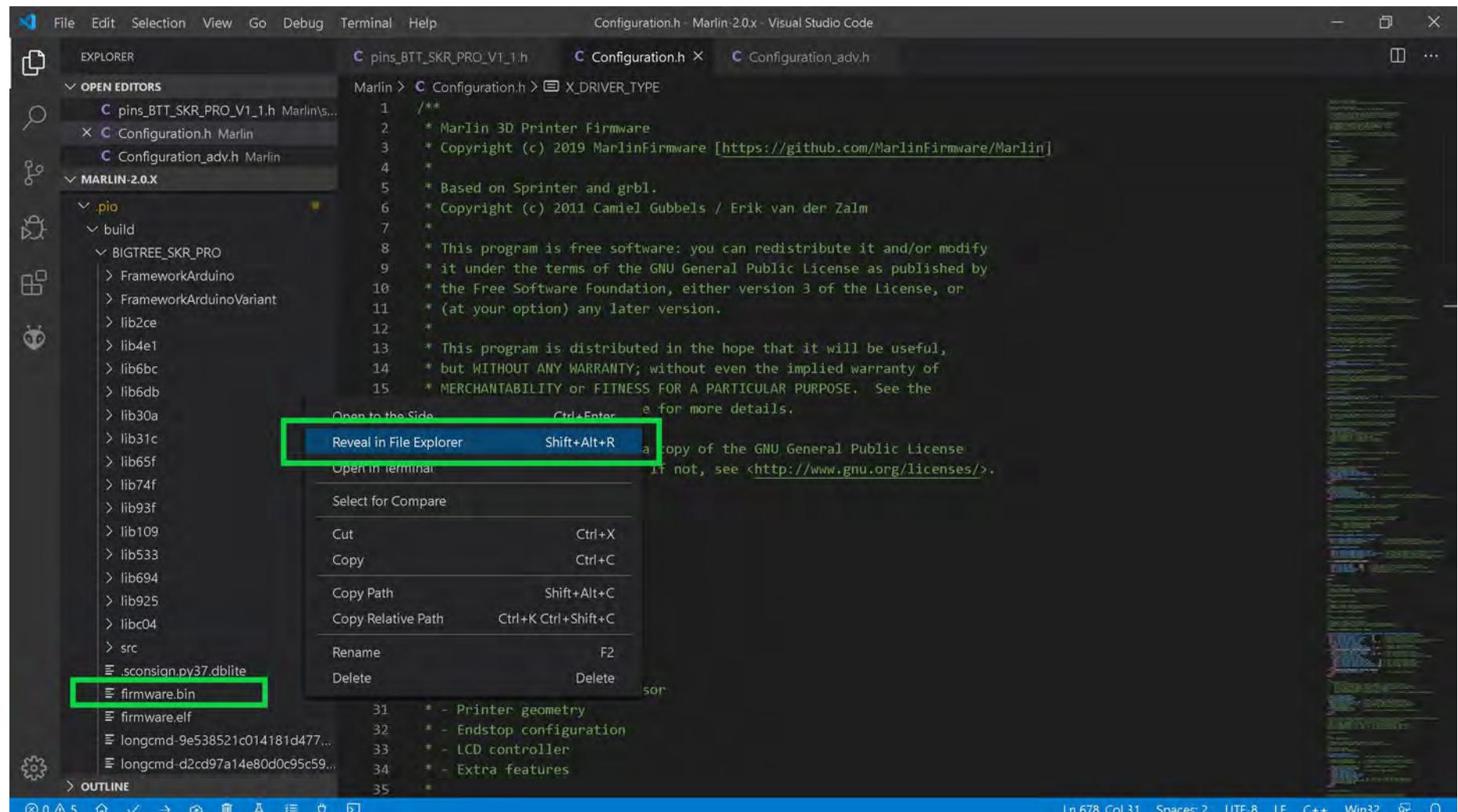
===== 1 succeeded in 00:02:31.294 =====

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for MKS TMC2100 Drivers in Stand-alone Mode

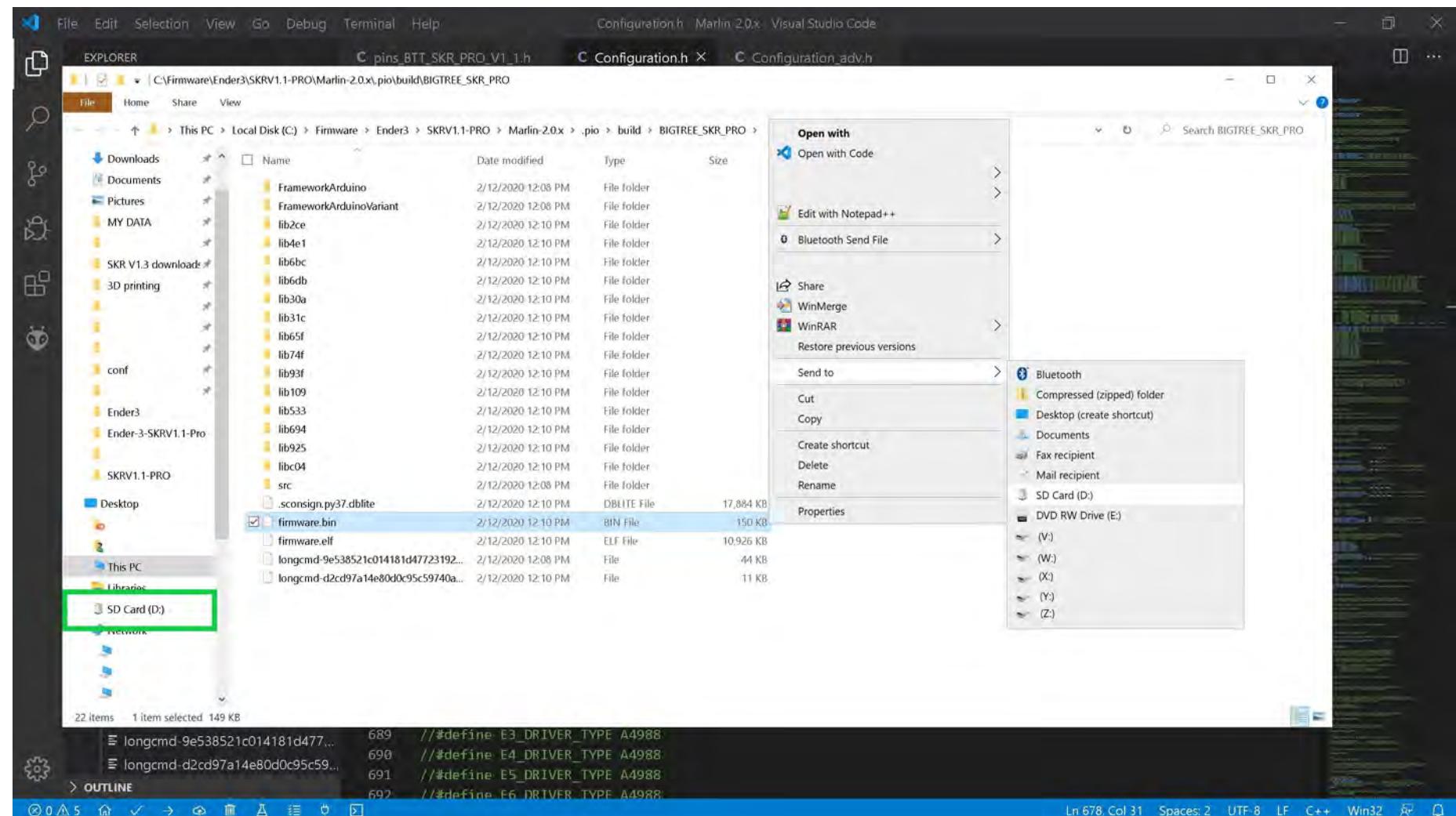
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



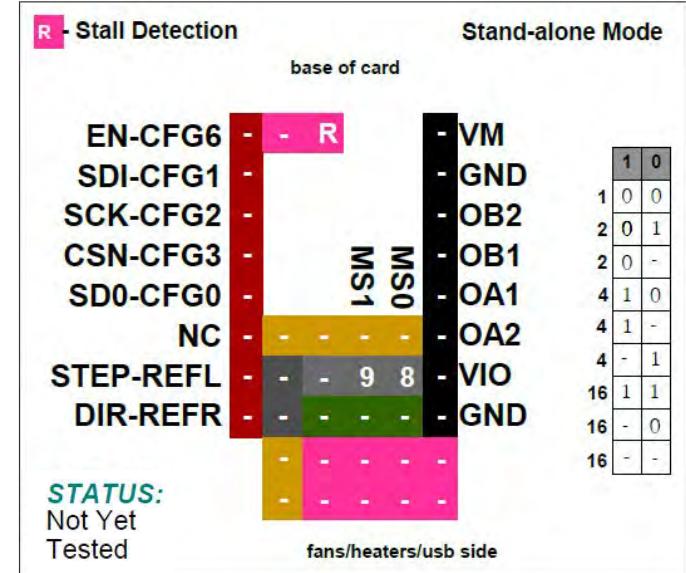
- Go to the next page.

The (latest release of) Marlin Setup for MKS TMC2100 Drivers in Stand-alone Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".

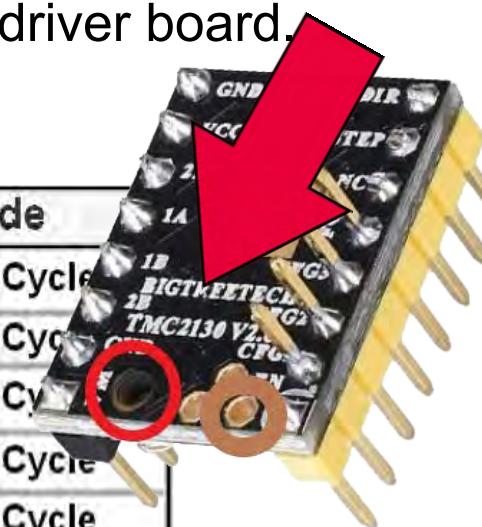


- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

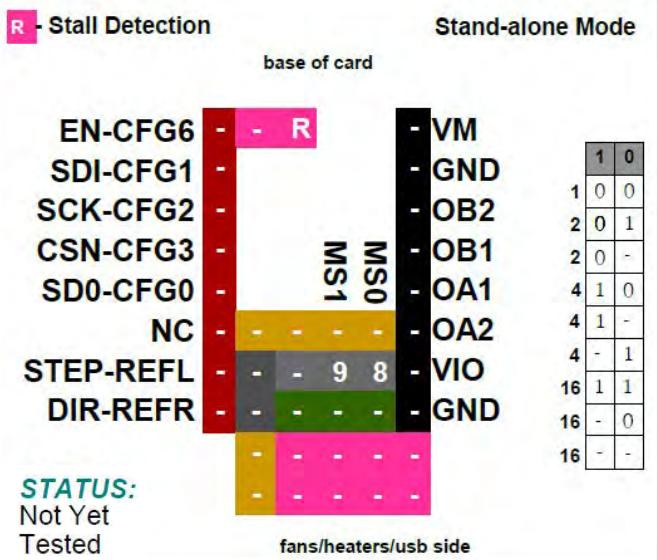
**BIQU TMC2130**Stand-alone Mode

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your V_{ref} , as shown in **RED**; or use the " V_{ref} Test point" location on the top of the driver board, as shown in **BROWN**. See **Appendix A** for instructions on how to set the V_{ref} for the stepper driver board.



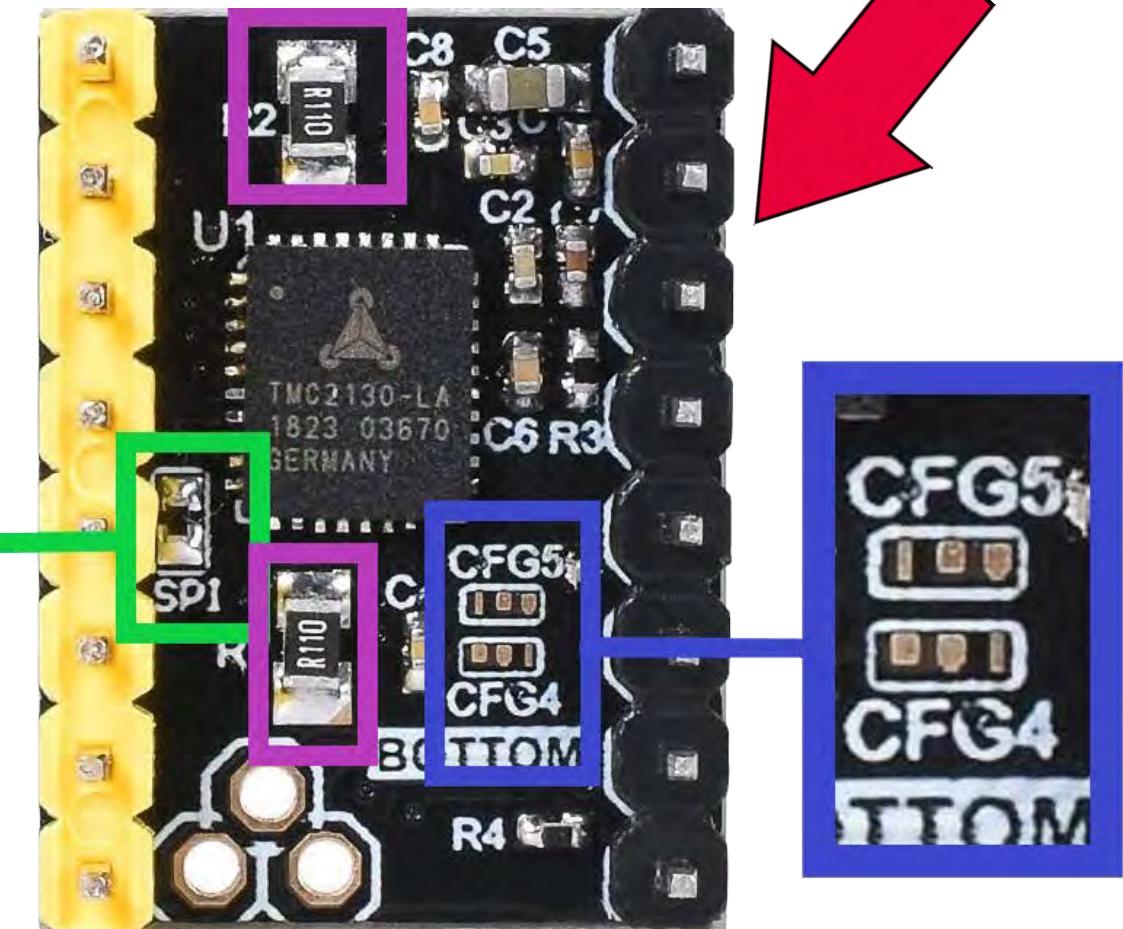
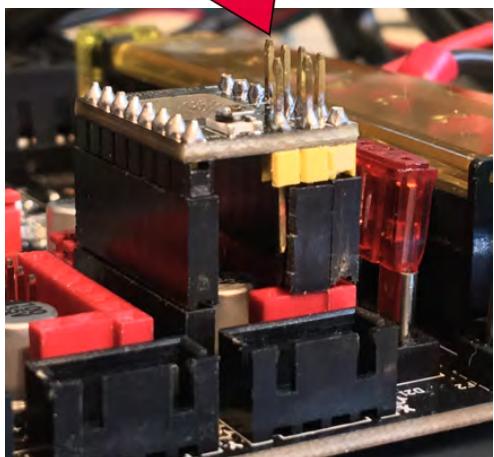
| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|---|---|------|---|---------------|-------------|
| P Biqu® TMC2130 Stand Alone Mode Maximum 16 Subdivision 46V DC 2.5A (peak) | GND | GND | 1 | NONE | spreadCycle |
| | GND | VIO | 1 / 2 | NONE | spreadCycle |
| | GND | OPEN | 1 / 2 | 1 / 256 | spreadCycle |
| | VIO | GND | 1 / 4 | NONE | spreadCycle |
| | VIO | OPEN | 1 / 4 | 1 / 256 | spreadCycle |
| | OPEN | VIO | 1 / 4 | 1 / 256 | stealthChop |
| | VIO | VIO | 1 / 16 | NONE | spreadCycle |
| | OPEN | GND | 1 / 16 | 1 / 256 | spreadCycle |
| | OPEN | OPEN | 1 / 16 | 1 / 256 | stealthChop |
| Driving Current Calculation Formula | $I_{MAX} = V_{ref}$ | | $V_{ref} = I_{MAX}$ | | |
| R_S (Typical Sense Resistor) = 0.11Ω | See Appendix B #2. Use 50% to 90% as shown below: | | See Appendix B #2. Use 50% to 90% as shown below: | | |
| | $I_{MAX} = I_{MAX} * 0.90$ | | $V_{ref} = V_{ref} * 0.90$ | | |

BIQU TMC2130Stand-alone Mode

To place the BIQU TMC2130 into Stand-alone mode:

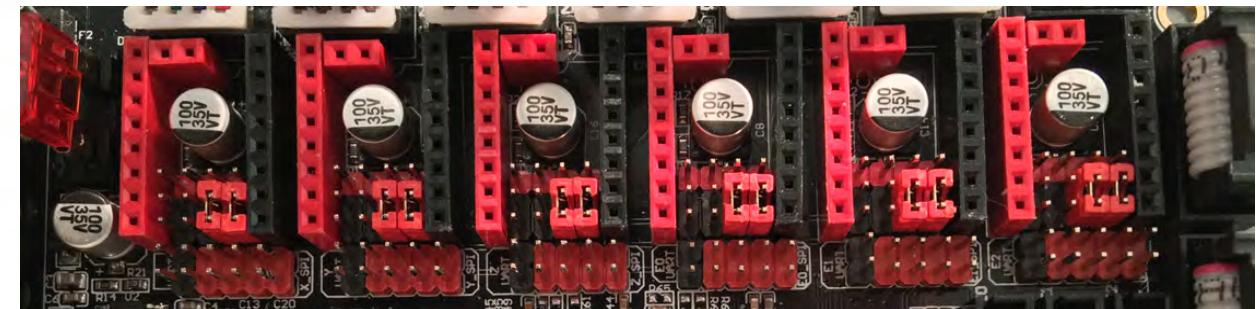
Solder the SPI Jumper together, on the bottom of the driver board to the adjacent pad, as shown in the **GREEN** box below. Ensure at CFG4 location and CFG5 location that those pads are NOT soldered together to form a bridge, as shown in **BLUE**. The **PURPLE** box shows the location of the current sense resistors (R_s).

Note: When the stall-guard function is **not used**, the stall-guard pin ("R") of the TMC2130 must be removed (desoldered) or use long pin header risers so that the "R" pin does not connect to the SKR PRO V1.1 board.



Stand-alone Mode

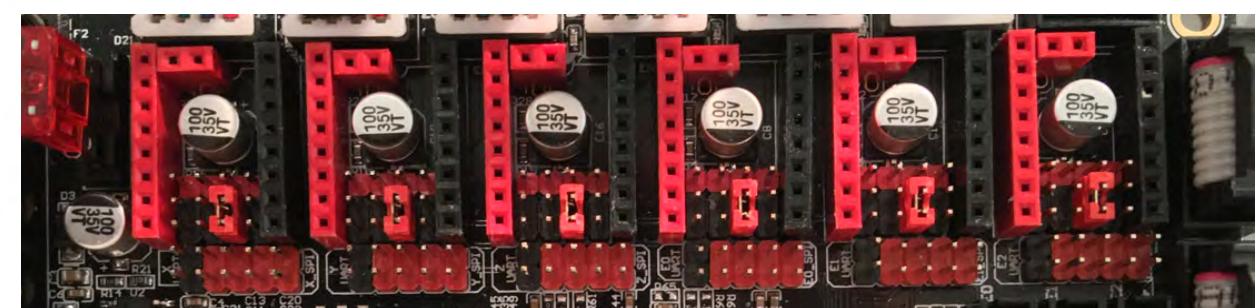
| | | | | | |
|---------------------|-----------|---|-----|-----|-----|
| Stand-alone Mode | EN-CFG6 | - | R | - | VM |
| STEP | SDI-CFG1 | - | - | - | GND |
| | SCK-CFG2 | - | - | - | OB2 |
| | CSN-CFG3 | - | - | - | OB1 |
| Interpolation: none | SD0-CFG0 | - | MS1 | MS0 | OA1 |
| | NC | - | - | - | OA2 |
| SpreadCycle | STEP-REFL | - | 9 | 8 | VIO |
| | DIR-REFR | - | 9 | 8 | GND |



| | | | | | |
|---------------------|-----------|---|-----|-----|-----|
| Stand-alone Mode | EN-CFG6 | - | R | - | VM |
| 1 / 2 | SDI-CFG1 | - | - | - | GND |
| | SCK-CFG2 | - | - | - | OB2 |
| | CSN-CFG3 | - | - | - | OB1 |
| Interpolation: none | SD0-CFG0 | - | MS1 | MS0 | OA1 |
| | NC | - | - | 8 | OA2 |
| SpreadCycle | STEP-REFL | - | - | 9 | VIO |
| | DIR-REFR | - | 9 | - | GND |

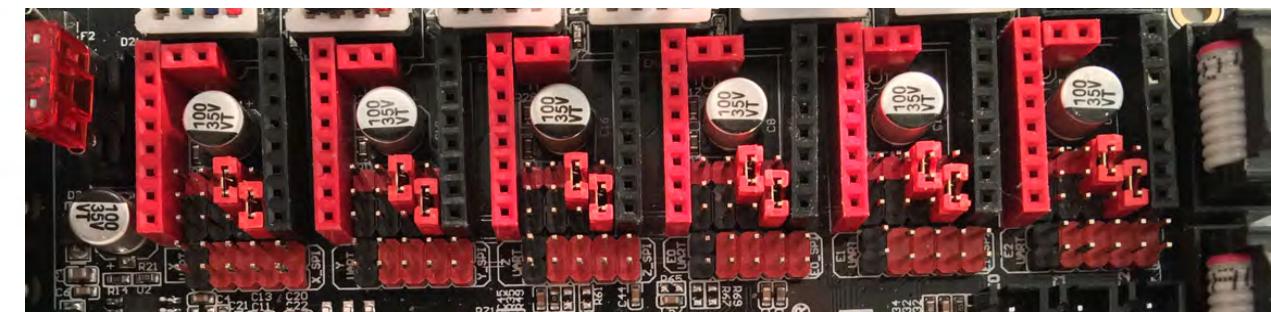


| | | | | | |
|----------------------|-----------|---|-----|-----|-----|
| Stand-alone Mode | EN-CFG6 | - | R | - | VM |
| 1 / 2 | SDI-CFG1 | - | - | - | GND |
| | SCK-CFG2 | - | - | - | OB2 |
| | CSN-CFG3 | - | - | - | OB1 |
| Interpolation: 1/256 | SD0-CFG0 | - | MS1 | MS0 | OA1 |
| | NC | - | - | - | OA2 |
| SpreadCycle | STEP-REFL | - | - | 9 | VIO |
| | DIR-REFR | - | 9 | - | GND |

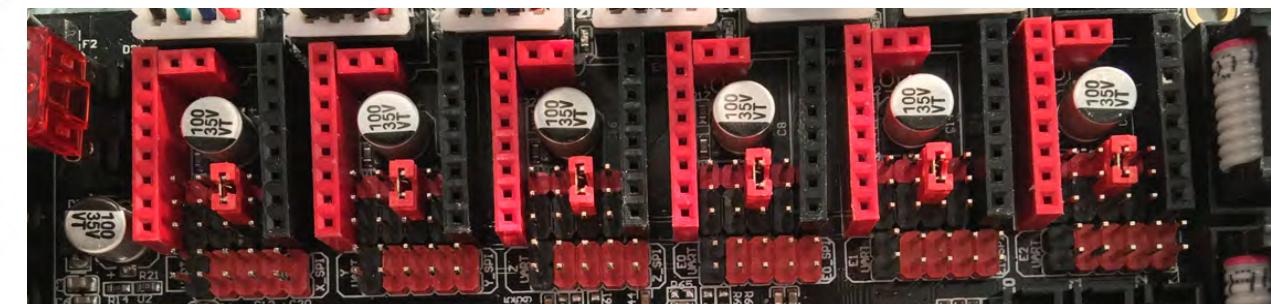


Stand-alone Mode

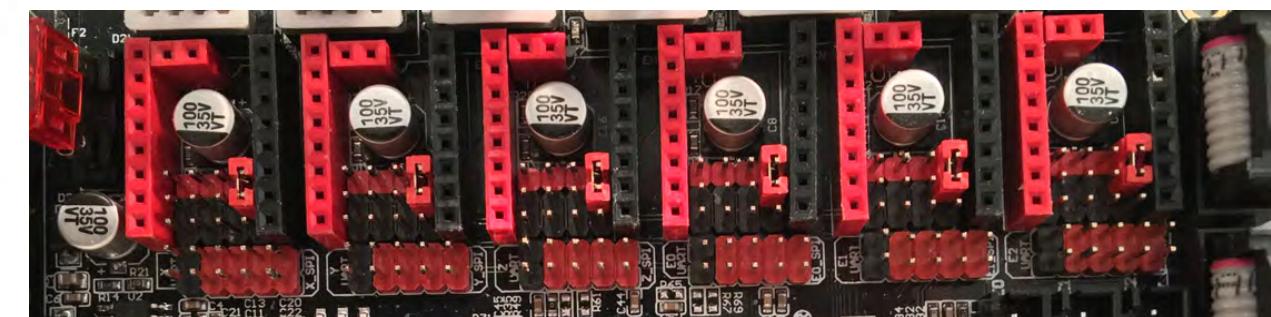
| | | | |
|----------------------------|-----------|------------|-----|
| Stand-alone Mode | EN-CFG6 | R | VM |
| | SDI-CFG1 | - | GND |
| | SCK-CFG2 | - | OB2 |
| | CSN-CFG3 | - | OB1 |
| Interpolation: none | SD0-CFG0 | MS1 MS0 | OA1 |
| | NC | 9 | OA2 |
| SpreadCycle | STEP-REFL | 9 8 | VIO |
| | DIR-REFR | 8 | GND |



| | | | |
|-----------------------------|-----------|------------|-----|
| Stand-alone Mode | EN-CFG6 | R | VM |
| | SDI-CFG1 | - | GND |
| | SCK-CFG2 | - | OB2 |
| | CSN-CFG3 | - | OB1 |
| Interpolation: 1/256 | SD0-CFG0 | MS1 MS0 | OA1 |
| | NC | 9 | OA2 |
| SpreadCycle | STEP-REFL | 9 | VIO |
| | DIR-REFR | - | GND |

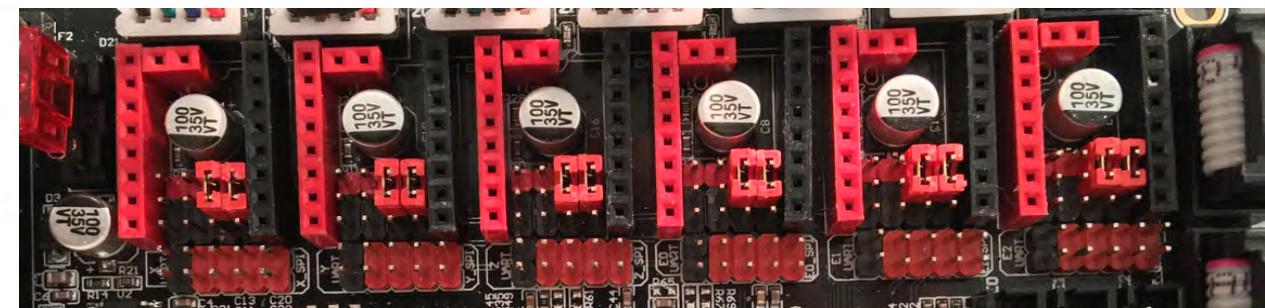


| | | | |
|-----------------------------|-----------|------------|-----|
| Stand-alone Mode | EN-CFG6 | R | VM |
| | SDI-CFG1 | - | GND |
| | SCK-CFG2 | - | OB2 |
| | CSN-CFG3 | - | OB1 |
| Interpolation: 1/256 | SD0-CFG0 | MS1 MS0 | OA1 |
| | NC | - - 8 | OA2 |
| StealthChop | STEP-REFL | - - 8 | VIO |
| | DIR-REFR | - - - | GND |



Stand-alone Mode

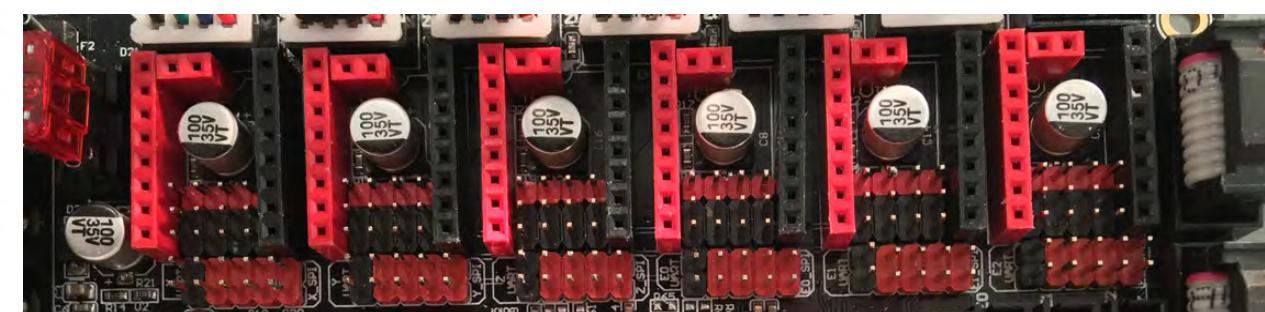
| | | | |
|---------------------|-----------|-------|-------|
| Stand-alone Mode | EN-CFG6 | - R | - VM |
| | SDI-CFG1 | - | - GND |
| | SCK-CFG2 | - | - OB2 |
| | CSN-CFG3 | - | - OB1 |
| Interpolation: none | SD0-CFG0 | - MS1 | - OA1 |
| | NC | - MS0 | - OA2 |
| SpreadCycle | STEP-REFL | - 9 8 | - VIO |
| | DIR-REFR | - 9 8 | - GND |
| | | - - - | - - - |



| | | | |
|----------------------|-----------|-------|-------|
| Stand-alone Mode | EN-CFG6 | - R | - VM |
| | SDI-CFG1 | - | - GND |
| | SCK-CFG2 | - | - OB2 |
| | CSN-CFG3 | - | - OB1 |
| Interpolation: 1/256 | SD0-CFG0 | - MS1 | - OA1 |
| | NC | - MS0 | - OA2 |
| SpreadCycle | STEP-REFL | - - - | - VIO |
| | DIR-REFR | - - - | - GND |
| | | - - - | - - - |



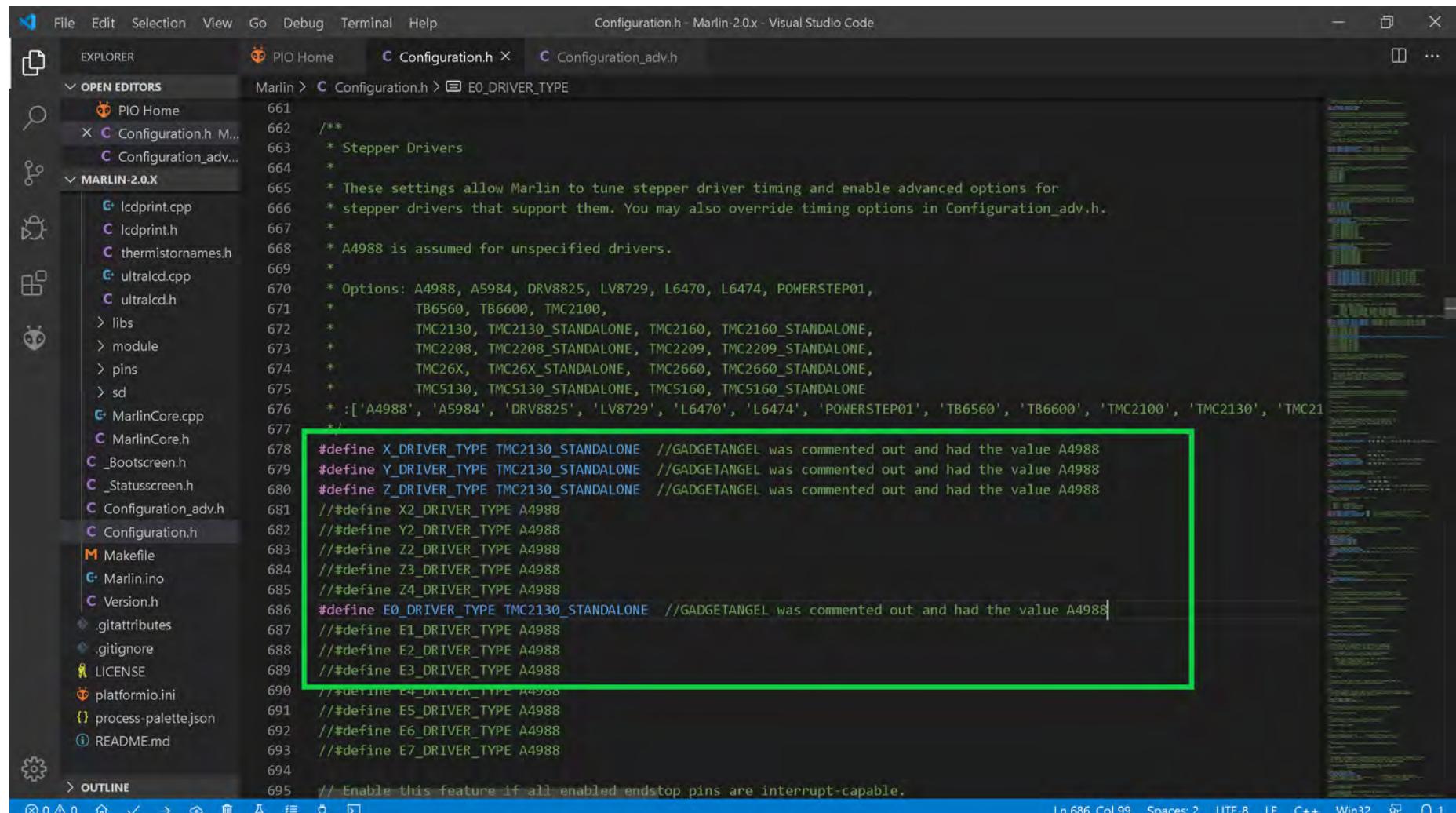
| | | | |
|----------------------|-----------|-------|-------|
| Stand-alone Mode | EN-CFG6 | - R | - VM |
| | SDI-CFG1 | - | - GND |
| | SCK-CFG2 | - | - OB2 |
| | CSN-CFG3 | - | - OB1 |
| Interpolation: 1/256 | SD0-CFG0 | - MS1 | - OA1 |
| | NC | - MS0 | - OA2 |
| StealthChop | STEP-REFL | - - - | - VIO |
| | DIR-REFR | - - - | - GND |
| | | - - - | - - - |



The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in Stand-alone Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2130 stepper motor drivers in stand-alone mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2130 drivers in stand-alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2130 drivers in stand-alone mode. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following configuration for stepper drivers:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130']
676 */
677
678 #define X_DRIVER_TYPE TMC2130_STANDALONE //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE TMC2130_STANDALONE //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE TMC2130_STANDALONE //GADGETANGEL was commented out and had the value A4988
681 //##define X2_DRIVER_TYPE A4988
682 //##define Y2_DRIVER_TYPE A4988
683 //##define Z2_DRIVER_TYPE A4988
684 //##define Z3_DRIVER_TYPE A4988
685 //##define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2130_STANDALONE //GADGETANGEL was commented out and had the value A4988
687 //##define E1_DRIVER_TYPE A4988
688 //##define E2_DRIVER_TYPE A4988
689 //##define E3_DRIVER_TYPE A4988
690 //##define E4_DRIVER_TYPE A4988
691 //##define E5_DRIVER_TYPE A4988
692 //##define E6_DRIVER_TYPE A4988
693 //##define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

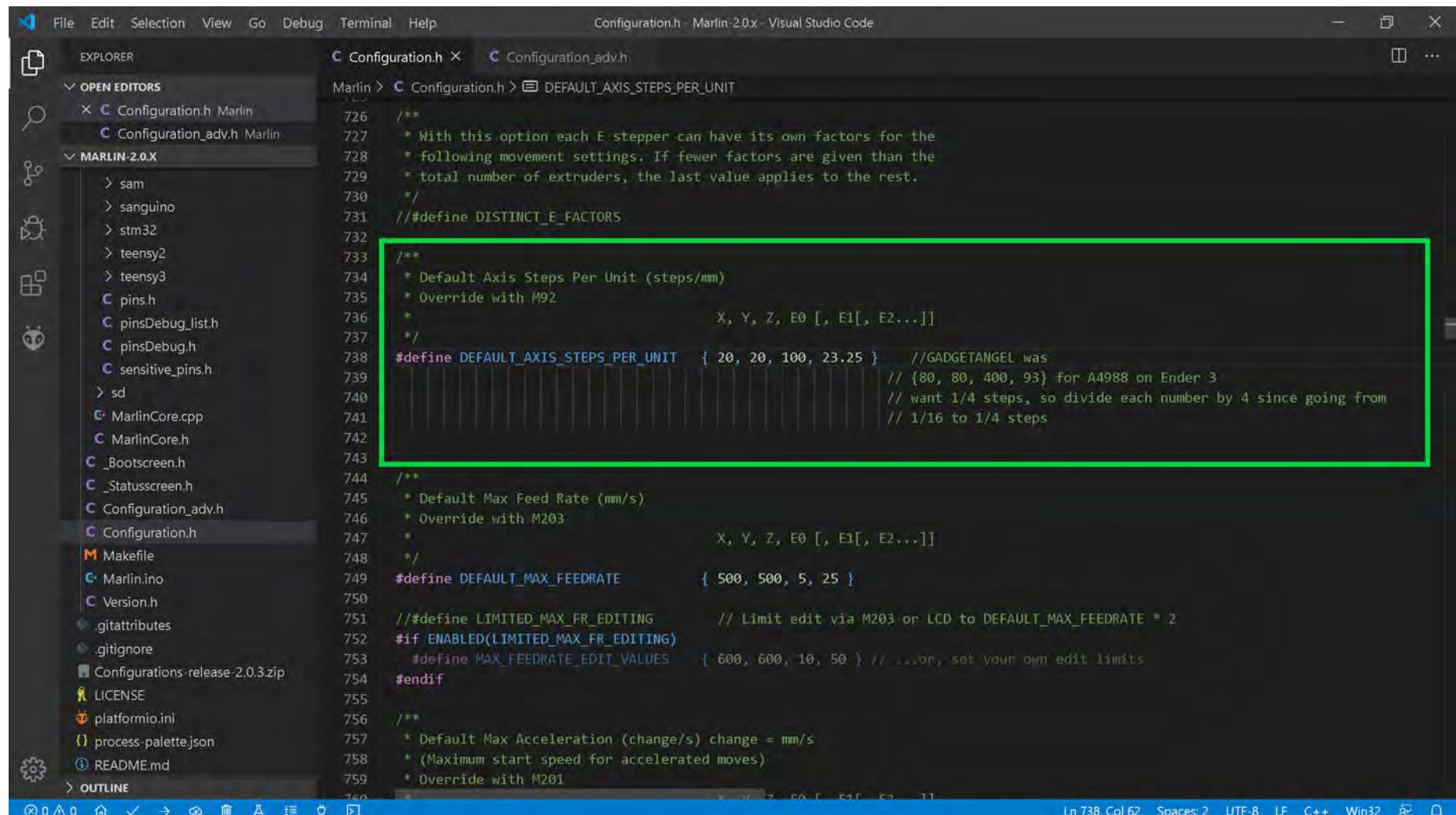
```

A green rectangular box highlights the driver configuration section starting from line 678. The lines define driver types for X, Y, Z, and E0 axes, each preceded by a double slash (//) indicating they were previously commented out. The code editor status bar at the bottom right shows "Ln 686, Col 99" and other standard developer tools information.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in Stand-alone Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to BIQU TMC2130 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as seen in the GREEN box below.



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the Marlin configuration files. A green rectangular box highlights the following code snippet in the `Configuration.h` file:

```

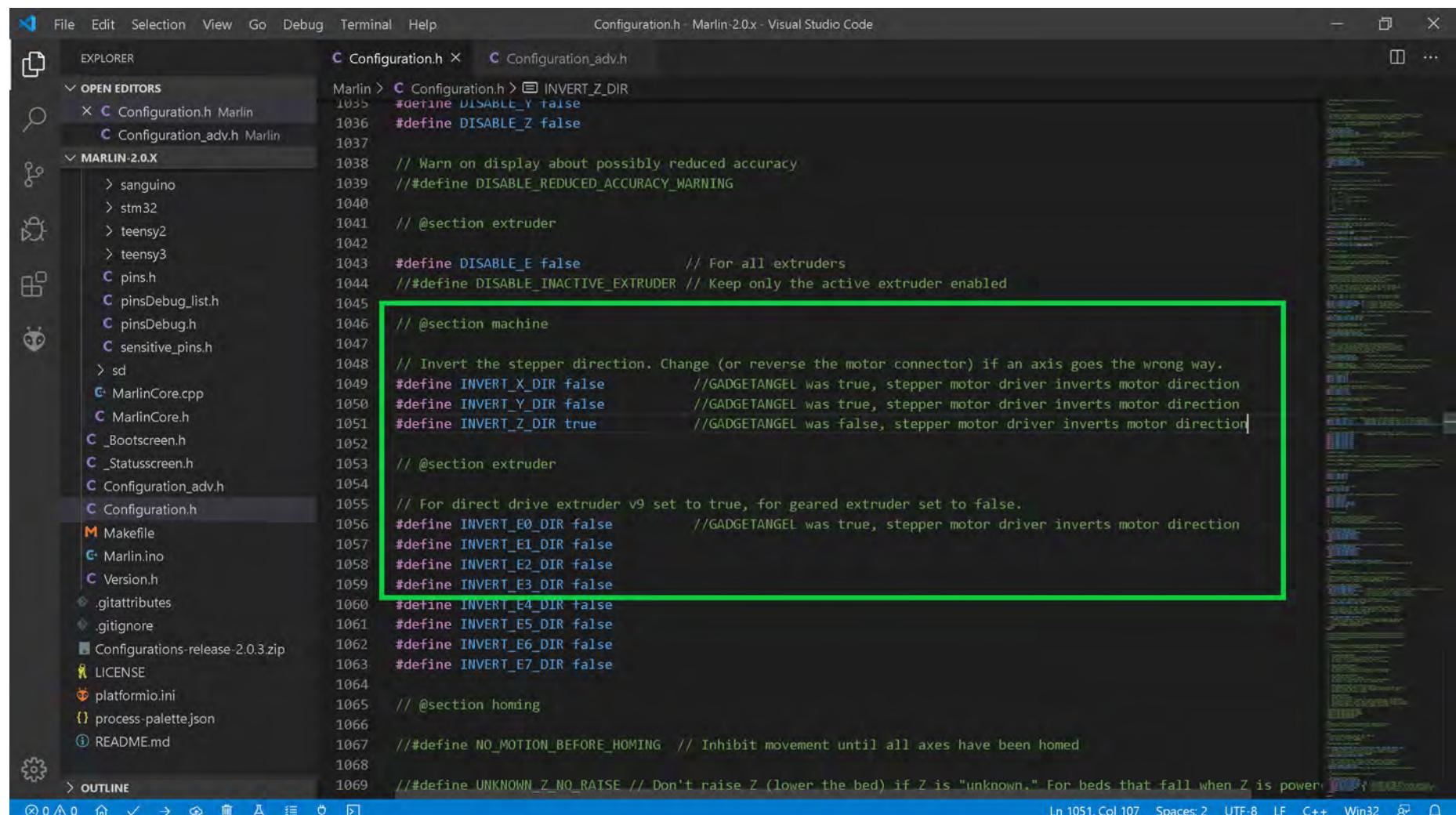
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 *
737 X, Y, Z, E0 [, E1[, E2...]]
738
739 #define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 } // GADGETANGEL was
740 // {80, 80, 400, 93} for A4988 on Ender 3
741 // want 1/4 steps, so divide each number by 4 since going from
742 // 1/16 to 1/4 steps
743
744 /**
745 * Default Max Feed Rate (mm/s)
746 * Override with M203
747 *
748 X, Y, Z, E0 [, E1[, E2...]]
749 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }
750
751 // #define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
752 #if ENABLED(LIMITED_MAX_FR_EDITING)
753 #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ...or, set your own edit limits
754 #endif
755
756 /**
757 * Default Max Acceleration (change/s) change = mm/s
758 * (Maximum start speed for accelerated moves)
759 * Override with M201

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in Stand-alone Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2130 drivers, I must invert the stepper motor direction because the TMC2130 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2130 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as show in the **GREEN** box below



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > INVERT_Z_DIR
  Configuration.h Marlin
  Configuration_adv.h Marlin
MARLIN-2.0.X
  sanguino
  stm32
  teensy2
  teensy3
  pins.h
  pinsDebug_list.h
  pinsDebug.h
  sensitive_pins.h
  sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  Configurations-release-2.0.3.zip
  LICENSE
  platformio.ini
  process-palettejson
  README.md
  OUTLINE
  1035 #define DISABLE_Y false
  1036 #define DISABLE_Z false
  1037
  // Warn on display about possibly reduced accuracy
  1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
  1040
  // @section extruder
  1041
  1042
  1043 #define DISABLE_E false          // For all extruders
  1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
  1045
  1046
  // @section machine
  1047
  // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
  1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
  1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
  1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
  1052
  // @section extruder
  1053
  // For direct drive extruder v9 set to true, for geared extruder set to false.
  1055 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
  1056 #define INVERT_E1_DIR false
  1057 #define INVERT_E2_DIR false
  1058 #define INVERT_E3_DIR false
  1059 #define INVERT_E4_DIR false
  1060 #define INVERT_E5_DIR false
  1061 #define INVERT_E6_DIR false
  1062 #define INVERT_E7_DIR false
  1063
  // @section homing
  1065 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
  1066
  1067 // #define UNKNOWN_Z_NO_RATSE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered
  1068
  1069
  
```

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in Stand-alone Mode

- The end of Marlin setup for BIQU TMC2130 drivers in stand-alone mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

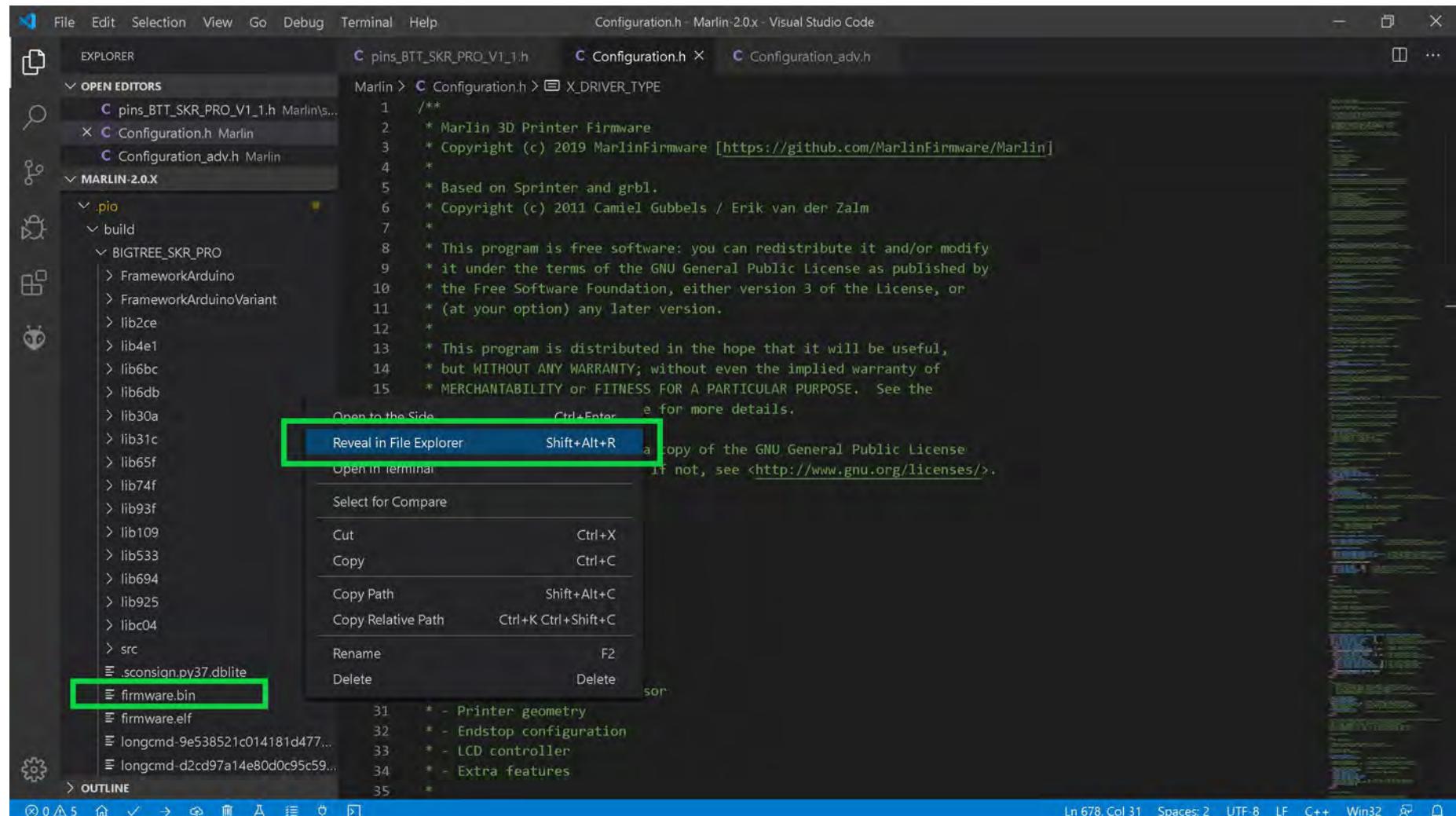
The screenshot shows the Visual Studio Code interface with the following details:

- File Menu:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Title Bar:** Configuration.h - Marlin 2.0.x - Visual Studio Code
- Left Sidebar (EXPLORER):** Shows the project structure under MARLIN-2.0.X, including pins_BTT_SKR_PRO_V1_1.h, Configuration.h, Configuration_adv.h, pins_THE_BORG.h, pins_VAKE403D.h, teensy2, teensy3, pins.h, pinsDebug_list.h, pinsDebug.h, sensitive_pins.h, sd, MarlinCore.cpp, MarlinCore.h, Bootscreen.h, Statusscreen.h, Configuration_adv.h, Configuration.h, Makefile, Marlin.ino, Version.h, .gitattributes, .gitignore, LICENSE, platformio.ini, process-palette.json, and README.md.
- Central Area:** The main editor window displays the Configuration.h file with code related to endstop and probe logic inversion. The code includes defines for Y_MAX_ENDSTOP_INVERTING, Z_MAX_ENDSTOP_INVERTING, and Z_MIN_PROBE_ENDSTOP_INVERTING, all set to false.
- Bottom Navigation:** PROBLEMS, OUTPUT, DEBUG CONSOLE, TERMINAL. The TERMINAL tab is active, showing the build output for tasks like BIGTREETECH_SKR_V1_1, BIGTREETECH_SKR_V1_2, BIGTREETECH_BTT002, teensy31, teensy35, esp32, linux_native, SAMD51_grandcentral_m4, rumba32_f446ve, mks_rumba32, and include_tree. The output indicates a success message: "1 succeeded in 00:02:31.294".
- Bottom Status Bar:** Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in Stand-alone Mode

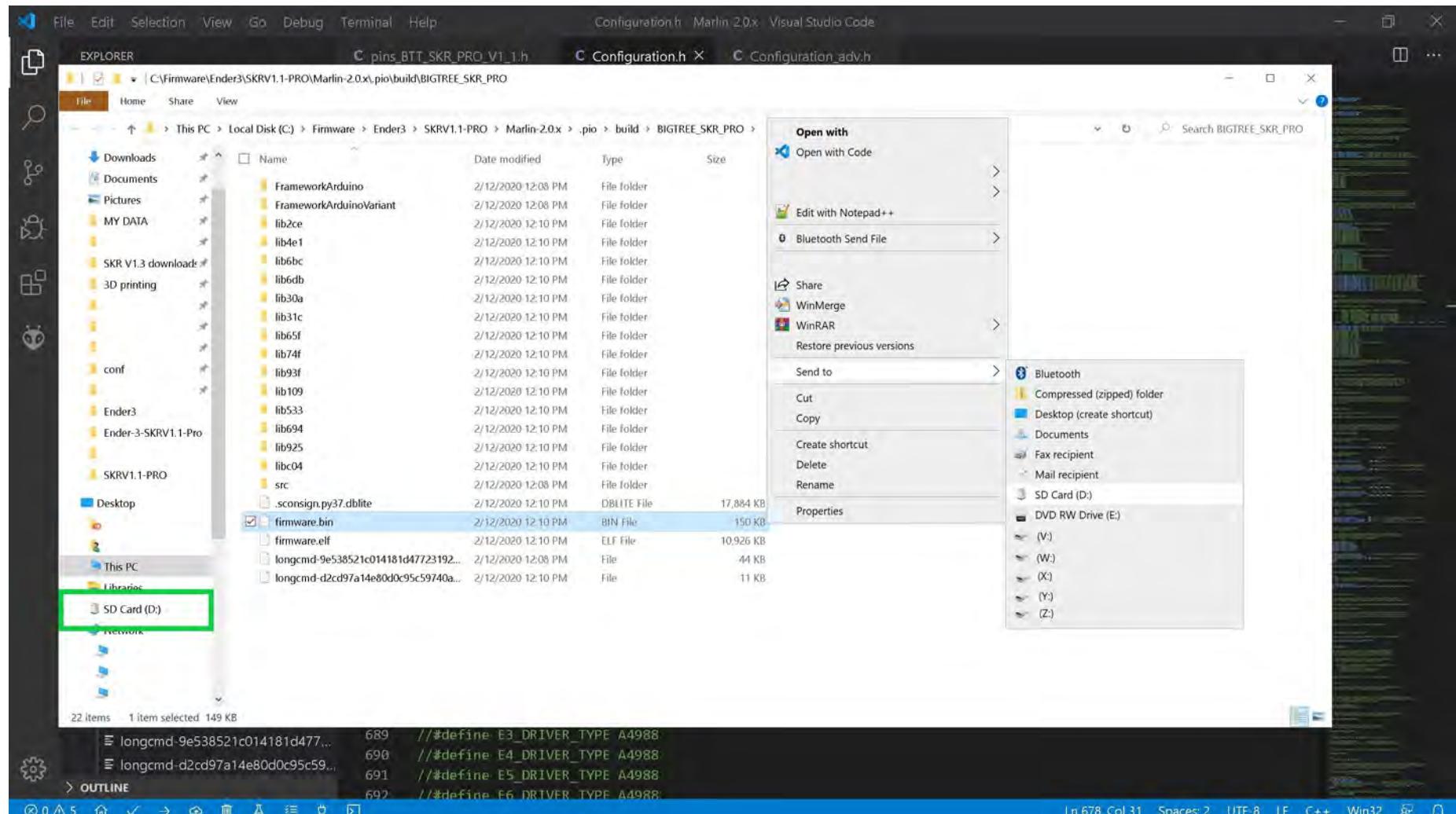
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer window.



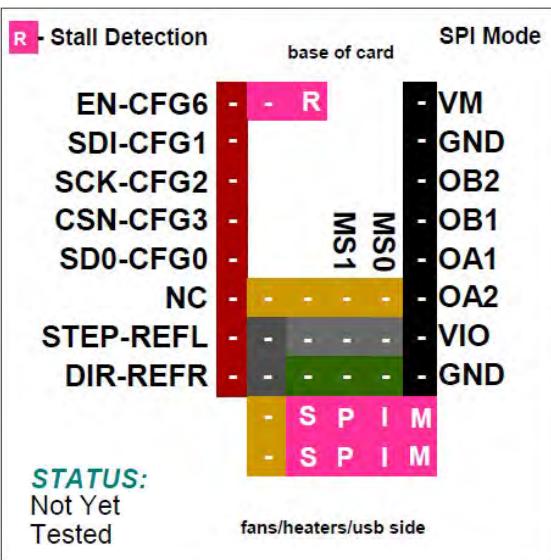
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in Stand-alone Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

**BIQU TMC2130**SPI Mode

Note: You can use 50% to 90% of the calculated I_{RMS} ($I_{MAX}/1.414$) when tuning ("X_CURRENT", "Y_CURRENT", etc.) the stepper motor driver in the firmware.

See the next page for further information.

| | |
|---|---|
| <p>Driver Chip</p> <p>B<small>BIQU</small>[®]</p> <p>TMC2130</p> <p>SPI Mode</p> <p>Maximum 256 Subdivision</p> <p>46V DC 2.5A (peak)</p> | <p>Steps are set inside of your Firmware</p> |
| <p>Driving Current Calculation Formula</p> <p>R_S(Typical Sense Resistor)= 0.11Ω</p> | <p>$I_{MAX}=V_{ref}$</p> <p>See Appendix B #2. Use 50% to 90% as shown below: $I_{MAX}=I_{MAX} * 0.90$</p> <p>$V_{ref}=I_{MAX}$</p> <p>See Appendix B #2. Use 50% to 90% as shown below: $V_{ref}=V_{ref} * 0.90$</p> |

| R - Stall Detection | | base of card | SPI Mode |
|---------------------|---|-----------------------|----------|
| EN-CFG6 | R | | VM |
| SDI-CFG1 | | | GND |
| SCK-CFG2 | | | OB2 |
| CSN-CFG3 | | | OB1 |
| SD0-CFG0 | | MS1 | OA1 |
| NC | | MS0 | OA2 |
| STEP-REFL | | | VIO |
| DIR-REFR | | | GND |
| | | - SPI M | - SPI M |
| STATUS: | | | |
| Not Yet Tested | | fans/heaters/usb side | |

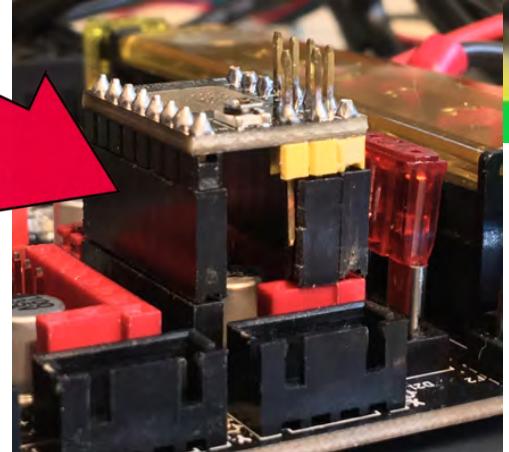
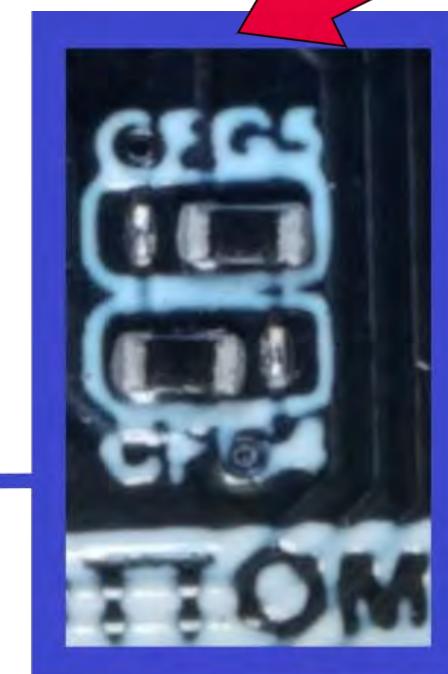
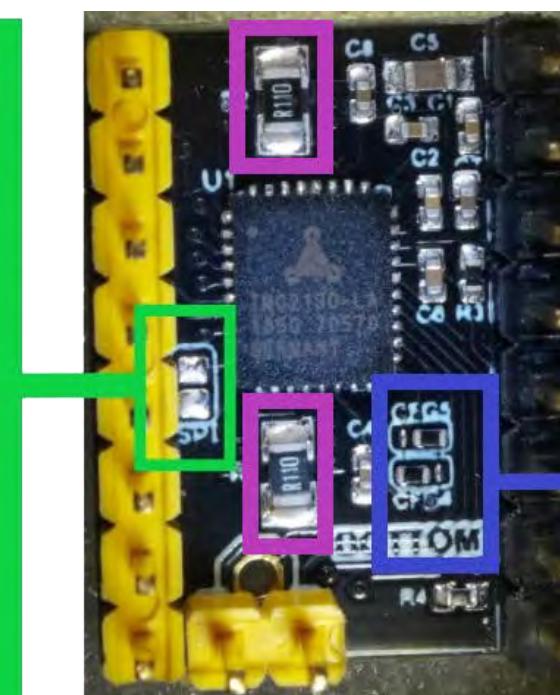
BIQU TMC2130

SPI Mode

To place the BIQU TMC2130 into SPI Mode:

The SPI Jumper must have a gap between the two SPI pads, on the bottom of the driver board, as shown in the **GREEN** box below. Ensure that at CFG4 location and CFG5 location the correct two pads are soldered together to form a bridge, as shown in the **BLUE** box. The **PURPLE** box shows the location of the current sense resistors (R_s). 

Note: When the stall-guard function is **not used**, the stall-guard pin ("R") of the TMC2130 must be removed (desoldered) or use long pin header risers so that the "R" pin does not connect to the SKR PRO V1.1 board. 



NOTICE: pin labels are relative to stepper driver board; double check compatibility before use. Numbered pairs denote required jumpers.

SPI Mode**BIQU TMC2130**SPI Mode

R - Stall Detection

Note: The location of the current sense resistors are shown in **GREEN**. Use the current sense resistors' value in the Marlin Firmware ("X_RSENSE", "Y_RSENSE", "Z_RSENSE" and/or "E0_RSENSE") so that the appropriate current limit can be sent to the driver board. If you do not want to use V_{ref} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT", and/or "E0_CURRENT".

$R_s = R050$ is 0.05 Ohms

$R_s = R062$ is 0.062 Ohms

$R_s = R068$ is 0.068 Ohms

$R_s = R075$ is 0.075 Ohms

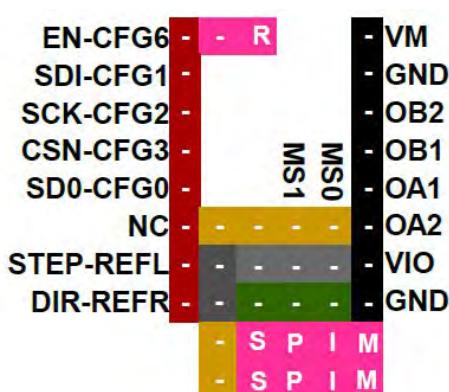
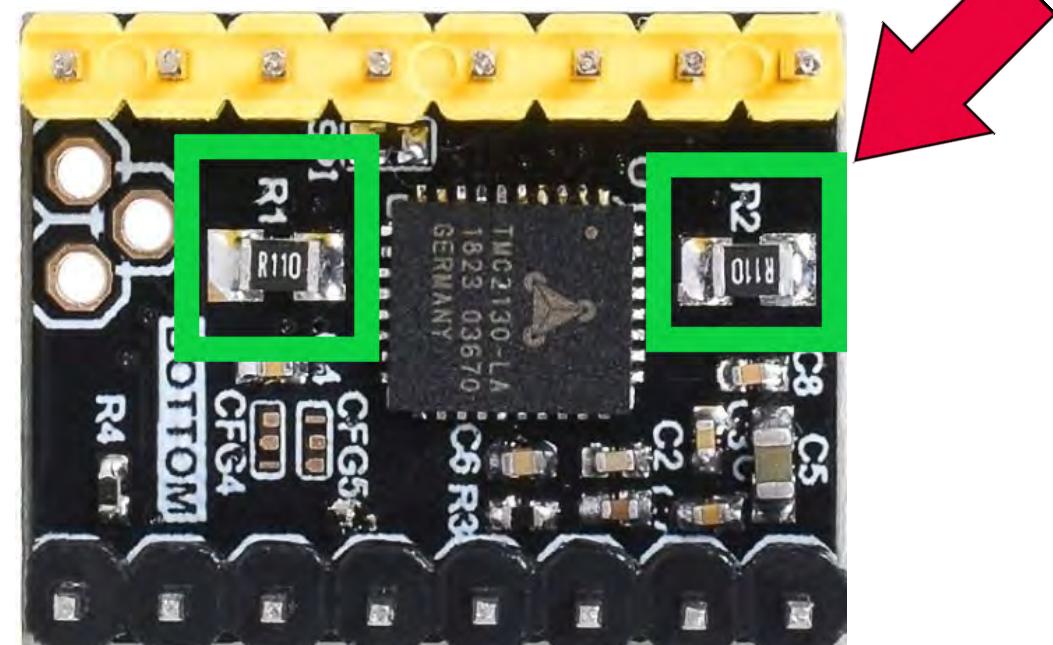
$R_s = R100$ is 0.1 Ohms

$R_s = R110$ is 0.11 Ohms

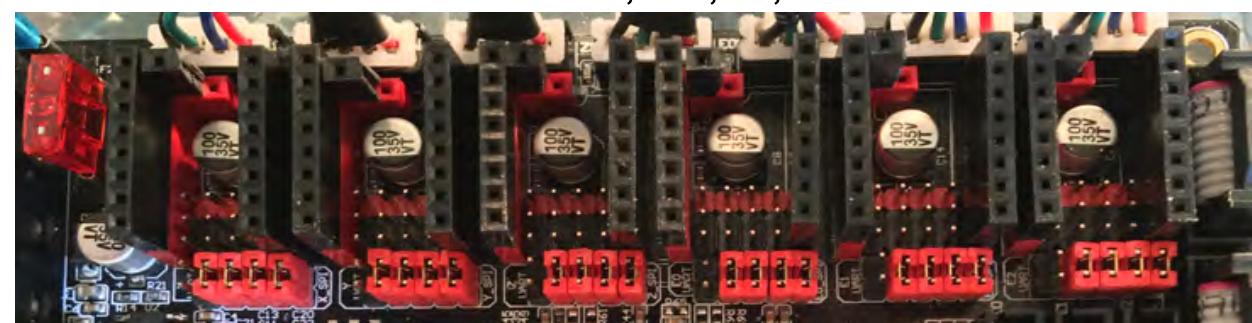
$R_s = R150$ is 0.15 Ohms

$R_s = R200$ is 0.2 Ohms

$R_s = R220$ is 0.22 Ohms

**SPI**

Note: Set JUMPERS "S","P","I","M" on the board!!



The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2130 stepper motor drivers in SPI. mode.

- Change the stepper motor drivers so that Marlin knows you are using BIQU TMC2130 drivers in SPI mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2130 drivers in SPI mode. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

```
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin 2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h

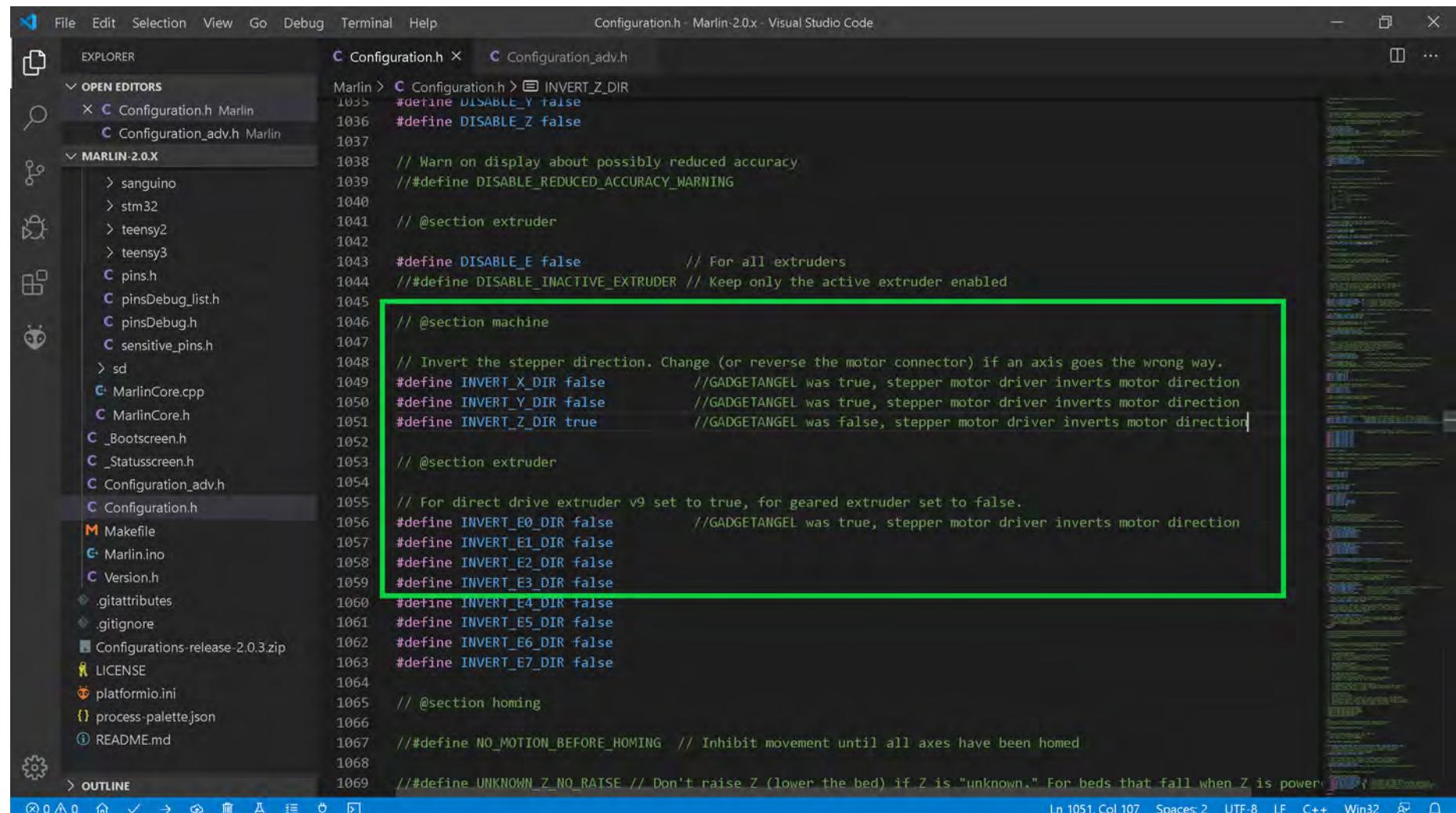
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160',
676 * 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130']
677 */
678 #define X_DRIVER_TYPE TMC2130 //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE TMC2130 //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE TMC2130 //GADGETANGEL was commented out and had the value A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2130 //GADGETANGEL was commented out and had the value A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2130 drivers, I must invert the stepper motor direction because the TMC2130 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2130 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



Configuration.h - Marlin-2.0.x - Visual Studio Code

```

File Edit Selection View Go Debug Terminal Help Configuration.h Configuration_adv.h

Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Next you want to set your V_{ref} in the Marlin firmware for each axis that has the TMC2130 driver, as seen in the **GREEN** box below. I changed the "X_CURRENT" to be the calculated V_{ref} for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated V_{ref} for my Y-Axis, which is 760mV on the Ender 3.
- Ensure "X_RSENSE" is set to 0.11. Ensure "Y_RSENSE" is set to 0.11.
- If you **do not want to use V_{ref}** as the value for "X_CURRENT" and/or "Y_CURRENT", you should **use I_{RMS} instead**. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "X_CURRENT" and/or "Y_CURRENT".

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0x - Visual Studio Code
Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > Y_CURRENT
1990 * To use the reading capabilities, also connect #_SERIAL_RX_PIN to PDN_UART without
1991 * a resistor.
1992 * The drivers can also be used with hardware serial.
1993 *
1994 * TMCStepper library is required to use TMC stepper drivers.
1995 * https://github.com/teemuatlut/TMCStepper
1996 */
1997 #if HAS_TRINAMIC
1998
1999 #define HOLD_MULTIPLIER    0.5 // Scales down the holding current from run current
2000 #define INTERPOLATE        true // Interpolate X/Y/Z_MICROSTEPS to 256
2001
2002 #if AXIS_IS_TMC(X)
2003     #define X_CURRENT          760      // (mA) RMS current. Multiply by 1.414 for peak current. //GADGETANGEL was 580
2004     #define X_CURRENT_HOME    X_CURRENT // (mA) RMS current for sensorless homing
2005     #define X_MICROSTEPS       16       // 0..256
2006     #define X_RSENSE            0.11
2007     #define X_CHAIN_POS         -1      // <=0 : Not chained. 1 : MCU MOSI connected. 2 : Next in chain, ...
2008 #endif
2009
2010 #if AXIS_IS_TMC(X2)
2011     #define X2_CURRENT          800
2012     #define X2_CURRENT_HOME    X2_CURRENT
2013     #define X2_MICROSTEPS       16
2014     #define X2_RSENSE            0.11
2015     #define X2_CHAIN_POS         -1
2016 #endif
2017
2018 #if AXIS_IS_TMC(Y)
2019     #define Y_CURRENT          760      //GADGETANGEL was 580
2020     #define Y_CURRENT_HOME    Y_CURRENT
2021     #define Y_MICROSTEPS       16
2022     #define Y_RSENSE            0.11
2023     #define Y_CHAIN_POS         -1
2024 #endif

```

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- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Now, I am setting the V_{ref} for Z-Axis and the extruder, as seen in the **GREEN** boxes below. I changed the "Z_CURRENT" to be the calculated V_{ref} for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated V_{ref} for my Extruder, which is 900mV on the Ender 3.
- Ensure "Z_RSENSE" is set to 0.11. Ensure "E0_RSENSE" is set to 0.11.
- If you **do not want to use V_{ref}** as the value for "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS} = I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "Z_CURRENT" and/or "E0_CURRENT".

```

File Edit Selection View Go Debug Terminal Help
Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

Configuration.h Configuration_adv.h X

2033
2034 #if AXIS_IS_TMC(Z)
2035   #define Z_CURRENT      760           //GADGETANGEL was 580
2036   #define Z_CURRENT_HOME Z_CURRENT
2037   #define Z_MICROSTEPS    16
2038   #define Z_RSENSE        0.11
2039   #define Z_CHAIN_POS     -1
2040 #endif

```

```

File Edit Selection View Go Debug Terminal Help
Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

Marlin > Configuration.h > Configuration_adv.h > E0_CURRENT

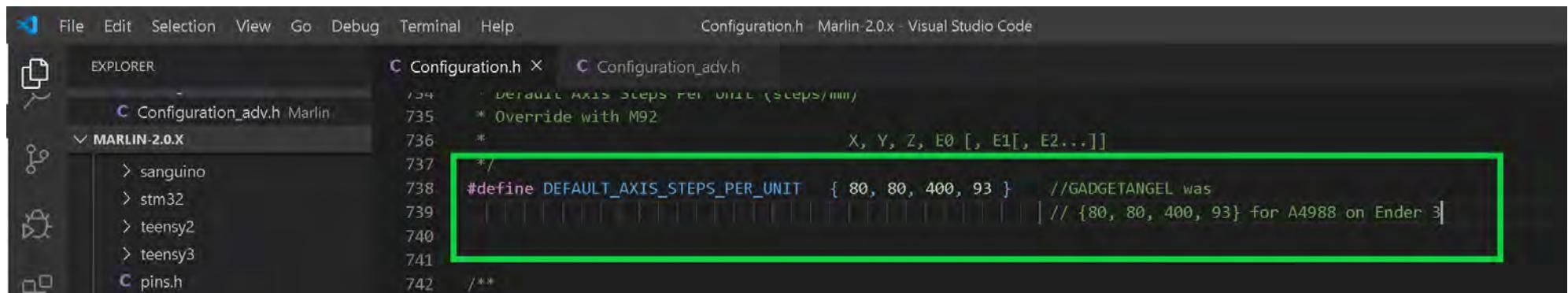
2065
2066 #if AXIS_IS_TMC(E0)
2067   #define E0_CURRENT      900           //GADGETANGEL was 650
2068   #define E0_MICROSTEPS   16
2069   #define E0_RSENSE        0.11
2070   #define E0_CHAIN_POS     -1
2071 #endif

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



File Edit Selection View Go Debug Terminal Help Configuration.h Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

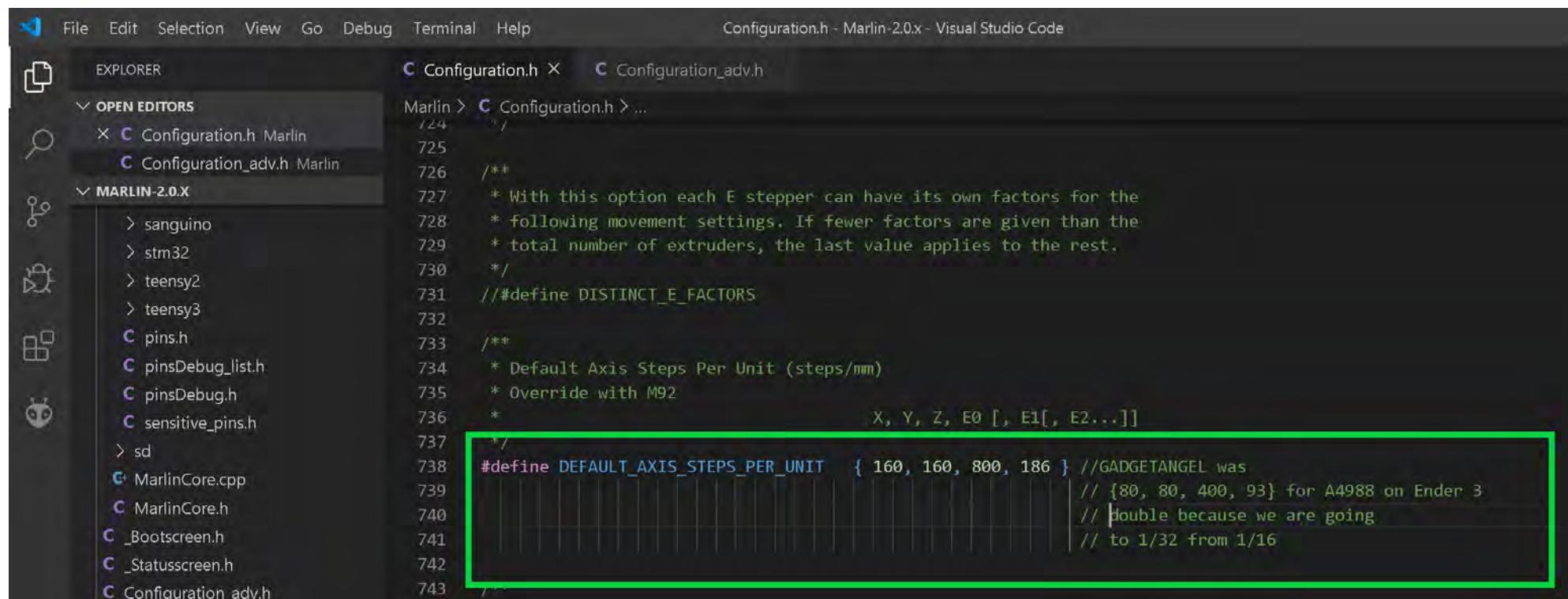
MARLIN-2.0.X

```

734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 80, 80, 400, 93 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740
741 /**
742 */

```

- FOR EXAMPLE if you wanted to use 1/32 stepping instead of the default 1/16, you would be **doubling** your STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

MARLIN-2.0.X

```

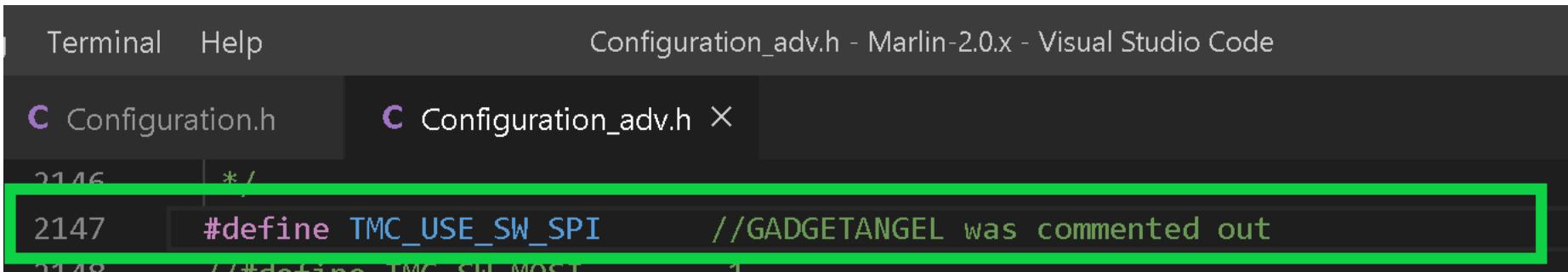
724 */
725
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 *
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // Double because we are going
741 // to 1/32 from 1/16
742
743 /**

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- We need to uncomment out the "TMC_USE_SW_SPI" because the SKR PRO V1.1 pins file depends on this variable to define its SPI pins

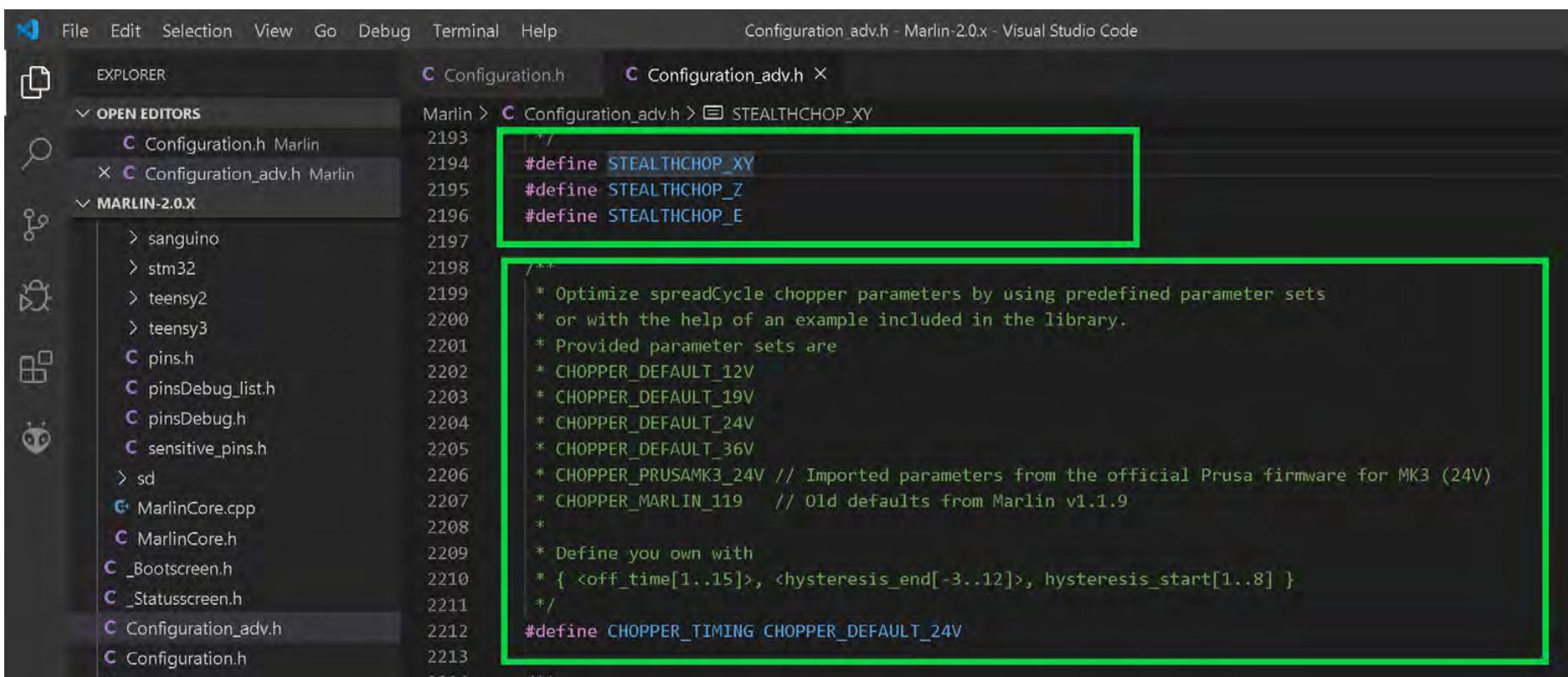


Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

C Configuration.h C Configuration_adv.h X

```
2146 */  
2147 #define TMC_USE_SW_SPI //GADGETANGEL was commented out  
2148 /*#define TMC_SW_MOST
```

- By default stealthChop is enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I **want stealthChop enabled** so I want to make sure the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.



File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h X

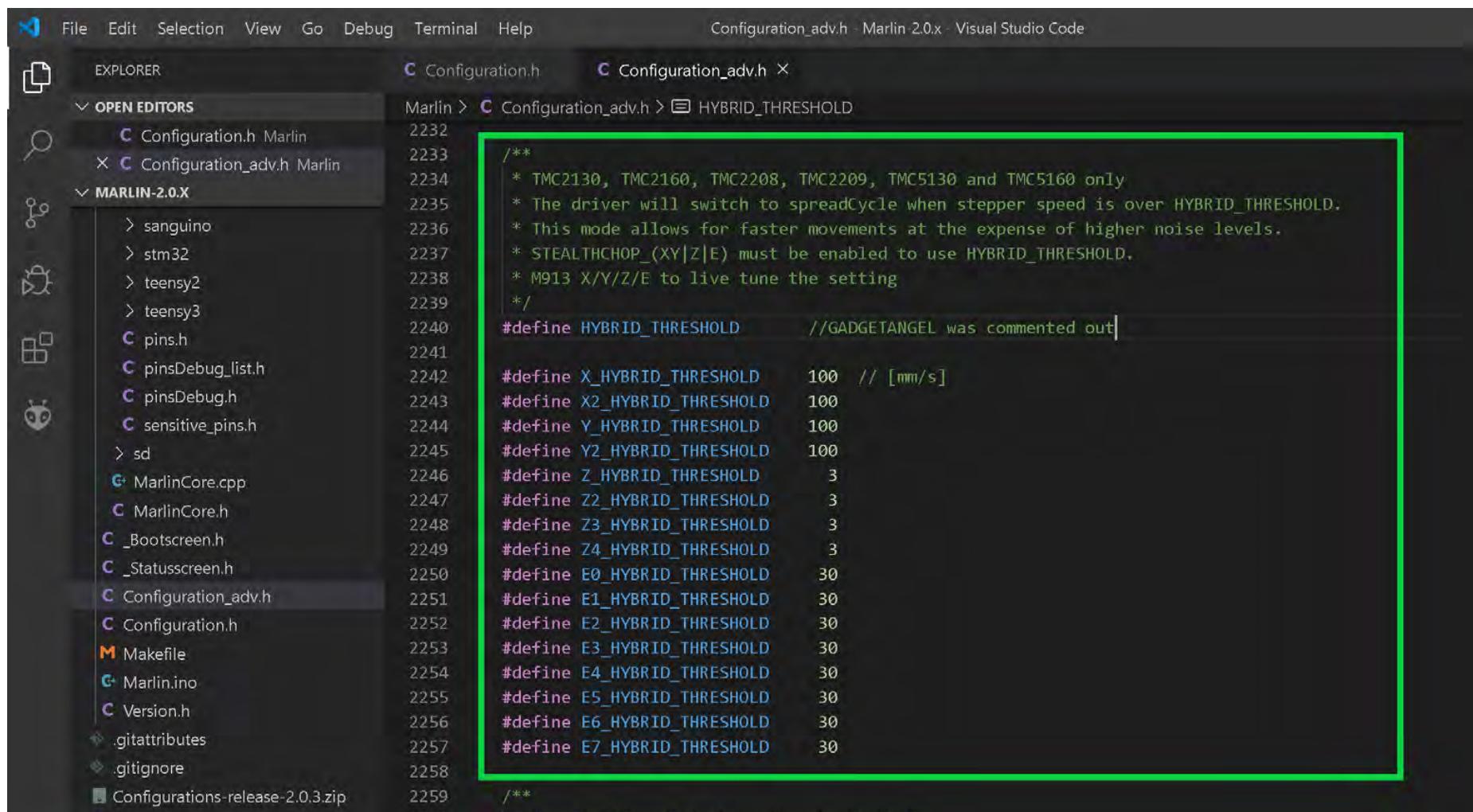
Marlin > C Configuration_adv.h > STEALTHCHOP_XY

```
2193 /*  
2194 #define STEALTHCHOP_XY  
2195 #define STEALTHCHOP_Z  
2196 #define STEALTHCHOP_E  
2197 */  
2198 * Optimize spreadCycle chopper parameters by using predefined parameter sets  
2199 * or with the help of an example included in the library.  
2200 * Provided parameter sets are  
2201 * CHOPPER_DEFAULT_12V  
2202 * CHOPPER_DEFAULT_19V  
2203 * CHOPPER_DEFAULT_24V  
2204 * CHOPPER_DEFAULT_36V  
2205 * CHOPPER_PRUSAMK3_24V // Imported parameters from the official Prusa firmware for MK3 (24V)  
2206 * CHOPPER_MARLIN_119 // Old defaults from Marlin v1.1.9  
2207 *  
2208 * Define your own with  
2209 * { <off_time[1..15]>, <hysteresis_end[-3..12]>, hysteresis_start[1..8] }  
2210 * /  
2211 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V  
2212 */  
2213 */
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Now you either enable "HYBRID_THRESHOLD" or disable it. By default it is disabled. "HYBRID_THRESHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin 2.0.x Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h ×
OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin
MARLIN-2.0.X
  > sanguino
  > stm32
  > teensy2
  > teensy3
  C pins.h
  C pinsDebug_list.h
  C pinsDebug.h
  C sensitive_pins.h
  > sd
  C MarlinCore.cpp
  C MarlinCore.h
  C _Bootscreen.h
  C _Statusscreen.h
  C Configuration_adv.h
  C Configuration.h
  M Makefile
  C Marlin.ino
  C Version.h
  .gitattributes
  .gitignore
  Configurations-release-2.0.3.zip

2232
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2245
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2247
2248
2249
2250
2251
2252
2253
2254
2255
2256
2257
2258
2259
2260

  /**
   * TMC2130, TMC2160, TMC2208, TMC2209, TMC5130 and TMC5160 only
   * The driver will switch to spreadCycle when stepper speed is over HYBRID_THRESHOLD.
   * This mode allows for faster movements at the expense of higher noise levels.
   * STEALTHCHOP_(XY|Z|E) must be enabled to use HYBRID_THRESHOLD.
   * M913 X/Y/Z/E to live tune the setting
   */
#define HYBRID_THRESHOLD //GADGETANGEL was commented out

#define X_HYBRID_THRESHOLD 100 // [mm/s]
#define X2_HYBRID_THRESHOLD 100
#define Y_HYBRID_THRESHOLD 100
#define Y2_HYBRID_THRESHOLD 100
#define Z_HYBRID_THRESHOLD 3
#define Z2_HYBRID_THRESHOLD 3
#define Z3_HYBRID_THRESHOLD 3
#define Z4_HYBRID_THRESHOLD 3
#define E0_HYBRID_THRESHOLD 30
#define E1_HYBRID_THRESHOLD 30
#define E2_HYBRID_THRESHOLD 30
#define E3_HYBRID_THRESHOLD 30
#define E4_HYBRID_THRESHOLD 30
#define E5_HYBRID_THRESHOLD 30
#define E6_HYBRID_THRESHOLD 30
#define E7_HYBRID_THRESHOLD 30

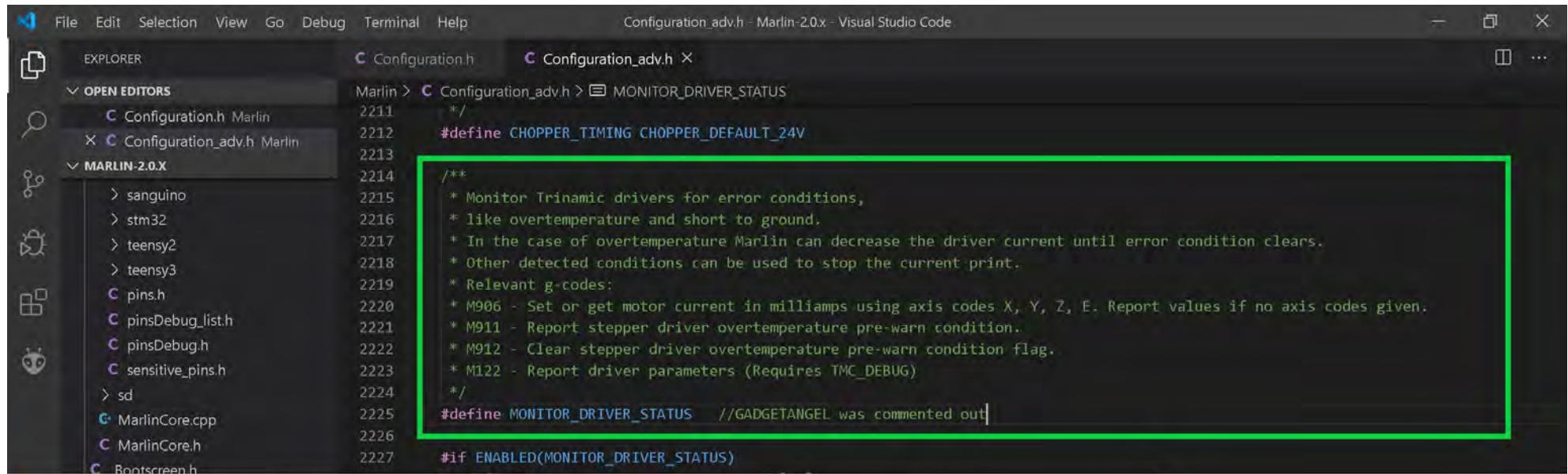
  /**

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Now I want to enable some statements that allow me access to debugging the TMC drivers. I will uncomment "MONITOR_DRIVER_STATUS" and "TMC_DEBUG". "MONITOR_DRIVER_STATUS" will enable the following G-codes: M906, M911, and M912, "TMC_DEBUG" will enable the M122 G-code command. You can read about these from the comments in the firmware and in [Marlin's documentation located on-line](#).



File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h

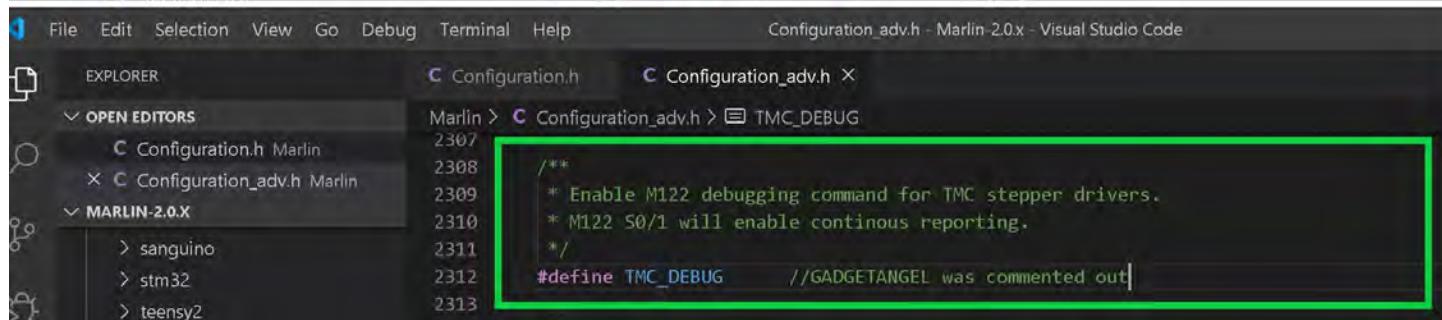
OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X

```

2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213
2214 /**
2215 * Monitor Trinamic drivers for error conditions,
2216 * like overtemperature and short to ground.
2217 * In the case of overtemperature Marlin can decrease the driver current until error condition clears.
2218 * Other detected conditions can be used to stop the current print.
2219 * Relevant g-codes:
2220 * M906 - Set or get motor current in milliamps using axis codes X, Y, Z, E. Report values if no axis codes given.
2221 * M911 - Report stepper driver overtemperature pre-warn condition.
2222 * M912 - Clear stepper driver overtemperature pre-warn condition flag.
2223 * M122 - Report driver parameters (Requires TMC_DEBUG)
2224 */
2225 #define MONITOR_DRIVER_STATUS //GADGETANGEL was commented out
2226
2227 #if ENABLED(MONITOR_DRIVER_STATUS)

```



File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X

```

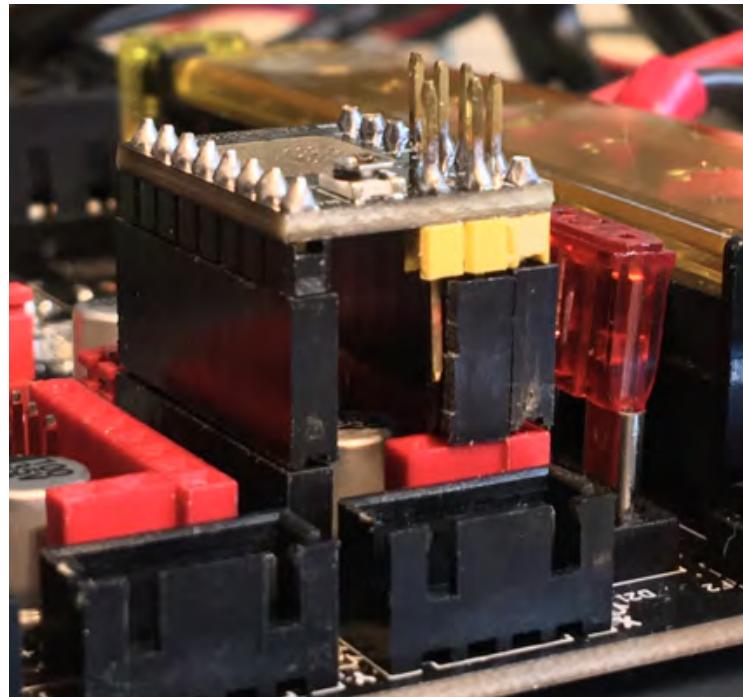
2307
2308 /**
2309 * Enable M122 debugging command for TMC stepper drivers.
2310 * M122 S0/1 will enable continuous reporting.
2311 */
2312 #define TMC_DEBUG //GADGETANGEL was commented out
2313

```

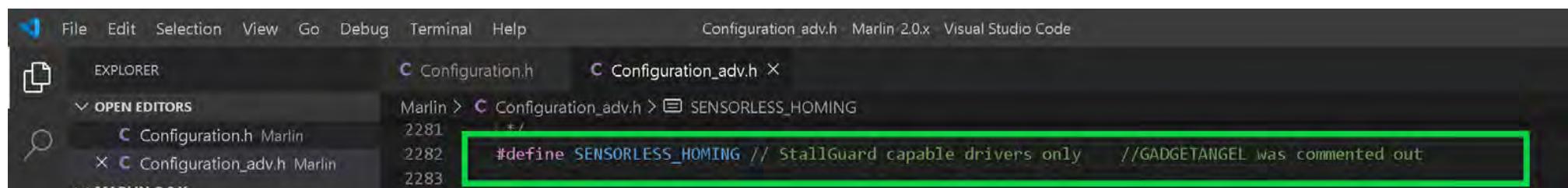
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- This next section covers sensor-less homing which is available for the TMC2130 in SPI mode. I want to enable it so I will be covering sensor-less homing for the X and Y axis only. I will not be using sensor-less homing on my Z axis on my Ender 3 printer. For sensor-less homing to work the DIAG1 pin on the TMC2130 driver has to be plugged into the SKR PRO V1.1 board. Since I am not using sensor-less homing on my Z axis I will need to ensure that my DIAG1 pin on the Z axis TMC2130 is NOT connected to the board. I plan to plug my Z axis TMC2130 as seen in the picture below



- Sensor-less homing is commented out by default. So I remove the two leading "://" to un-comment "SENSORLESS_HOMING"



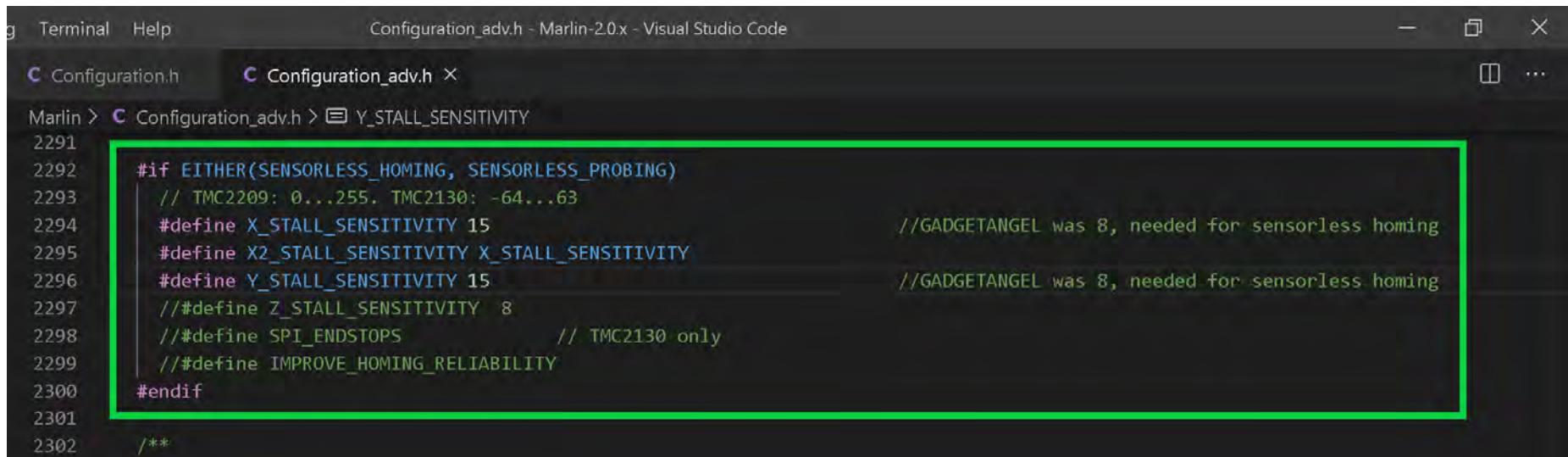
```
File Edit Selection View Go Debug Terminal Help Configuration_adv.h Marlin 2.0.x Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h X
OPEN EDITORS Marlin > Configuration_adv.h > SENSORLESS_HOMING
2281 */
2282 #define SENSORLESS_HOMING // StallGuard capable drivers only //GADGETANGEL was commented out
2283
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Next we set the "starting" stall sensitivity for sensor-less homing. I choose to make it 15. If the stall sensitivity is too high your motor will grind and not stop when it hits the end of travel on the axis. If the stall sensitivity is too low then the motor will barely move because it thinks it has hit the end of travel for the axis. Notice I only uncommented the "X_STALL_SENSITIVITY" and the "Y_STALL_SENSITIVITY". If you want sensor-less homing on the Z axis, then you will have to uncomment "Z_STALL_SENSITIVITY".

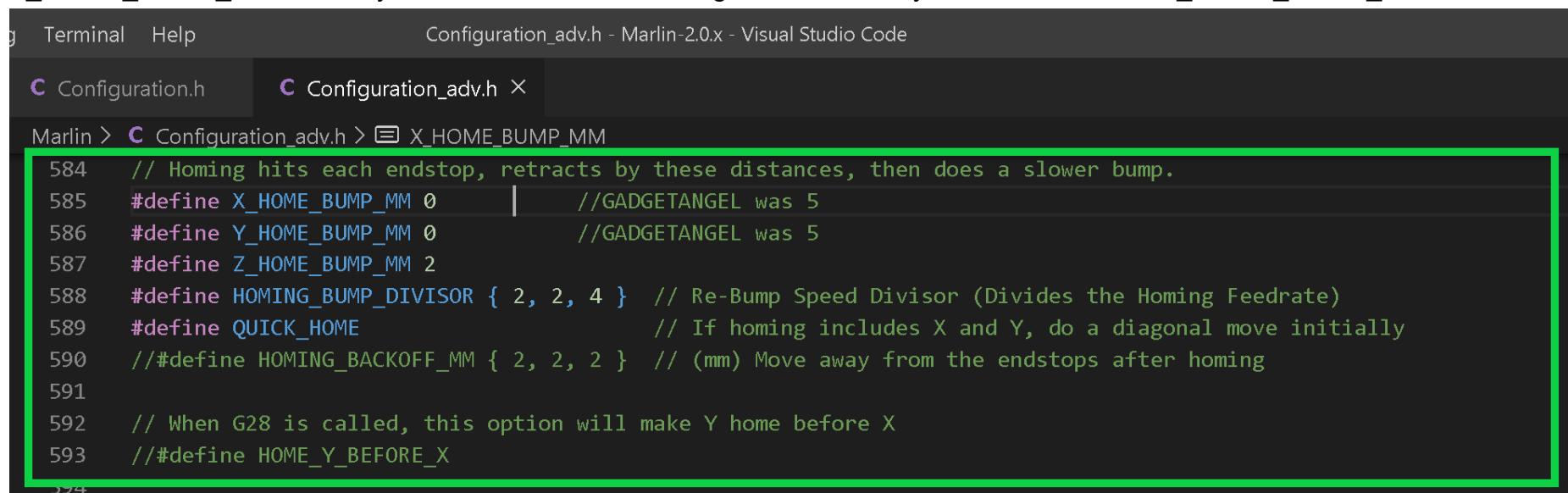


```

g Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > Y_STALL_SENSITIVITY
2291
2292 #if EITHER(SENSORLESS_HOMING, SENSORLESS_PROBING)
2293 // TMC2209: 0...255. TMC2130: -64...63
2294 #define X_STALL_SENSITIVITY 15 //GADGETANGEL was 8, needed for sensorless homing
2295 #define X2_STALL_SENSITIVITY X_STALL_SENSITIVITY
2296 #define Y_STALL_SENSITIVITY 15 //GADGETANGEL was 8, needed for sensorless homing
2297 //#define Z_STALL_SENSITIVITY 8
2298 //">#define SPI_ENDSTOPS // TMC2130 only
2299 //">#define IMPROVE_HOMING_RELIABILITY
2300 #endif
2301
2302 /**

```

- We now have to set our home bump to 0 for each axis with sensor-less homing enabled. So I will set "X_HOME_BUMP_MM" to 0 and "Y_HOME_BUMP_MM" to 0. If you want sensor-less homing on Z axis then you will need to set "Z_HOME_BUMP_MM" to 0.



```

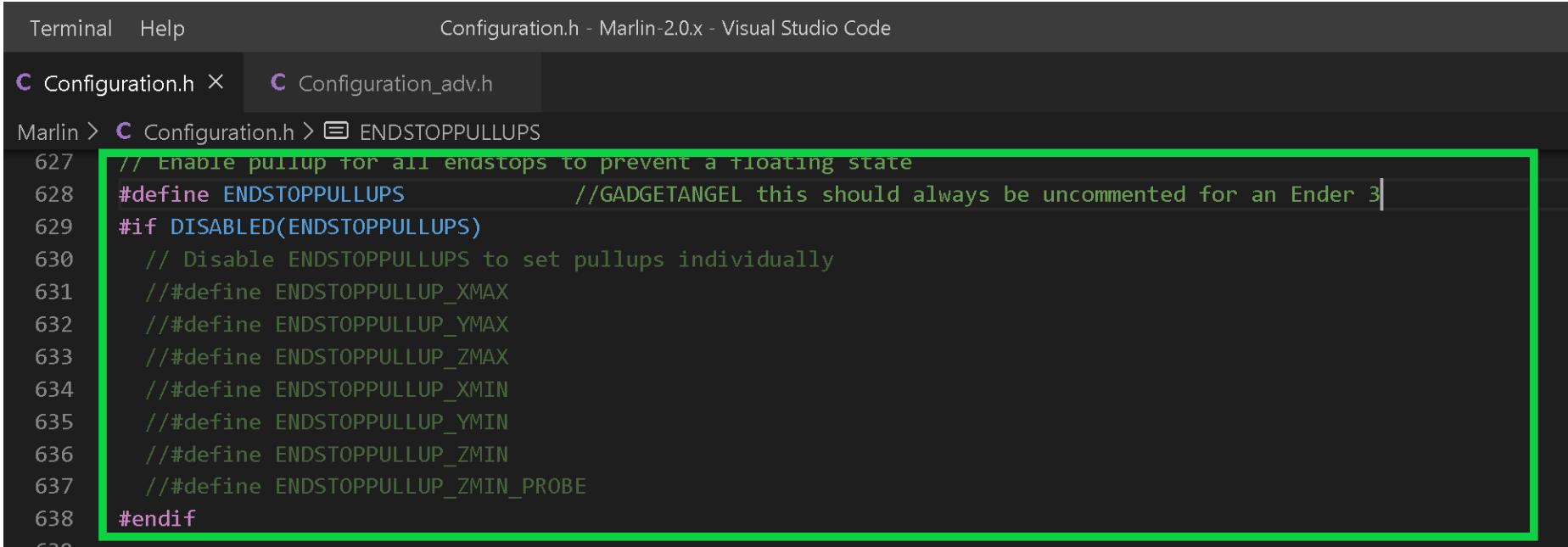
g Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > X_HOME_BUMP_MM
584 // Homing hits each endstop, retracts by these distances, then does a slower bump.
585 #define X_HOME_BUMP_MM 0 //GADGETANGEL was 5
586 #define Y_HOME_BUMP_MM 0 //GADGETANGEL was 5
587 #define Z_HOME_BUMP_MM 2
588 #define HOMING_BUMP_DIVISOR { 2, 2, 4 } // Re-Bump Speed Divisor (Divides the Homing Feedrate)
589 #define QUICK_HOME // If homing includes X and Y, do a diagonal move initially
590 //">#define HOMING_BACKOFF_MM { 2, 2, 2 } // (mm) Move away from the endstops after homing
591
592 // When G28 is called, this option will make Y home before X
593 //">#define HOME_Y_BEFORE_X
594

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Let's check the firmware to ensure that "ENDSTOPPULLUPS" is enabled. It is by default.



```

Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

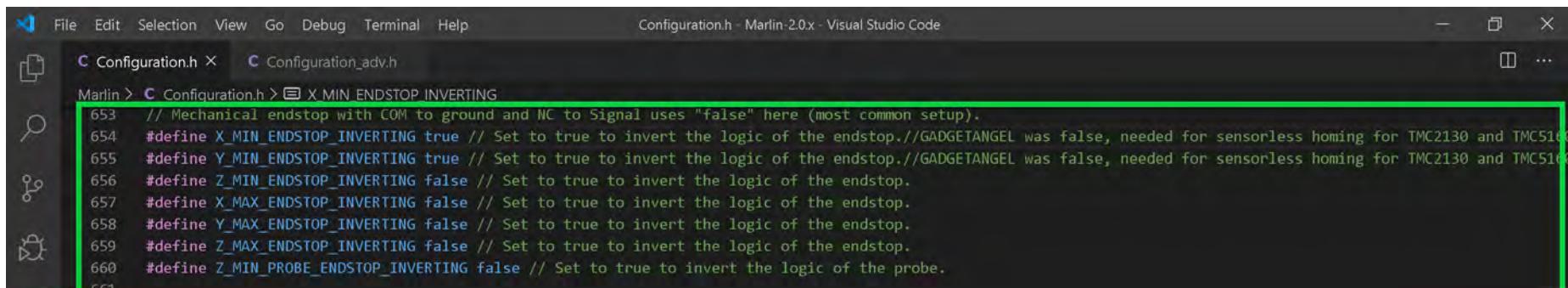
Configuration.h X Configuration_adv.h

Marlin > Configuration.h > ENDSTOPPULLUPS

627 // Enable pullup for all endstops to prevent a floating state
628 #define ENDSTOPPULLUPS //GADGETANGEL this should always be uncommented for an Ender 3
629 #if DISABLED(ENDSTOPPULLUPS)
630     // Disable ENDSTOPPULLUPS to set pullups individually
631     //#define ENDSTOPPULLUP_XMAX
632     //#define ENDSTOPPULLUP_YMAX
633     //#define ENDSTOPPULLUP_ZMAX
634     //#define ENDSTOPPULLUP_XMIN
635     //#define ENDSTOPPULLUP_YMIN
636     //#define ENDSTOPPULLUP_ZMIN
637     //#define ENDSTOPPULLUP_ZMIN_PROBE
638 #endif
639

```

- Next to allow sensor-less homing to work (while using the BIQU TMC2130) we need to change our end stop logic. Therefore I set "X_MIN_ENDSTOP_INVERTING" to true and "Y_MIN_ENSTOP_INVERTING" to true. If you want sensor-less homing on the Z axis, you will need to set "Z_MIN_ENDSTOP_INVERTING" to true. But since I do not want sensor-less homing on the Z axis I will leave "Z_MIN_ENDSTOP_INVERTING" set to false.



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

Configuration.h X Configuration_adv.h

Marlin > Configuration.h > X-MIN ENDSTOP INVERTING

653 // Mechanical endstop with COM to ground and NC to Signal uses "false" here (most common setup).
654 #define X_MIN_ENDSTOP_INVERTING true // Set to true to invert the logic of the endstop.//GADGETANGEL was false, needed for sensorless homing for TMC2130 and TMC5100
655 #define Y_MIN_ENDSTOP_INVERTING true // Set to true to invert the logic of the endstop.//GADGETANGEL was false, needed for sensorless homing for TMC2130 and TMC5100
656 #define Z_MIN_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
657 #define X_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
661

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- The end of Marlin setup for BIQU TMC2130 drivers in SPI mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS MARLIN-2.0.X

pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h

Marlin > Configuration.h > X_DRIVER_TYPE

```
#define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.  
#define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.  
#define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
```

/*
 * Stepper Drivers
 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
 * A4988 is assumed for unspecified drivers.
 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
 * TB6560, TB6600, TMC2100,
 * TMC2130, TMC2130_STANDALONE, TMC2100, TMC2100_STANDALONE,
 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: Task - Build

| BIGTREETECH_BTT002 | IGNORED | SUCCESS | 00:02:31.294 |
|------------------------|---------|---------|--------------|
| BIGTREETECH_BTT002 | IGNORED | | |
| teensy31 | IGNORED | | |
| teensy35 | IGNORED | | |
| esp32 | IGNORED | | |
| linux_native | IGNORED | | |
| SAMD51_grandcentral_m4 | IGNORED | | |
| rumba32_f446ve | IGNORED | | |
| mks_rumba32 | IGNORED | | |
| include_tree | IGNORED | | |

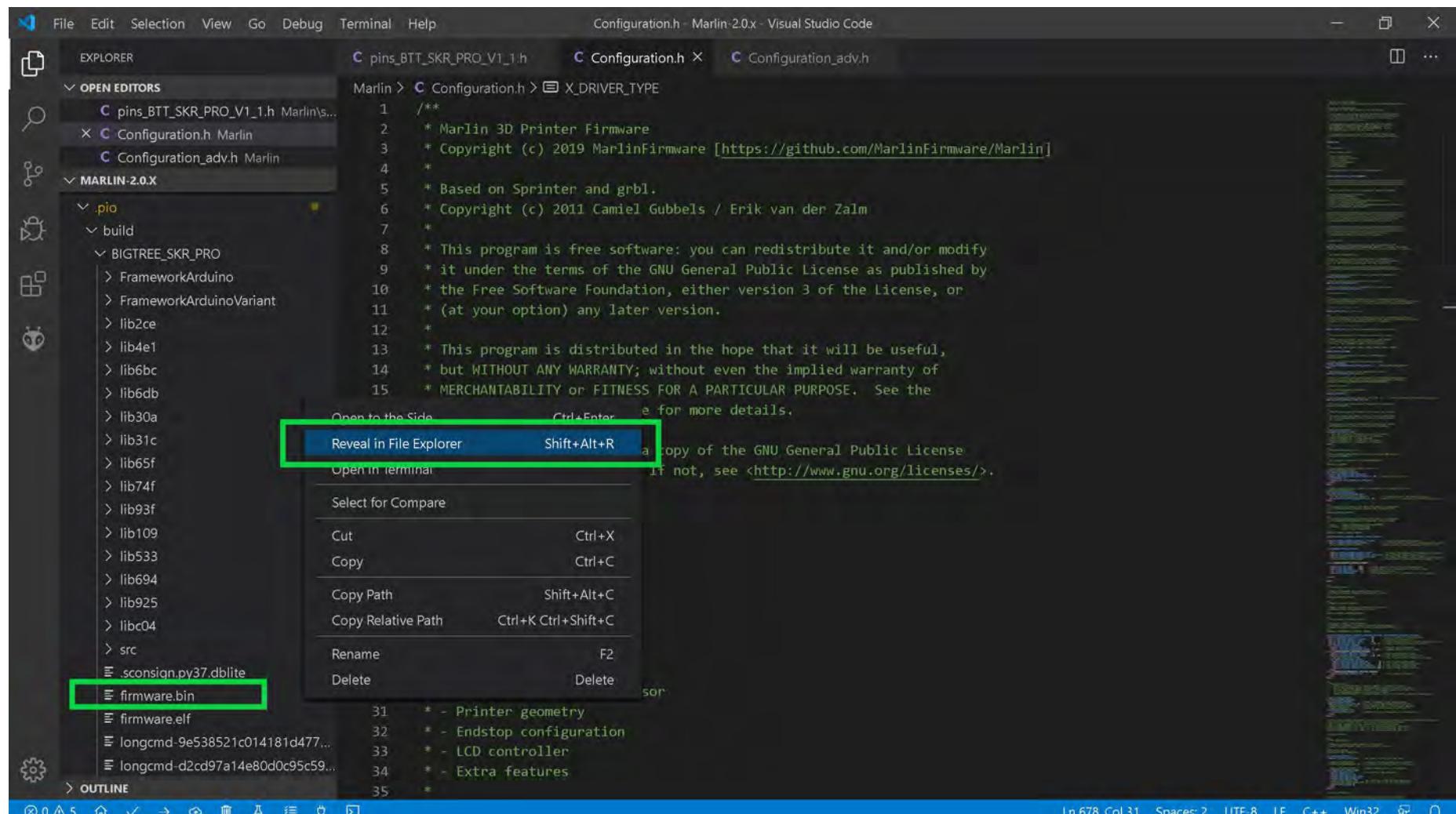
```
===== 1 succeeded in 00:02:31.294 =====
```

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

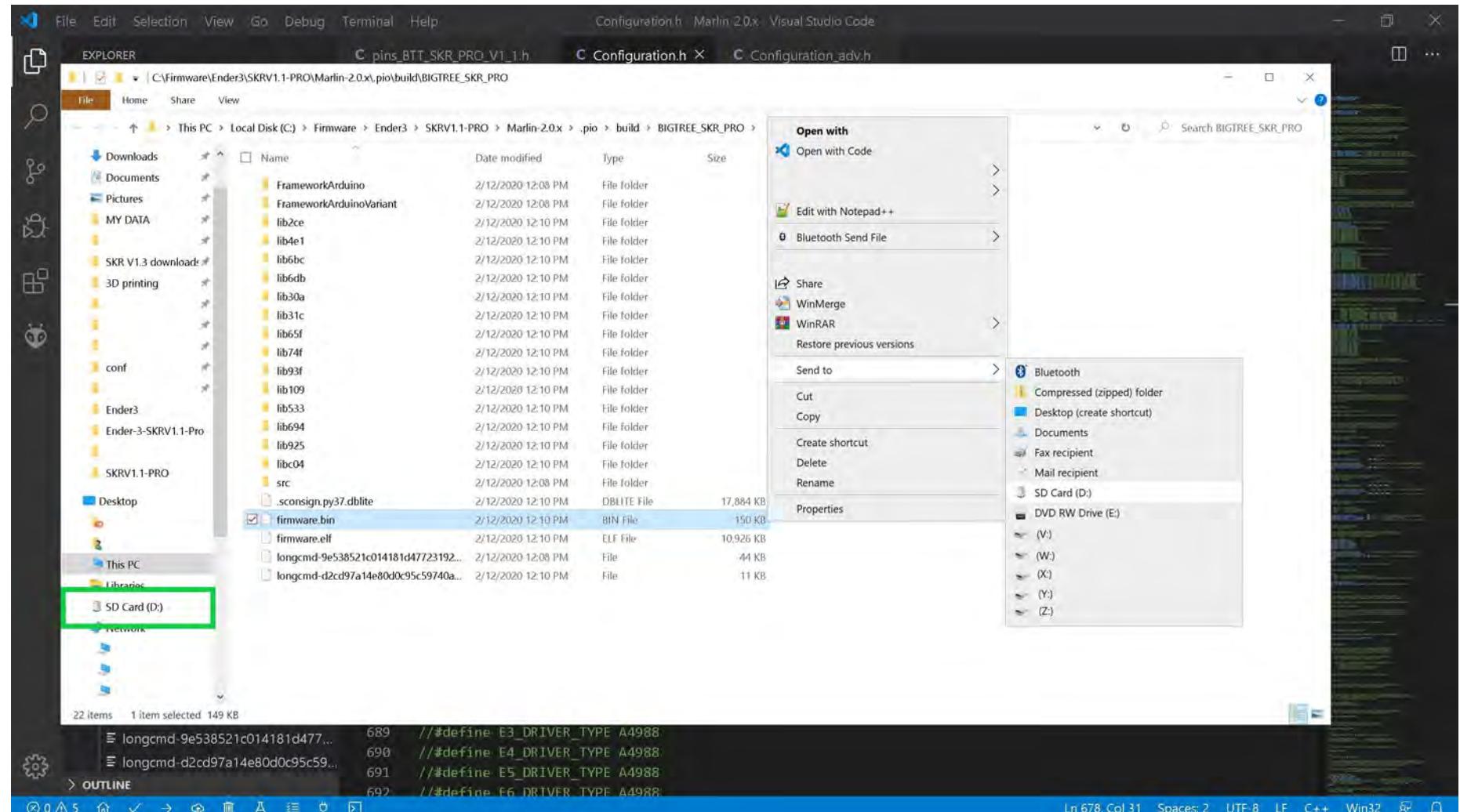
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



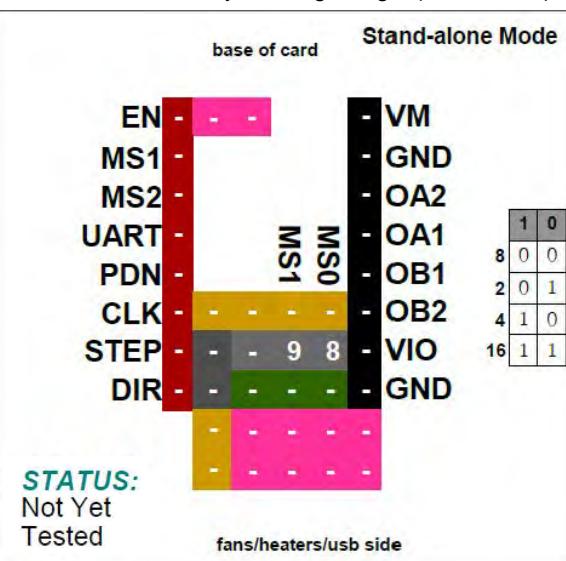
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".

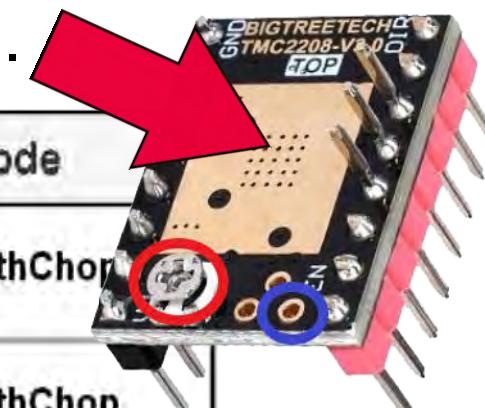


- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

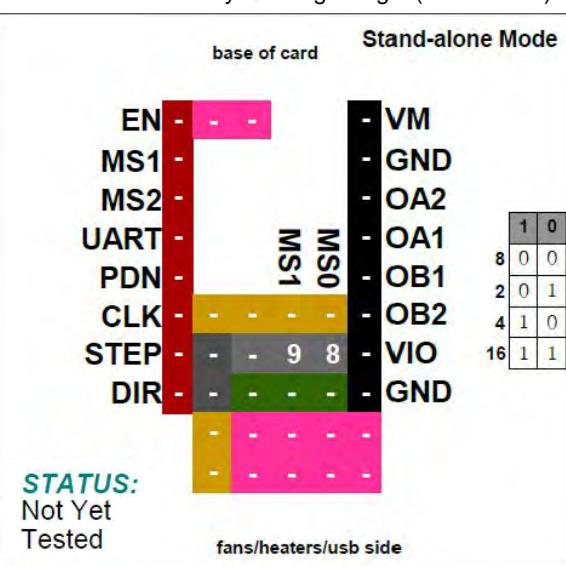
BIQU TMC2208 V3.0**Stand-alone Mode**

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

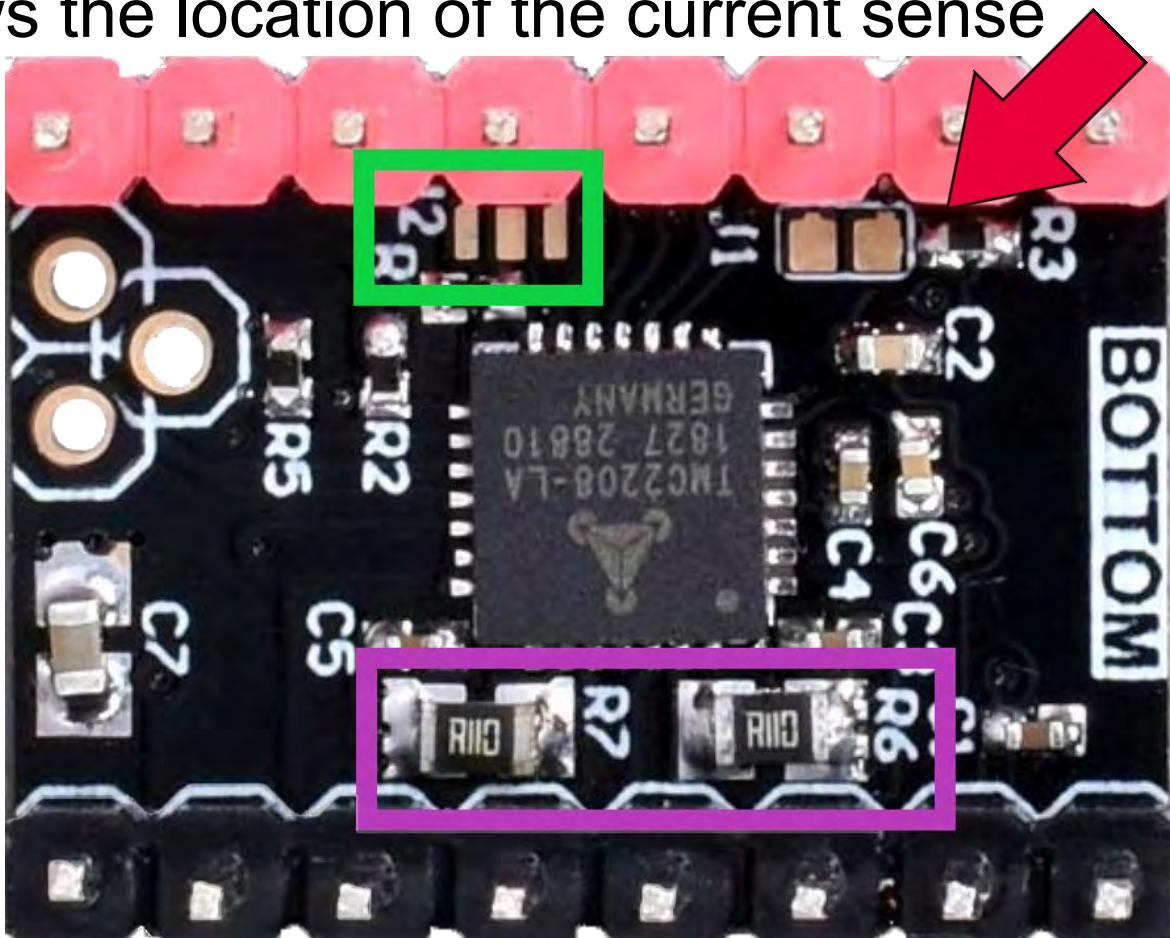
NOTE: Use the potentiometer (POT) on the top of the board, as shown in **RED**; or use the board's " V_{ref} Test point" location, as shown in **BLUE**, to set your V_{ref} . See **Appendix A** for instructions on how to set the V_{ref} on a driver board.



| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|---|---|-----|--------|---|-------------|
| BIQU® TMC2208 <small>Stand Alone Mode Maximum 16 Subdivision 35V DC 2A (peak)</small> | GND | GND | 1 / 8 | 1 / 256 | stealthChop |
| | GND | VIO | 1 / 2 | 1 / 256 | stealthChop |
| | VIO | GND | 1 / 4 | 1 / 256 | stealthChop |
| | VIO | VIO | 1 / 16 | 1 / 256 | stealthChop |
| Driving Current Calculation Formula | $I_{MAX} = V_{ref} * 0.9286$ | | | $V_{ref} = I_{MAX} * 1.0769$ | |
| R_S (Typical Sense Resistor) = 0.11Ω | See Appendix B #3. Use 50% to 90% as shown below: | | | See Appendix B #3. Use 50% to 90% as shown below: | |
| | $I_{MAX} = (V_{ref} * 0.9286) * 0.90$ | | | $V_{ref} = (I_{MAX} * 1.0769) * 0.90$ | |

BIQU TMC2208 V3.0**Stand-alone Mode**

Note: The three pads (J2), on the bottom of the BIQU TMC2208 V3.0 driver boards, **MUST NOT** be connected. Again, a gap MUST be in place between all three J2 pads to obtain stand-alone mode for the TMC2208 V3.0, as seen in the **GREEN** box below. The **PURPLE** box shows the location of the current sense resistors (R_s).



Note: MOST BIQU TMC2208 V3.0 driver boards, when purchased for UART mode will have two adjacent J2 pads already soldered together (located on the bottom of the driver board).

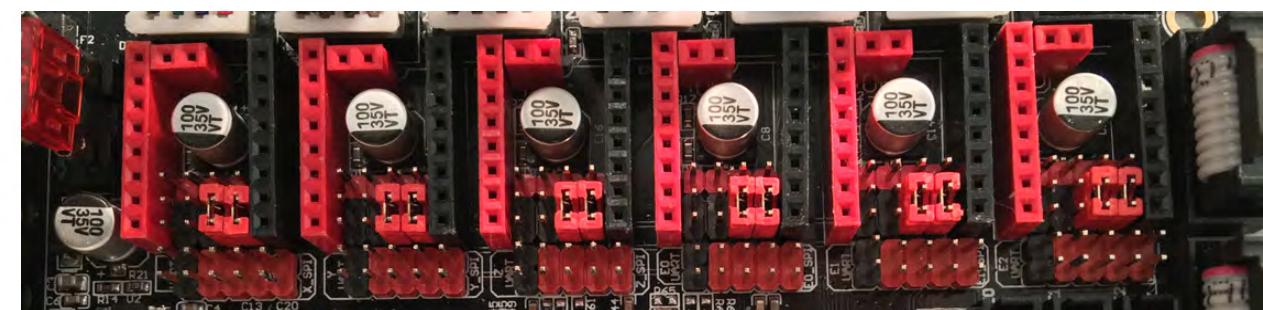
Stand-alone Mode

Stand-alone Mode

1 / 8Interpolation: **1/256**

StealthChop

| | | | | |
|------|---|---|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | OA2 |
| UART | - | - | MS0 | OA1 |
| PDN | - | - | - | OB1 |
| CLK | - | - | - | OB2 |
| STEP | - | - | 9 8 | VIO |
| DIR | - | 9 | 8 | GND |
| | - | - | - | - |

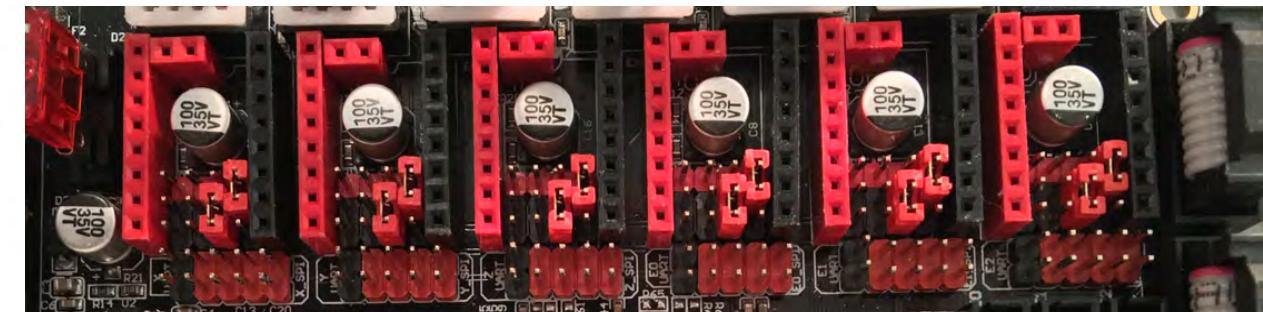


Stand-alone Mode

1 / 2Interpolation: **1/256**

StealthChop

| | | | | |
|------|---|---|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | OA2 |
| UART | - | - | MS0 | OA1 |
| PDN | - | - | - | OB1 |
| CLK | - | - | - | OB2 |
| STEP | - | - | 9 8 | VIO |
| DIR | - | 9 | - | GND |
| | - | - | - | - |



Stand-alone Mode

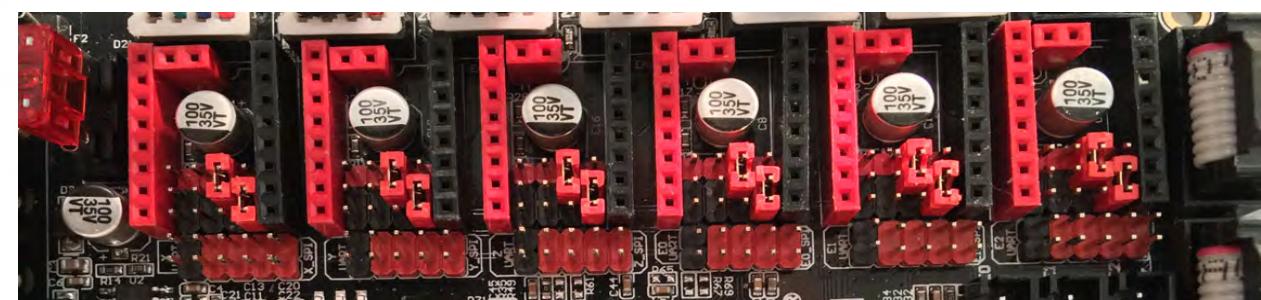
Stand-alone Mode

1 / 4

Interpolation: 1/256

StealthChop

| | | | |
|------|---|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | OA2 |
| UART | - | MS1 | OA1 |
| PDN | - | MS0 | OB1 |
| CLK | - | 9 | OB2 |
| STEP | - | 9 8 | VIO |
| DIR | - | 8 | GND |



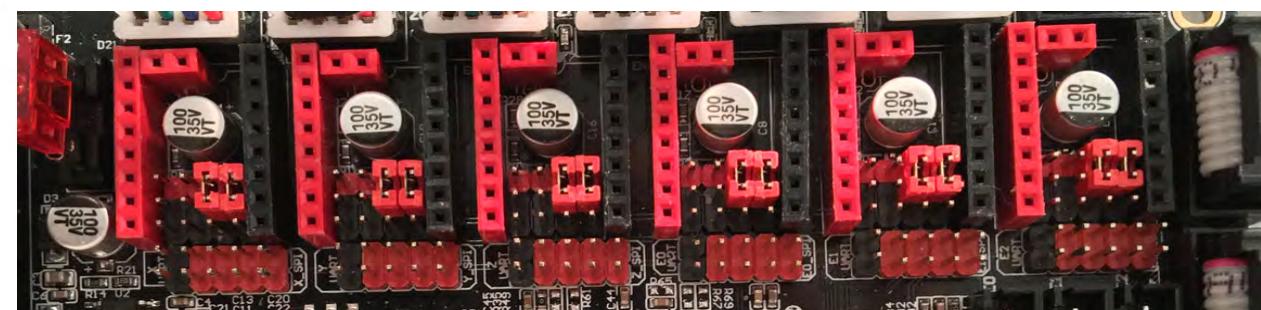
Stand-alone Mode

1 / 16

Interpolation: 1/256

StealthChop

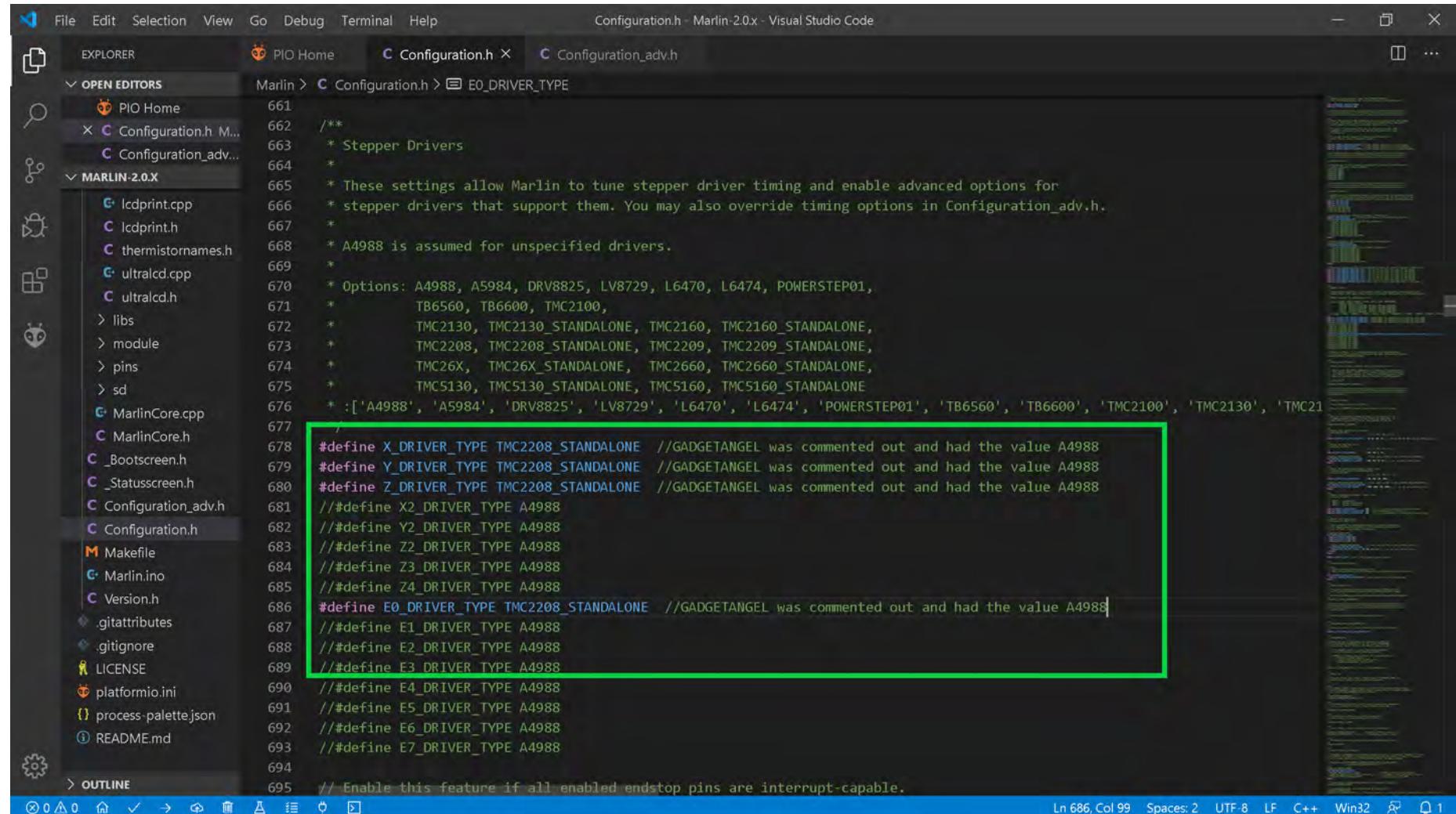
| | | | |
|------|---|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | OA2 |
| UART | - | MS1 | OA1 |
| PDN | - | MS0 | OB1 |
| CLK | - | 9 8 | OB2 |
| STEP | - | 9 8 | VIO |
| DIR | - | - | GND |



The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand-alone Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2208 stepper motor drivers in stand-alone mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in stand-alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in stand-alone mode. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin 2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h X Configuration_adv.h
Marlin > Configuration.h > E0_DRIVER_TYPE

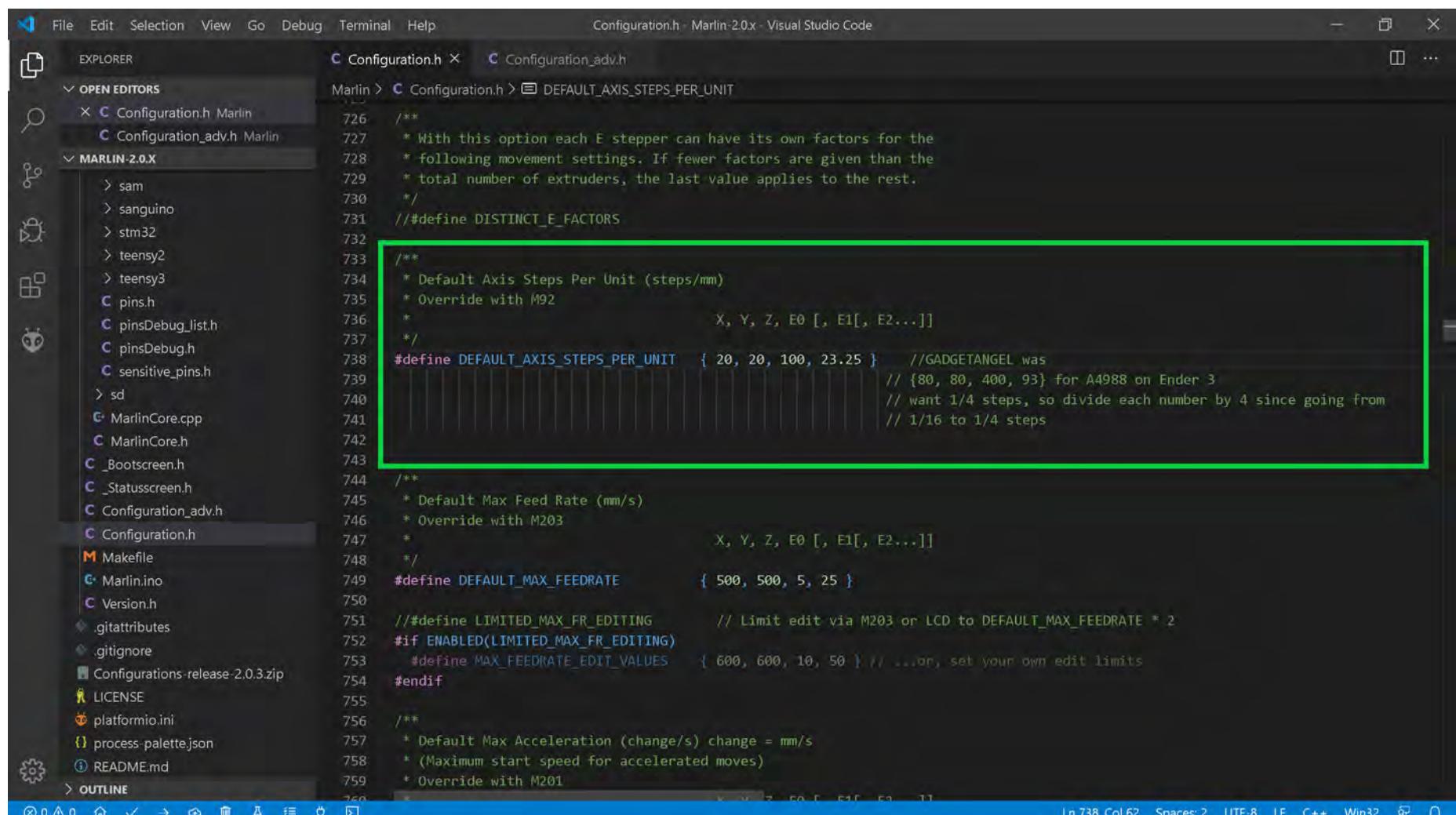
661 /**
662 * Stepper Drivers
663 *
664 */
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
676 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2160', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130', 'TMC5160']
677 */
678 #define X_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand-alone Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to TMC2208 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as seen in the GREEN box below.



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the Marlin 2.0.x configuration file. A green rectangular box highlights the following code block:

```

726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS

732 /**
733 * Default Axis Steps Per Unit (steps/mm)
734 * Override with M92
735 *
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 } // GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // want 1/4 steps, so divide each number by 4 since going from
741 // 1/16 to 1/4 steps
742
743 /**
744 * Default Max Feed Rate (mm/s)
745 * Override with M203
746 *
747 * X, Y, Z, E0 [, E1[, E2...]]
748 */
749 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }
750
751 // #define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
752 #if ENABLED(LIMITED_MAX_FR_EDITING)
753 #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ...or, set your own edit limits
754#endif
755
756 /**
757 * Default Max Acceleration (change/s) change = mm/s
758 * (Maximum start speed for accelerated moves)
759 * Override with M201
760 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand-alone Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below

```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > INVERT_Z_DIR
  Configuration.h Marlin
  Configuration_adv.h Marlin
MARLIN-2.0.X
  sanguino
  stm32
  teensy2
  teensy3
  pins.h
  pinsDebug_list.h
  pinsDebug.h
  sensitive_pins.h
  sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  Configurations-release-2.0.3.zip
  LICENSE
  platformio.ini
  process-palette.json
  README.md
  OUTLINE
Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false          // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered up

```

- Go to the next page.

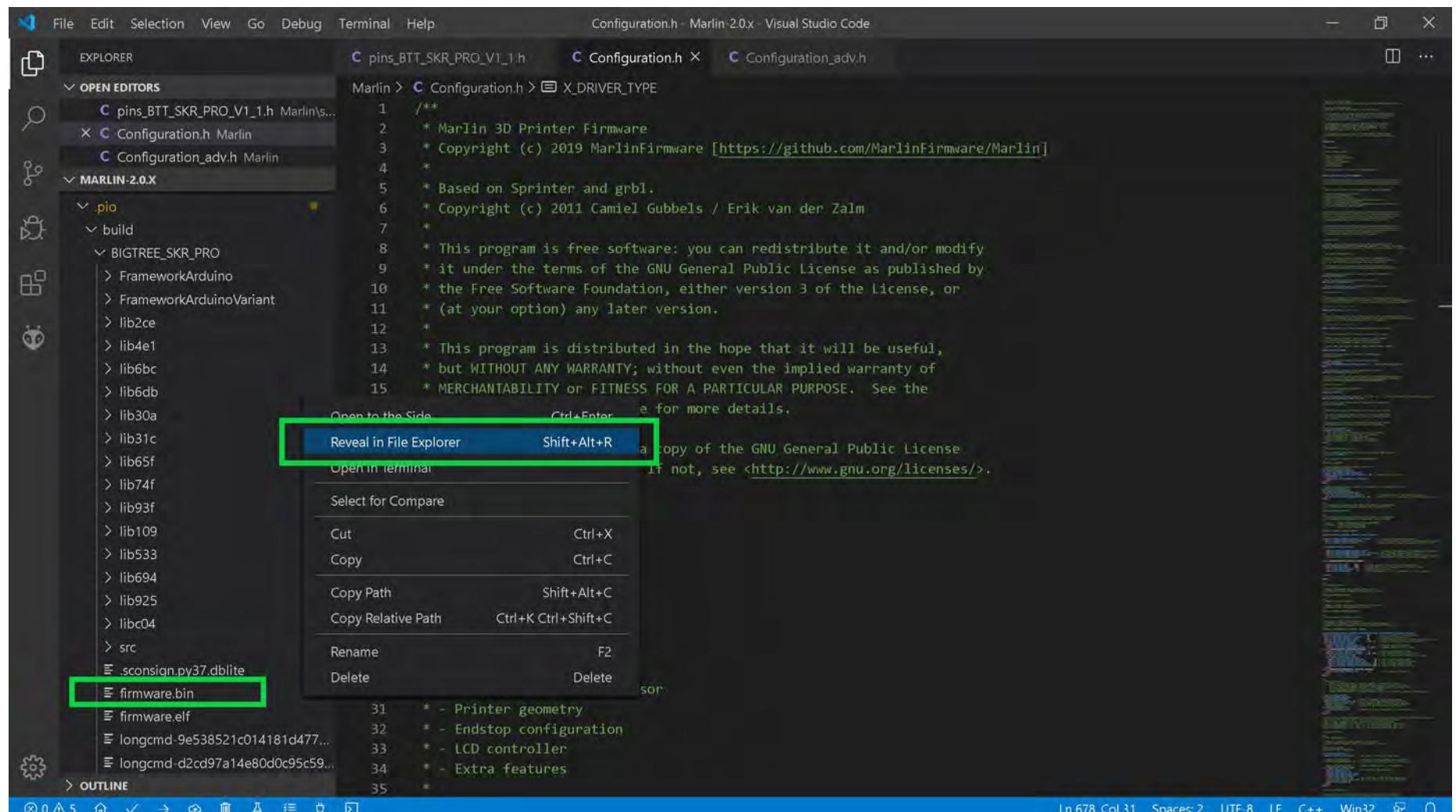
The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand-alone Mode

- The end of Marlin setup for BIQU TMC2208 V3.0 drivers in stand-alone mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand-alone Mode

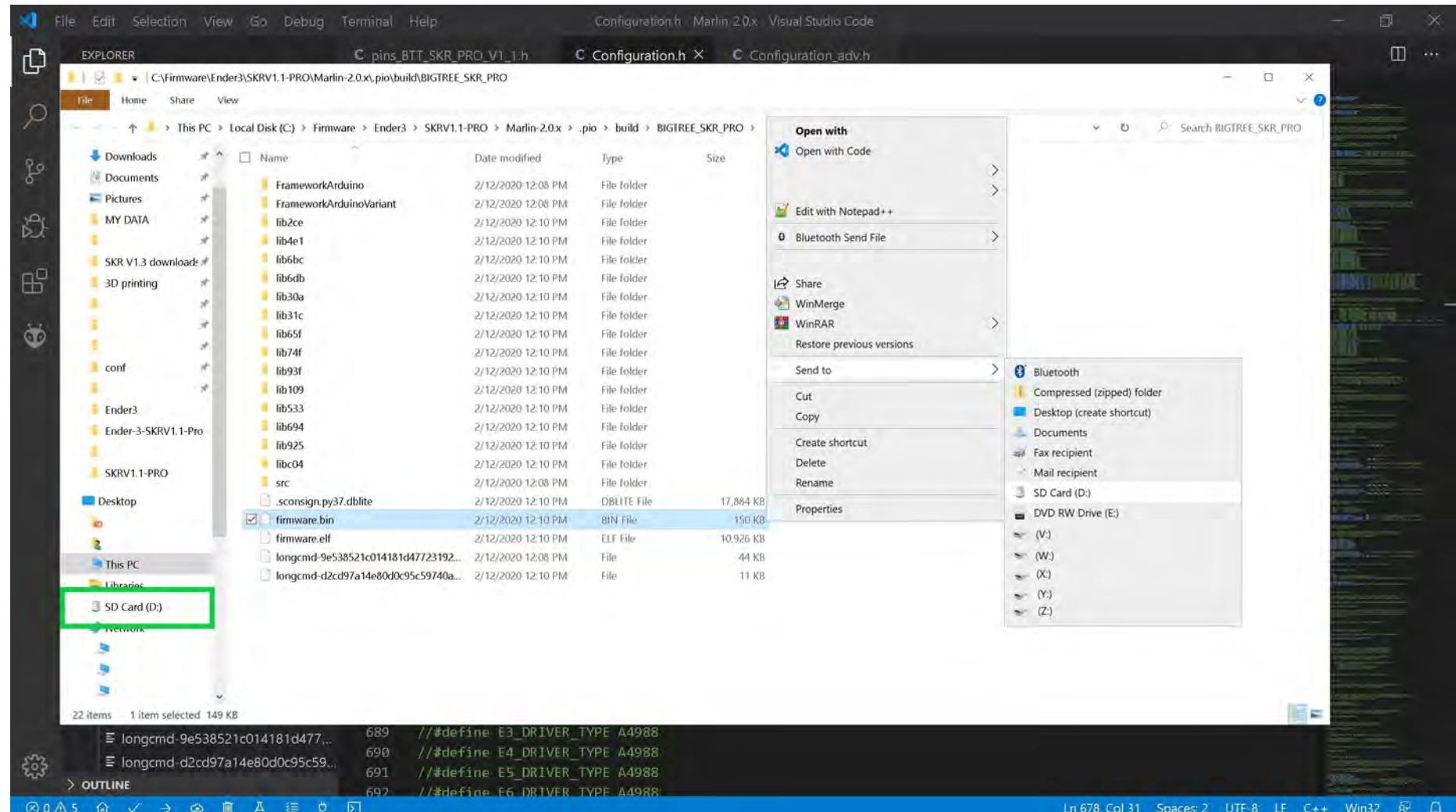
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



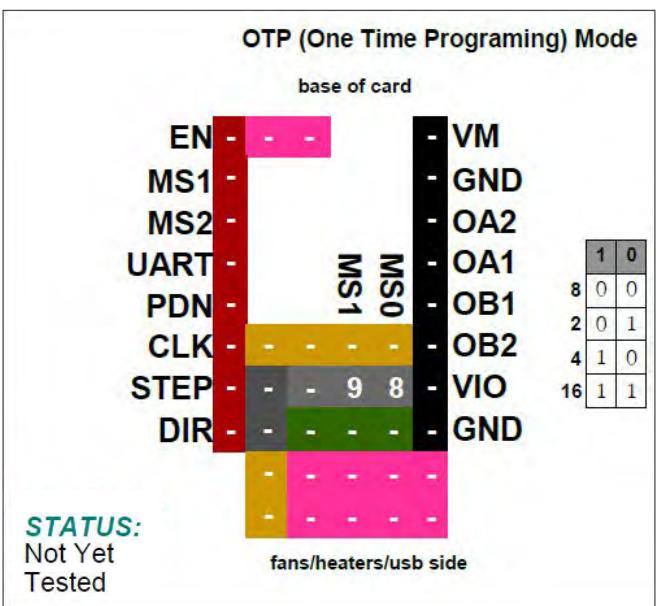
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand-alone Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".

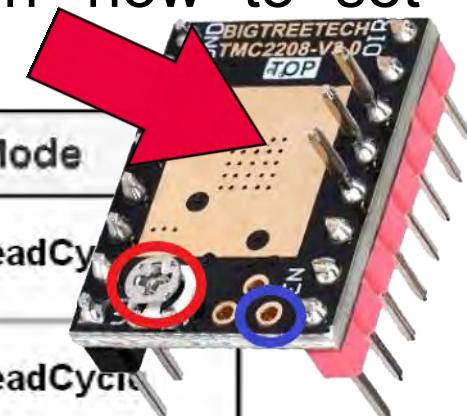


- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

One Time Programming (OTP) Mode

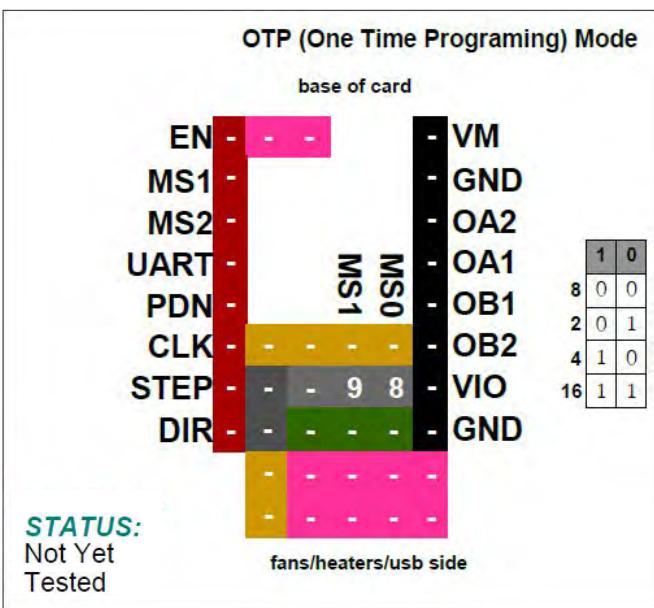
Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

NOTE: Use the potentiometer (POT) on the top of the board, as shown in **RED**; or use the board's " V_{ref} Test point" location, as shown in **BLUE**, to set your V_{ref} . See **Appendix A** for instructions on how to set the V_{ref} on a driver board.



| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|--|-----|-----|--------|---------------|-------------|
| BBIQU® TMC2208 <small>OTP Mode Maximum 16 Subdivision 35V DC 2A (peak)</small> | GND | GND | 1 / 8 | 1 / 256 | spreadCycle |
| | GND | VIO | 1 / 2 | 1 / 256 | spreadCycle |
| | VIO | GND | 1 / 4 | 1 / 256 | spreadCycle |
| | VIO | VIO | 1 / 16 | 1 / 256 | spreadCycle |

| | | |
|---|--|--|
| Driving Current Calculation Formula R_S (Typical Sense Resistor)= 0.11Ω | $I_{MAX}=V_{ref}*0.9286$ See Appendix B #3. Use 50% to 90% as shown below: $I_{MAX}=(V_{ref}*0.9286)*0.90$ | $V_{ref}=I_{MAX}*1.0769$ See Appendix B #3. Use 50% to 90% as shown below: $V_{ref}=(I_{MAX}*1.0769)*0.90$ |
|---|--|--|

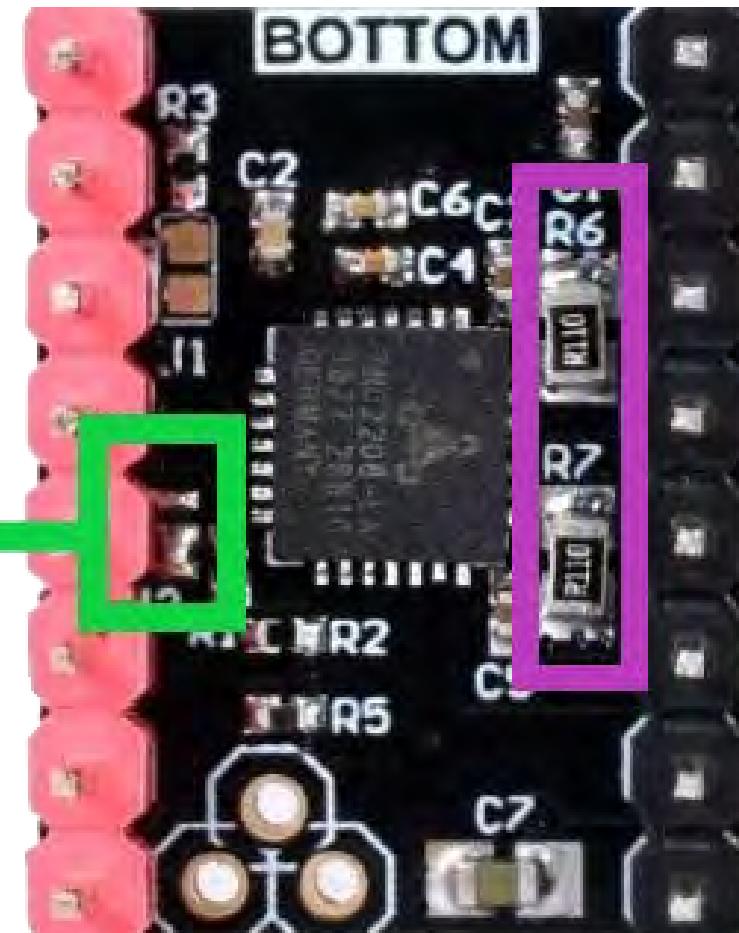


As an example, the picture shows the TOP two pads soldered together, as shown in the **GREEN box**, so that OTP mode can be obtained. To do One-Time-Programming (OTP), the TMC2208 must be placed in UART mode to program it. The **PURPLE box** shows the location of the current sense resistors (R_s).

One Time Programming (OTP) Mode

NOTE: Stand-alone Mode by default uses StealthChop, if you want SpreadCycle, you **MUST** use OTP mode. See TMC220x Configurator for One-Time-Programming Information: [TMC220x Configurator](#).

Important: To place Biqu TMC2208 V3.0 into OTP mode, at J2, you **must solder the top two pads together OR solder the bottom two pads together** on the bottom of the driver board.



MOST Biqu TMC2208 V3.0 driver boards, when purchased for UART mode, will have two adjacent J2 pads already soldered together (located on the bottom of the driver board).

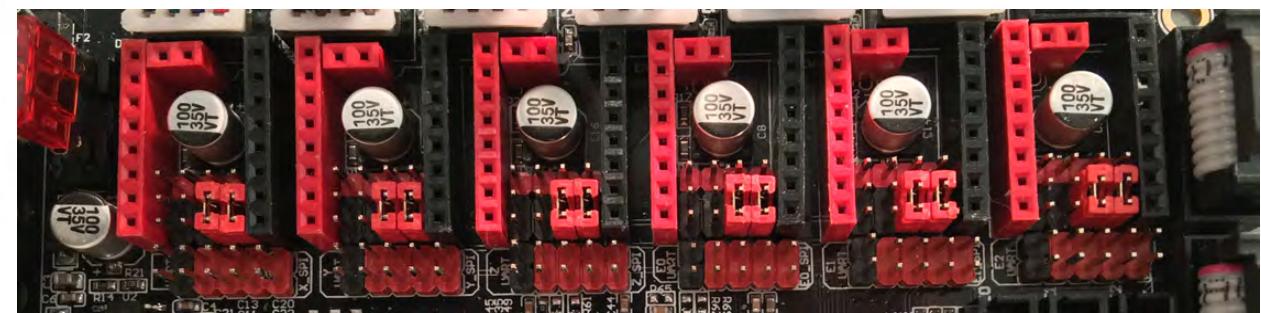
OTP (One Time Programming) Mode

BIGU TMC2208 V3.0

One Time Programming (OTP) Mode

OTP
1 / 8Interpolation: 1/256
SpreadCycle

| | | | |
|------|-----|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | OA2 |
| UART | - | - | OA1 |
| PDN | MS1 | MS0 | OB1 |
| CLK | - | - | OB2 |
| STEP | - | 9 8 | VIO |
| DIR | 9 | 8 | GND |
| | - | - | - |

OTP
1 / 2Interpolation: 1/256
SpreadCycle

| | | | |
|------|-----|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | OA2 |
| UART | - | - | OA1 |
| PDN | MS1 | MS0 | OB1 |
| CLK | - | - | OB2 |
| STEP | - | 9 8 | VIO |
| DIR | 9 | 8 | GND |
| | - | - | - |

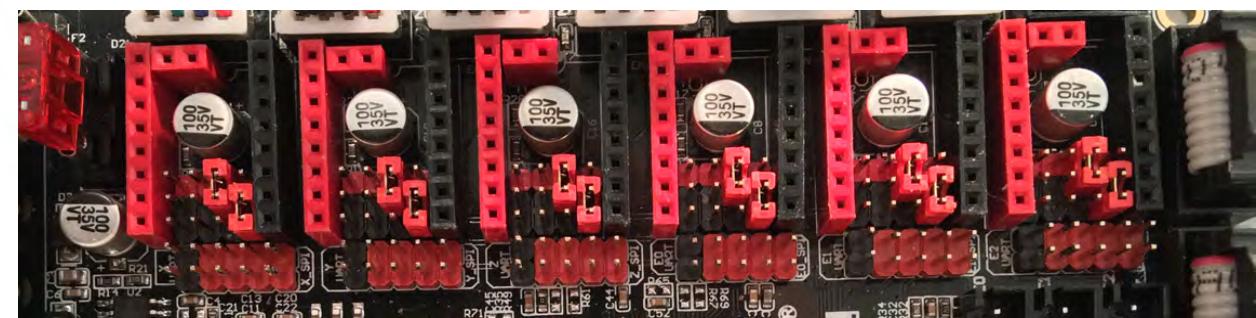


OTP (One Time Programming) Mode

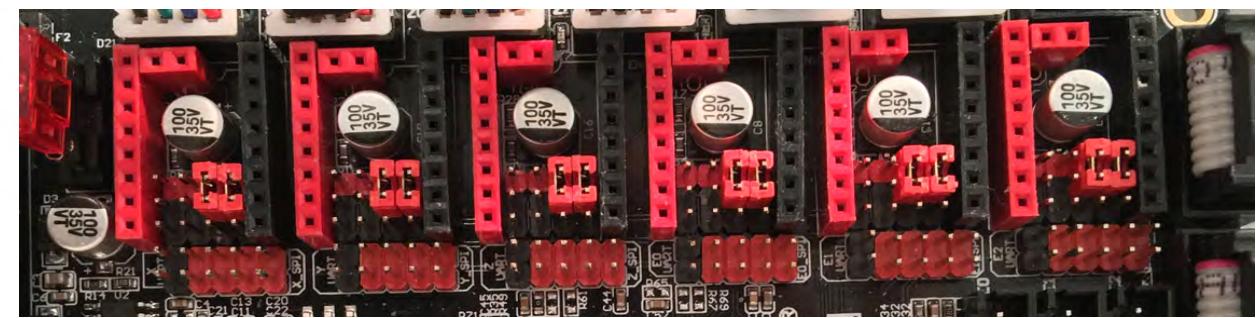
OTP
1 / 4Interpolation: 1/256
SpreadCycle

| | | | | |
|--|------|---|-----|-----|
| | EN | - | - | VM |
| | MS1 | - | - | GND |
| | MS2 | - | - | OA2 |
| | UART | - | MS1 | OA1 |
| | PDN | - | MS0 | OB1 |
| | CLK | - | 9 | OB2 |
| | STEP | - | 9 8 | VIO |
| | DIR | - | - | GND |
| | | | | |

One Time Programming (OTP) Mode

OTP
1 / 16Interpolation: 1/256
SpreadCycle

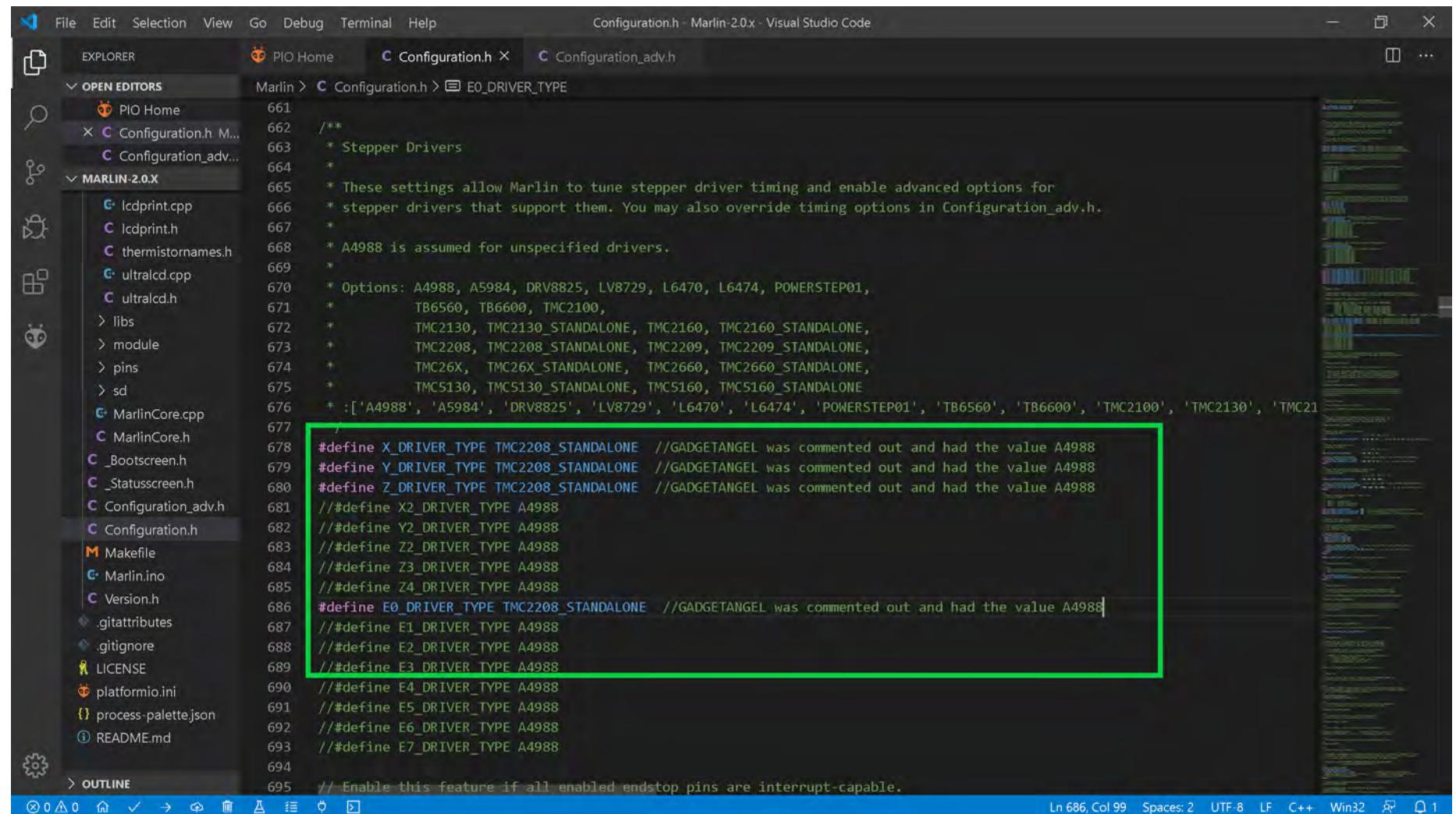
| | | | | |
|--|------|---|-----|-----|
| | EN | - | - | VM |
| | MS1 | - | - | GND |
| | MS2 | - | - | OA2 |
| | UART | - | MS1 | OA1 |
| | PDN | - | MS0 | OB1 |
| | CLK | - | 9 8 | OB2 |
| | STEP | - | 9 8 | VIO |
| | DIR | - | - | GND |
| | | | | |



The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2208 stepper motor drivers in OTP mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in OTP mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in OTP mode. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin 2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
  PIO Home
  Configuration.h M...
  Configuration_adv...
MARLIN-2.0.X
  Lcdprint.cpp
  Lcdprint.h
  thermistornames.h
  ultralcd.cpp
  ultralcd.h
  > libs
  > module
  > pins
  > sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  LICENSE
  platformio.ini
  process-palette.json
  README.md

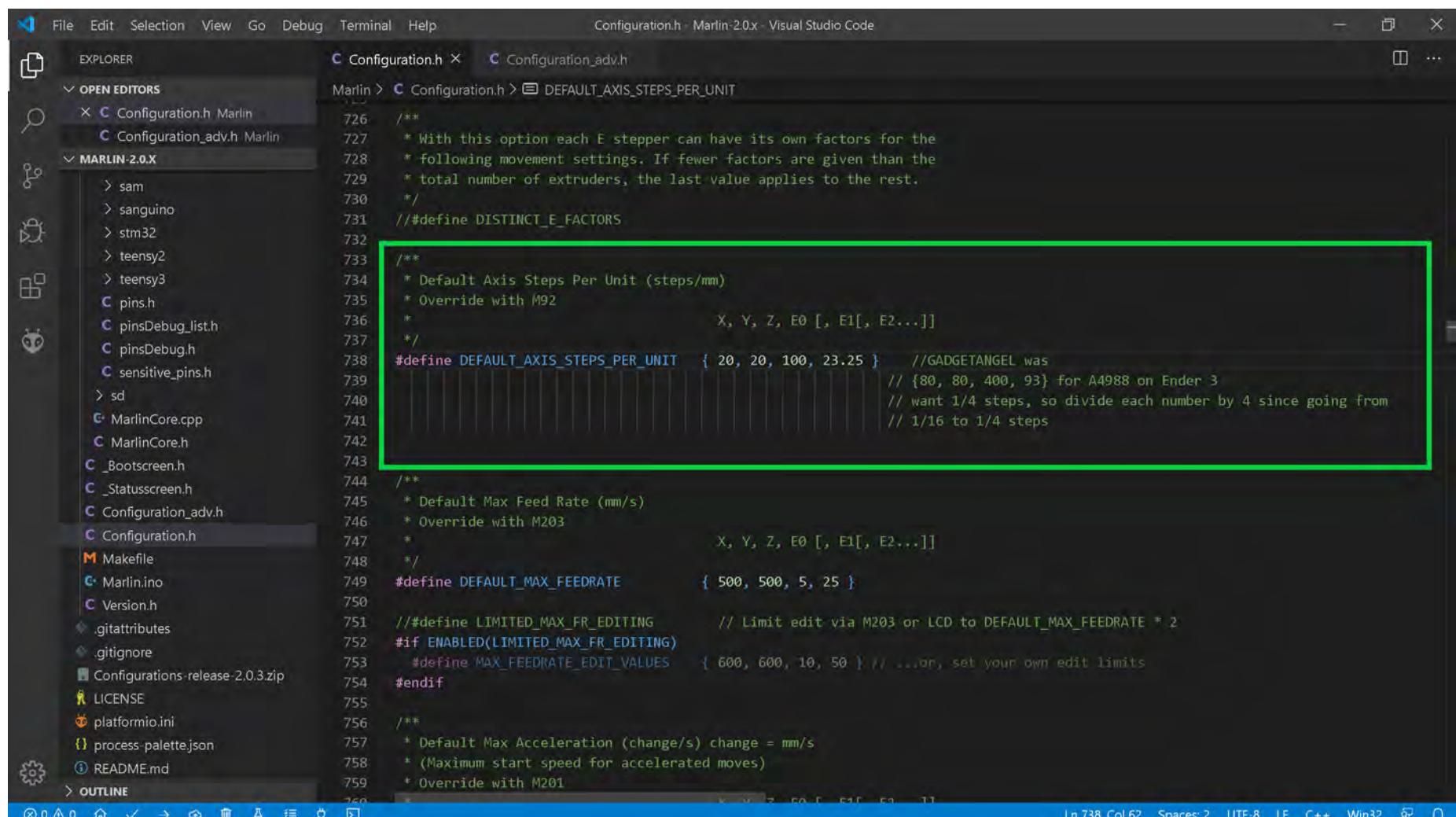
  661 /**
  662 * Stepper Drivers
  663 *
  664 */
  665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
  666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
  667 *
  668 * A4988 is assumed for unspecified drivers.
  669 *
  670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
  671 *           TB6560, TB6600, TMC2100,
  672 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
  673 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
  674 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
  675 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
  676 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130']
  677 */
  678 #define X_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
  679 #define Y_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
  680 #define Z_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
  681 // #define X2_DRIVER_TYPE A4988
  682 // #define Y2_DRIVER_TYPE A4988
  683 // #define Z2_DRIVER_TYPE A4988
  684 // #define Z3_DRIVER_TYPE A4988
  685 // #define Z4_DRIVER_TYPE A4988
  686 #define E0_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
  687 // #define E1_DRIVER_TYPE A4988
  688 // #define E2_DRIVER_TYPE A4988
  689 // #define E3_DRIVER_TYPE A4988
  690 // #define E4_DRIVER_TYPE A4988
  691 // #define E5_DRIVER_TYPE A4988
  692 // #define E6_DRIVER_TYPE A4988
  693 // #define E7_DRIVER_TYPE A4988
  694
  695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to TMC2208 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as seen in the GREEN box below.



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the Marlin 2.0.x configuration header. A green rectangular box highlights the following code block:

```

726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS

732 /**
733 * Default Axis Steps Per Unit (steps/mm)
734 * Override with M92
735 *
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 } // GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // want 1/4 steps, so divide each number by 4 since going from
741 // 1/16 to 1/4 steps
742
743 /**
744 * Default Max Feed Rate (mm/s)
745 * Override with M203
746 *
747 * X, Y, Z, E0 [, E1[, E2...]]
748 */
749 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }

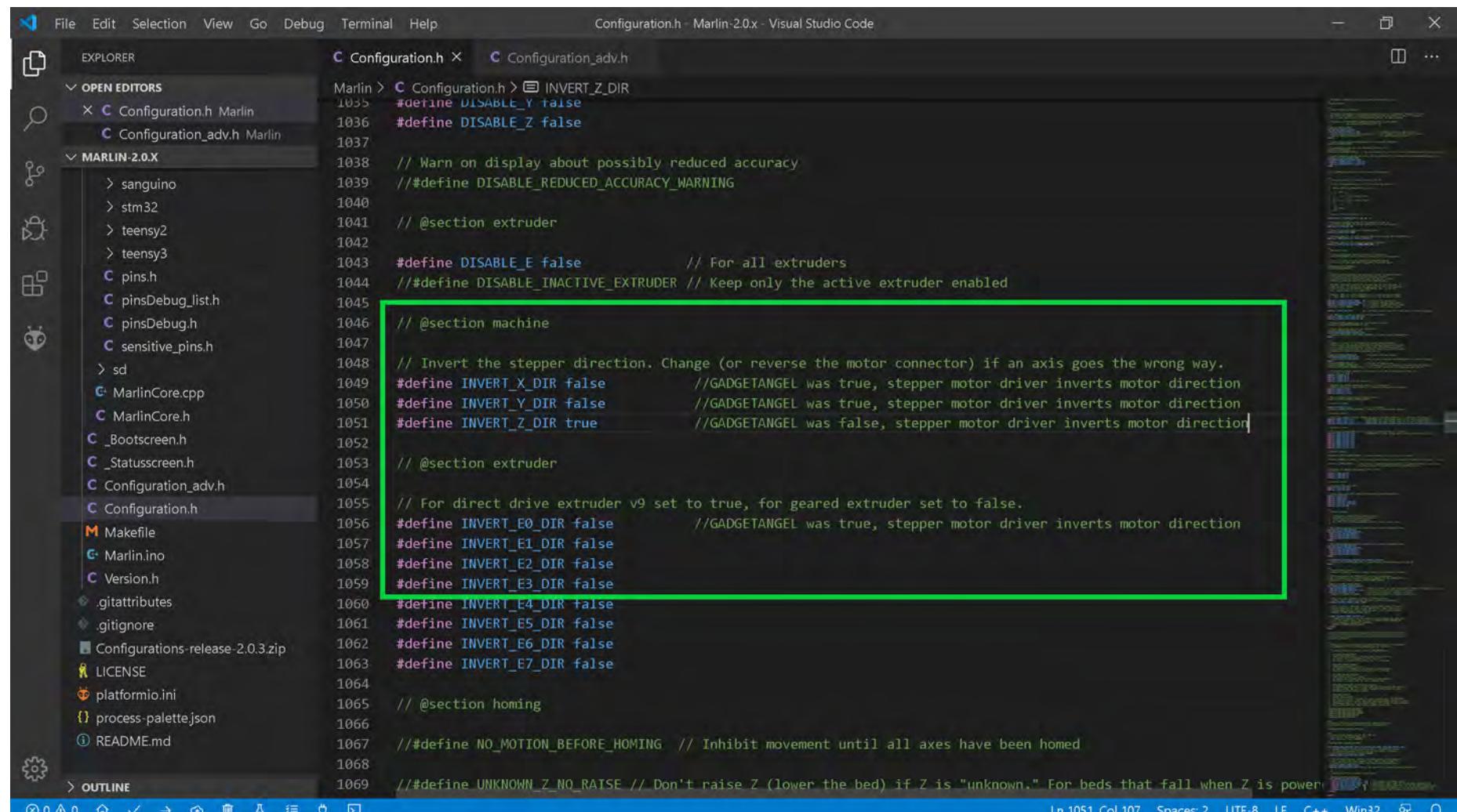
750
751 // #define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
752 #if ENABLED(LIMITED_MAX_FR_EDITING)
753 #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ... or, set your own edit limits
754#endif
755
756 /**
757 * Default Max Acceleration (change/s) change = mm/s
758 * (Maximum start speed for accelerated moves)
759 * Override with M201
760 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the following snippet of C++ code:

```

Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

A green rectangular box highlights the line of code: '#define INVERT_Z_DIR true'. This indicates that the code has been modified to invert the Z-axis direction, as per the instructions in the text above.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

- The end of Marlin setup for BIQU TMC2208 V3.0 drivers in OTP mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x Visual Studio Code

EXPLORER OPEN EDITORS Marlin > Configuration.h X DRIVER_TYPE

pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h

MARLIN-2.0.X

pins_THE_BORG.h pins_VAKE403D.h
teensy2 teensy3 pins.h pinsDebug_list.h pinsDebug.h sensitive_pins.h
sd MarlinCore.cpp MarlinCore.h
Bootscreen.h Statusscreen.h Configuration_adv.h Configuration.h Makefile Marlin.ino Version.h .gitattributes .gitignore LICENSE platformio.ini process-palettejson README.md

PROBLEMS 5 OUTPUT DEBUG CONSOLE TERMINAL 1: Task - Build + ↻ ^ ×

```
STV32F103VE_L1_1 BIGTREE_SKR_PRO SUCCESS 00:02:31.294
BIGTREE_SKR_V1_0 IGNORED
BIGTREE_BTT002 IGNORED
teensy31 IGNORED
teensy35 IGNORED
esp32 IGNORED
linux_native IGNORED
SAMDS1_grandcentral_m4 IGNORED
rumba32_f446ve IGNORED
mks_rumba32 IGNORED
include_tree IGNORED
=====
===== 1 succeeded in 00:02:31.294 =====
```

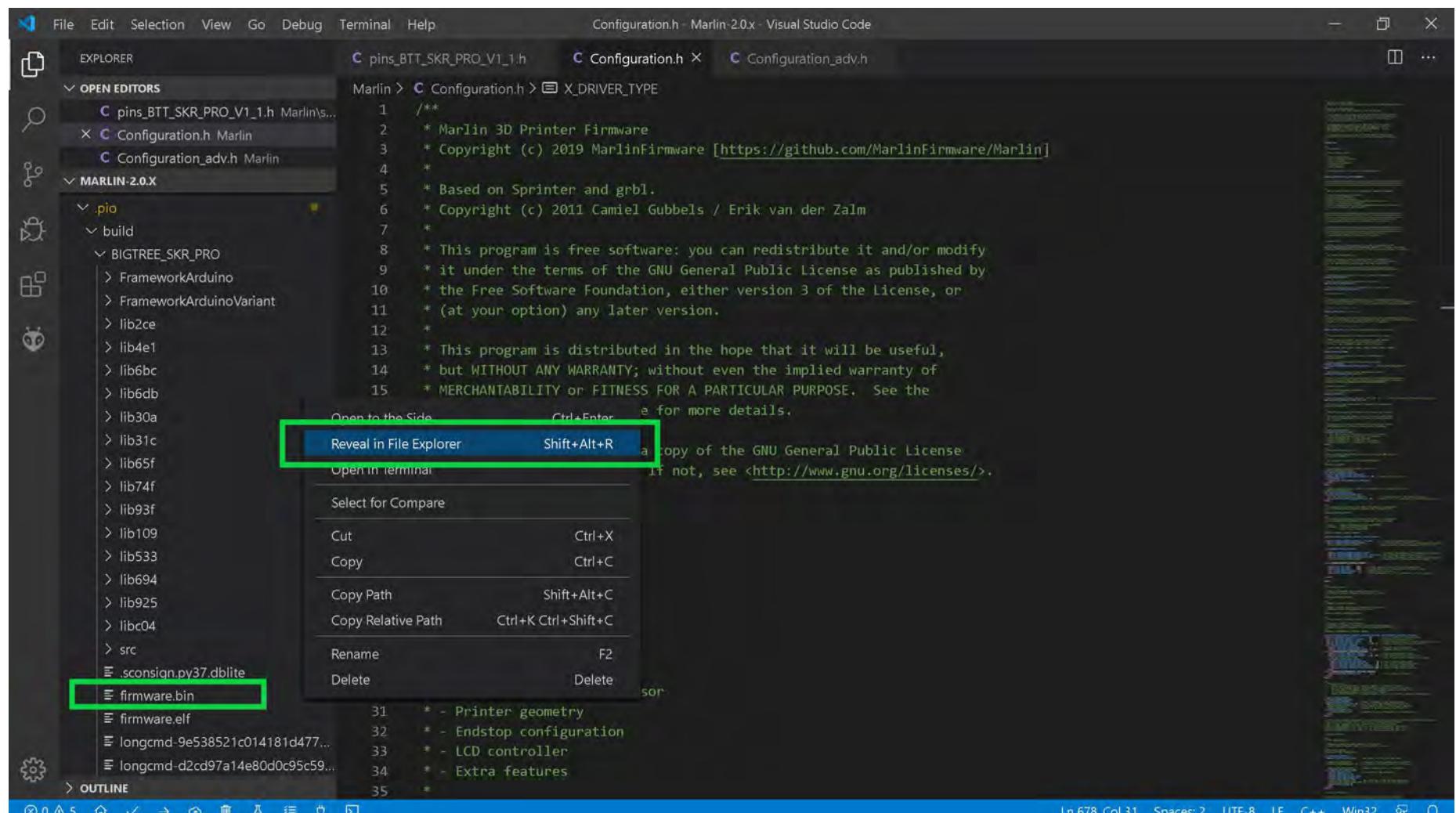
Terminal will be reused by tasks, press any key to close it.

Ln 678, Col 31 Spaces: 2 UTF-8 LF C++ Win32 ↻

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

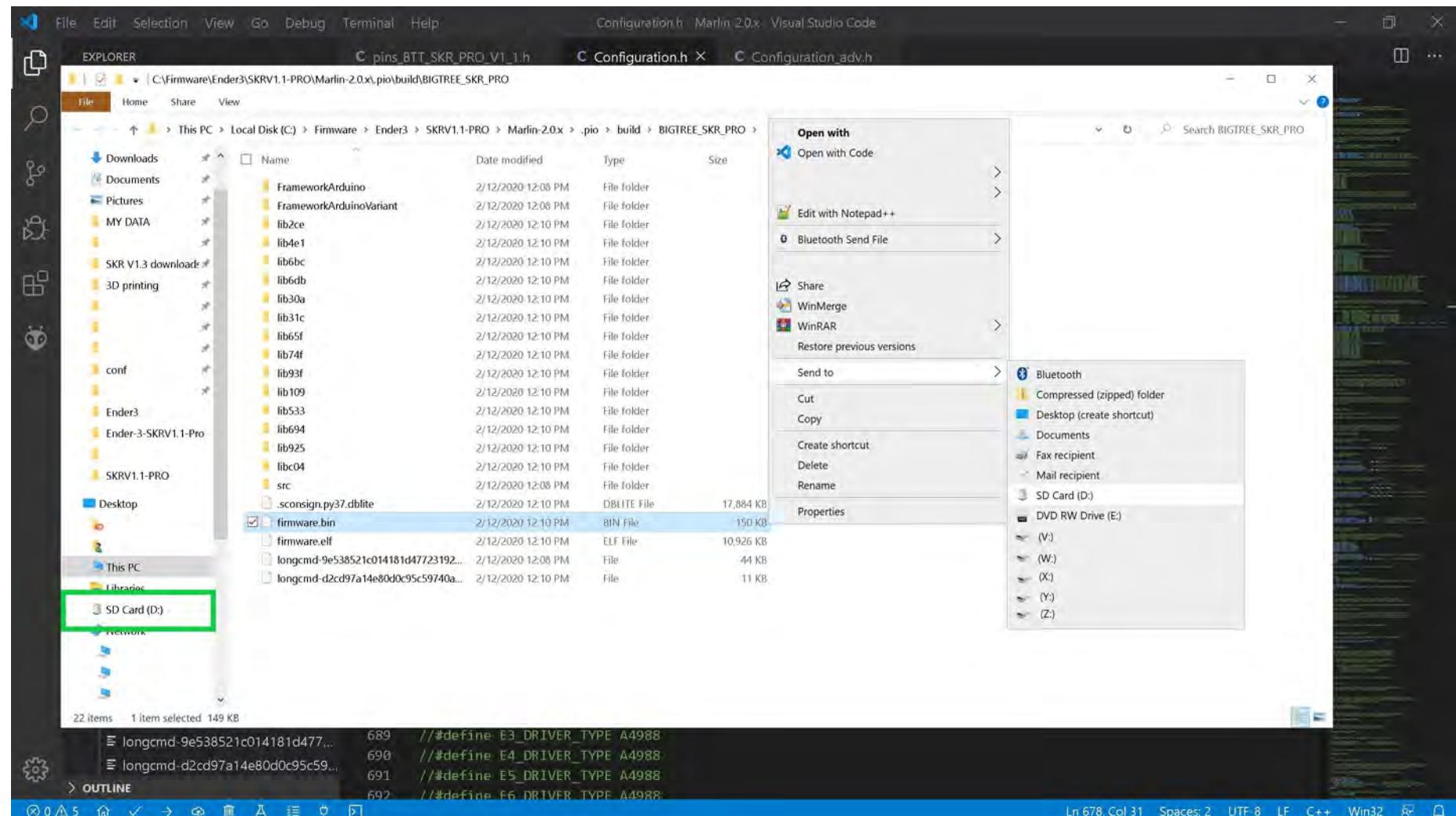
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



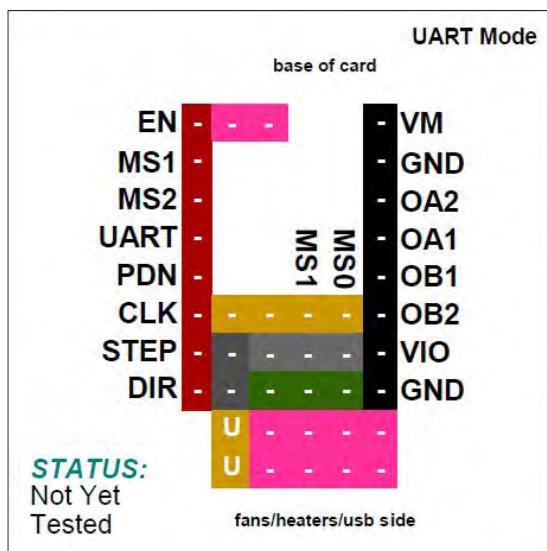
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



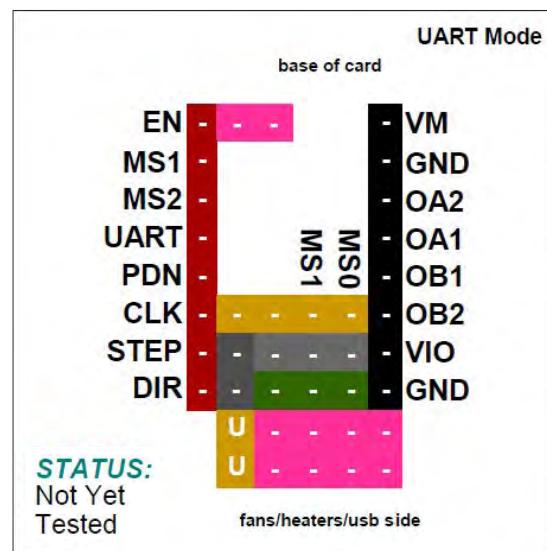
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

BIQU TMC2208 V3.0UART Mode

Note: You can use 50% to 90% of the calculated I_{RMS} ($I_{MAX}/1.414$) when tuning ("X_CURRENT", "Y_CURRENT", etc. the stepper motor driver in the firmware.

See the next page for further information.

| | |
|--|--|
| Driver Chip  TMC2208 UART Mode Maximum 256 Subdivision 35V DC 2A (peak) | Steps are set inside of your Firmware |
| Driving Current Calculation Formula R_S (Typical Sense Resistor)= 0.11Ω | $I_{MAX} = V_{ref}$ See Appendix B #4. Use 50% to 90% as shown below: $I_{MAX} = I_{MAX} * 0.90$ |
| | $V_{ref} = I_{MAX}$ See Appendix B #4. Use 50% to 90% as shown below: $V_{ref} = V_{ref} * 0.90$ |

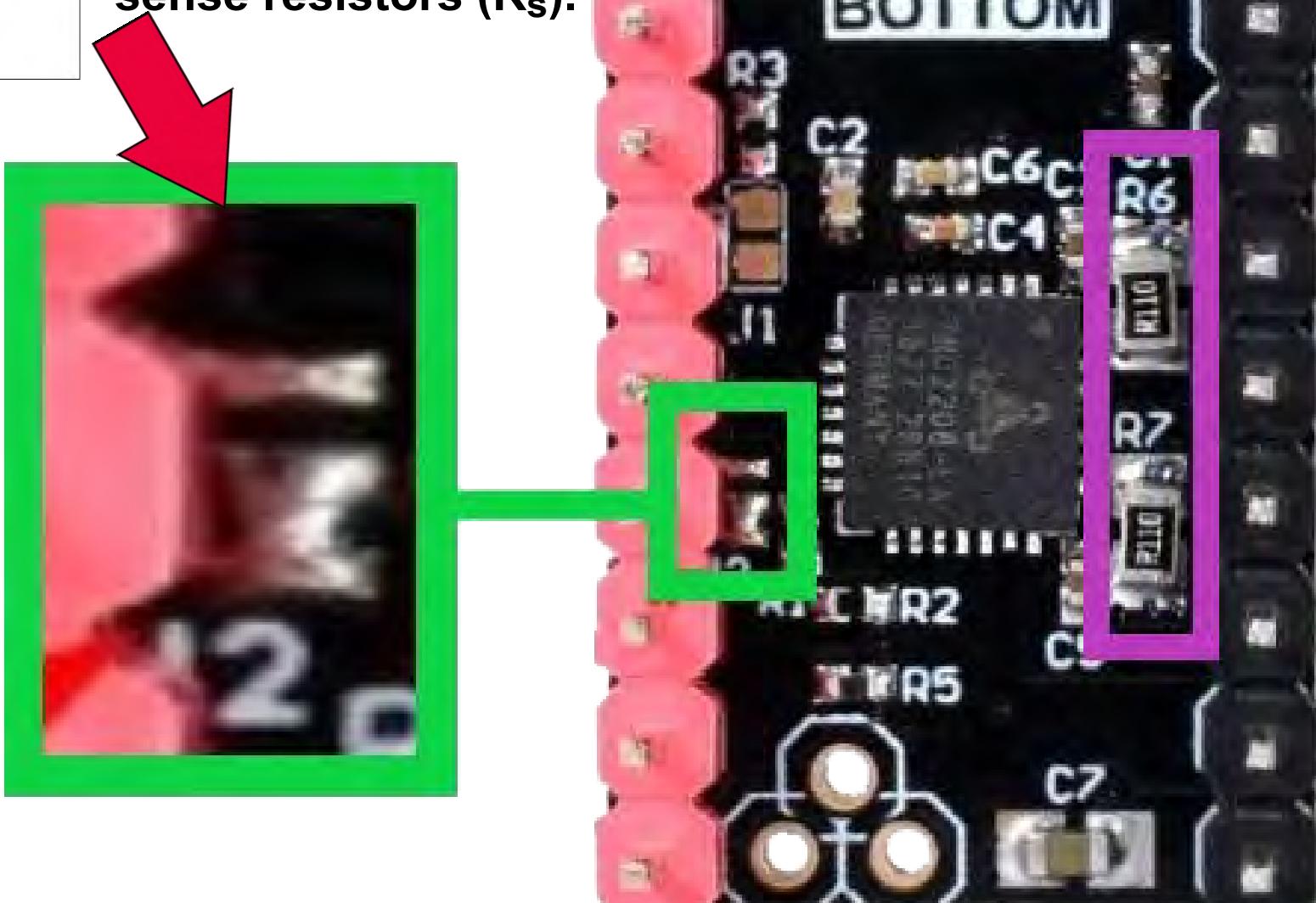


MOST Biqu TMC2208 V3.0 driver boards, when purchased for UART mode, will have two adjacent J2 pads already soldered together (located on the bottom of the driver board).

BIQU TMC2208 V3.0

UART Mode

Important: To ensure that the BIQU TMC2208 V3.0 is in UART Mode, check to see if two adjacent J2 pads are soldered together on the bottom of the driver board, as seen in the **GREEN box** below. The **PURPLE box** shows the location of the current sense resistors (R_s). 



UART Mode**UART Mode**

Note: The location of the current sense resistors are shown in **GREEN**. Use the current sense resistors' value in the Marlin Firmware ("X_RSENSE", "Y_RSENSE", "Z_RSENSE" and/or "E0_RSENSE") so that the appropriate current limit can be sent to the driver board. If you do not want to use V_{ref} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT", and/or "E0_CURRENT".

$R_s = R_{050}$ is 0.05 Ohms

$R_s = R_{062}$ is 0.062 Ohms

$R_s = R_{068}$ is 0.068 Ohms

$R_s = R_{075}$ is 0.075 Ohms

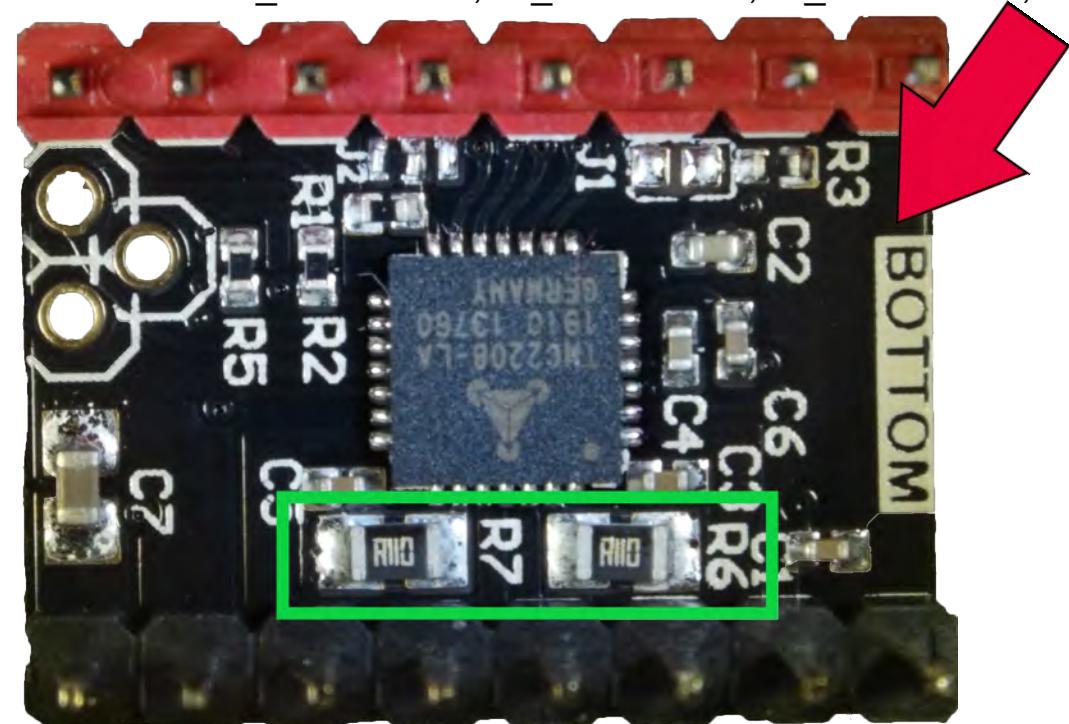
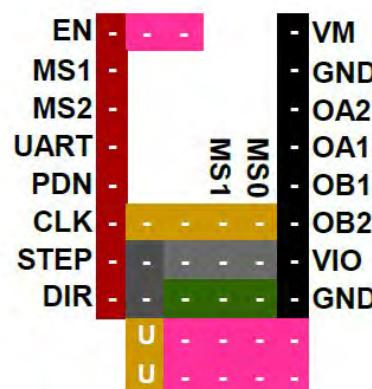
$R_s = R_{100}$ is 0.1 Ohms

$R_s = R_{110}$ is 0.11 Ohms

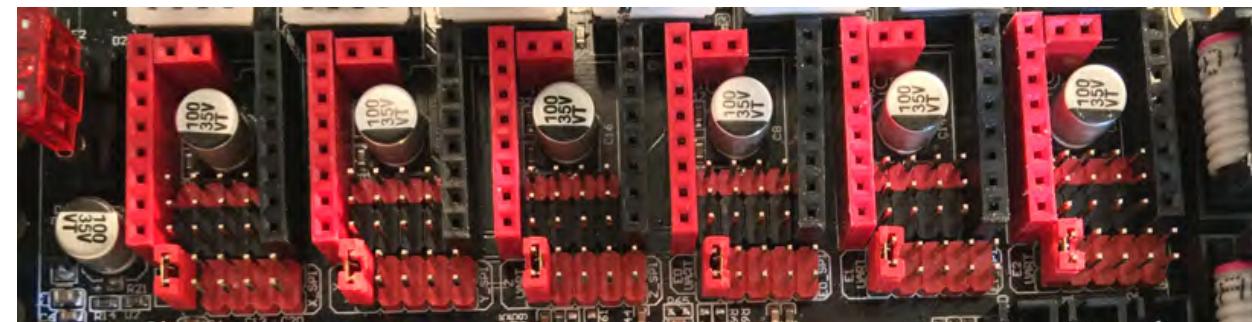
$R_s = R_{150}$ is 0.15 Ohms

$R_s = R_{200}$ is 0.2 Ohms

$R_s = R_{220}$ is 0.22 Ohms

**UART**

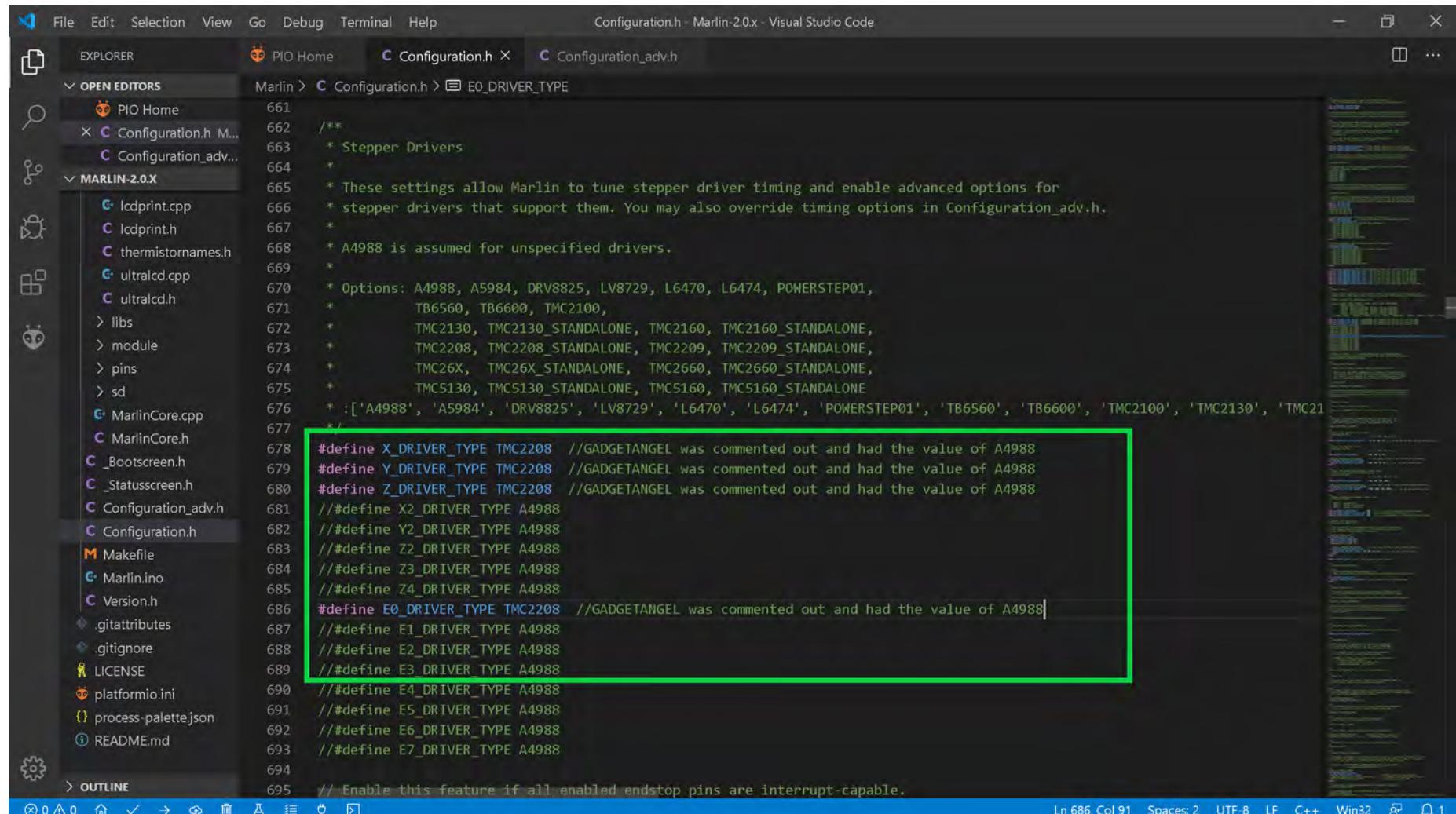
Note: Set Jumper "U" for UART MODE!!



The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2208 V3.0 stepper motor drivers in UART mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in UART mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in UART mode. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the following configuration for stepper drivers:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC26X', 'TMC5130']
676 */
677
678 #define X_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
679 #define Y_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
680 #define Z_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

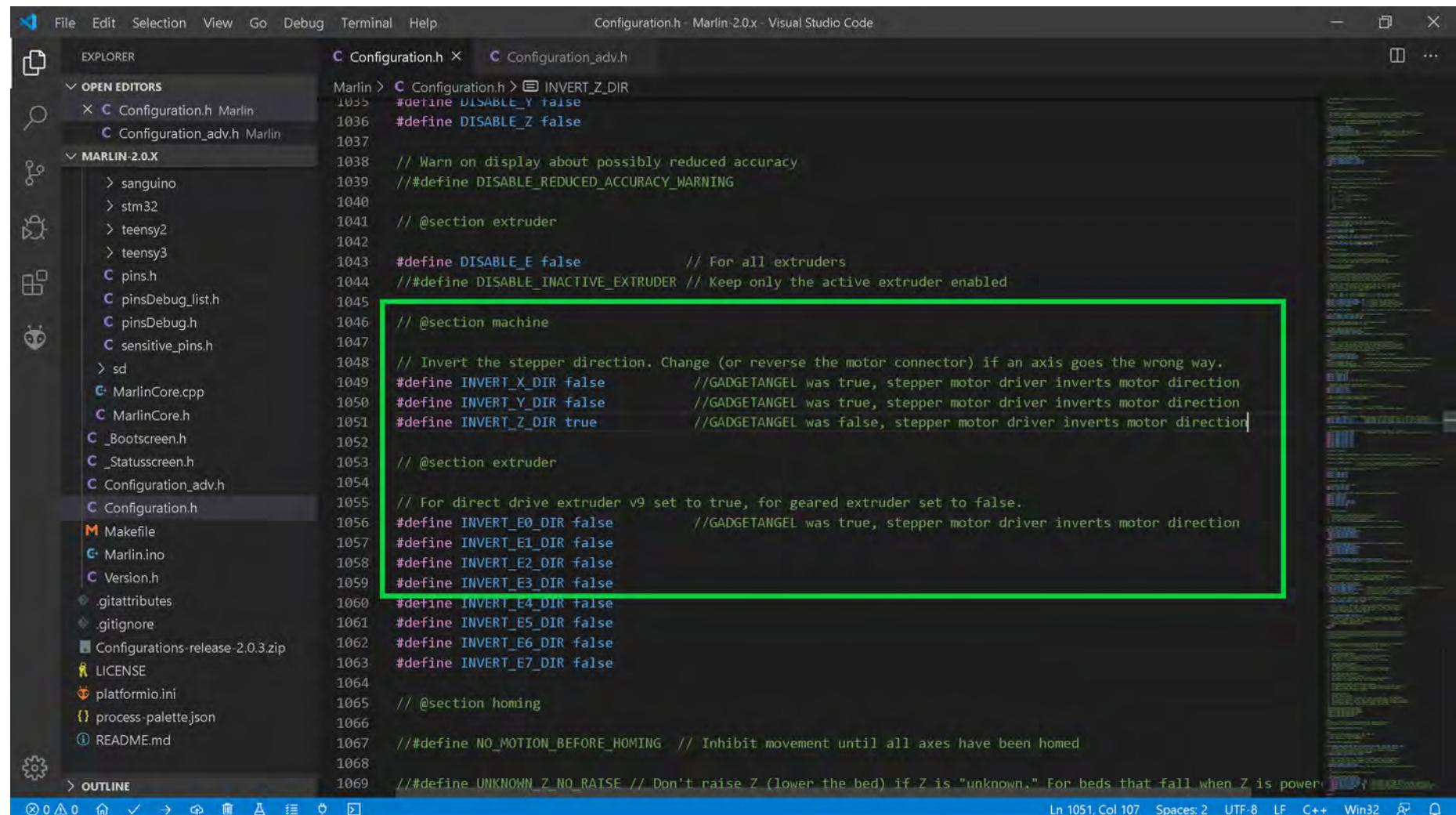
```

A green rectangular box highlights the driver type definitions for X, Y, Z, and E0 axes, showing the values GADGETANGEL had assigned to them. The rest of the code is standard Marlin driver configuration.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > INVERT_Z_DIR
  1035 #define DISABLE_Y false
  1036 #define DISABLE_Z false
  1037
  1038 // Warn on display about possibly reduced accuracy
  1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
  1040
  1041 // @section extruder
  1042
  1043 #define DISABLE_E false           // For all extruders
  1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
  1045
  1046 // @section machine
  1047
  1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
  1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
  1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
  1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
  1052
  1053 // @section extruder
  1054
  1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
  1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
  1057 #define INVERT_E1_DIR false
  1058 #define INVERT_E2_DIR false
  1059 #define INVERT_E3_DIR false
  1060 #define INVERT_E4_DIR false
  1061 #define INVERT_E5_DIR false
  1062 #define INVERT_E6_DIR false
  1063 #define INVERT_E7_DIR false
  1064
  1065 // @section homing
  1066
  1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
  1068
  1069 // #define UNKNOWN_Z_NO_RATE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered up

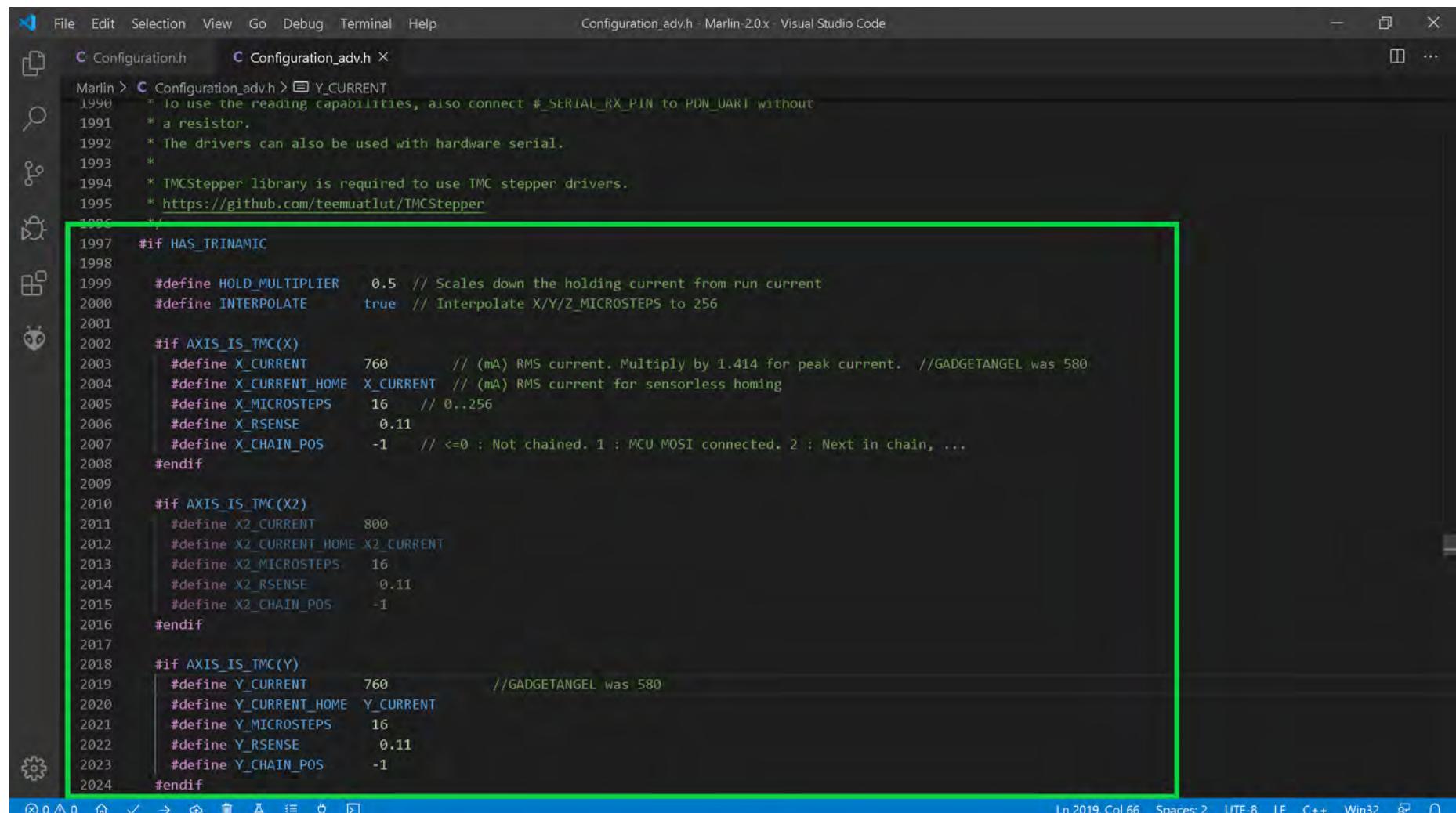
```

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- Next you want to set your V_{ref} in the Marlin firmware for each axis that has the TMC2208 driver, as seen in the **GREEN** box below. I changed the "X_CURRENT" to be the calculated V_{ref} for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated V_{ref} for my Y-Axis, which is 760mV on the Ender 3.
- Ensure "X_RSENSE" is set to 0.11. Ensure "Y_RSENSE" is set to 0.11.
- If you **do not want to use V_{ref}** as the value for "X_CURRENT" and/or "Y_CURRENT", you should **use I_{RMS} instead**. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "X_CURRENT" and/or "Y_CURRENT".



```

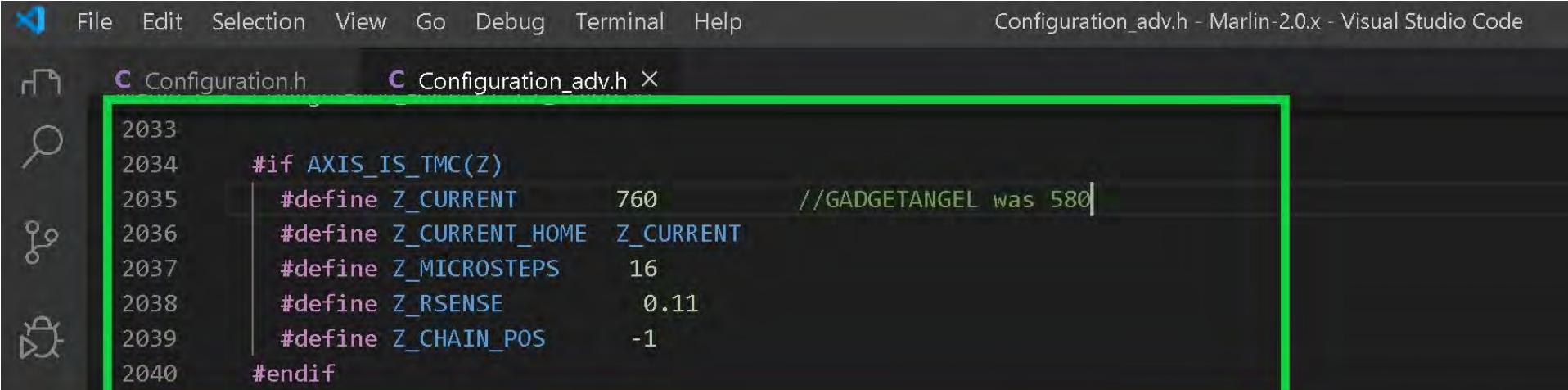
File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0x - Visual Studio Code
Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > Y_CURRENT
1990 * To use the reading capabilities, also connect #_SERIAL_RX_PIN to PDN_UART without
1991 * a resistor.
1992 * The drivers can also be used with hardware serial.
1993 *
1994 * TMCStepper library is required to use TMC stepper drivers.
1995 * https://github.com/teemuatlut/TMCStepper
1996 */
1997 #if HAS_TRINAMIC
1998
1999 #define HOLD_MULTIPLIER 0.5 // Scales down the holding current from run current
2000 #define INTERPOLATE true // Interpolate X/Y/Z_MICROSTEPS to 256
2001
2002 #if AXIS_IS_TMC(X)
2003 #define X_CURRENT 760 // (mA) RMS current. Multiply by 1.414 for peak current. //GADGETANGEL was 580
2004 #define X_CURRENT_HOME X_CURRENT // (mA) RMS current for sensorless homing
2005 #define X_MICROSTEPS 16 // 0..256
2006 #define X_RSENSE 0.11
2007 #define X_CHAIN_POS -1 // <=0 : Not chained. 1 : MCU MOSI connected. 2 : Next in chain, ...
2008#endif
2009
2010 #if AXIS_IS_TMC(X2)
2011 #define X2_CURRENT 800
2012 #define X2_CURRENT_HOME X2_CURRENT
2013 #define X2_MICROSTEPS 16
2014 #define X2_RSENSE 0.11
2015 #define X2_CHAIN_POS -1
2016#endif
2017
2018 #if AXIS_IS_TMC(Y)
2019 #define Y_CURRENT 760 //GADGETANGEL was 580
2020 #define Y_CURRENT_HOME Y_CURRENT
2021 #define Y_MICROSTEPS 16
2022 #define Y_RSENSE 0.11
2023 #define Y_CHAIN_POS -1
2024#endif

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- Now, I am setting the V_{ref} for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated V_{ref} for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated V_{ref} for my Extruder, which is 900mV on the Ender 3.
- Ensure "Z_RSENSE" is set to 0.11. Ensure "E0_RSENSE" is set to 0.11.
- If you do not want to use V_{ref} as the value for "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS} = I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "Z_CURRENT" and/or "E0_CURRENT".



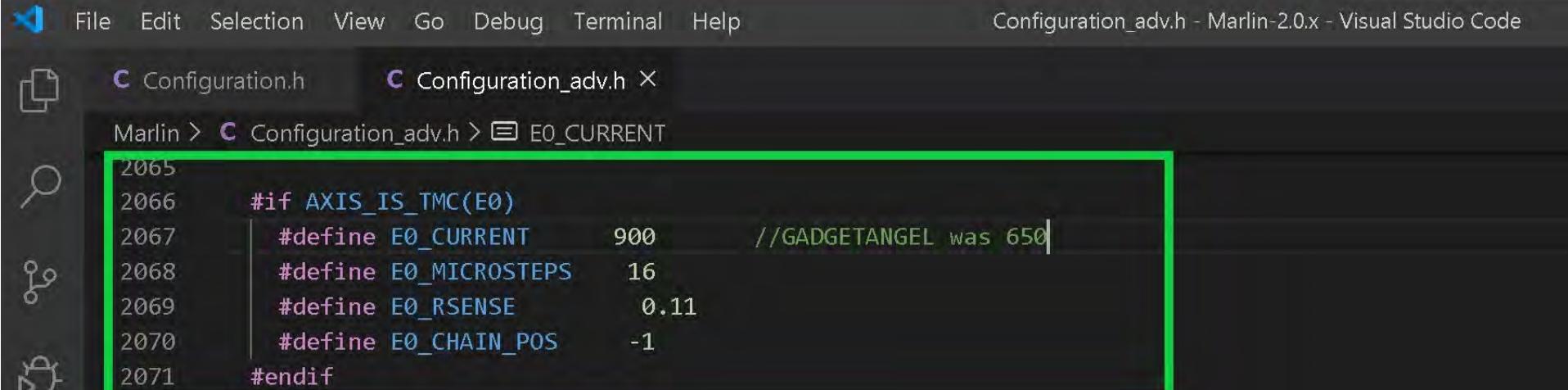
```

File Edit Selection View Go Debug Terminal Help
Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

Configuration.h Configuration_adv.h X

2033
2034 #if AXIS_IS_TMC(Z)
2035   #define Z_CURRENT      760           //GADGETANGEL was 580
2036   #define Z_CURRENT_HOME Z_CURRENT
2037   #define Z_MICROSTEPS    16
2038   #define Z_RSENSE        0.11
2039   #define Z_CHAIN_POS     -1
2040 #endif

```



```

File Edit Selection View Go Debug Terminal Help
Configuration.h Configuration_adv.h X
Marlin > Configuration_adv.h > E0_CURRENT

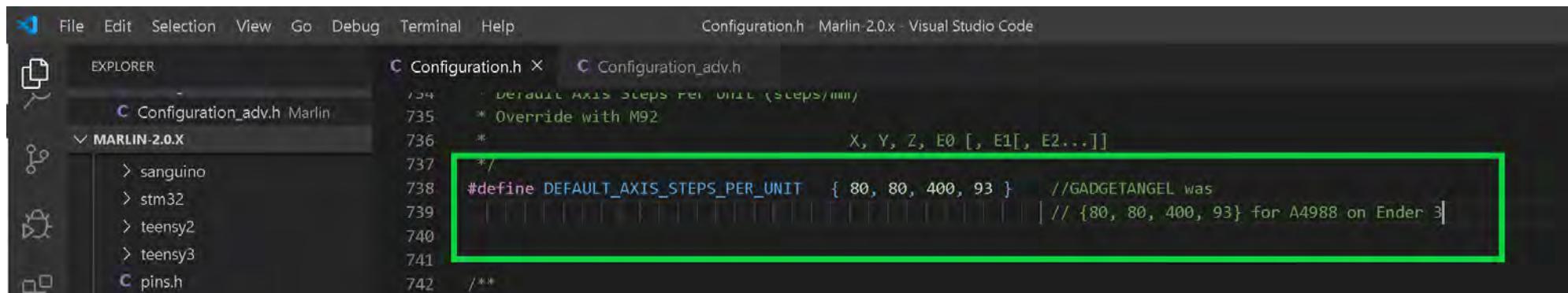
2065
2066 #if AXIS_IS_TMC(E0)
2067   #define E0_CURRENT      900           //GADGETANGEL was 650
2068   #define E0_MICROSTEPS   16
2069   #define E0_RSENSE        0.11
2070   #define E0_CHAIN_POS     -1
2071 #endif

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



File Edit Selection View Go Debug Terminal Help Configuration.h Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

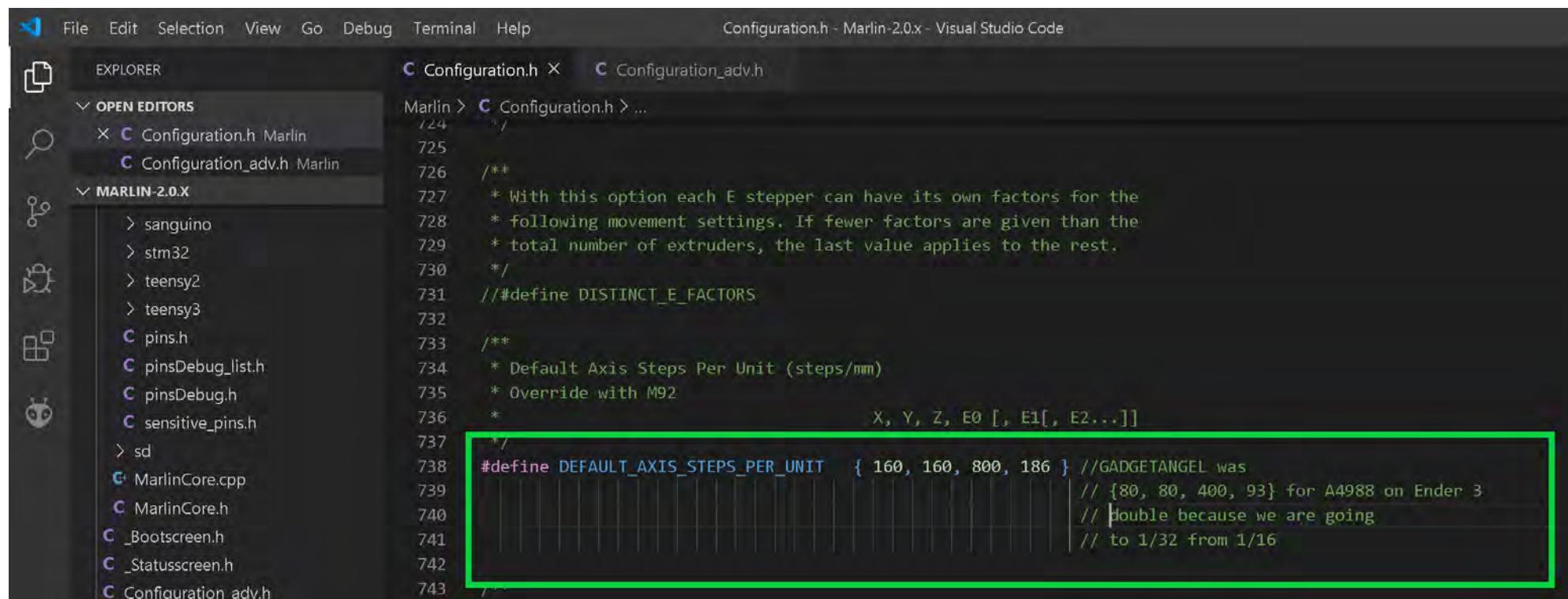
MARLIN-2.0.X

```

734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 80, 80, 400, 93 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740
741 /**
742 */

```

- FOR EXAMPLE if you wanted to use 1/32 stepping instead of the default 1/16, you would be **doubling** your STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X

```

724 */
725
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 *
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // Double because we are going
741 // to 1/32 from 1/16
742
743 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- By default stealthChop is enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

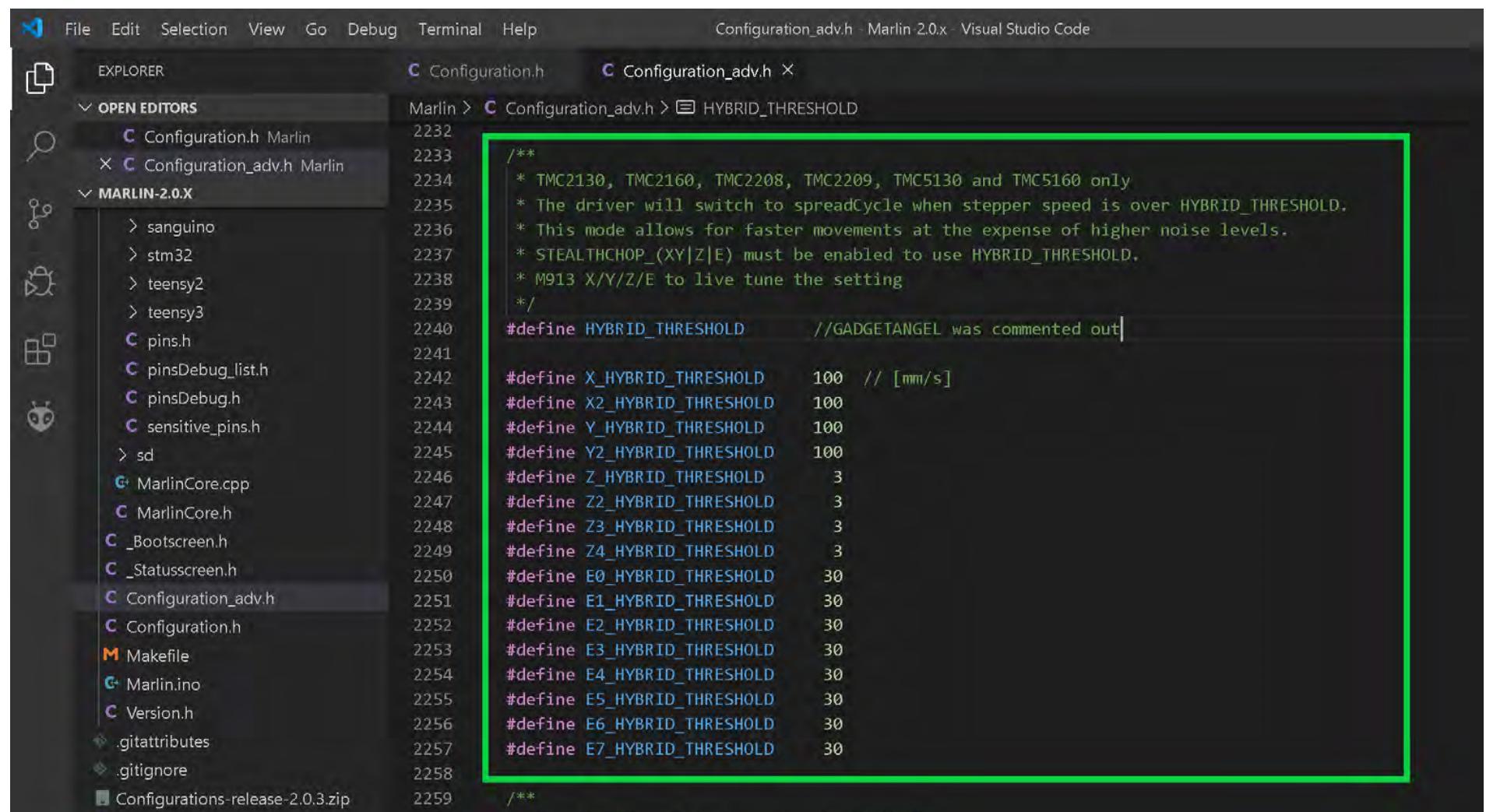
EXPLORER Configuration.h Configuration_adv.h ×
OPEN EDITORS Marlin > Configuration_adv.h > STEALTHCHOP_XY
  Configuration.h Marlin Configuration_adv.h Marlin
  Configuration.h Marlin Configuration_adv.h Marlin
MARLIN-2.0.X
    > sanguino
    > stm32
    > teensy2
    > teensy3
    pins.h
    pinsDebug_list.h
    pinsDebug.h
    sensitive_pins.h
    > sd
    MarlinCore.cpp
    MarlinCore.h
    _Bootscreen.h
    _Statusscreen.h
    Configuration_adv.h
    Configuration.h
  2193  */
  2194 #define STEALTHCHOP_XY
  2195 #define STEALTHCHOP_Z
  2196 #define STEALTHCHOP_E
  2197
  2198 /**
  2199 * Optimize spreadCycle chopper parameters by using predefined parameter sets
  2200 * or with the help of an example included in the library.
  2201 * Provided parameter sets are
  2202 * CHOPPER_DEFAULT_12V
  2203 * CHOPPER_DEFAULT_19V
  2204 * CHOPPER_DEFAULT_24V
  2205 * CHOPPER_DEFAULT_36V
  2206 * CHOPPER_PRUSAMK3_24V // Imported parameters from the official Prusa firmware for MK3 (24V)
  2207 * CHOPPER_MARLIN_119 // Old defaults from Marlin v1.1.9
  2208 *
  2209 * Define your own with
  2210 * { <off_time[1..15]>, <hysteresis_end[-3..12]>, hysteresis_start[1..8] }
  2211 */
  2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
  2213
  2214 /**

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- Now you either enable "HYBRID_THRESHOLD" or disable it. By default, it is disabled. "HYBRID_THRESHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



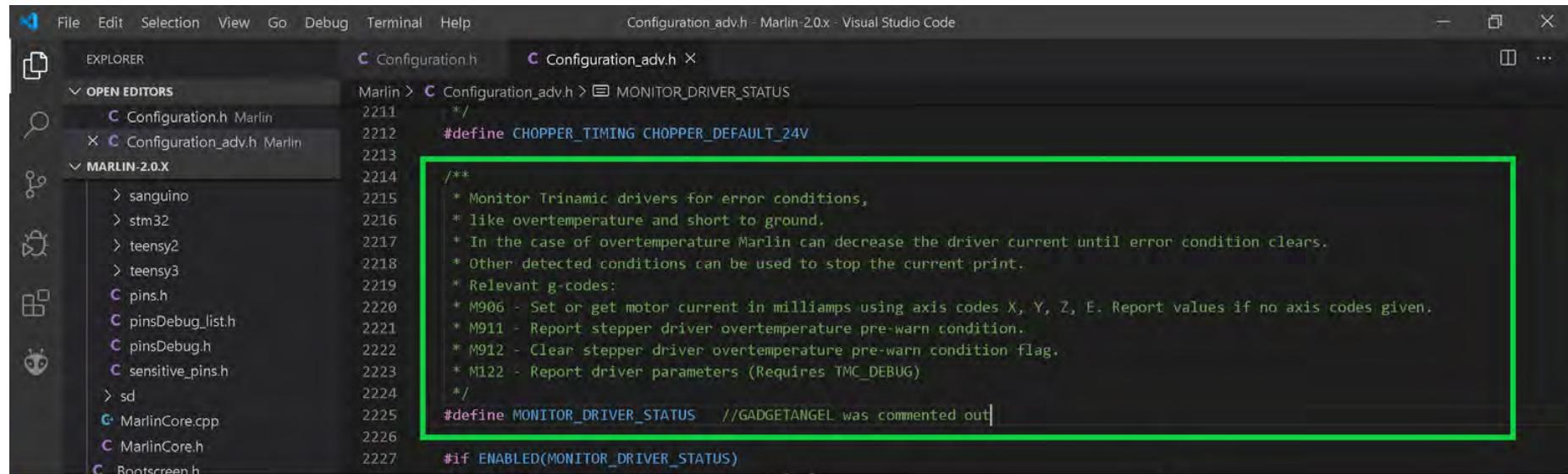
The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Debug, Terminal, Help
- Title Bar:** Configuration_adv.h - Marlin 2.0.x - Visual Studio Code
- Explorer:** Shows the project structure under 'OPEN EDITORS' and 'MARLIN-2.0.X' (including sanguino, stm32, teensy2, teensy3, pins.h, pinsDebug_list.h, pinsDebug.h, sensitive_pins.h, sd, MarlinCore.cpp, MarlinCore.h, _Bootscreen.h, _Statusscreen.h, Configuration_adv.h, Configuration.h, Makefile, Marlin.ino, Version.h, .gitattributes, .gitignore, Configurations-release-2.0.3.zip).
- Code Editor:** Displays the content of Configuration_adv.h. A specific line is highlighted with a green border:


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```

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- Now I want to enable some statements that allow me access to debugging the TMC drivers. I will uncomment "MONITOR_DRIVER_STATUS" and "TMC_DEBUG". "MONITOR_DRIVER_STATUS" will enable the following G-codes: M906, M911, and M912, "TMC_DEBUG" will enable the M122 G-code command. You can read about these from the comments in the firmware and in [Marlin's documentation located on-line.](#)



File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

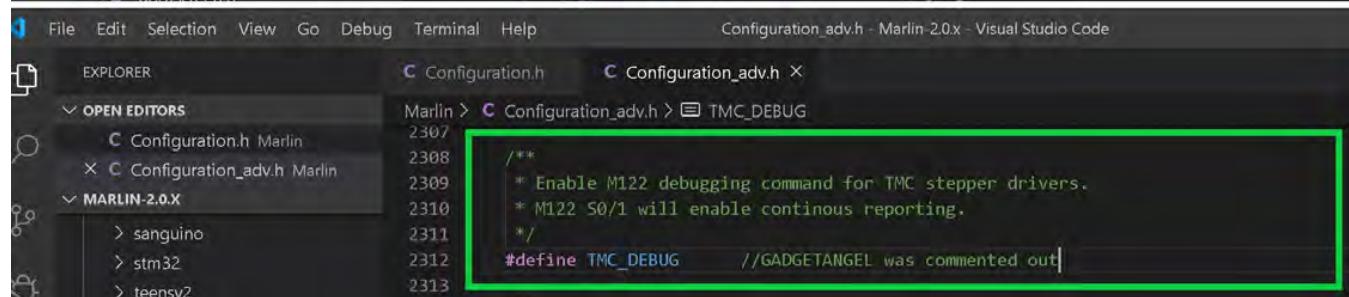
MARLIN-2.0.X

- sanguino
- stm32
- teensy2
- teensy3
- pins.h**
- pinsDebug_list.h**
- pinsDebug.h**
- sensitive_pins.h**
- sd
- MarlinCore.cpp
- MarlinCore.h
- Bootscreen.h

```

2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213
2214 /**
2215 * Monitor Trinamic drivers for error conditions,
2216 * like overtemperature and short to ground.
2217 * In the case of overtemperature Marlin can decrease the driver current until error condition clears.
2218 * Other detected conditions can be used to stop the current print.
2219 * Relevant g-codes:
2220 * M906 - Set or get motor current in millamps using axis codes X, Y, Z, E. Report values if no axis codes given.
2221 * M911 - Report stepper driver overtemperature pre-warn condition.
2222 * M912 - Clear stepper driver overtemperature pre-warn condition flag.
2223 * M122 - Report driver parameters (Requires TMC_DEBUG)
2224 */
2225 #define MONITOR_DRIVER_STATUS //GADGETANGEL was commented out
2226
2227 #if ENABLED(MONITOR_DRIVER_STATUS)

```



File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin 2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X

- sanguino
- stm32
- teensy2

```

2307 */
2308 /**
2309 * Enable M122 debugging command for TMC stepper drivers.
2310 * M122 S0/1 will enable continuous reporting.
2311 */
2312 #define TMC_DEBUG //GADGETANGEL was commented out
2313

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- The end of Marlin setup for BIQU TMC2208 V3.0 drivers in UART mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

The screenshot shows the Visual Studio Code interface with the Marlin 2.0.x repository open. The left sidebar displays the file structure, including `pins_BTT_SKR_PRO_V1_1.h`, `Configuration.h`, and `Configuration_adv.h`. The main editor area shows configuration code for stepper drivers, with comments explaining tuning options for different driver types. The bottom right corner features a terminal window showing the results of a build task. A green box highlights the entry for `BIGTREETECH_SKR_PRO` in the terminal log, which completed successfully in 00:02:31.294. Other entries listed include `BIGTREETECH_SKR_V1.1.0`, `BIGTREETECH_SKR_V1.1.2`, `teensy31`, `teensy35`, `esp32`, `linux_native`, `SAMD51_grandcentral_m4`, `rumba32_f446ve`, `mks_rumba32`, and `include_tree`. The terminal also displays a message indicating 1 succeeded in 00:02:31.294.

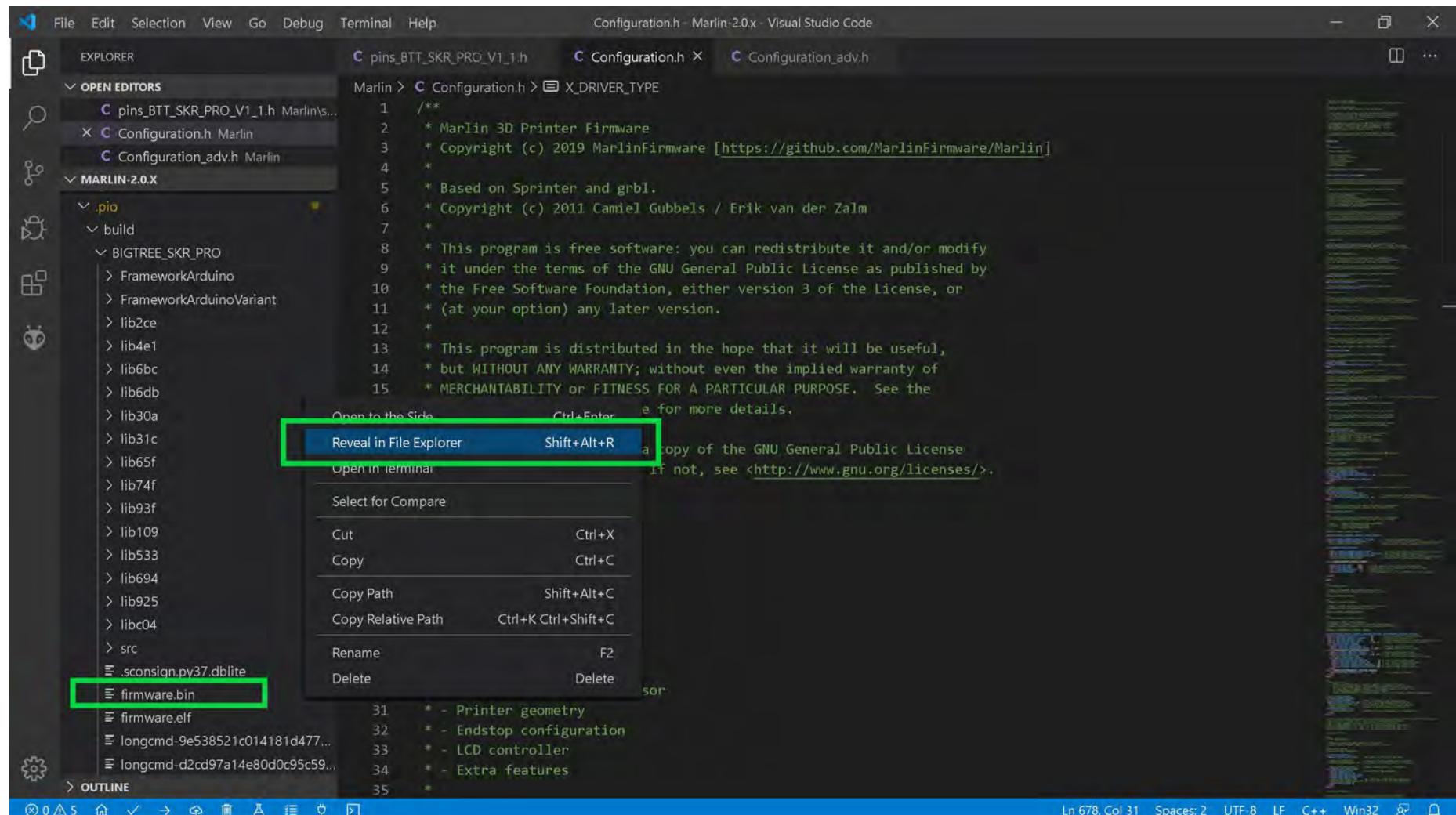
| Board | Status | Time |
|------------------------|---------|--------------|
| BIGTREETECH_SKR_PRO | SUCCESS | 00:02:31.294 |
| BIGTREETECH_SKR_V1.1.0 | IGNORED | |
| BIGTREETECH_SKR_V1.1.2 | IGNORED | |
| teensy31 | IGNORED | |
| teensy35 | IGNORED | |
| esp32 | IGNORED | |
| linux_native | IGNORED | |
| SAMD51_grandcentral_m4 | IGNORED | |
| rumba32_f446ve | IGNORED | |
| mks_rumba32 | IGNORED | |
| include_tree | IGNORED | |

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

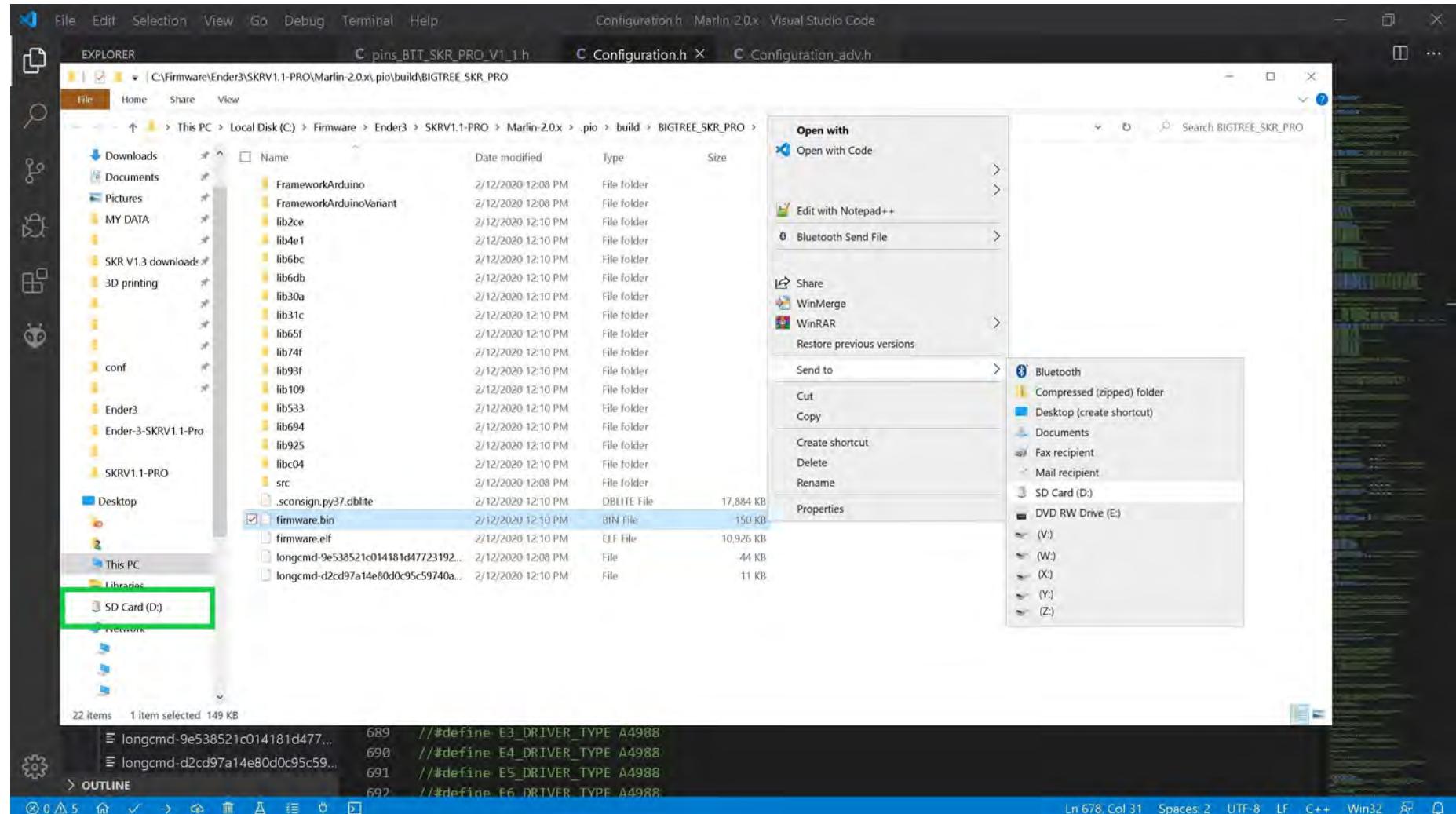
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



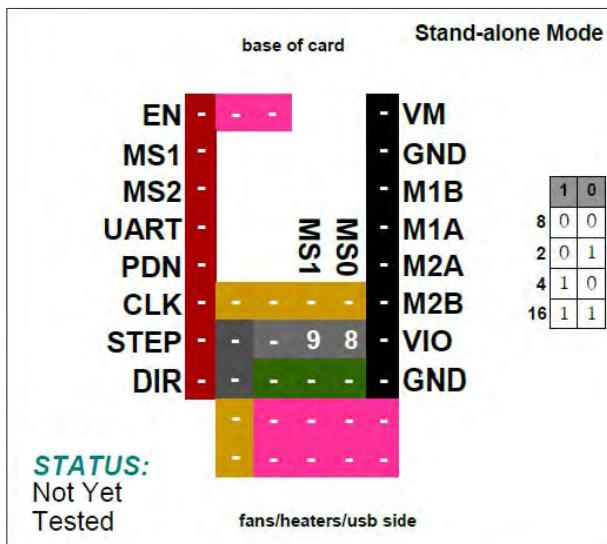
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



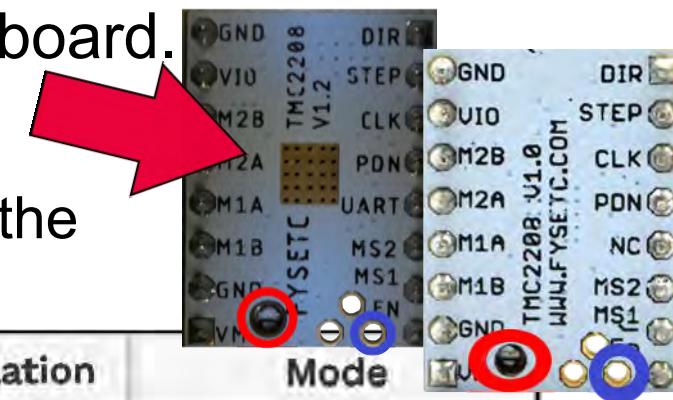
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.



FYSETC TMC2208 V1.2

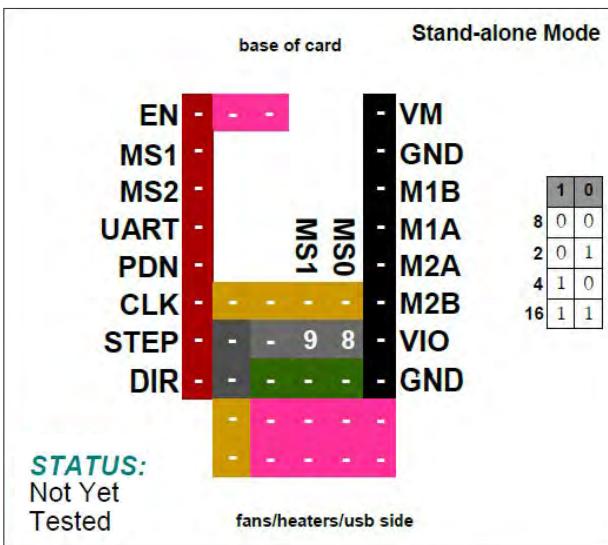
Stand-alone Mode

NOTE: Use the potentiometer (POT) on the top of the board, as shown in **RED**; or use the board's " V_{ref} Test point" location, as shown in **BLUE**, to set your V_{ref} . See **Appendix A** for instructions on how to set the V_{ref} on a driver board.



Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|--|--|-----|--------|--|-------------|
| FYSETC TMC2208 Stand Alone Mode Maximum 16 Subdivision 35V DC 2A (peak) | GND | GND | 1 / 8 | 1 / 256 | stealthChop |
| | GND | VIO | 1 / 2 | 1 / 256 | stealthChop |
| | VIO | GND | 1 / 4 | 1 / 256 | stealthChop |
| | VIO | VIO | 1 / 16 | 1 / 256 | stealthChop |
| Driving Current Calculation Formula R_S (Typical Sense Resistor) = 0.11Ω | $I_{MAX} = V_{ref} * 0.9286$ See Appendix B #3. Use 50% to 90% as shown below: $I_{MAX} = (V_{ref} * 0.9286) * 0.90$ | | | $V_{ref} = I_{MAX} * 1.0769$ See Appendix B #3. Use 50% to 90% as shown below: $V_{ref} = (I_{MAX} * 1.0769) * 0.90$ | |

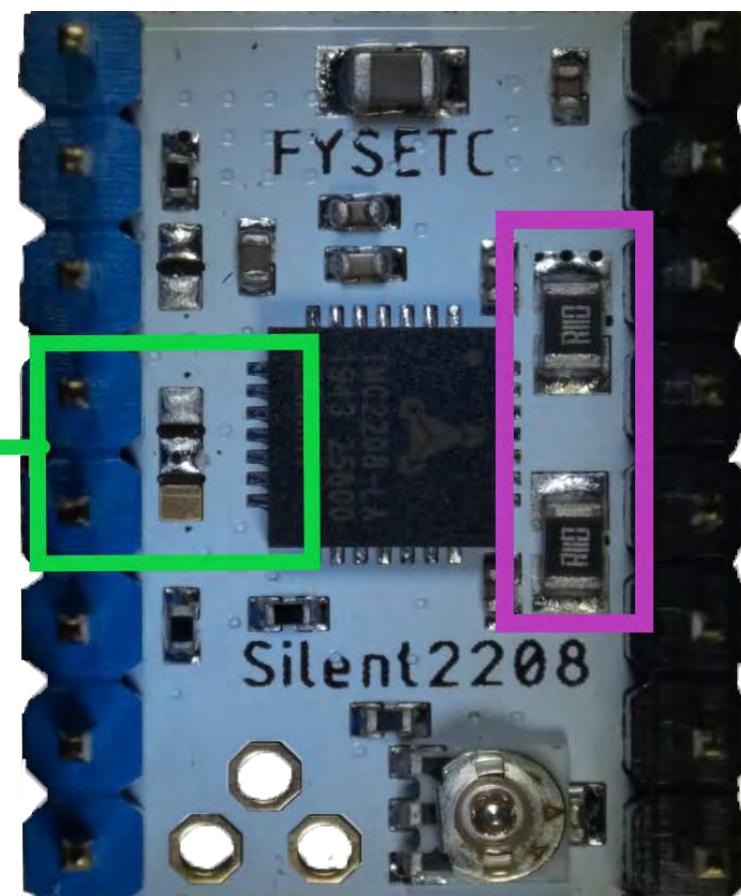
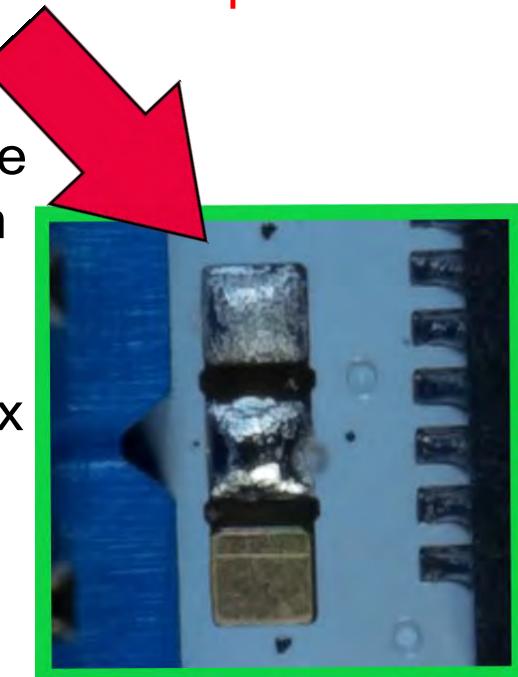


FYSETC TMC2208 V1.2

Stand-alone Mode

Note: To determine if your driver board is in UART mode, check the bottom of the driver board for three pads, located in the same position as shown in the picture below. There could be two or three pads located at this position (let's call it the "J2" position). To have the driver board in STANDALONE MODE, ALL the pads at "J2" MUST NOT be connected.

Again, a gap MUST be in place between on all (three or two) "J2" pads to obtain Standalone Mode for the FYSETC TMC2208 V1.X, as seen in the **GREEN** box below. The **PURPLE** box shows the location of the current sense resistors (R_s).



MOST FYSETC TMC2208 boards are sold as V1.2 driver boards. The V1.2 driver board **might be** setup to be in UART mode. BUT the V1.0 driver board is setup to be in STANDALONE mode by default. So **please check your boards to ensure they are in the correct mode!!**

FYSETC TMC2208 V1.2 for Standalone Mode

FYSETC TMC2208 V1.2

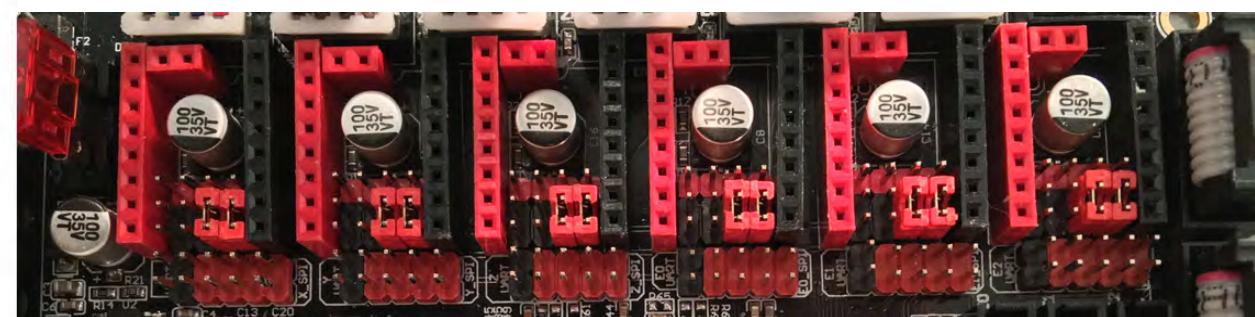
Stand-alone Mode

Stand-alone Mode

1 / 8Interpolation: **1/256**

StealthChop

| | | | | |
|------|---|---|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | M1B |
| UART | - | - | MS1 | M1A |
| PDN | - | - | MS0 | M2A |
| CLK | - | - | - | M2B |
| STEP | - | - | 9 | VIO |
| DIR | - | 9 | 8 | GND |
| | - | - | - | - |



Stand-alone Mode

1 / 2Interpolation: **1/256**

StealthChop

| | | | | |
|------|---|---|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | M1B |
| UART | - | - | MS1 | M1A |
| PDN | - | - | MS0 | M2A |
| CLK | - | - | 8 | M2B |
| STEP | - | - | 9 | VIO |
| DIR | - | 9 | - | GND |
| | - | - | - | - |



FYSETC TMC2208 V1.2

Stand-alone Mode

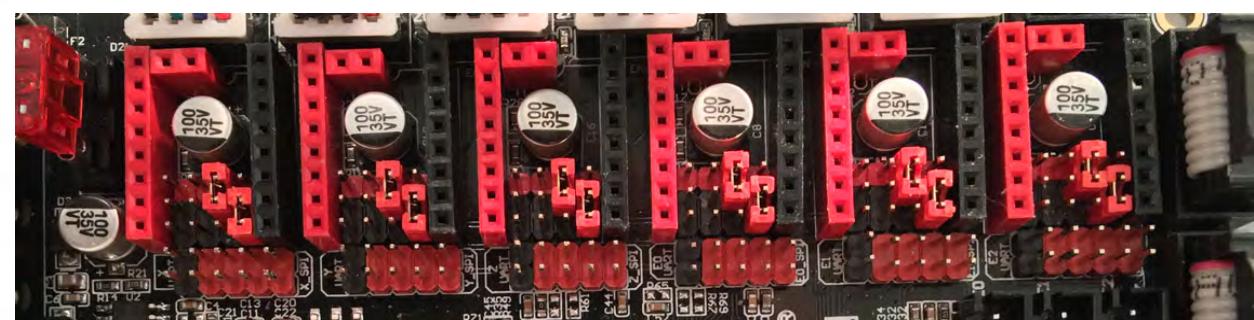
Stand-alone Mode

1 / 4

Interpolation: 1/256

StealthChop

| | | | |
|------|-----|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | M1B |
| UART | - | - | M1A |
| PDN | MS1 | MS0 | M2A |
| CLK | 9 | - | M2B |
| STEP | - | 9 8 | VIO |
| DIR | - | - | GND |



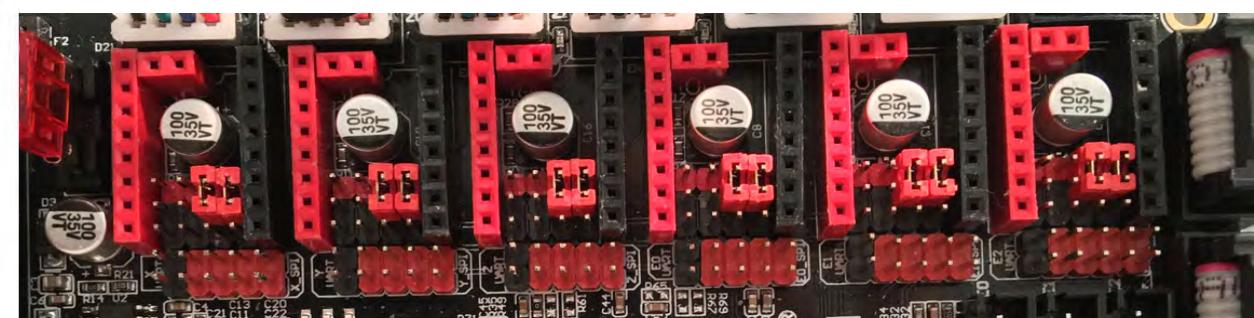
Stand-alone Mode

1 / 16

Interpolation: 1/256

StealthChop

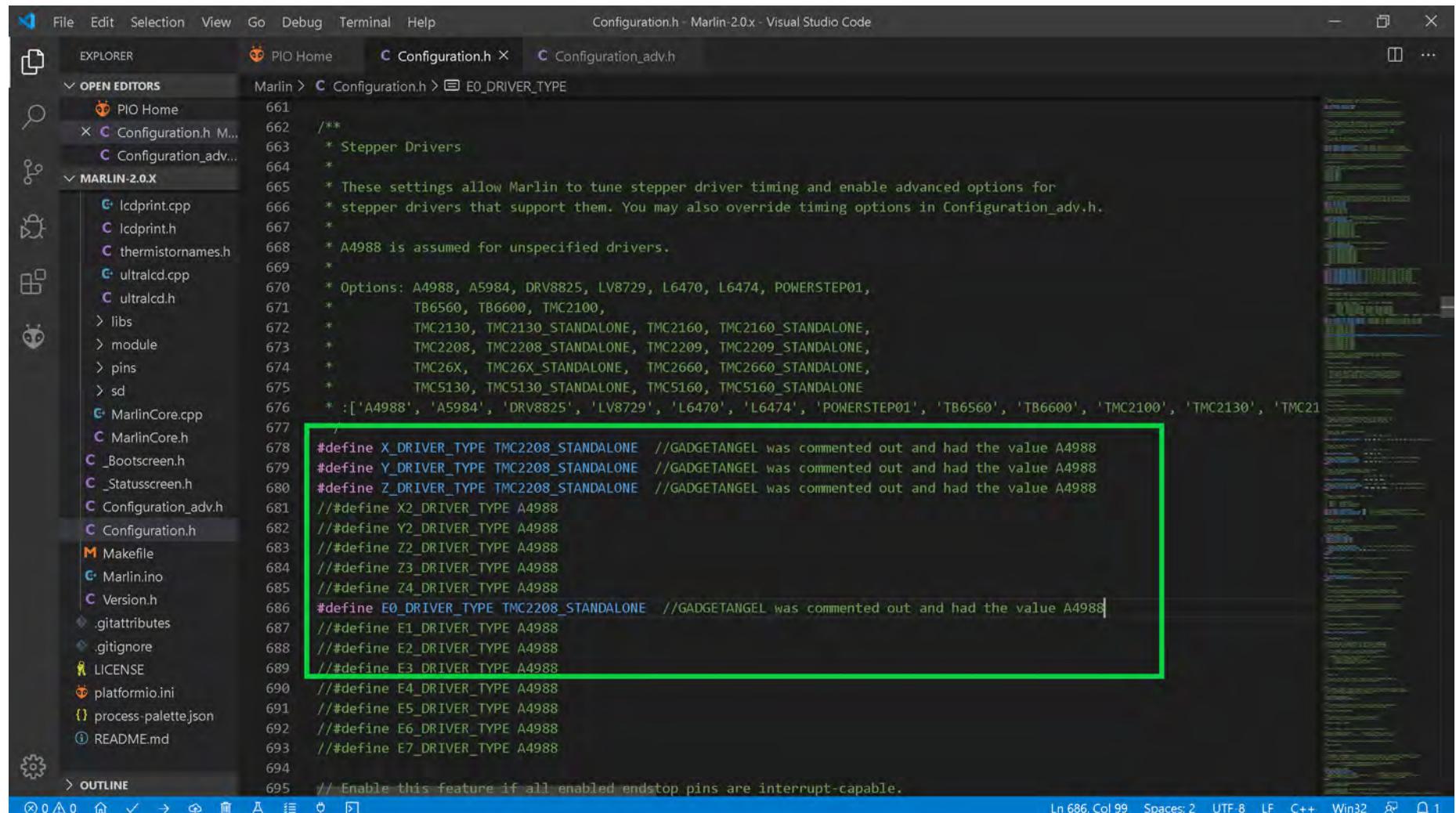
| | | | |
|------|-----|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | M1B |
| UART | - | - | M1A |
| PDN | MS1 | MS0 | M2A |
| CLK | 9 | 8 | M2B |
| STEP | - | 9 8 | VIO |
| DIR | - | - | GND |



The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand-alone Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for FYSETC TMC2208 V1.2 stepper motor drivers in stand-alone mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in stand-alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in stand-alone mode. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following configuration for stepper drivers:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 * TB6560, TB6600, TMC2100,
671 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE,
675 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208',
676 * TMC26X', 'TMC5130'],
677 */
678 #define X_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
681 //##define X2_DRIVER_TYPE A4988
682 //##define Y2_DRIVER_TYPE A4988
683 //##define Z2_DRIVER_TYPE A4988
684 //##define Z3_DRIVER_TYPE A4988
685 //##define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
687 //##define E1_DRIVER_TYPE A4988
688 //##define E2_DRIVER_TYPE A4988
689 //##define E3_DRIVER_TYPE A4988
690 //##define E4_DRIVER_TYPE A4988
691 //##define E5_DRIVER_TYPE A4988
692 //##define E6_DRIVER_TYPE A4988
693 //##define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

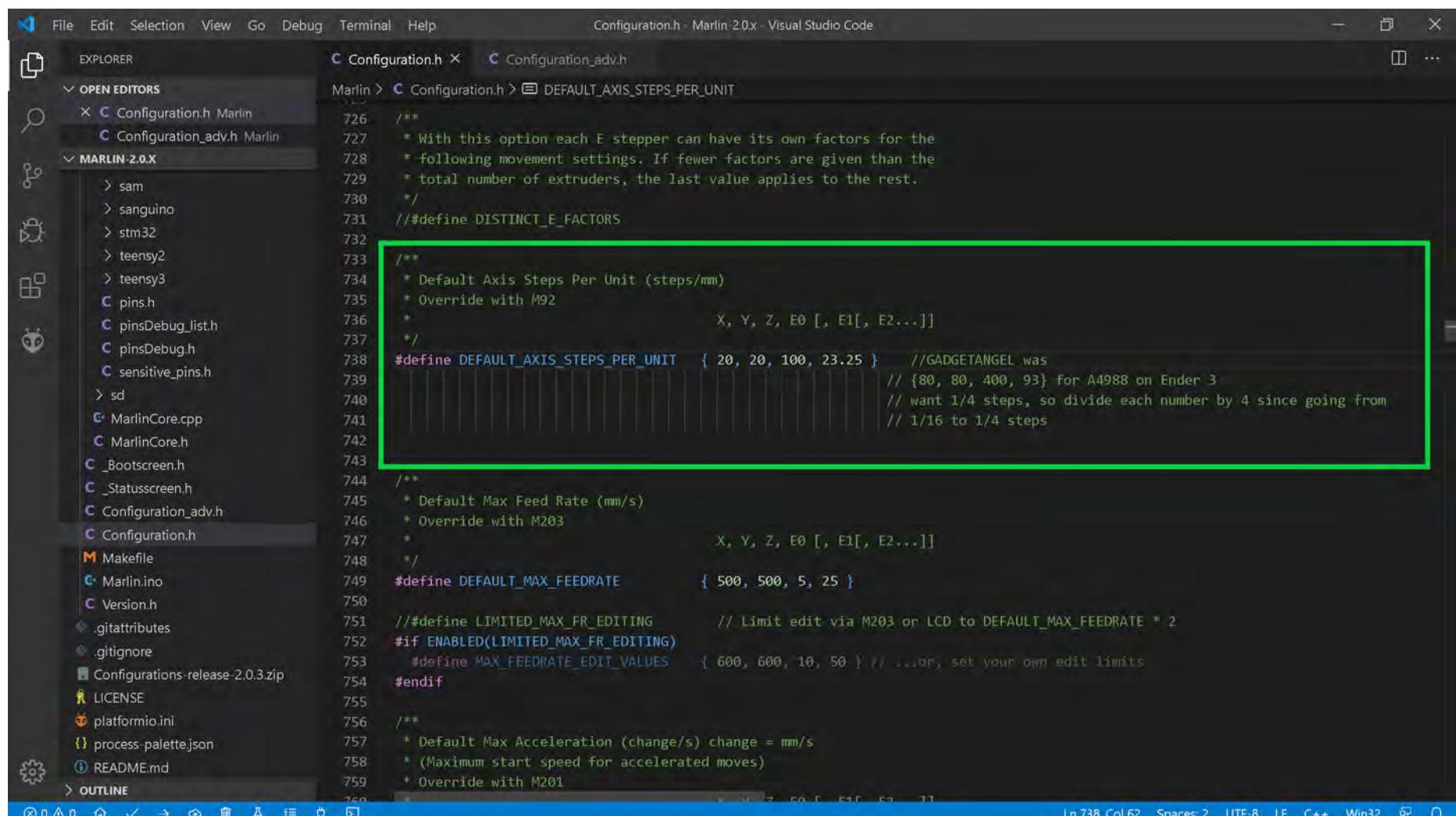
```

A green rectangular box highlights the driver type definitions for axes X, Y, Z, and E0, specifically the lines starting with `#define`. These lines were previously commented out with double slashes (//).

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand-alone Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to FYSETC TMC2208 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as seen in the GREEN box below.



The screenshot shows the Visual Studio Code interface with the Marlin 2.0.x repository open. The left sidebar shows various files and folders, including Configuration.h, Configuration_adv.h, and several pins and core files. The main editor window displays the Configuration.h file. A green rectangular box highlights the following code block:

```

726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS

732 /**
733 * Default Axis Steps Per Unit (steps/mm)
734 * Override with M92
735 *
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 } // GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // want 1/4 steps, so divide each number by 4 since going from
741 // 1/16 to 1/4 steps
742

743 /**
744 * Default Max Feed Rate (mm/s)
745 * Override with M203
746 *
747 * X, Y, Z, E0 [, E1[, E2...]]
748 */
749 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }

750
751 // #define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
752 #if ENABLED(LIMITED_MAX_FR_EDITING)
753   #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ...or, set your own edit limits
754 #endif

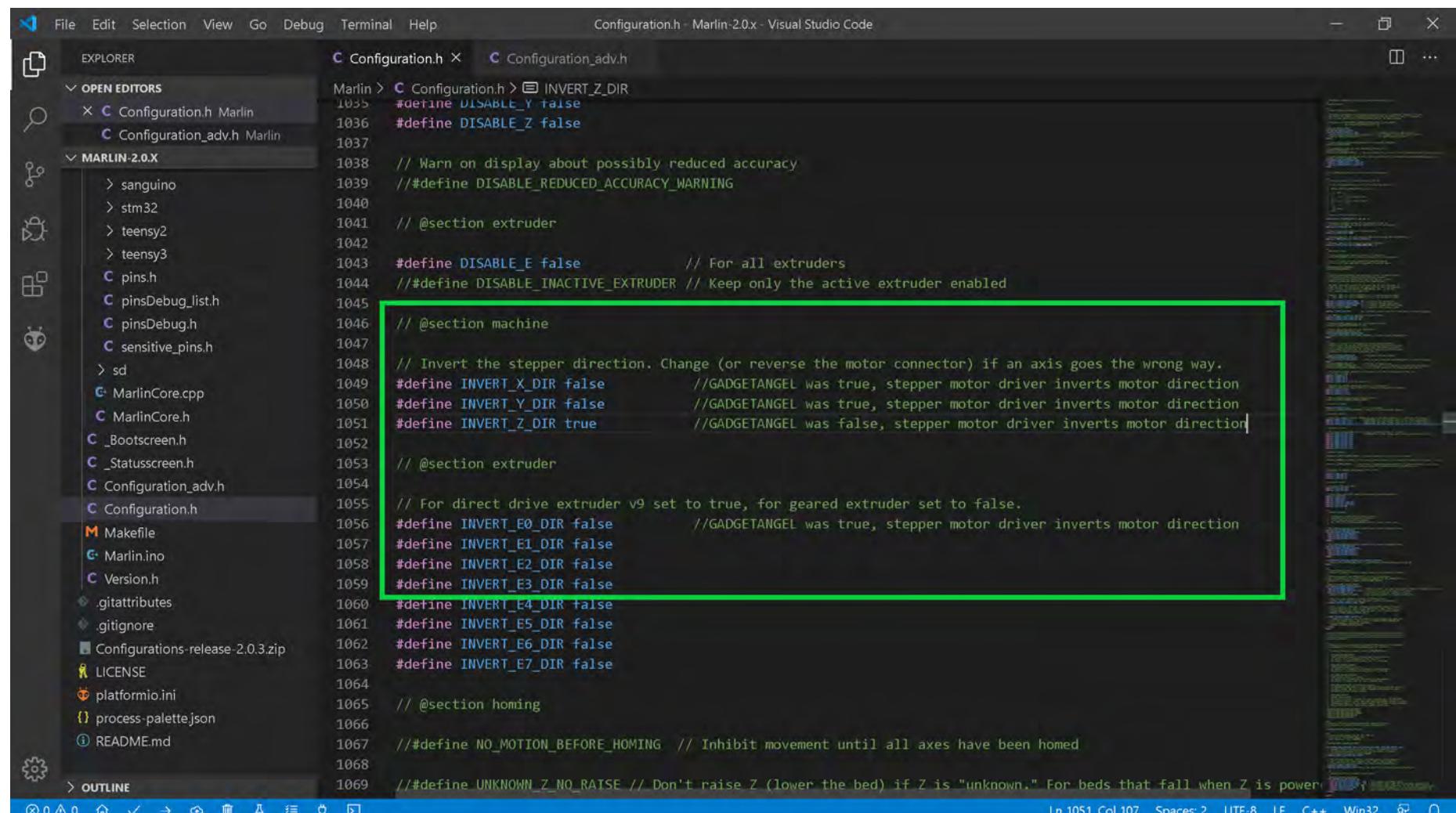
755 /**
756 * Default Max Acceleration (change/s) change = mm/s
757 * (Maximum start speed for accelerated moves)
758 * Override with M201
759 */

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand-alone Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following relevant sections:

```

    Configuration.h - Marlin-2.0.x - Visual Studio Code

File Edit Selection View Go Debug Terminal Help Configuration.h Configuration_adv.h

Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 //#define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false          // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

A green rectangular box highlights the following lines of code in the `Configuration.h` file:

```

#define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
#define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
#define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction

```

- Go to the next page.

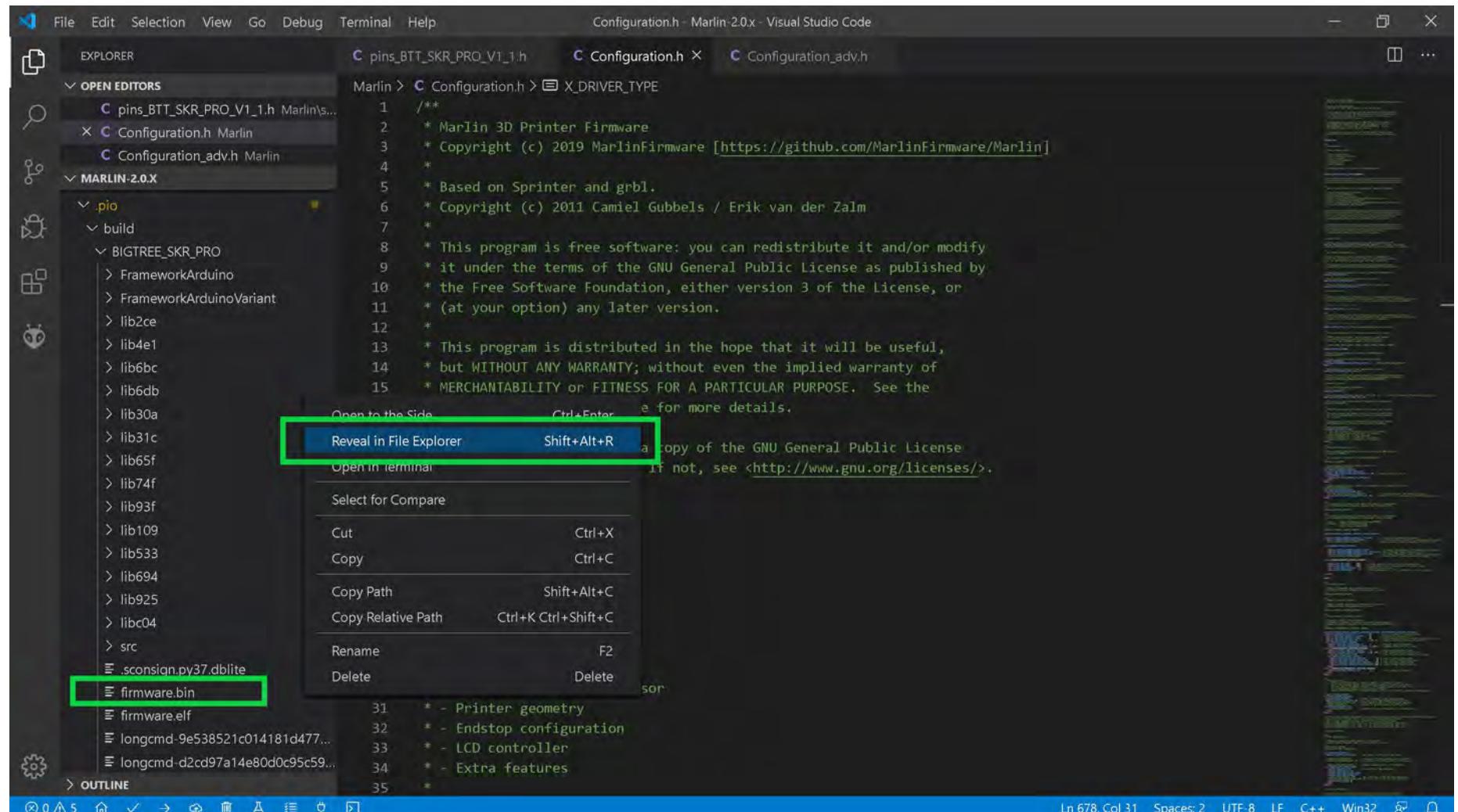
The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand-alone Mode

- The end of Marlin setup for FYSETC TMC2208 V1.2 drivers in stand-alone mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand-alone Mode

- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer window.

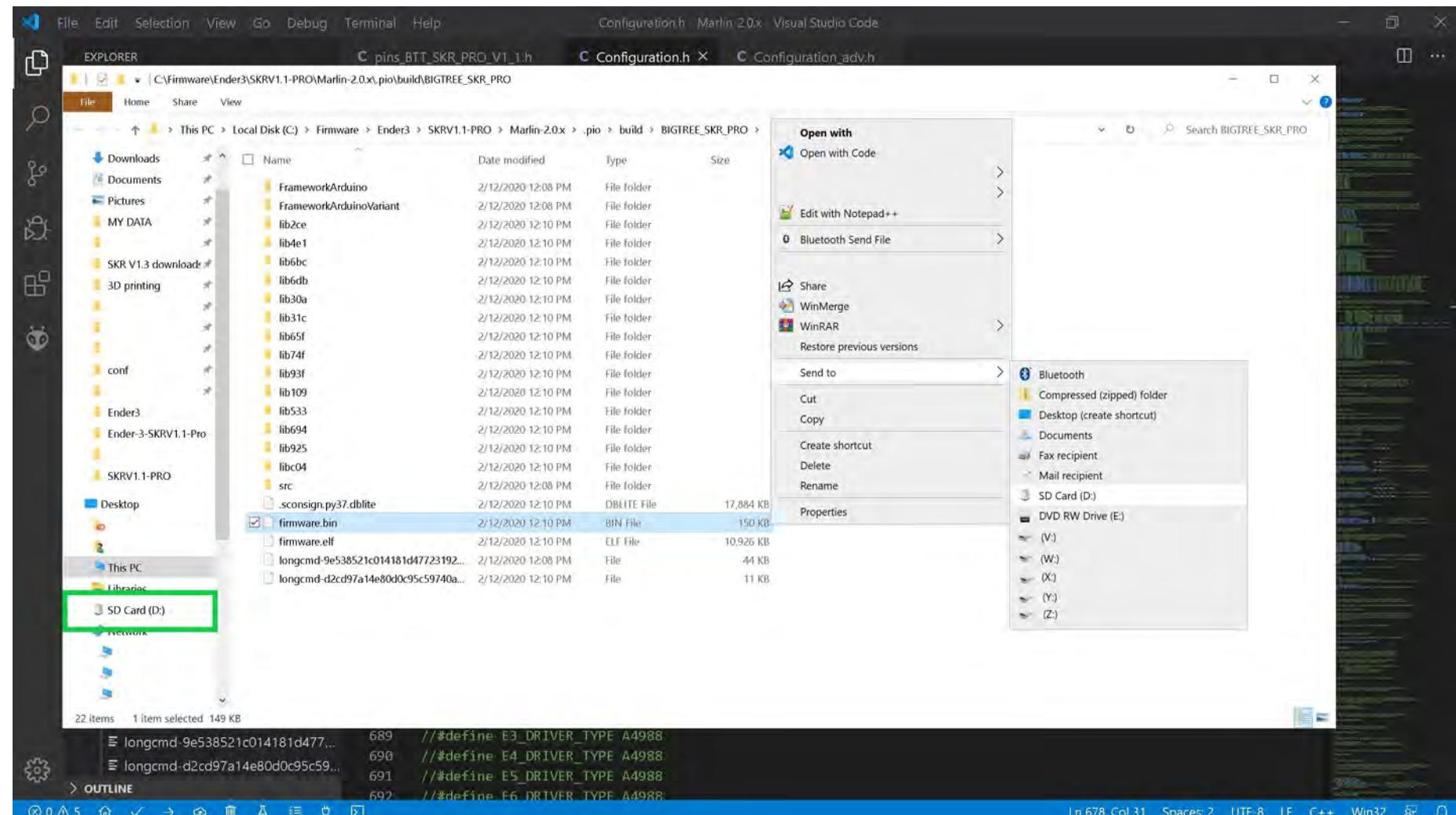


- Go to the next page.

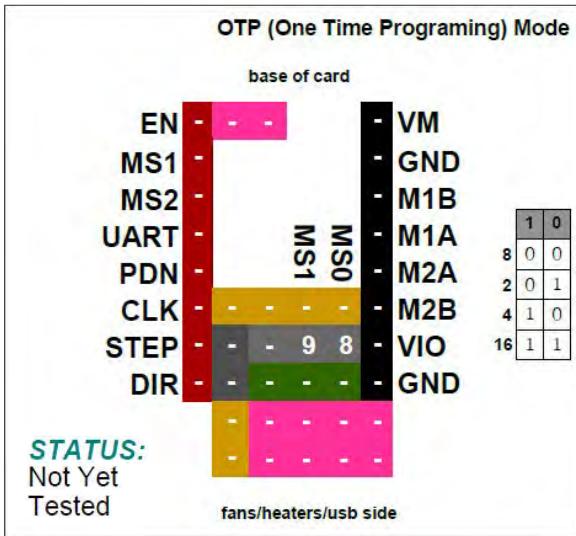
The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand-alone Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.

- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



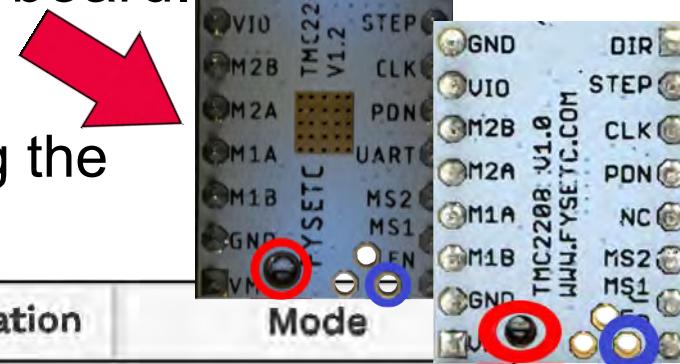
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.



FYSETC TMC2208 V1.2

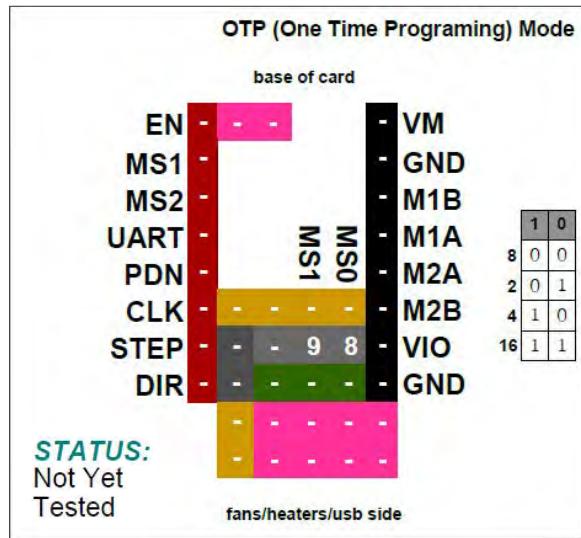
One Time Programming (OTP) Mode

NOTE: Use the potentiometer (POT) on the top of the board, as shown in **RED**; or use the board's " V_{ref} Test point" location, as shown in **BLUE**, to set your V_{ref} . See **Appendix A** for instructions on how to set the V_{ref} on a driver board.



Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|--|--|-----|--------|--|-------------|
| FYSETC TMC2208 OTP Mode Maximum 16 Subdivision 35V DC 2A (peak) | GND | GND | 1 / 8 | 1 / 256 | spreadCycle |
| | GND | VIO | 1 / 2 | 1 / 256 | spreadCycle |
| | VIO | GND | 1 / 4 | 1 / 256 | spreadCycle |
| | VIO | VIO | 1 / 16 | 1 / 256 | spreadCycle |
| Driving Current Calculation Formula R_S (Typical Sense Resistor)= 0.11Ω | $I_{MAX}=V_{ref}*0.9286$ See Appendix B #3. Use 50% to 90% as shown below: $I_{MAX}=(V_{ref} * 0.9286)*0.90$ | | | $V_{ref}=I_{MAX}*1.0769$ See Appendix B #3. Use 50% to 90% as shown below: $V_{ref}=(I_{MAX} * 1.0769)*0.90$ | |



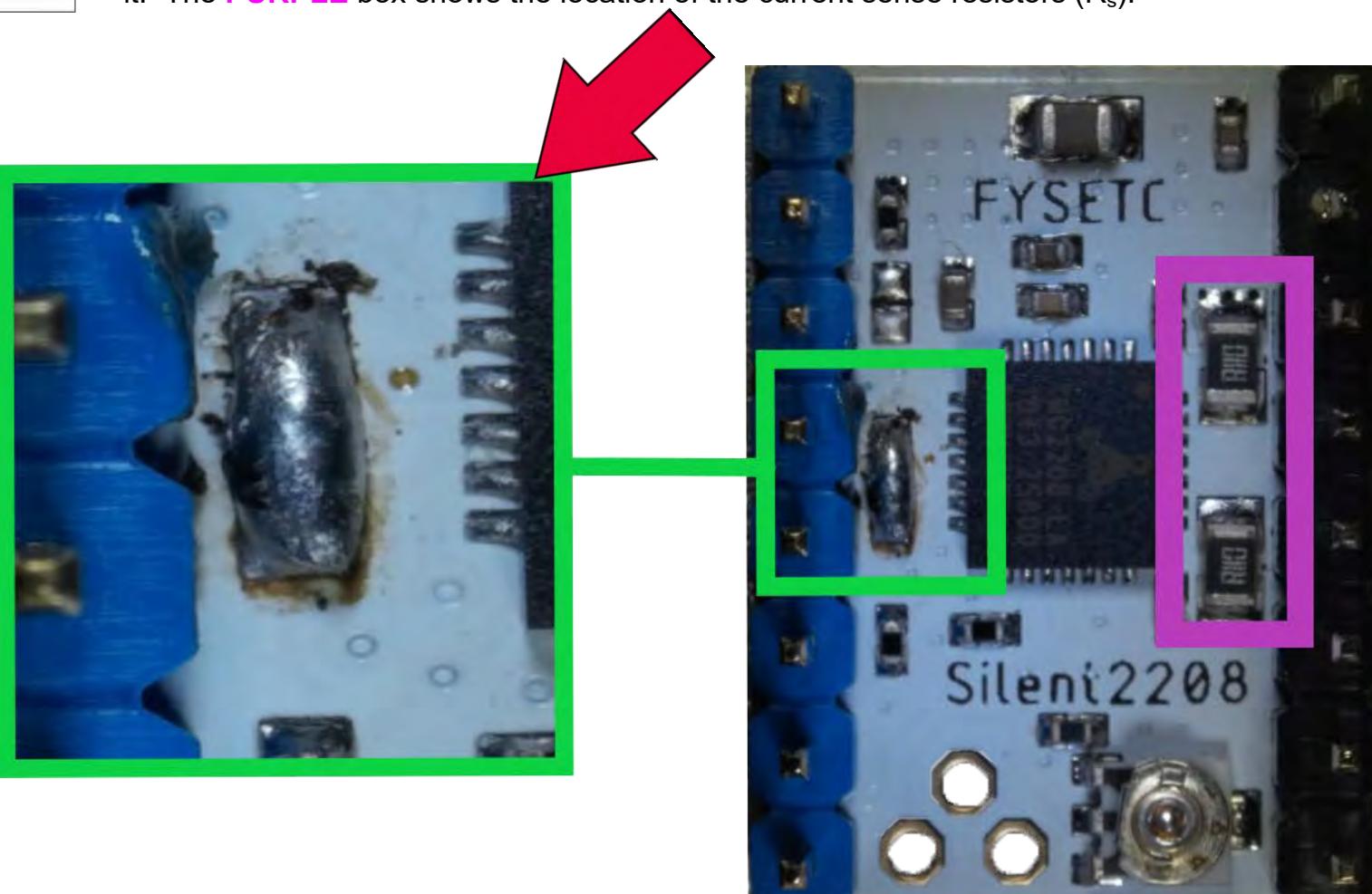
MOST FYSETC TMC2208 boards are sold as V1.2 driver boards. The V1.2 driver board **might be** setup to be in UART mode. BUT the V1.0 driver board is setup to be in STANDALONE mode by default. So **please check your boards to ensure they are in the correct mode you desire!** To be able to program the Chip for OTP mode, the FYSETC TMC2208 board **MUST** be set in UART (all three pads bridged together!).

FYSETC TMC2208 V1.2

One Time Programming (OTP) Mode

NOTE: Stand-alone Mode by default uses StealthChop, if you **want SpreadCycle, you MUST use OTP mode.** Here are the directions for running the TMC220x Configurator: <https://wiki.fysetc.com/TMC2208/#to-run-the-program>. See TMC220x Configurator for One-Time-Programming Information: [TMC220x Configurator](#).

Important: To place FYSETC TMC2208 V1.0 or V1.2 into OTP Mode you **must solder all adjacent pads together** on the bottom of the driver board. As an example, the picture (V1.2) below shows all the pads soldered together, as shown in **GREEN**. To do One-Time-Programming (OTP), the TMC2208 must be placed in UART mode to program it. The **PURPLE** box shows the location of the current sense resistors (R_s).

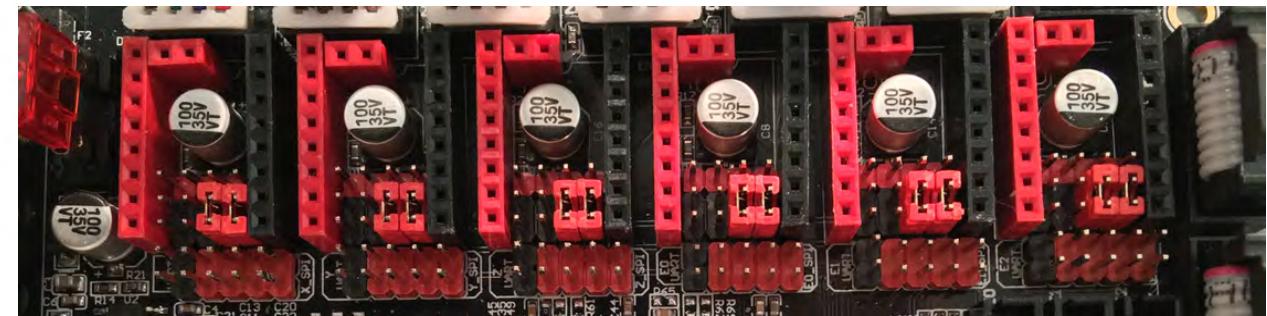
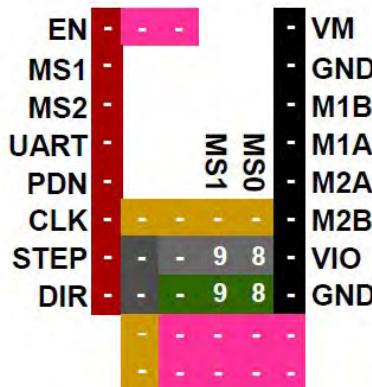


FYSETC TMC2208 V1.2

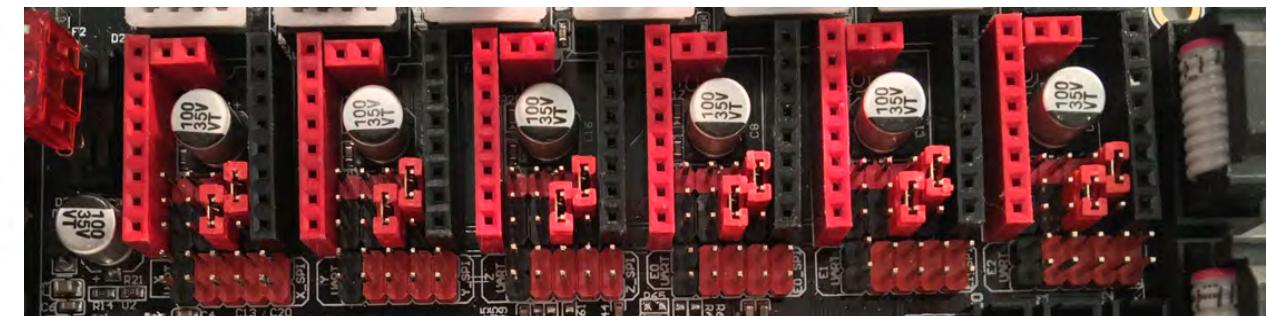
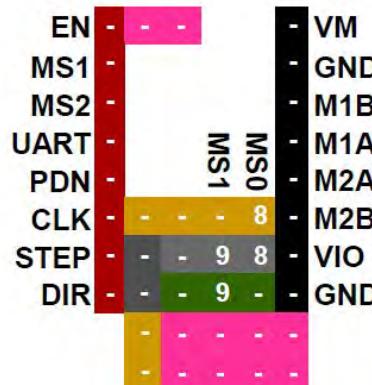
One Time Programming (OTP) Mode

OTP (One Time Programming) Mode

OTP
1 / 8
Interpolation: 1/256
SpreadCycle



OTP
1 / 2
Interpolation: 1/256
SpreadCycle



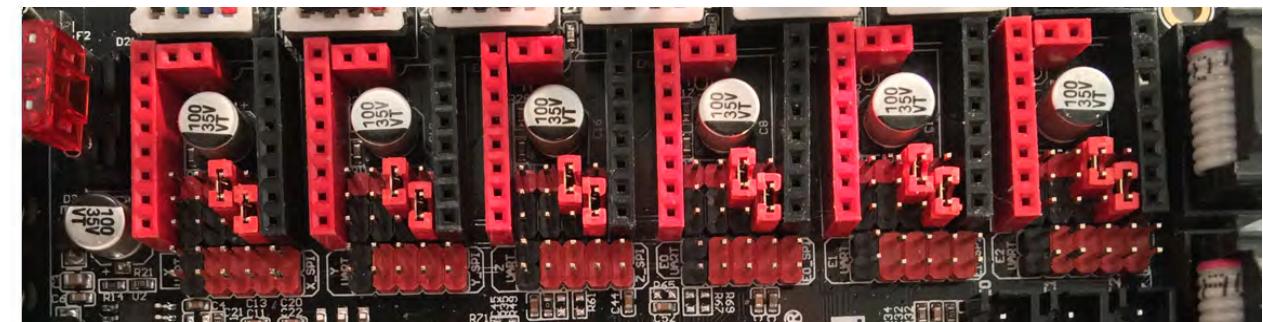
OTP (One Time Programming) Mode

FYSETC TMC2208 V1.2

One Time Programming (OTP) Mode

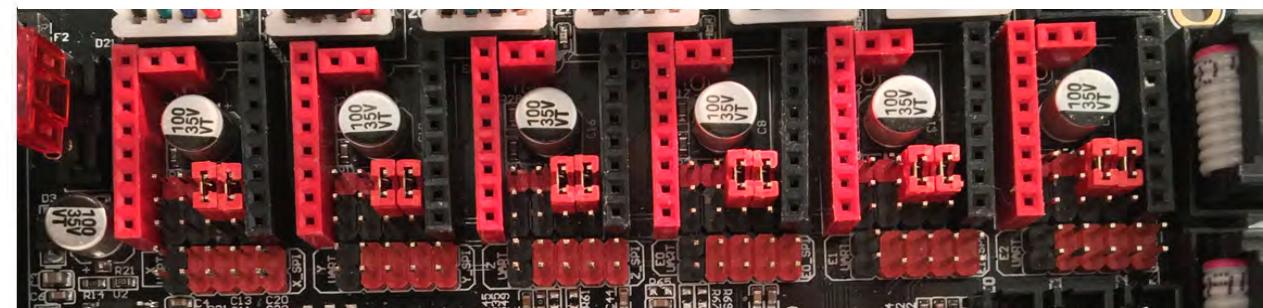
OTP
1 / 4
Interpolation: 1/256
SpreadCycle

| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | M1B |
| UART | - | - | MS1 | M1A |
| PDN | - | MS0 | - | M2A |
| CLK | 9 | - | - | M2B |
| STEP | - | 9 | 8 | VIO |
| DIR | - | - | 8 | GND |



OTP
1 / 16
Interpolation: 1/256
SpreadCycle

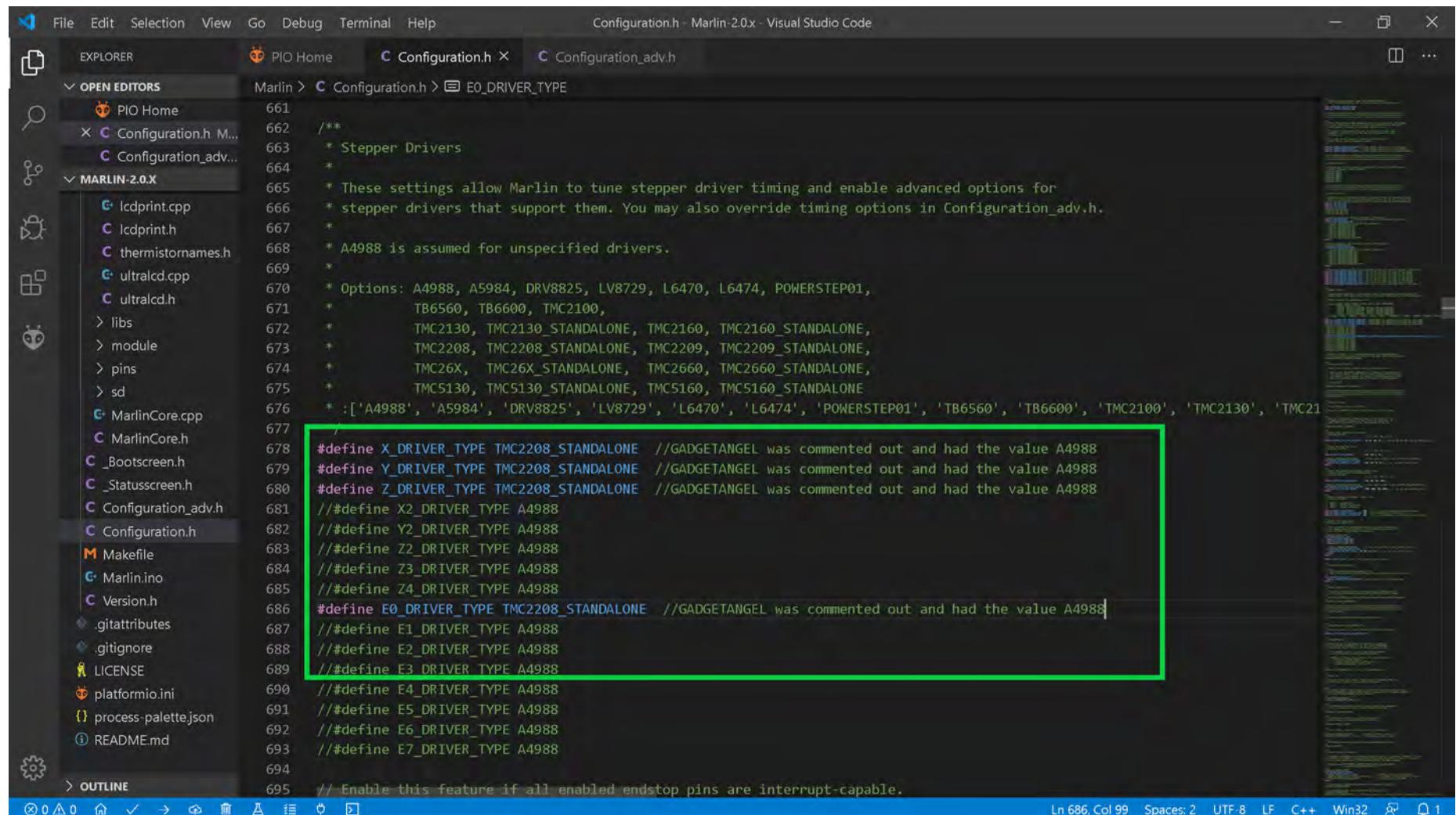
| | | | | |
|------|---|-----|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | M1B |
| UART | - | - | MS1 | M1A |
| PDN | - | MS0 | - | M2A |
| CLK | 9 | 8 | - | M2B |
| STEP | - | 9 | 8 | VIO |
| DIR | - | - | - | GND |



The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for FYSETC TMC2208 V1.2 stepper motor drivers in OTP mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in OTP mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in OTP mode. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



```

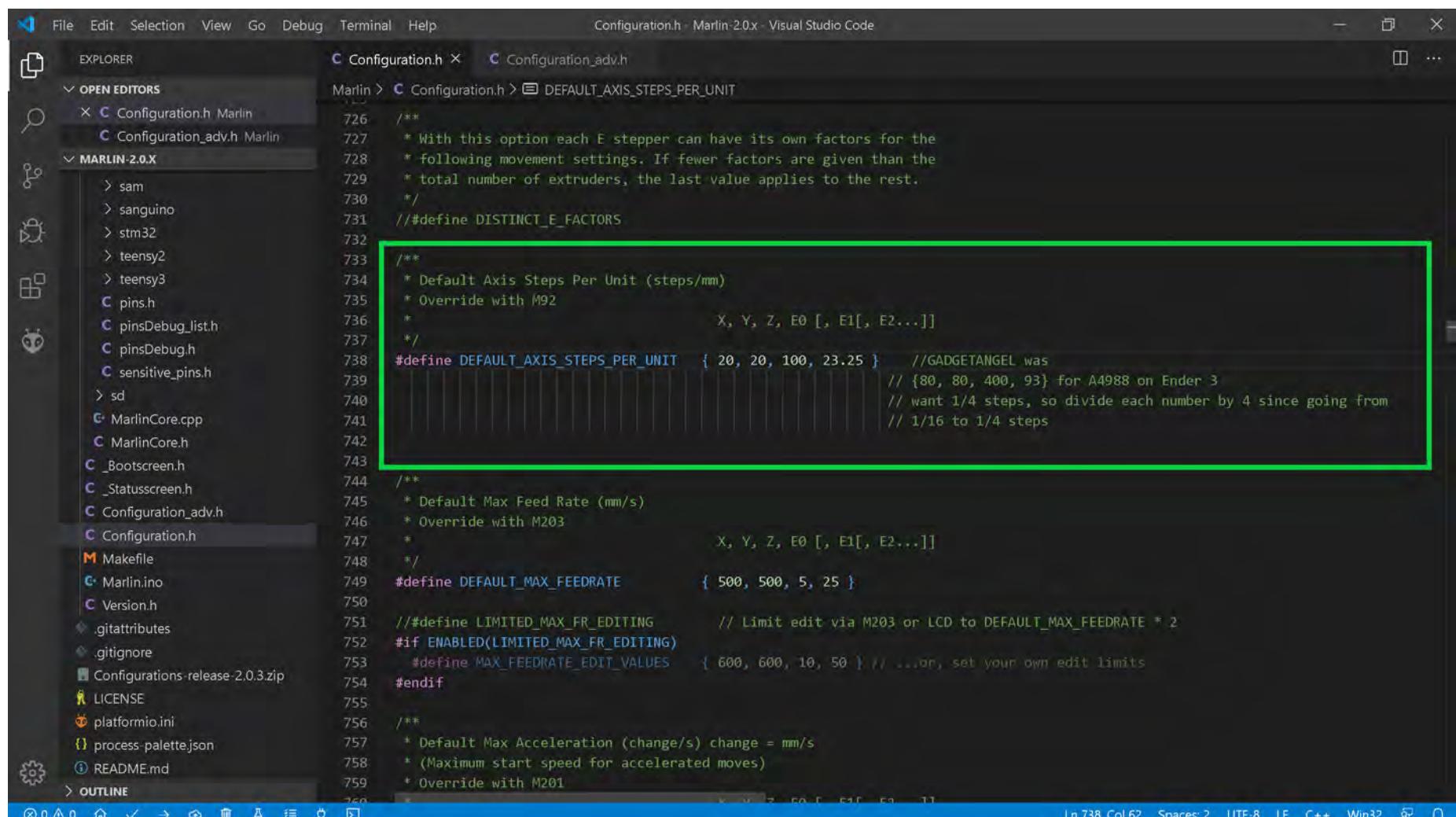
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin 2.0.x - Visual Studio Code
EXPLORER PIO Home C Configuration.h X C Configuration_adv.h
OPEN EDITORS Marlin > C Configuration.h > E0_DRIVER_TYPE
PIO Home 661 /**
X C Configuration.h M... 662 */
C Configuration_adv... 663 * Stepper Drivers
664 *
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
676 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC2209_STANDALONE', 'TMC26X', 'TMC26X_STANDALONE', 'TMC2660', 'TMC2660_STANDALONE', 'TMC5130', 'TMC5130_STANDALONE', 'TMC5160', 'TMC5160_STANDALONE']
677 */
#define X_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
#define Y_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
#define Z_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
#define X2_DRIVER_TYPE A4988
#define Y2_DRIVER_TYPE A4988
#define Z2_DRIVER_TYPE A4988
#define Z3_DRIVER_TYPE A4988
#define Z4_DRIVER_TYPE A4988
#define E0_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
#define E1_DRIVER_TYPE A4988
#define E2_DRIVER_TYPE A4988
#define E3_DRIVER_TYPE A4988
#define E4_DRIVER_TYPE A4988
#define E5_DRIVER_TYPE A4988
#define E6_DRIVER_TYPE A4988
#define E7_DRIVER_TYPE A4988
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to FYSETC TMC2208 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as seen in the GREEN box below.



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the Marlin 2.0.x configuration file. A green rectangular box highlights the following code block:

```

726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS

732 /**
733 * Default Axis Steps Per Unit (steps/mm)
734 * Override with M92
735 *
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 } // GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // want 1/4 steps, so divide each number by 4 since going from
741 // 1/16 to 1/4 steps
742

743 /**
744 * Default Max Feed Rate (mm/s)
745 * Override with M203
746 *
747 * X, Y, Z, E0 [, E1[, E2...]]
748 */
749 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }

750
751 // #define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
752 #if ENABLED(LIMITED_MAX_FR_EDITING)
753   #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ... or, set your own edit limits
754 #endif

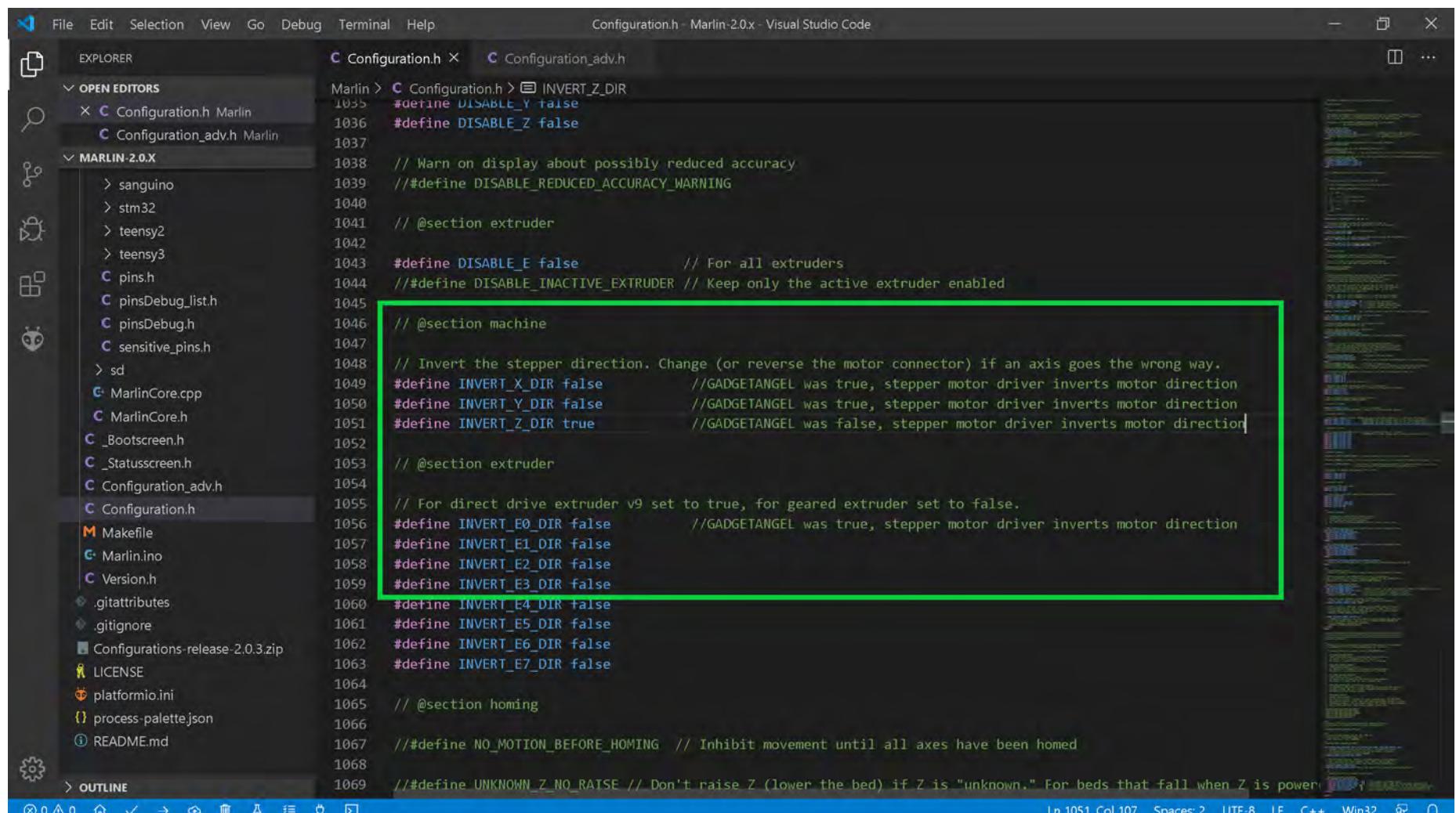
755 /**
756 * Default Max Acceleration (change/s) change = mm/s
757 * (Maximum start speed for accelerated moves)
758 * Override with M201
759 */

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following relevant snippets:

```

1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

A green rectangular box highlights the following lines of code, indicating they are the focus of the instructions:

```

1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

- The end of Marlin setup for FYSETC TMC2208 V1.2 drivers in OTP mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x Visual Studio Code

EXPLORER OPEN EDITORS Marlin > Configuration.h > X_DRIVER_TYPE

MARLIN-2.0.X

pins_BTT_SKR_PRO_V1_1.h Marlin's... Configuration.h Marlin Configuration_adv.h Marlin

pins_THE_BORG.h pins_VAKE403D.h
> teensy2
> teensy3
pins.h pinsDebug_list.h pinsDebug.h sensitive_pins.h
> sd MarlinCore.cpp MarlinCore.h
_Bootscreen.h _Statusscreen.h Configuration_adv.h Configuration.h Makefile Marlin.ino Version.h .gitattributes .gitignore LICENSE platformio.ini process-palette.json README.md

pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h

Marlin > Configuration.h > X_DRIVER_TYPE

658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
661
662 /*
663 * Stepper Drivers
664 *
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 * TMC2660_STANDALONE, TMC2660_STANDALONE, TMC2660_STANDALONE, TMC2660_STANDALONE

PROBLEMS 5 OUTPUT DEBUG CONSOLE TERMINAL 1: Task - Build

| | |
|------------------------|----------------------|
| CTH2E407VC_1.3.1 | IGNORED |
| BIGTREETECH_1.3.1 | SUCCESS 00:02:31.294 |
| BTCTREE_CTC_V1_0 | IGNORED |
| BIGTREE_BTT002 | IGNORED |
| teensy31 | IGNORED |
| teensy35 | IGNORED |
| esp32 | IGNORED |
| linux_native | IGNORED |
| SAMD51_grandcentral_m4 | IGNORED |
| rumba32_f446ve | IGNORED |
| mks_rumba32 | IGNORED |
| include_tree | IGNORED |

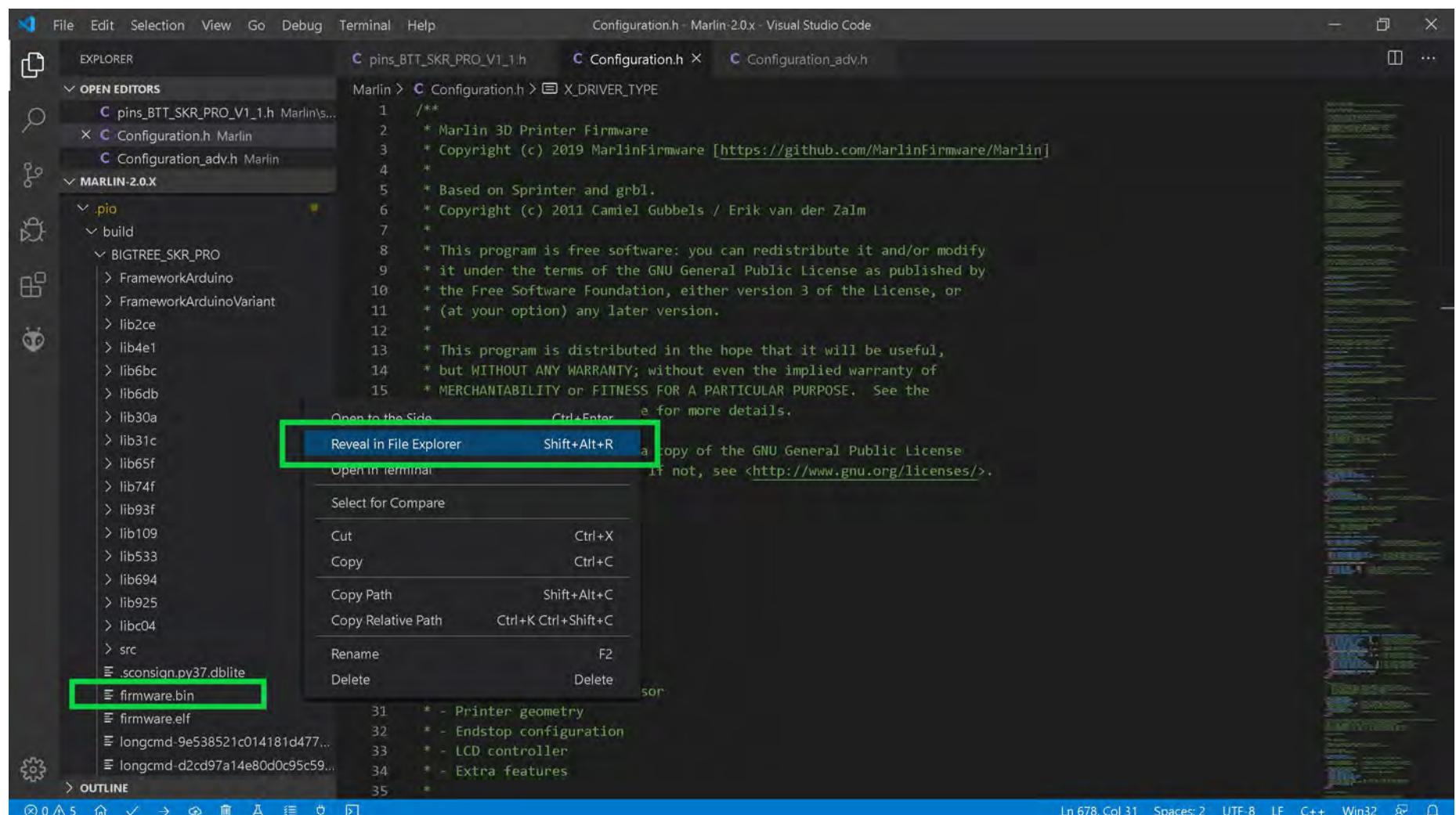
===== 1 succeeded in 00:02:31.294 =====

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

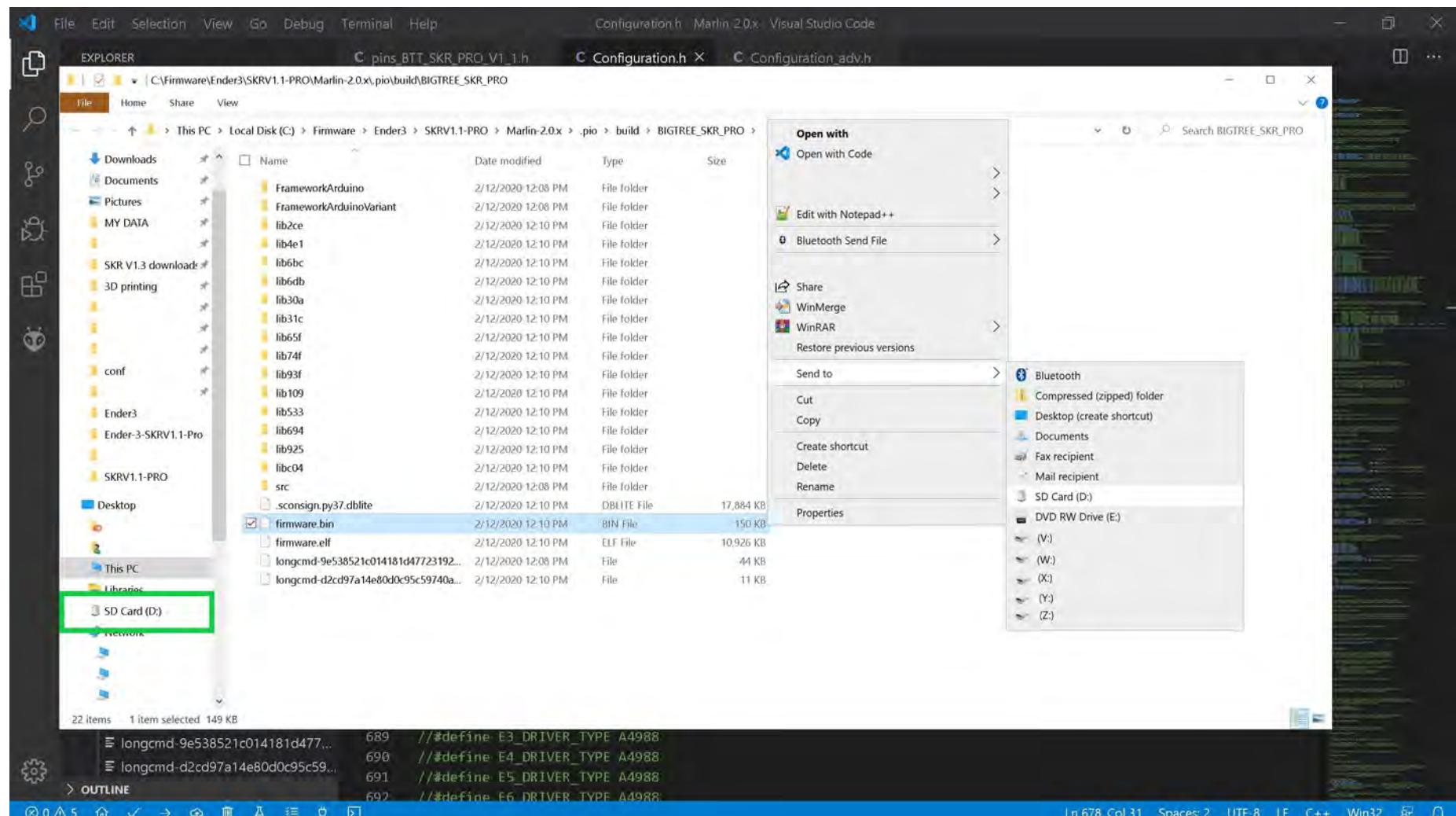
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



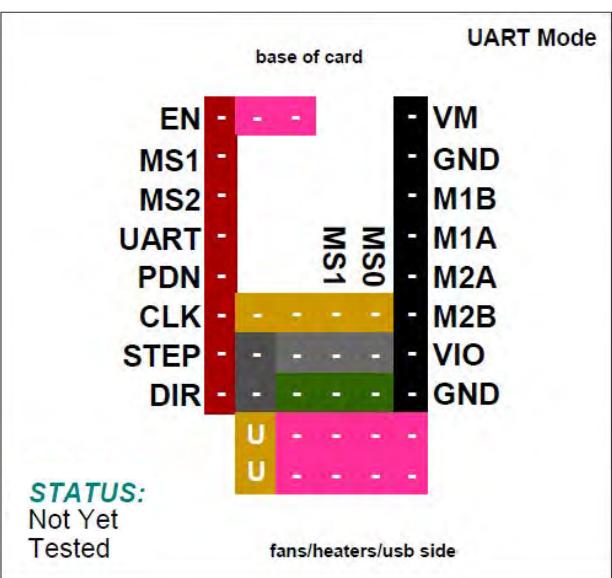
- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

FYSETC TMC2208 V1.2**UART Mode**

Note: You can use 50% to 90% of the calculated I_{RMS} ($I_{MAX}/1.414$) when tuning ("X_CURRENT", "Y_CURRENT", etc. the stepper motor driver in the firmware.

See the next page for further information.

| Driver Chip |
|-------------------------|
| FYSETC |
| TMC2208 |
| UART Mode |
| Maximum 256 Subdivision |
| 35V DC |
| 2A (peak) |

**Steps are set inside
of your Firmware**

| Driving Current Calculation Formula |
|---|
| R_S (Typical Sense Resistor) = 0.11Ω |

$$I_{MAX} = V_{ref}$$

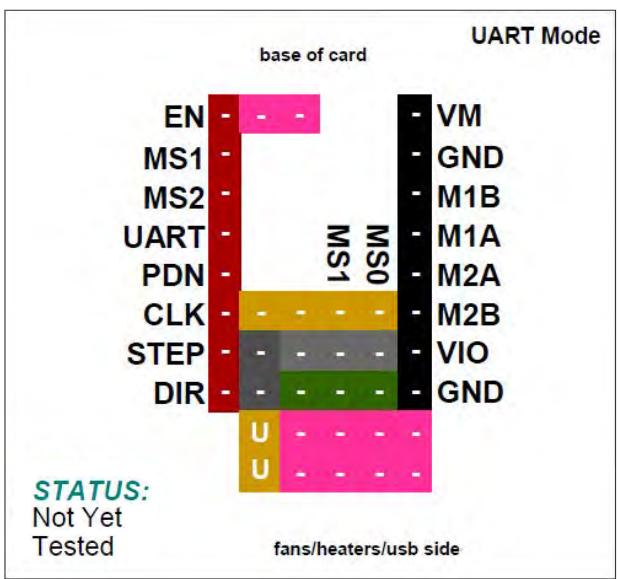
See Appendix B #4. Use 50% to 90% as shown below:

$$I_{MAX} = I_{MAX} * 0.90$$

$$V_{ref} = I_{MAX}$$

See Appendix B #4. Use 50% to 90% as shown below:

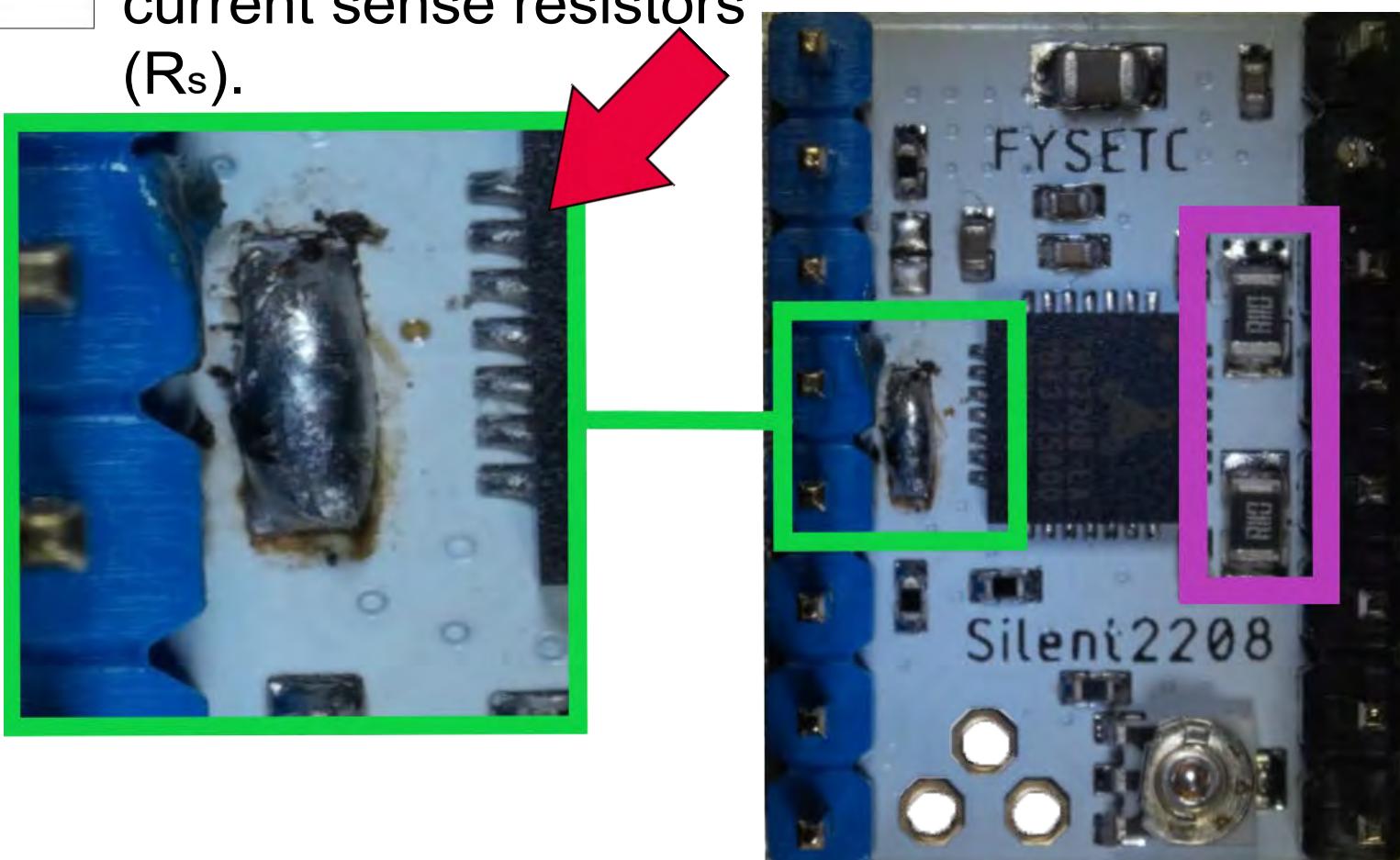
$$V_{ref} = V_{ref} * 0.90$$



FYSETC TMC2208 V1.2

UART Mode

Important: To ensure that the FYSETC TMC2208 V1.0 or V1.2 is in UART Mode, check to see if all the adjacent pads are soldered together on the bottom of the driver board, as shown in the **GREEN** box. The **PURPLE** box shows the location of the current sense resistors (R_s).



MOST FYSETC TMC2208 boards are sold as V1.2 driver boards. The V1.2 driver board **might be** setup to be in UART mode. BUT the V1.0 driver board is setup to be in stand-alone mode by default. **So please check your boards to ensure they are in the correct mode you desire!**

FYSETC TMC2208 V1.2 in **UART Mode**

UART Mode**UART Mode**

Note: The location of the current sense resistors are shown in **GREEN**. Use the current sense resistors' value in the Marlin Firmware ("X_RSENSE", "Y_RSENSE", "Z_RSENSE" and/or "E0_RSENSE") so that the appropriate current limit can be sent to the driver board. If you do not want to use V_{ref} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT", and/or "E0_CURRENT".

$R_s = R_{050}$ is 0.05 Ohms

$R_s = R_{062}$ is 0.062 Ohms

$R_s = R_{068}$ is 0.068 Ohms

$R_s = R_{075}$ is 0.075 Ohms

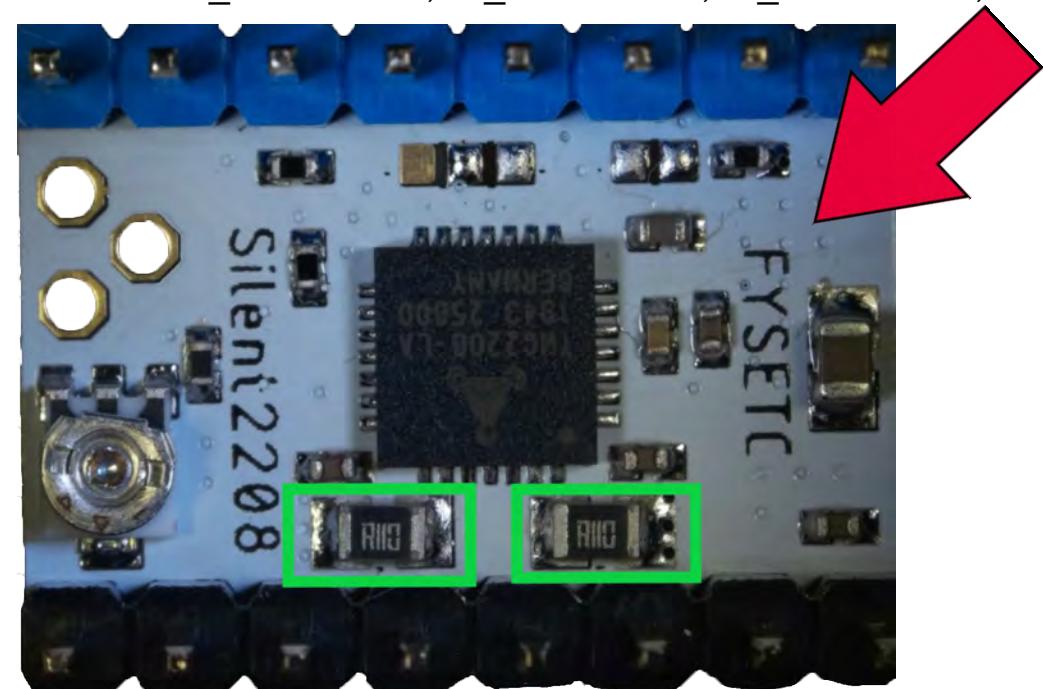
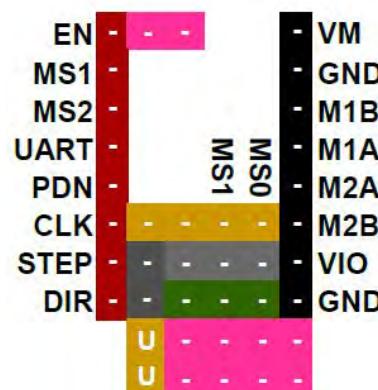
$R_s = R_{100}$ is 0.1 Ohms

$R_s = R_{110}$ is 0.11 Ohms

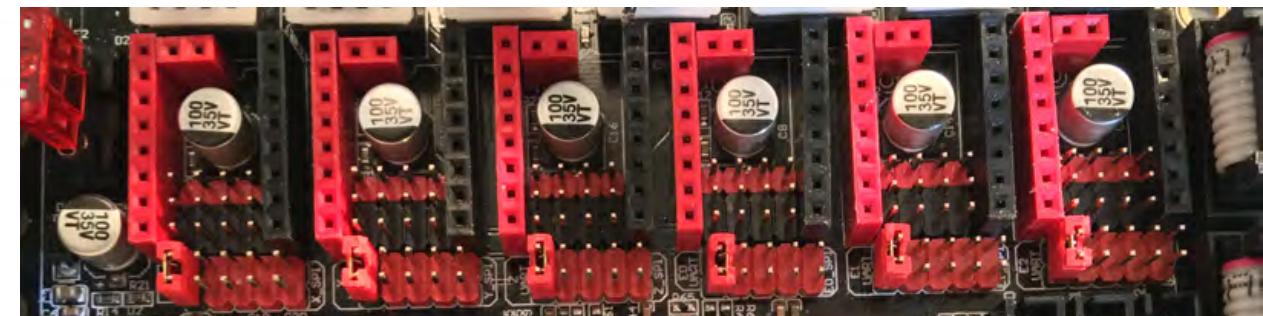
$R_s = R_{150}$ is 0.15 Ohms

$R_s = R_{200}$ is 0.2 Ohms

$R_s = R_{220}$ is 0.22 Ohms

**UART**

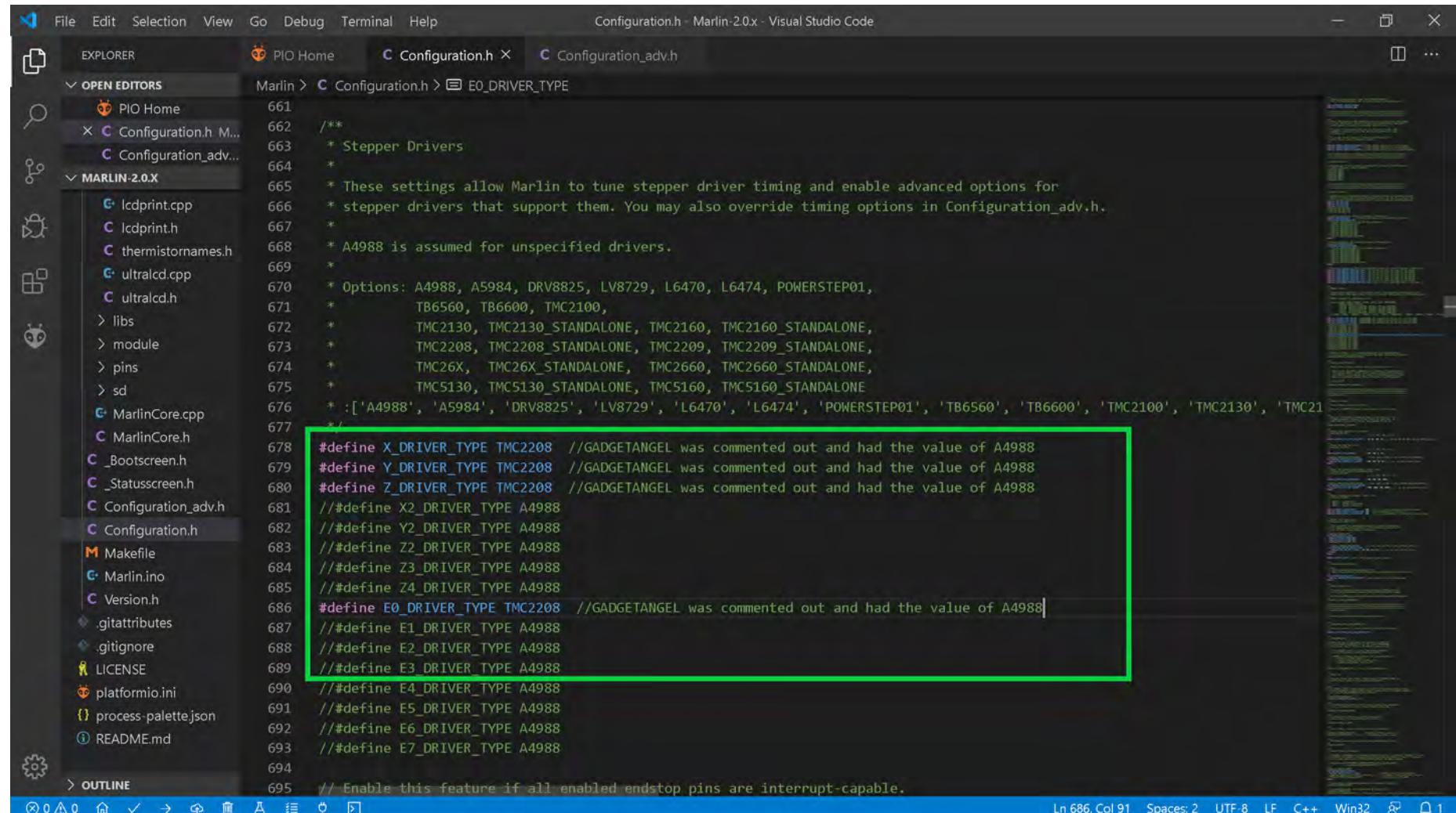
Note: Set Jumper "U" for UART MODE!!



The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for FYSETC TMC2208 stepper motor drivers in UART mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in UART mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in UART mode. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



```

File Edit Selection View Go Debug Terminal Help
Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
PIO Home Configuration.h ...
Configuration_adv.h
MARLIN-2.0.X
LCDprint.cpp
LCDprint.h
thermistornames.h
ultralcd.cpp
ultralcd.h
libs
module
pins
sd
MarlinCore.cpp
MarlinCore.h
_Bootscreen.h
_Statusscreen.h
Configuration_adv.h
Configuration.h
Makefile
Marlin.ino
Version.h
.gitattributes
.gitignore
LICENSE
platformio.ini
process-palette.json
README.md
OUTLINE
Ln 686, Col 91 Spaces: 2 UTF-8 LF C++ Win32 ⌂ ⌂ 1

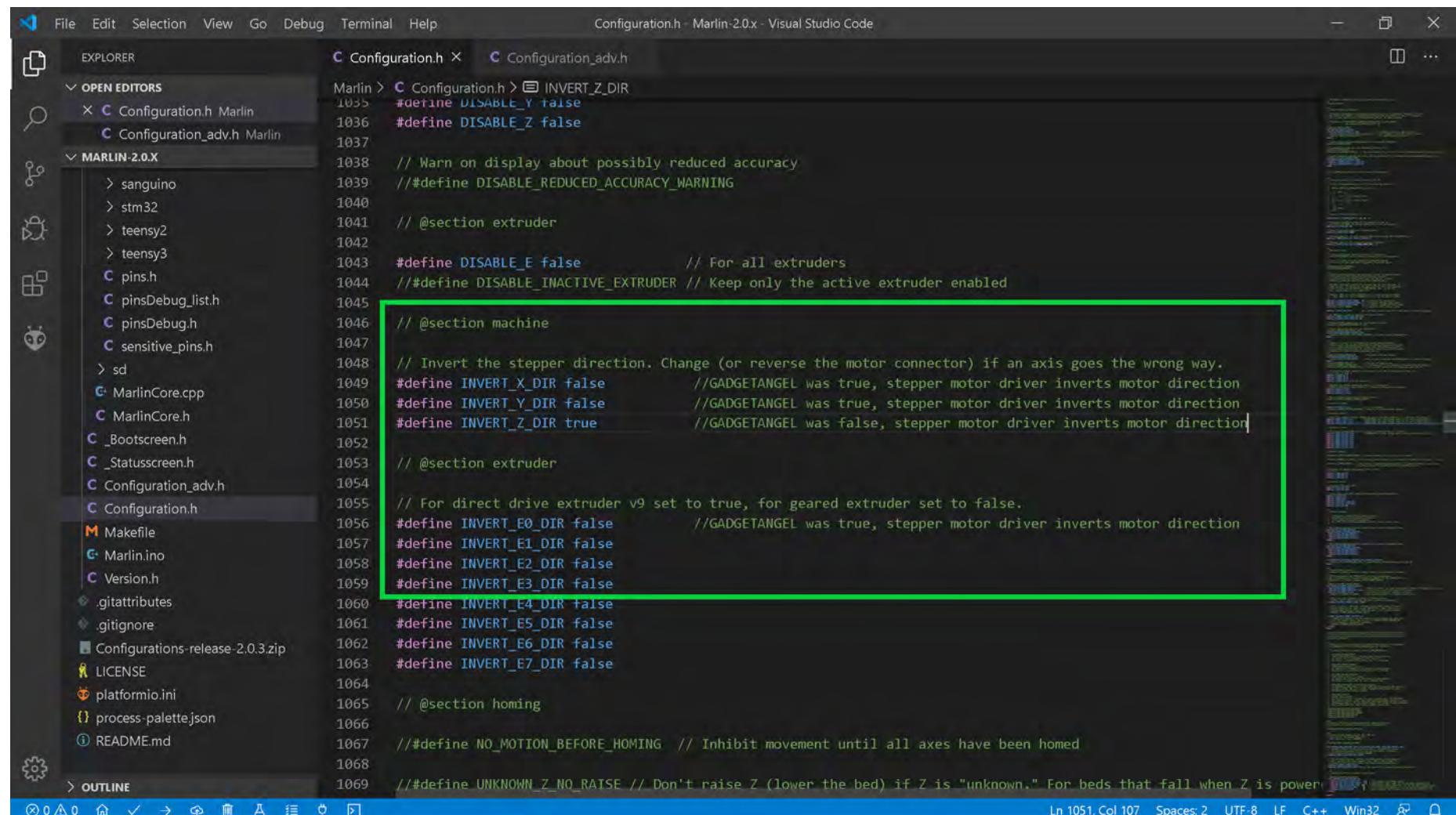
661 /**
662 * Stepper Drivers
663 *
664 */
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
676 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2
677 */
678 #define X_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
679 #define Y_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
680 #define Z_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RATSE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

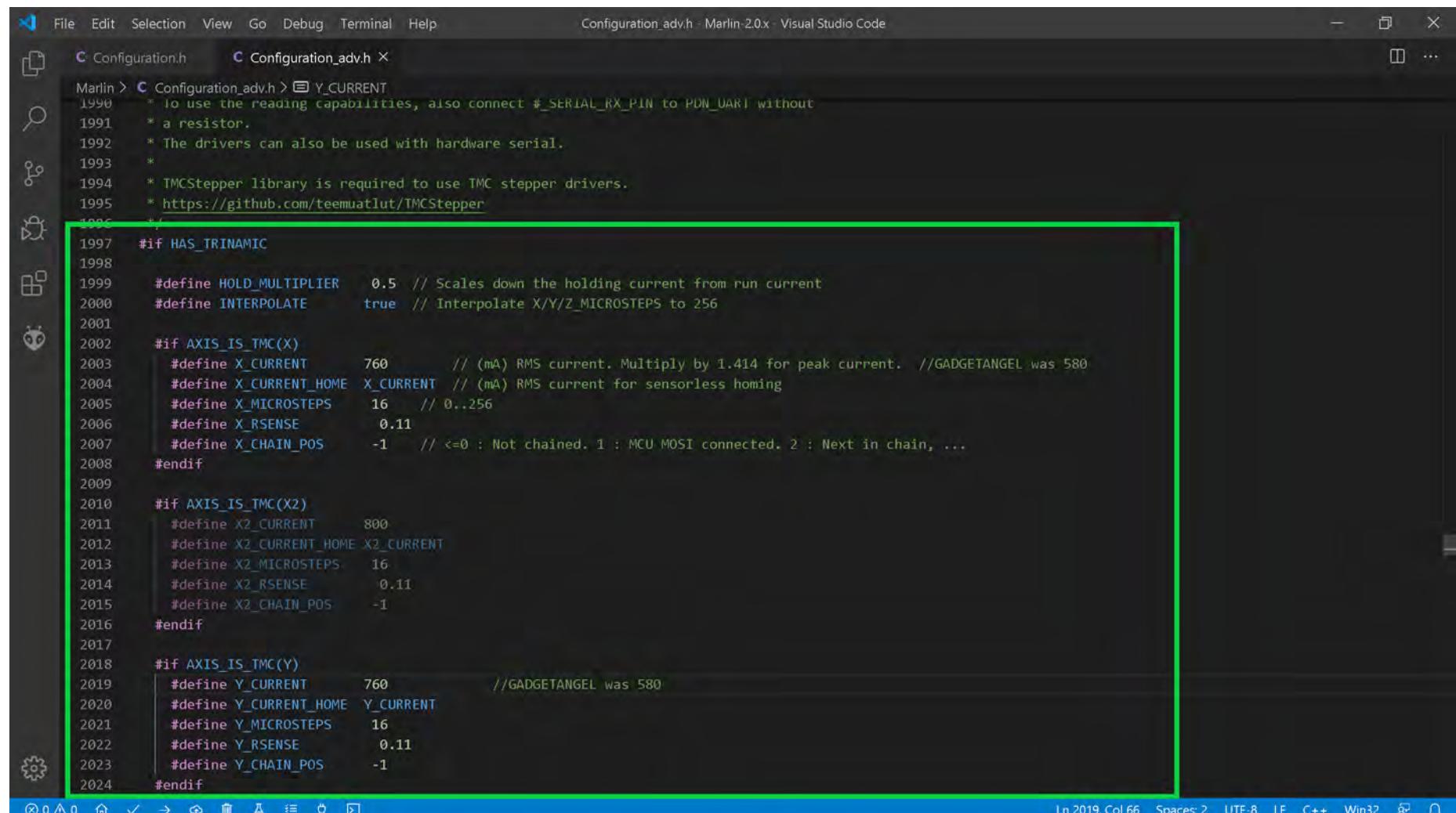
```

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- Next you want to set your V_{ref} in the Marlin firmware for each axis that has the TMC2208 driver, as seen in the **GREEN** box below. I changed the "X_CURRENT" to be the calculated V_{ref} for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated V_{ref} for my Y-Axis, which is 760mV on the Ender 3.
- Ensure "X_RSENSE" is set to 0.11. Ensure "Y_RSENSE" is set to 0.11.
- If you **do not want to use V_{ref}** as the value for "X_CURRENT" and/or "Y_CURRENT", you should **use I_{RMS} instead**. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "X_CURRENT" and/or "Y_CURRENT".



```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > Y_CURRENT
1990 * To use the reading capabilities, also connect #_SERIAL_RX_PIN to PDN_UART without
1991 * a resistor.
1992 * The drivers can also be used with hardware serial.
1993 *
1994 * TMCStepper library is required to use TMC stepper drivers.
1995 * https://github.com/teemuatlut/TMCStepper
1996 */
1997 #if HAS_TRINAMIC
1998
1999 #define HOLD_MULTIPLIER    0.5 // Scales down the holding current from run current
2000 #define INTERPOLATE        true // Interpolate X/Y/Z_MICROSTEPS to 256
2001
2002 #if AXIS_IS_TMC(X)
2003     #define X_CURRENT          760      // (mA) RMS current. Multiply by 1.414 for peak current. //GADGETANGEL was 580
2004     #define X_CURRENT_HOME    X_CURRENT // (mA) RMS current for sensorless homing
2005     #define X_MICROSTEPS       16       // 0..256
2006     #define X_RSENSE            0.11
2007     #define X_CHAIN_POS         -1      // <=0 : Not chained. 1 : MCU MOSI connected. 2 : Next in chain, ...
2008 #endif
2009
2010 #if AXIS_IS_TMC(X2)
2011     #define X2_CURRENT          800
2012     #define X2_CURRENT_HOME    X2_CURRENT
2013     #define X2_MICROSTEPS       16
2014     #define X2_RSENSE            0.11
2015     #define X2_CHAIN_POS         -1
2016 #endif
2017
2018 #if AXIS_IS_TMC(Y)
2019     #define Y_CURRENT          760      //GADGETANGEL was 580
2020     #define Y_CURRENT_HOME    Y_CURRENT
2021     #define Y_MICROSTEPS       16
2022     #define Y_RSENSE            0.11
2023     #define Y_CHAIN_POS         -1
2024 #endif

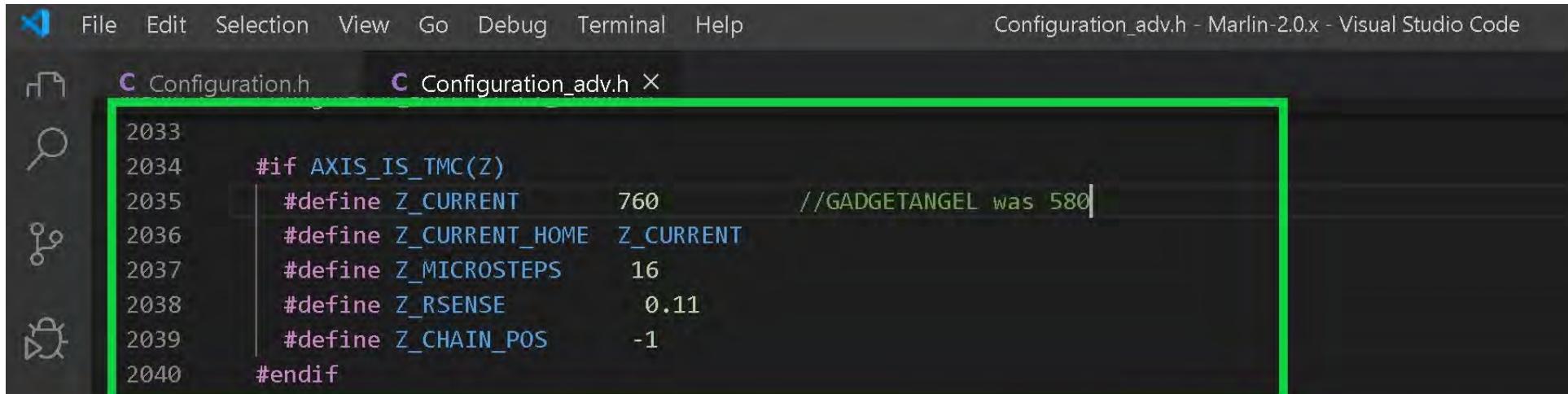
```

Ln 199, Col 66 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- Now, I am setting the V_{ref} for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated V_{ref} for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated V_{ref} for my Extruder, which is 900mV on the Ender 3.
- Ensure "Z_RSENSE" is set to 0.11. Ensure "E0_RSENSE" is set to 0.11.
- If you do not want to use V_{ref} as the value for "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS} = I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "Z_CURRENT" and/or "E0_CURRENT".



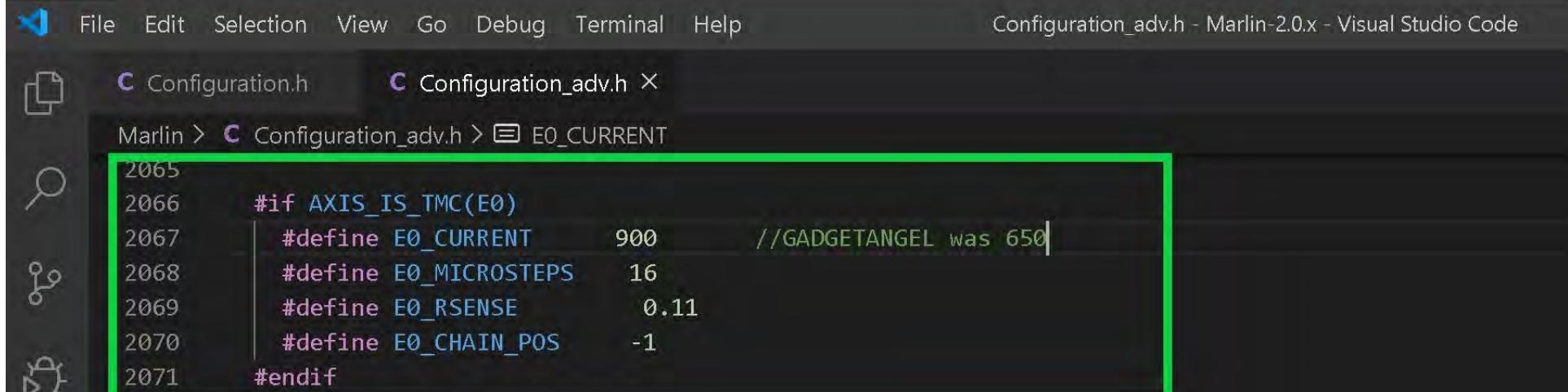
```

File Edit Selection View Go Debug Terminal Help
Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

Configuration.h Configuration_adv.h X

2033
2034 #if AXIS_IS_TMC(Z)
2035   #define Z_CURRENT      760           //GADGETANGEL was 580
2036   #define Z_CURRENT_HOME Z_CURRENT
2037   #define Z_MICROSTEPS    16
2038   #define Z_RSENSE        0.11
2039   #define Z_CHAIN_POS     -1
2040 #endif

```



```

File Edit Selection View Go Debug Terminal Help
Configuration.h Configuration_adv.h X
Marlin > Configuration_adv.h > E0_CURRENT

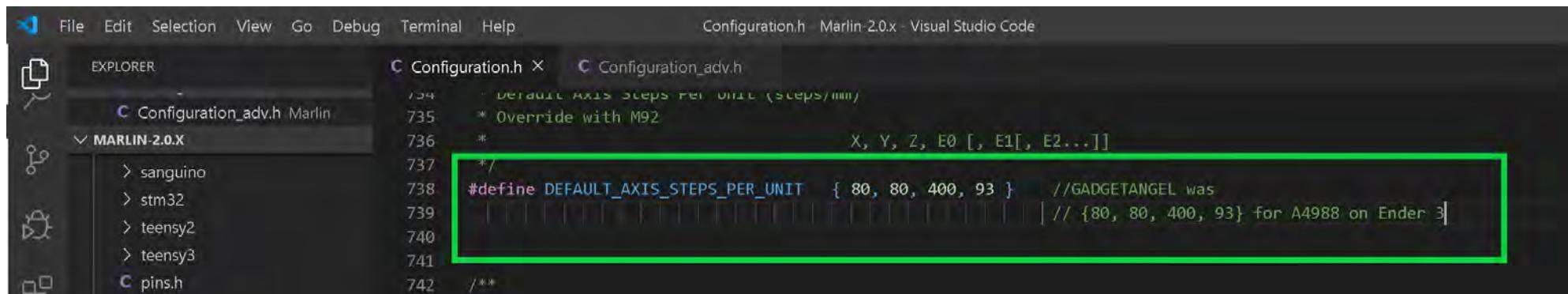
2065
2066 #if AXIS_IS_TMC(E0)
2067   #define E0_CURRENT      900           //GADGETANGEL was 650
2068   #define E0_MICROSTEPS   16
2069   #define E0_RSENSE        0.11
2070   #define E0_CHAIN_POS     -1
2071 #endif

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



File Edit Selection View Go Debug Terminal Help Configuration.h Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

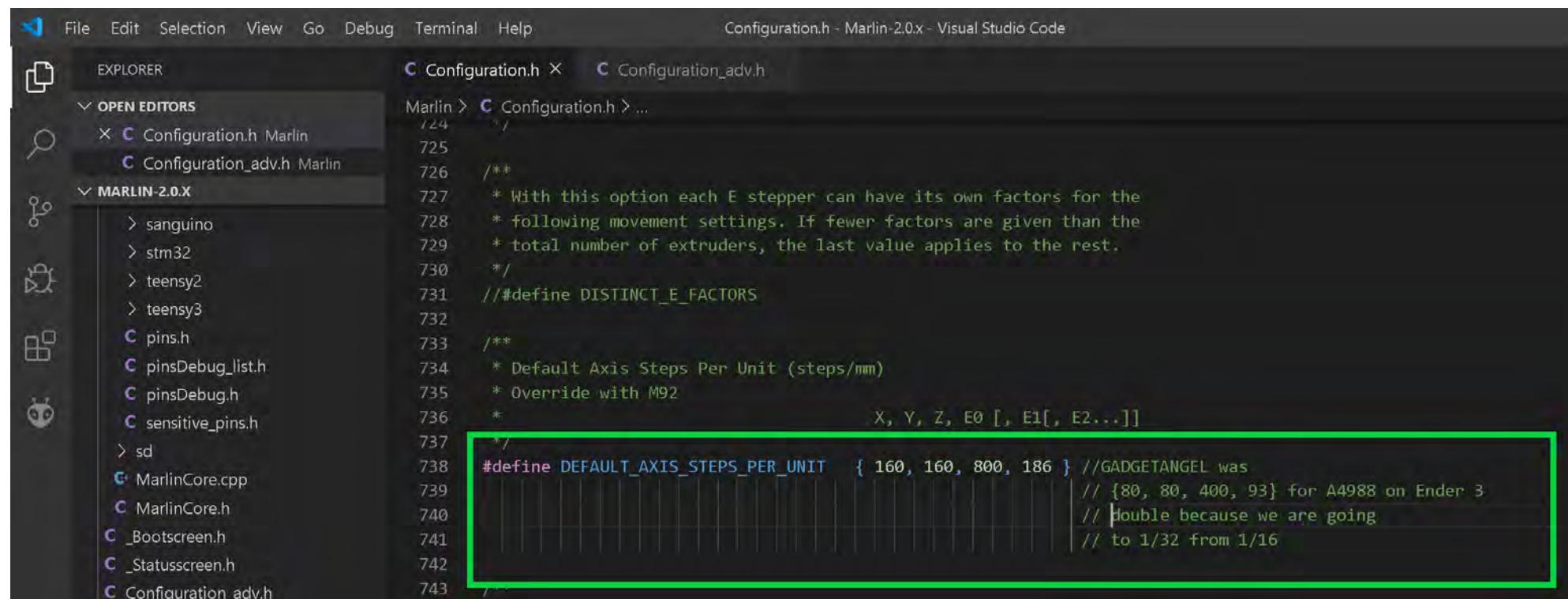
MARLIN-2.0.X

```

 734 * Default Axis Steps Per Unit (steps/mm)
 735 * Override with M92
 736 * X, Y, Z, E0 [, E1[, E2...]]
 737 */
 738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 80, 80, 400, 93 } //GADGETANGEL was
 739 // {80, 80, 400, 93} for A4988 on Ender 3
 740
 741 /**
 742 */

```

- FOR EXAMPLE if you wanted to use 1/32 stepping instead of the default 1/16, you would be **doubling** your STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

MARLIN-2.0.X

```

 724 */
 725
 726 /**
 727 * With this option each E stepper can have its own factors for the
 728 * following movement settings. If fewer factors are given than the
 729 * total number of extruders, the last value applies to the rest.
 730 */
 731 // #define DISTINCT_E_FACTORS
 732
 733 /**
 734 * Default Axis Steps Per Unit (steps/mm)
 735 * Override with M92
 736 *
 737 */
 738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
 739 // {80, 80, 400, 93} for A4988 on Ender 3
 740 // Double because we are going
 741 // to 1/32 from 1/16
 742
 743 */

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- By default stealthChop is enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration_adv.h > STEALTHCHOP_XY
Configuration.h Marlin Configuration_adv.h Marlin
Configuration.h Marlin Configuration_adv.h Marlin
MARLIN-2.0.X
sanguino
stm32
teensy2
teensy3
pins.h
pinsDebug_list.h
pinsDebug.h
sensitive_pins.h
sd
MarlinCore.cpp
MarlinCore.h
_Bootscreen.h
_Statusscreen.h
Configuration_adv.h
Configuration.h

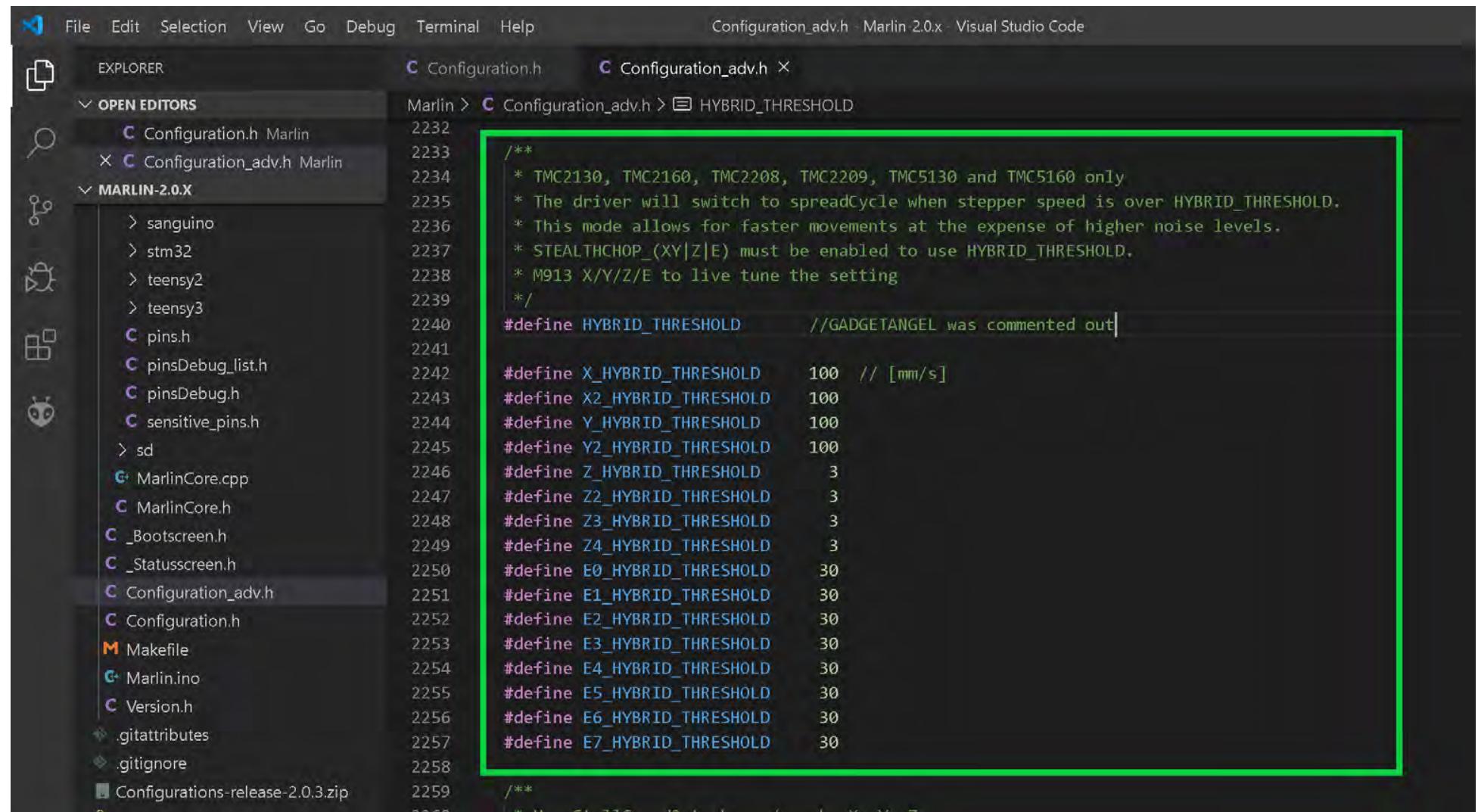
2193 */
2194 #define STEALTHCHOP_XY
2195 #define STEALTHCHOP_Z
2196 #define STEALTHCHOP_E
2197
2198 /**
2199 * Optimize spreadCycle chopper parameters by using predefined parameter sets
2200 * or with the help of an example included in the library.
2201 * Provided parameter sets are
2202 * CHOPPER_DEFAULT_12V
2203 * CHOPPER_DEFAULT_19V
2204 * CHOPPER_DEFAULT_24V
2205 * CHOPPER_DEFAULT_36V
2206 * CHOPPER_PRUSAMK3_24V // Imported parameters from the official Prusa firmware for MK3 (24V)
2207 * CHOPPER_MARLIN_119 // Old defaults from Marlin v1.1.9
2208 *
2209 * Define your own with
2210 * { <off_time[1..15]>, <hysteresis_end[-3..12]>, hysteresis_start[1..8] }
2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213
2214 /**

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- Now you either enable "HYBRID_THRESHOLD" or disable it. By default it is disabled. "HYBRID_THRESHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Title Bar:** Configuration_adv.h - Marlin 2.0.x - Visual Studio Code
- Explorer:** Shows the project structure under OPEN EDITORS and MARLIN-2.0.X. The Configuration_adv.h file is open in the editor.
- Editor:** The code editor displays the Configuration_adv.h file. A specific section of the code is highlighted with a green border:


```

      /**
       * TMC2130, TMC2160, TMC2208, TMC2209, TMC5130 and TMC5160 only
       * The driver will switch to spreadCycle when stepper speed is over HYBRID_THRESHOLD.
       * This mode allows for faster movements at the expense of higher noise levels.
       * STEALTHCHOP_(XY|Z|E) must be enabled to use HYBRID_THRESHOLD.
       * M913 X/Y/Z/E to live tune the setting
      */
#define HYBRID_THRESHOLD //GADGETANGEL was commented out

#define X_HYBRID_THRESHOLD 100 // [mm/s]
#define X2_HYBRID_THRESHOLD 100
#define Y_HYBRID_THRESHOLD 100
#define Y2_HYBRID_THRESHOLD 100
#define Z_HYBRID_THRESHOLD 3
#define Z2_HYBRID_THRESHOLD 3
#define Z3_HYBRID_THRESHOLD 3
#define Z4_HYBRID_THRESHOLD 3
#define E0_HYBRID_THRESHOLD 30
#define E1_HYBRID_THRESHOLD 30
#define E2_HYBRID_THRESHOLD 30
#define E3_HYBRID_THRESHOLD 30
#define E4_HYBRID_THRESHOLD 30
#define E5_HYBRID_THRESHOLD 30
#define E6_HYBRID_THRESHOLD 30
#define E7_HYBRID_THRESHOLD 30
      
```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- Now I want to enable some statements that allow me access to debugging the TMC drivers. I will uncomment "MONITOR_DRIVER_STATUS" and "TMC_DEBUG". "MONITOR_DRIVER_STATUS" will enable the following G-codes: M906, M911, and M912, "TMC_DEBUG" will enable the M122 G-code command. You can read about these from the comments in the firmware and in [Marlin's documentation located on-line](#).

Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h Configuration_adv.h X
Marlin > C Configuration_adv.h > #define MONITOR_DRIVER_STATUS
2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213
2214 /**
2215 * Monitor Trinamic drivers for error conditions,
2216 * like overtemperature and short to ground.
2217 * In the case of overtemperature Marlin can decrease the driver current until error condition clears.
2218 * Other detected conditions can be used to stop the current print.
2219 * Relevant g-codes:
2220 * M906 - Set or get motor current in milliamps using axis codes X, Y, Z, E. Report values if no axis codes given.
2221 * M911 - Report stepper driver overtemperature pre-warn condition.
2222 * M912 - Clear stepper driver overtemperature pre-warn condition flag.
2223 * M122 - Report driver parameters (Requires TMC_DEBUG)
2224 */
2225 #define MONITOR_DRIVER_STATUS //GADGETANGEL was commented out
2226
2227 #if ENABLED(MONITOR_DRIVER_STATUS)

```

Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h Configuration_adv.h X
Marlin > C Configuration_adv.h > #define TMC_DEBUG
2307
2308 /**
2309 * Enable M122 debugging command for TMC stepper drivers.
2310 * M122 S0/1 will enable continuous reporting.
2311 */
2312 #define TMC_DEBUG //GADGETANGEL was commented out
2313

```

- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- The end of Marlin setup for FYSETC TMC2208 V1.2 drivers in UART mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS

MARLIN 2.0.X

pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h

Marlin > Configuration.h > X_DRIVER_TYPE

```
#define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.  
#define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.  
#define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
```

/*
 * Stepper Drivers
 *
 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
 *
 * A4988 is assumed for unspecified drivers.
 *
 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
 * TB6560, TB6600, TMC2100,
 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,

PROBLEMS 5 OUTPUT DEBUG CONSOLE TERMINAL

1: Task - Build

| BIGTREE_SKR_PRO | SUCCESS | 00:02:31.294 |
|------------------------|---------|--------------|
| BIGTREE_CTP_V1_0 | IGNORED | |
| BIGTREE_BT002 | IGNORED | |
| teensy31 | IGNORED | |
| teensy35 | IGNORED | |
| esp32 | IGNORED | |
| linux_native | IGNORED | |
| SAMD51_grandcentral_m4 | IGNORED | |
| rumba32_f446ve | IGNORED | |
| mks_rumba32 | IGNORED | |
| include_tree | IGNORED | |

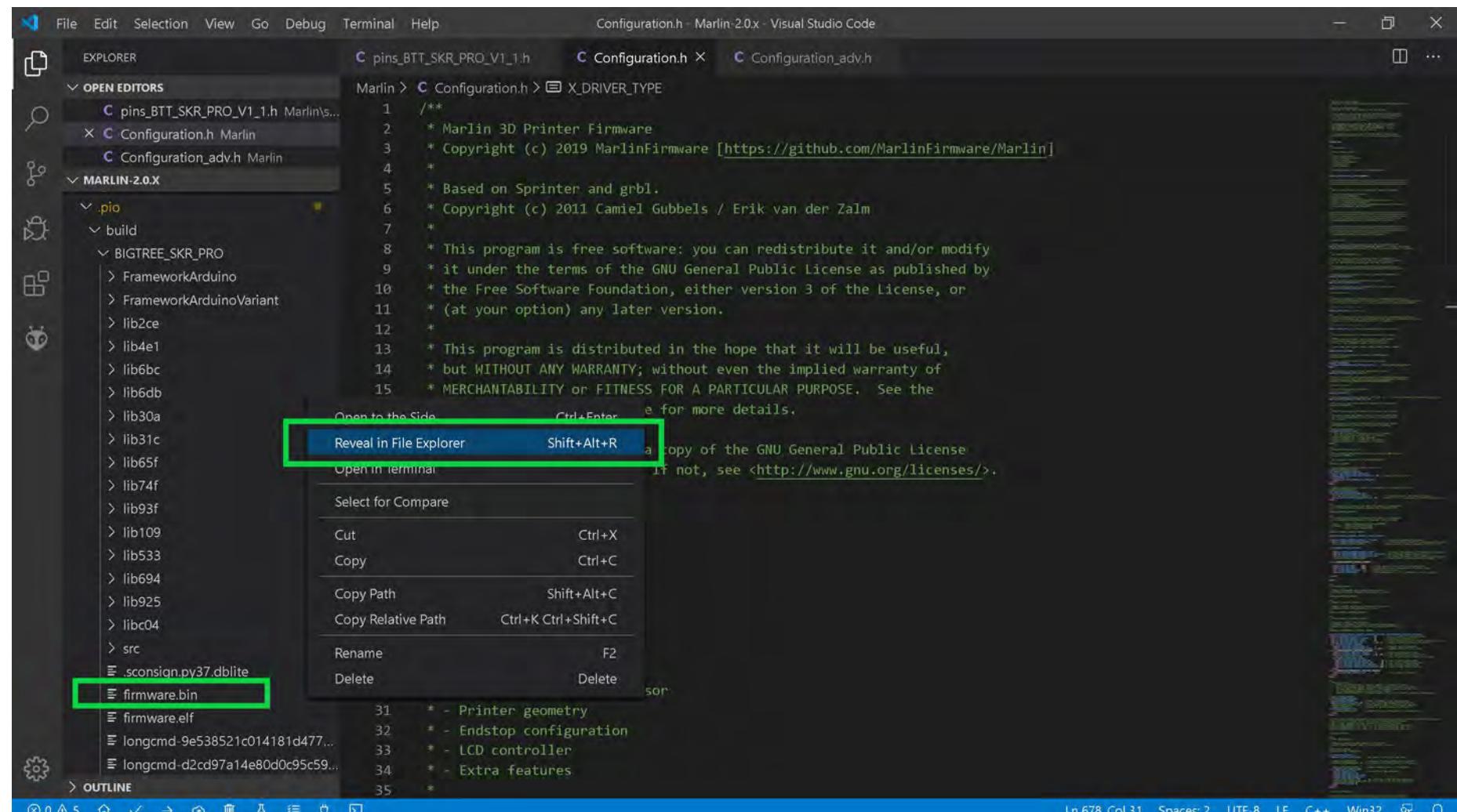
```
===== 1 succeeded in 00:02:31.294 =====
```

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

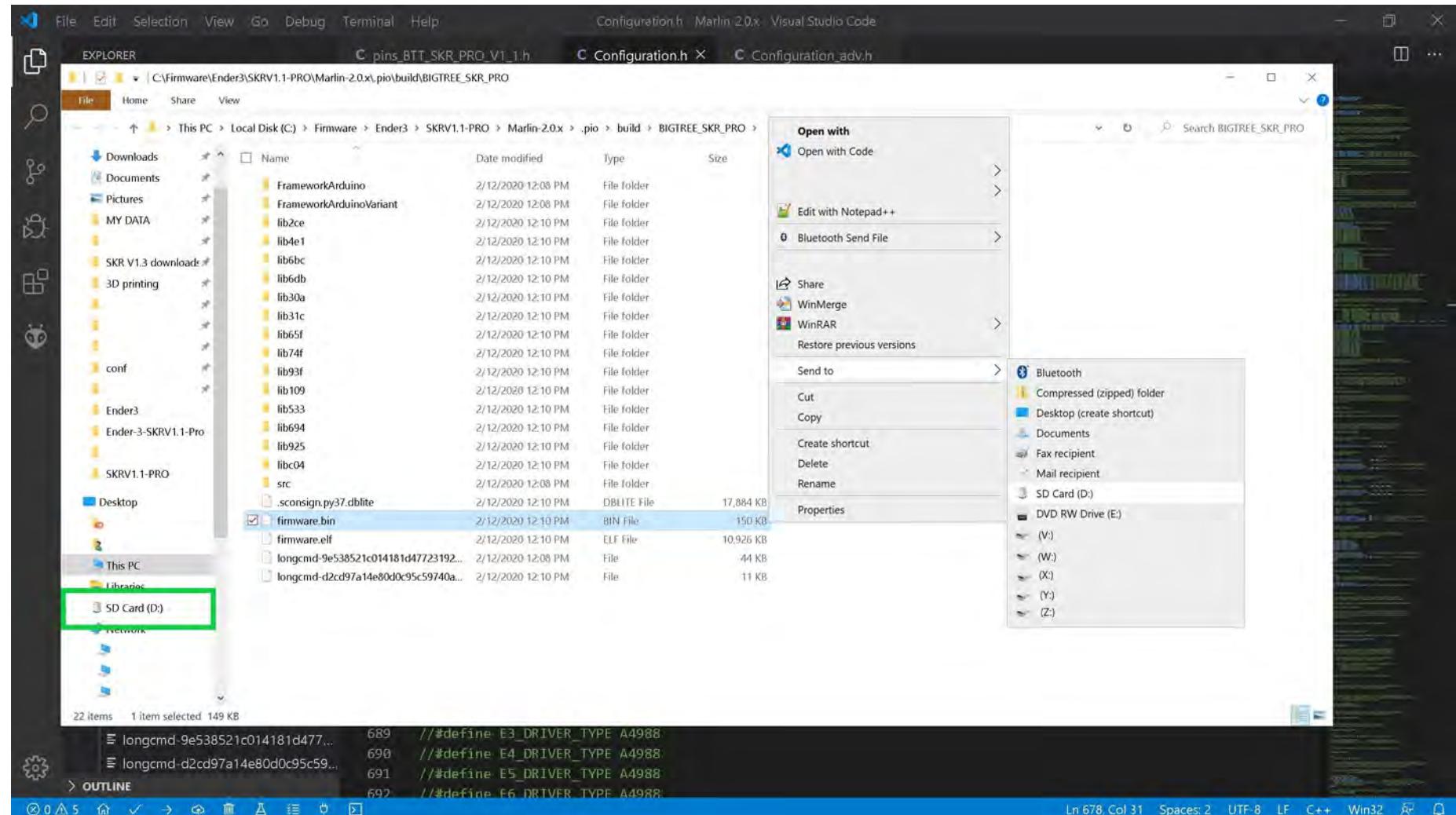
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



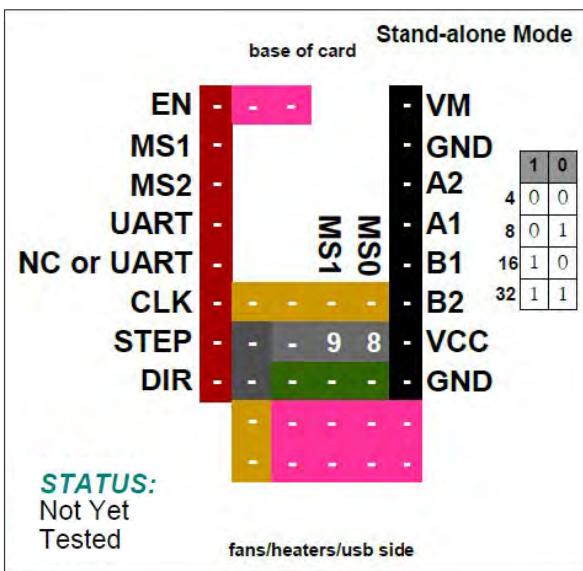
- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

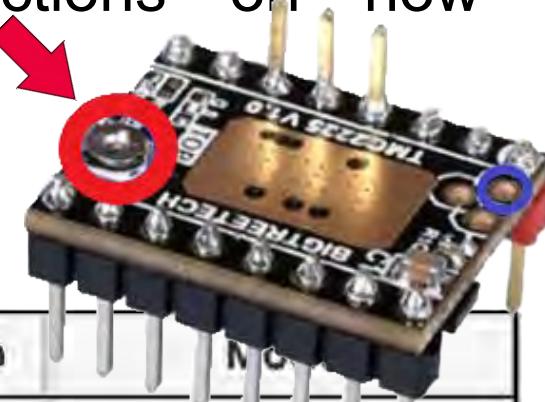
- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

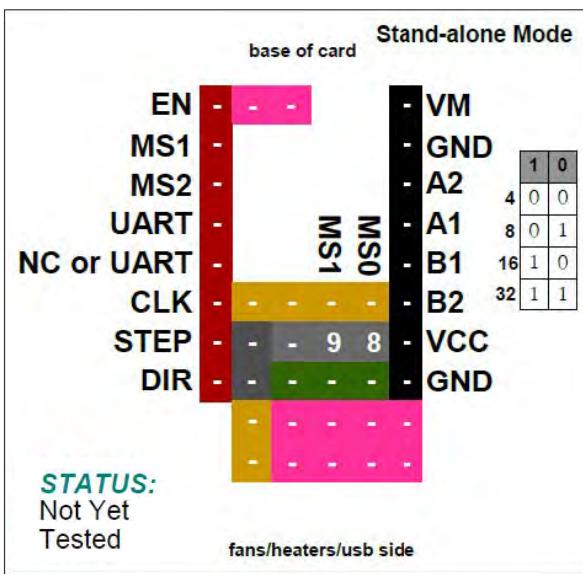
**BIQU TMC2225 V1.0****Stand-alone Mode**

NOTE: Use the potentiometer (POT) on the top of the board, as shown in **RED**; or use the board's " V_{ref} Test point" location, as shown in **BLUE**, to set your V_{ref} . See **Appendix A** for instructions on how to set the V_{ref} on a driver board.



Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

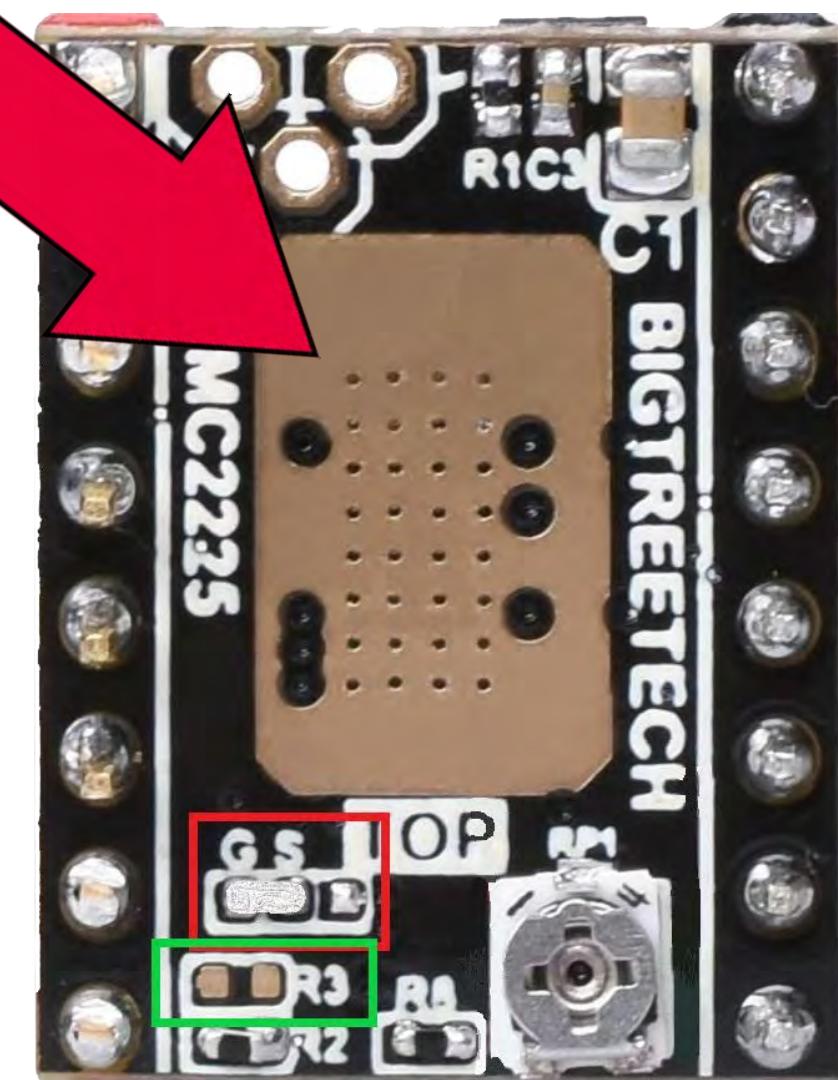
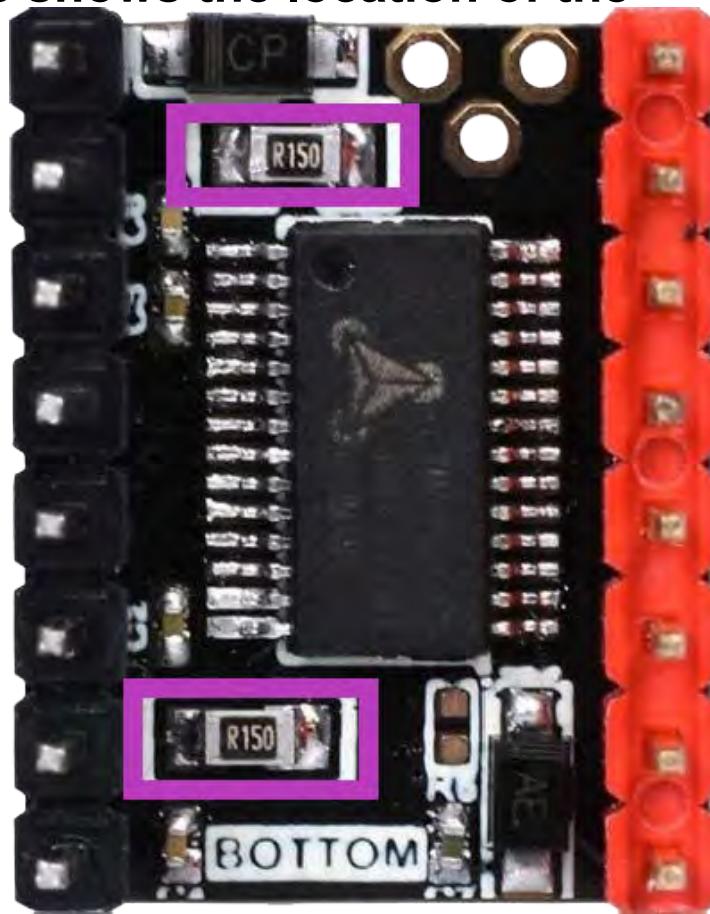
| Driver Chip | MS1 | MS0 | Steps | Interpolation | |
|---|--|-----|--------|--|-------------|
| BIQU® TMC2225 <small>Stand Alone Mode Maximum 32 Subdivision 35V DC 2A (peak)</small> | GND | GND | 1 / 4 | 1 / 256 | stealthChop |
| | GND | VIO | 1 / 8 | 1 / 256 | stealthChop |
| | VIO | GND | 1 / 16 | 1 / 256 | stealthChop |
| | VIO | VIO | 1 / 32 | 1 / 256 | stealthChop |
| Driving Current Calculation Formula R_S (Typical Sense Resistor) = 0.15Ω | $I_{MAX} = V_{ref} * 0.7222$ See Appendix B #10. Use 50% to 90% as shown below: | | | $V_{ref} = I_{MAX} * 1.3846$ See Appendix B #10. Use 50% to 90% as shown below: | |
| | $I_{MAX} = (V_{ref} * 0.7222) * 0.90$ | | | $V_{ref} = (I_{MAX} * 1.3846) * 0.90$ | |

**BIQU TMC2225 V1.0****Stand-alone Mode**

Note: To obtain **stand-alone mode** for the BIQU TMC2225 V1.0, the two pads located at R3 must have a gap between them, as seen in **GREEN** below, and the two pads at "G S" (located on the top of the driver board) must be set for StealthChop as seen in **RED** below.

The **PURPLE** boxes shows the location of the current sense resistors (R_s).

Note: MOST BIQU TMC2225 V1.0 driver boards, when purchased for **UART mode**, will have two R3 pads (located on the top of the driver board), which are **NOT soldered together**. This indicates the driver board can use the UART pin for the UART single wire interface (if the UART, "U", jumper is in place on the SKR PRO V1.1 board)



Stand-alone Mode

Stand-alone Mode

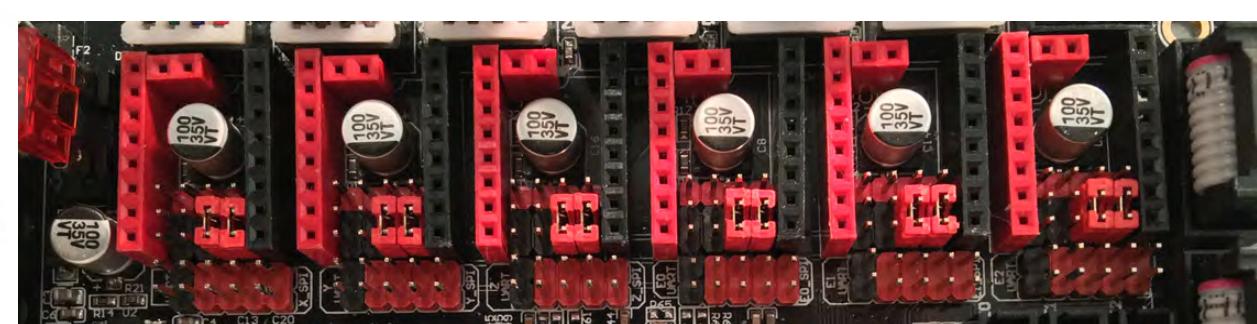
Stand-alone Mode

1 / 4

Interpolation: 1/256

StealthChop

| | | | | |
|------|---|---|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | A2 |
| UART | - | - | MS1 | A1 |
| CLK | - | - | MS0 | B1 |
| STEP | - | - | 9 8 | B2 |
| DIR | - | 9 | 8 | VCC |
| | - | - | - | GND |



Stand-alone Mode

1 / 8

Interpolation: 1/256

StealthChop

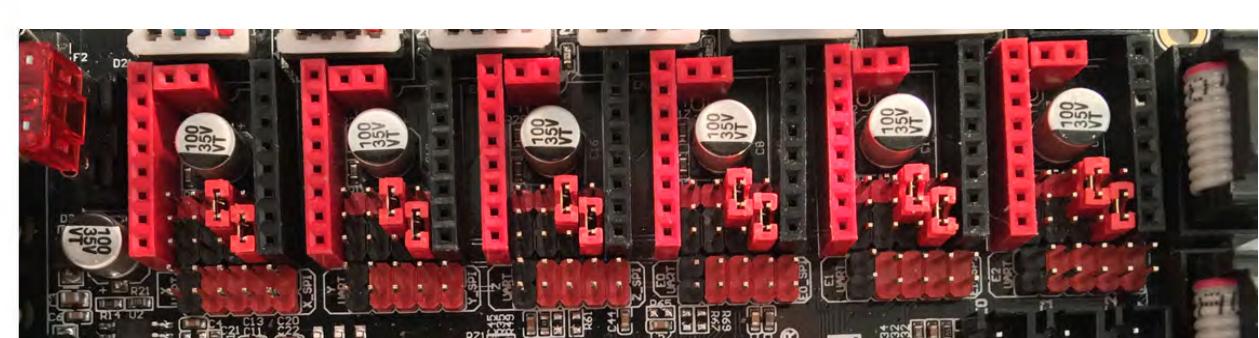
| | | | | |
|------|---|---|-----|-----|
| EN | - | - | - | VM |
| MS1 | - | - | - | GND |
| MS2 | - | - | - | A2 |
| UART | - | - | MS1 | A1 |
| CLK | - | - | MS0 | B1 |
| STEP | - | - | 8 | B2 |
| DIR | - | 9 | 8 | VCC |
| | - | - | - | GND |



Stand-alone Mode**Stand-alone Mode****1 / 16**Interpolation: **1/256**

StealthChop

| | | | |
|------|---|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | A2 |
| UART | - | - | A1 |
| CLK | - | 9 | B1 |
| STEP | - | 9 8 | B2 |
| DIR | - | 8 | VCC |
| | - | - | GND |

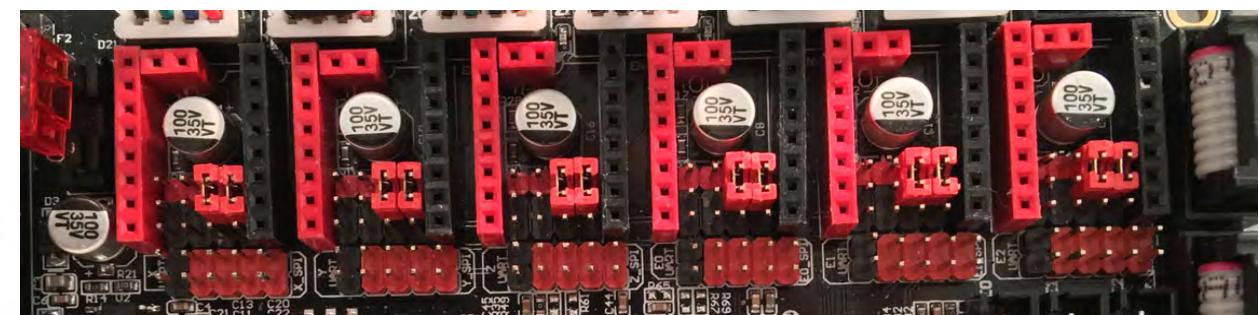


Stand-alone Mode

1 / 32Interpolation: **1/256**

StealthChop

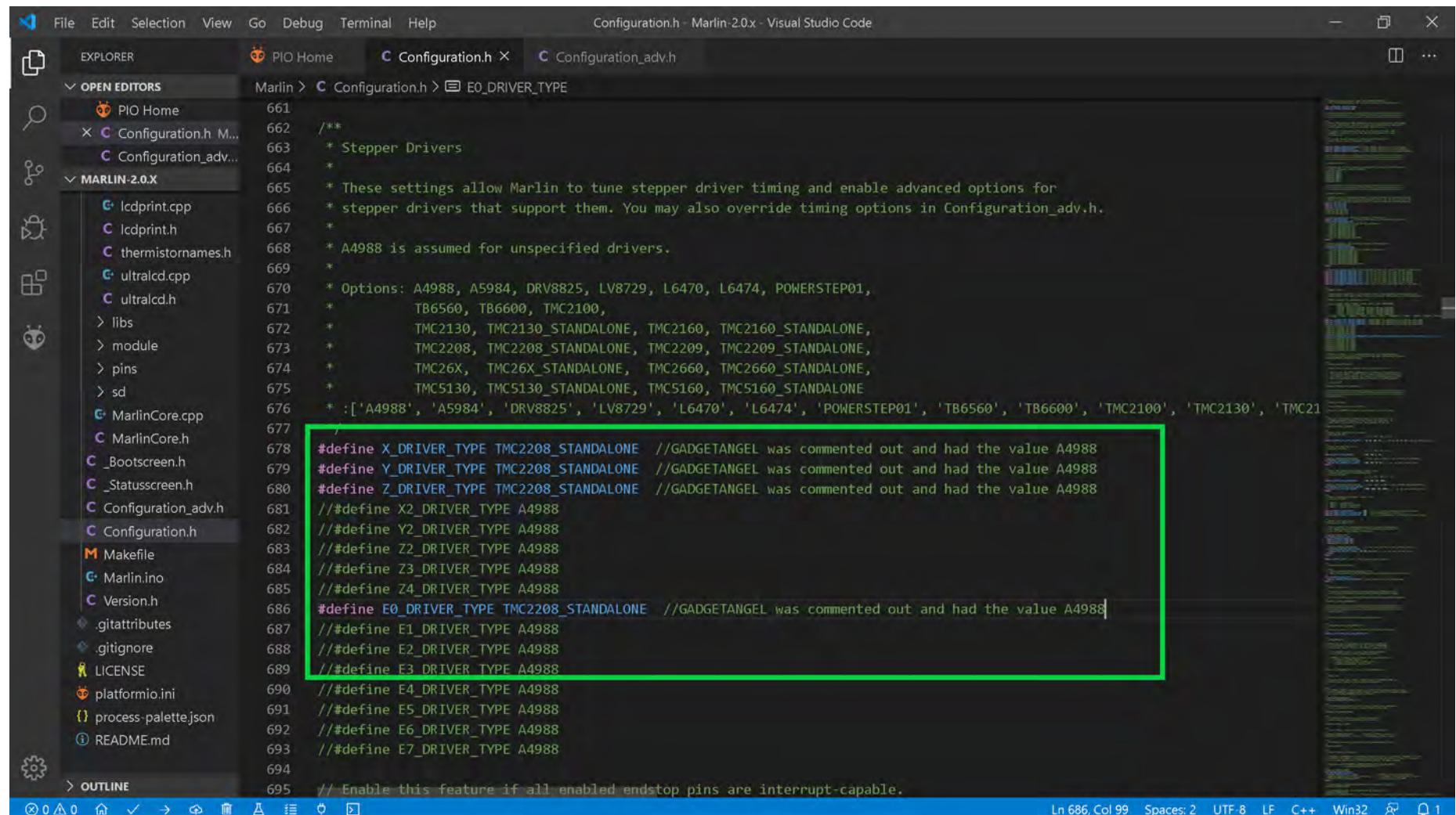
| | | | |
|------------|---|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | A2 |
| UART | - | - | A1 |
| NC or UART | - | - | B1 |
| CLK | - | 9 8 | B2 |
| STEP | - | 9 8 | VCC |
| DIR | - | - | GND |
| | - | - | - |



The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in Stand-alone Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2225 V1.0 stepper motor drivers in stand-alone mode.

- Change the stepper motor drivers so that Marlin knows you are using BIQU TMC2225 drivers in stand-alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2225 drivers in stand-alone mode. Since Marlin does not have an option for TMC2225 drivers we will use "TMC2208_STANDALONE" for the DRIVER_TYPE. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the following configuration for stepper drivers:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
668 *           TB6560, TB6600, TMC2100,
669 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
670 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
671 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
672 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
673 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC26X', 'TMC5130']
674 */
675
676 #define X_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
677 #define Y_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
678 #define Z_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
679
680 //##define X2_DRIVER_TYPE A4988
681 //##define Y2_DRIVER_TYPE A4988
682 //##define Z2_DRIVER_TYPE A4988
683 //##define Z3_DRIVER_TYPE A4988
684 //##define Z4_DRIVER_TYPE A4988
685
686 #define E0_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
687 //##define E1_DRIVER_TYPE A4988
688 //##define E2_DRIVER_TYPE A4988
689 //##define E3_DRIVER_TYPE A4988
690
691 //##define E4_DRIVER_TYPE A4988
692 //##define E5_DRIVER_TYPE A4988
693 //##define E6_DRIVER_TYPE A4988
694 //##define E7_DRIVER_TYPE A4988
695
696 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

A green rectangular box highlights the driver type definitions for all axes (X, Y, Z, E0-E7). The code shows that the original values (A4988) were commented out and replaced with TMC2208_STANDALONE.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in Stand-alone Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to TMC2225 (which are exactly like the TMC2208) stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as seen in the GREEN box below.

```

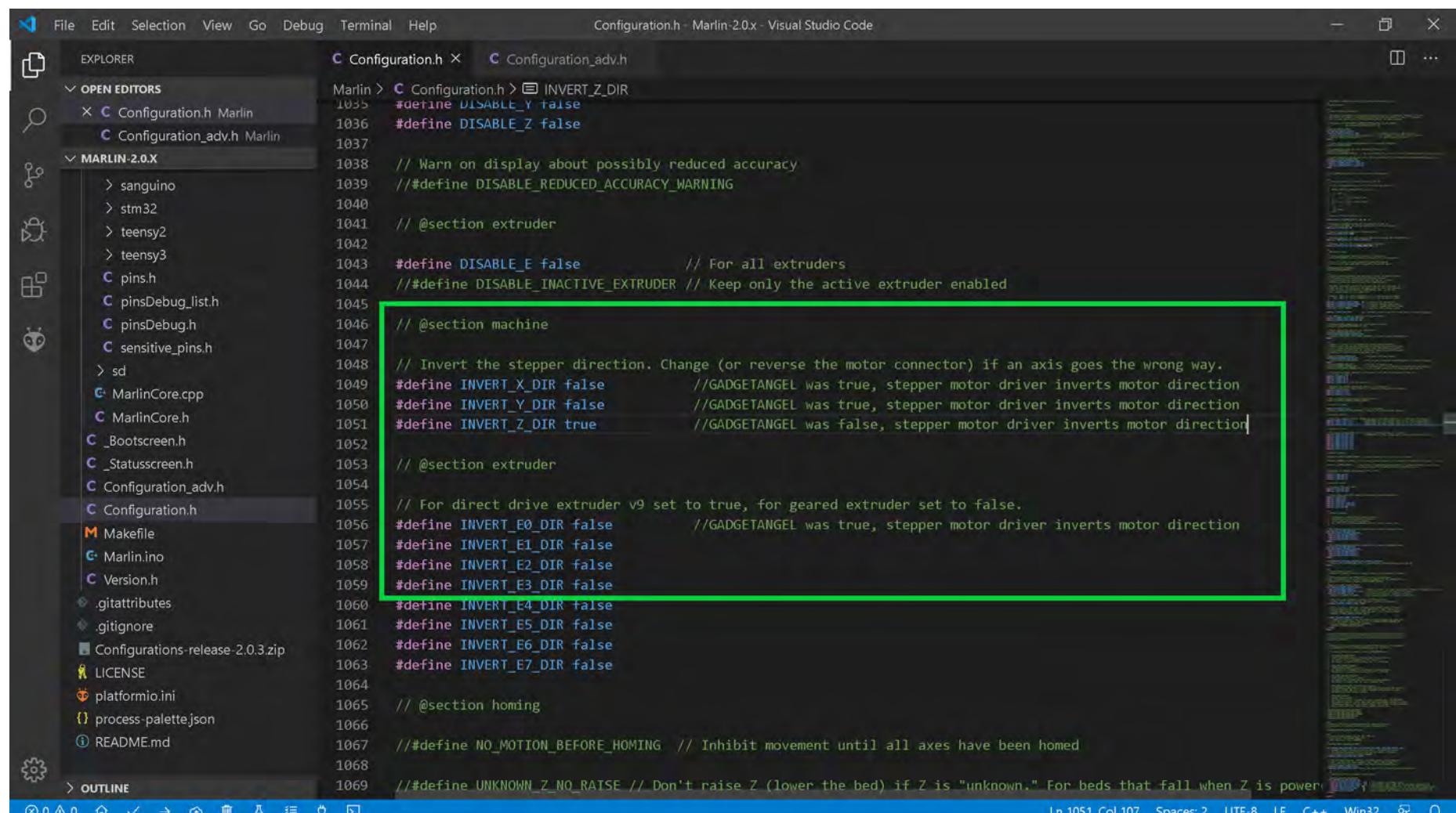
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin Configuration.h DEFAULT_AXIS_STEPS_PER_UNIT
sam
sanguino
stm32
teensy2
teensy3
pins.h
pinsDebug_list.h
pinsDebug.h
sensitive_pins.h
sd
MarlinCore.cpp
MarlinCore.h
_Bootscreen.h
_Statusscreen.h
Configuration_adv.h
Configuration.h
Makefile
Marlin.ino
Version.h
.gitattributes
.gitignore
Configurations-release-2.0.3.zip
LICENSE
platformio.ini
process-palette.json
README.md
OUTLINE
Ln 738, Col 62 Spaces: 2 UTF-8 LF C++ Win32
20 20 100 23.25
 726 /**
 727 * With this option each E stepper can have its own factors for the
 728 * following movement settings. If fewer factors are given than the
 729 * total number of extruders, the last value applies to the rest.
 730 */
 731 // #define DISTINCT_E_FACTORS
 732 /**
 733 * Default Axis Steps Per Unit (steps/mm)
 734 * Override with M92
 735 *
 736 X, Y, Z, E0 [, E1[, E2...]]
 737 */
 738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 } // GADGETANGEL was
 739 // {80, 80, 400, 93} for A4988 on Ender 3
 740 // want 1/4 steps, so divide each number by 4 since going from
 741 // 1/16 to 1/4 steps
 742 /**
 743 * Default Max Feed Rate (mm/s)
 744 * Override with M203
 745 *
 746 X, Y, Z, E0 [, E1[, E2...]]
 747 */
 748 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }
 749 /**
 750 * #define LIMITED_MAX_FR_EDITING // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
 751 #if ENABLED(LIMITED_MAX_FR_EDITING)
 752 #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ... or, set your own edit limits
 753 #endif
 754 /**
 755 * Default Max Acceleration (change/s) change = mm/s
 756 * (Maximum start speed for accelerated moves)
 757 * Override with M201
 758 */
 759

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in Stand-alone Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2225 drivers, I must invert the stepper motor direction because the TMC2225 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2225 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h

MARLIN-2.0.X

```

Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false          // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in Stand-alone Mode

- The end of Marlin setup for BIQU TMC2225 V1.0 drivers in stand-alone mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

```

Configuration.h Marlin 2.0.x Visual Studio Code
File Edit Selection View Go Debug Terminal Help Configuration.h X_DRIVER_TYPE
EXPLORER pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h
OPEN EDITORS Marlin Configuration.h X_DRIVER_TYPE
pins_BTT_SKR_PRO_V1_1.h Marlin\src...
Configuration.h Marlin Configuration_adv.h Marlin
MARLIN-2.0.X pins_THE_BORG.h
pins_VAKE403D.h
teensy2
teensy3
pins.h
pinsDebug_list.h
pinsDebug.h
sensitive_pins.h
sd
MarlinCore.cpp
MarlinCore.h
_Bootscreen.h
_Statusscreen.h
Configuration_adv.h
Configuration.h
Makefile
Marlin.ino
Version.h
.gitattributes
.gitignore
LICENSE
platformio.ini
process-palette.json
README.md
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
1: Task - Build + ×
TMC2225_V1_0
BIGTREE_SKR_PRO SUCCESS 00:02:31.294
BIGTREE_GTR_V1_0 IGNORED
BIGTREE_BT002 IGNORED
teensy31 IGNORED
teensy35 IGNORED
esp32 IGNORED
linux_native IGNORED
SAMD51_grandcentral_m4 IGNORED
rumba32_f446ve IGNORED
mks_rumba32 IGNORED
include_tree IGNORED
=====
===== 1 succeeded in 00:02:31.294 =====
Terminal will be reused by tasks, press any key to close it.

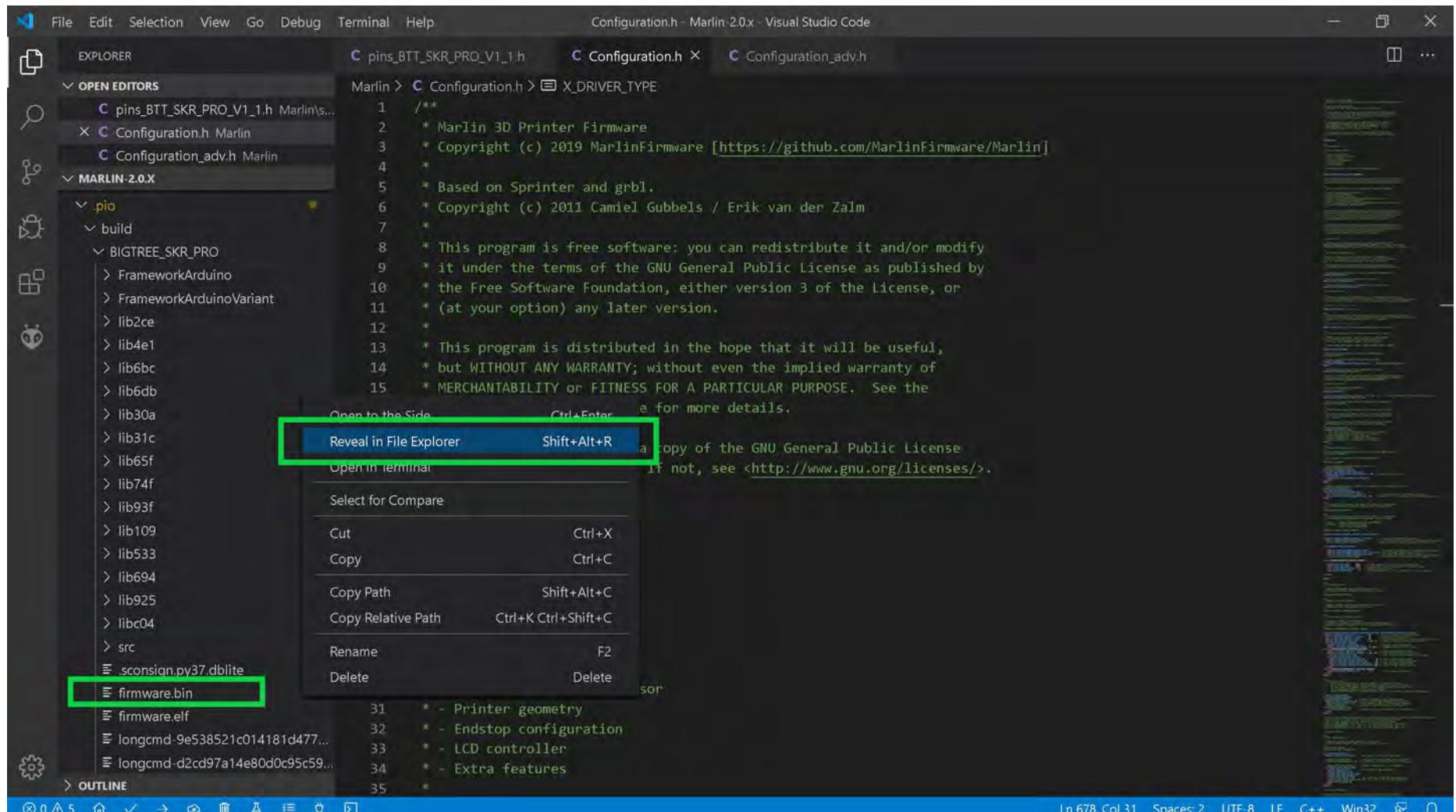
```

The screenshot shows the Visual Studio Code interface with the terminal tab active. The terminal output displays a successful build of Marlin 2.0.x for the TMC2225_V1_0 driver. The build took 00:02:31.294. A yellow box highlights the checkmark icon in the bottom-left corner of the terminal tab, indicating a successful build. A green box highlights the terminal output itself, showing the build results.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in Stand-alone Mode

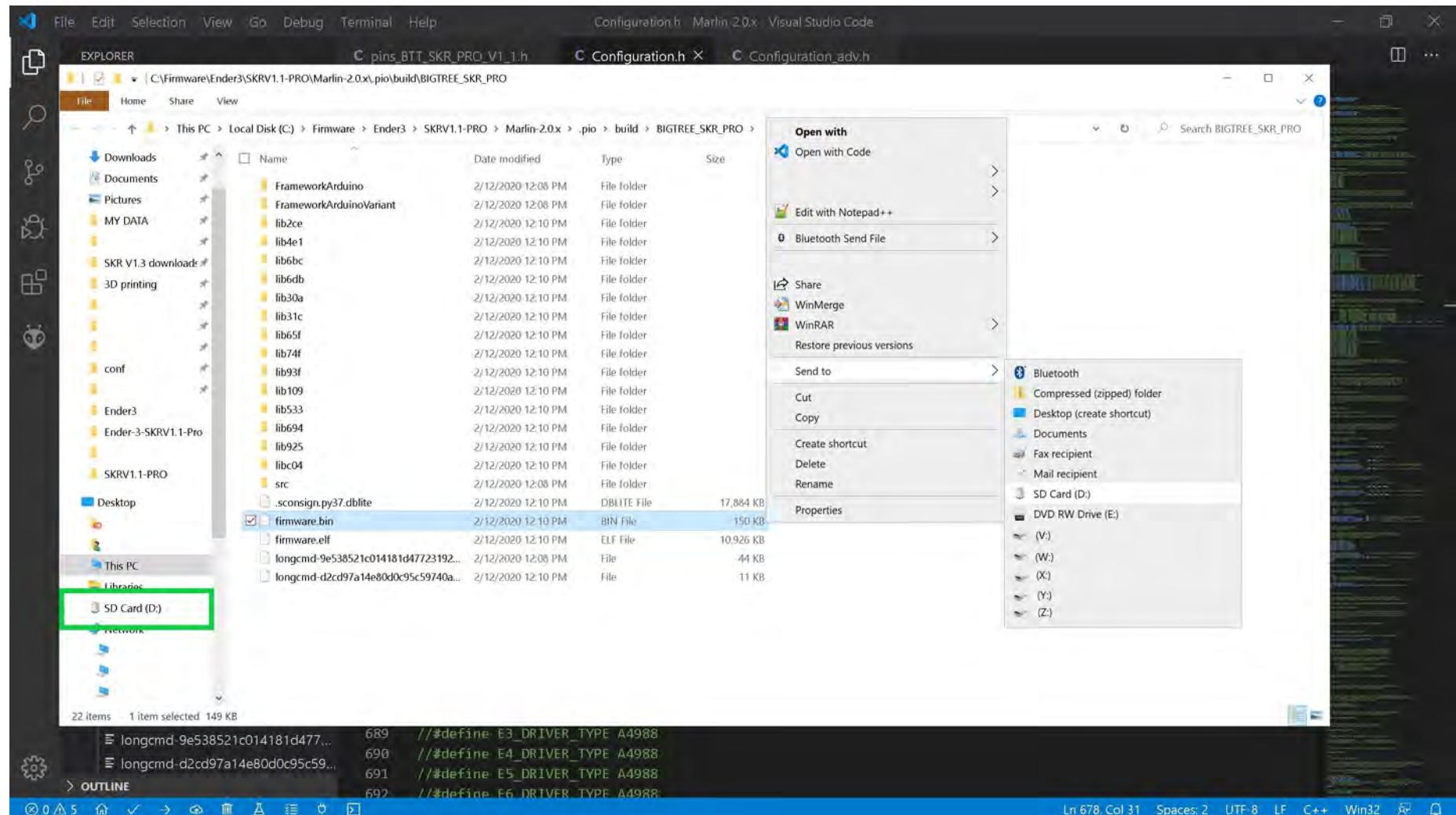
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



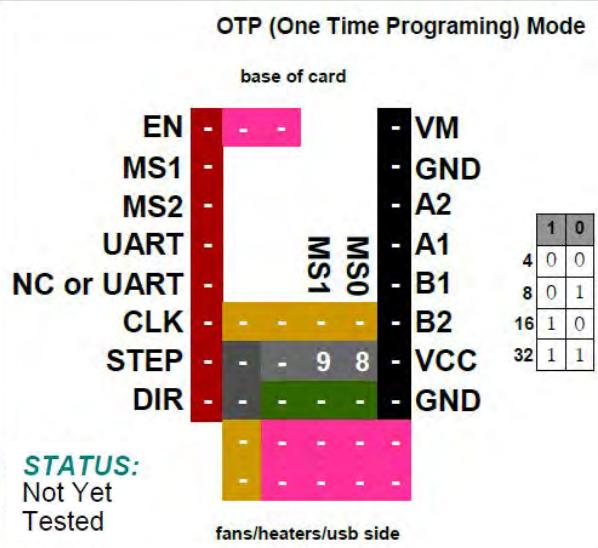
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in Stand-alone Mode

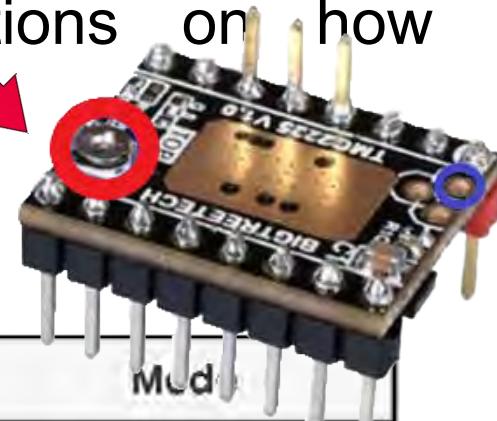
- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



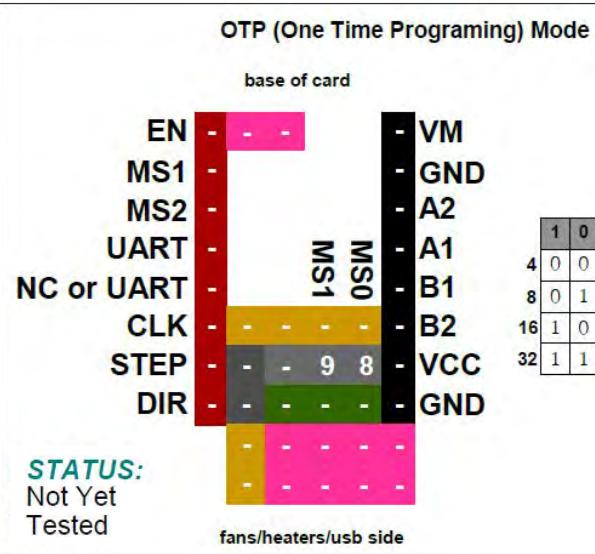
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

BIQU TMC2225 V1.0One Time Programming (OTP) Mode

Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.



| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|--|--|-----|--------|--|-------------|
| BIQU® TMC2225 <small>OTP Mode Maximum 32 Subdivision 35V DC 2A (peak)</small> | GND | GND | 1 / 4 | 1 / 256 | spreadCycle |
| | GND | VIO | 1 / 8 | 1 / 256 | spreadCycle |
| | VIO | GND | 1 / 16 | 1 / 256 | spreadCycle |
| | VIO | VIO | 1 / 32 | 1 / 256 | spreadCycle |
| Driving Current Calculation Formula <small>R_S(Typical Sense Resistor)=0.15Ω</small> | I_{MAX}=V_{ref}*0.7222 See Appendix B#10. Use 50% to 90% as shown below: | | | V_{ref}=I_{MAX}*1.3846 See Appendix B#10. Use 50% to 90% as shown below: | |
| | I_{MAX}=(V_{ref}*0.7222)*0.90 | | | V_{ref}=(I_{MAX}*1.3846)*0.90 | |

BIQU TMC2225 V1.0**One Time Programming (OTP) Mode**

OTP (One Time Programming) Mode

BIQU TMC2225 V1.0

One Time Programming (OTP) Mode

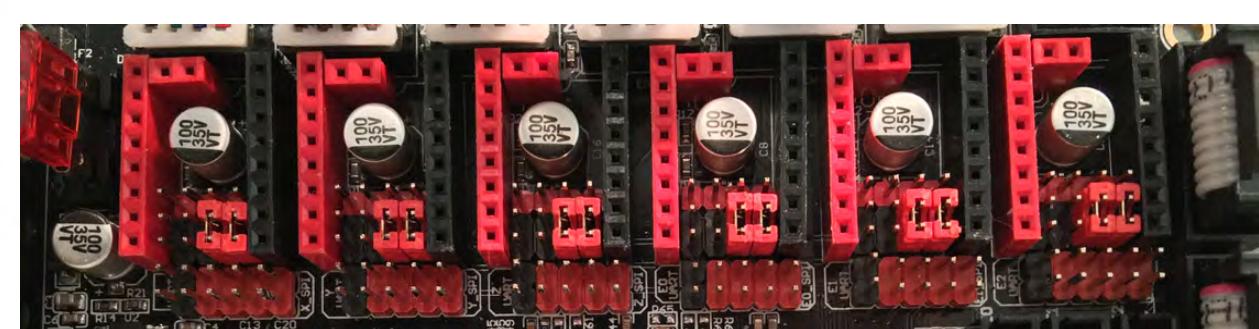
OTP

1 / 4

Interpolation: 1/256 NC or UART

SpreadCycle

| | | | |
|------|-----|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | A2 |
| UART | - | MS1 | A1 |
| CLK | MS0 | - | B1 |
| STEP | - | 9 8 | B2 |
| DIR | - | 9 8 | VCC |
| | - | - | GND |



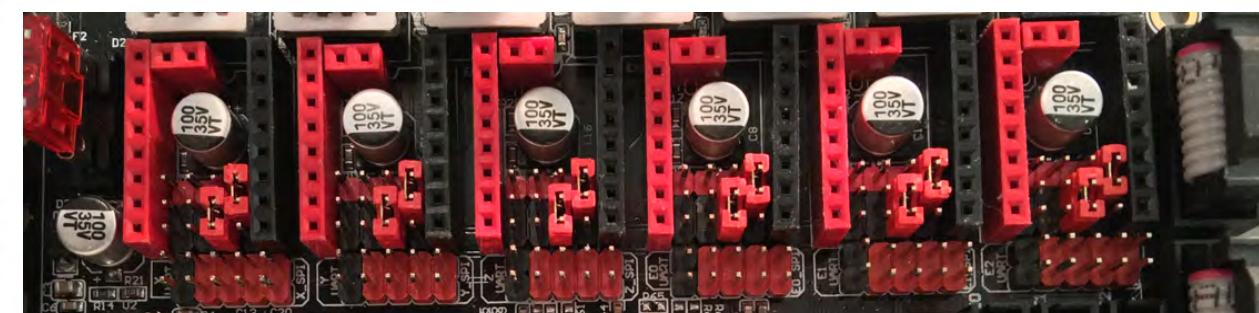
OTP

1 / 8

Interpolation: 1/256 NC or UART

SpreadCycle

| | | | |
|------|-----|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | A2 |
| UART | - | MS1 | A1 |
| CLK | MS0 | - | B1 |
| STEP | - | 8 | B2 |
| DIR | - | 9 8 | VCC |
| | - | - | GND |



OTP (One Time Programming) Mode

BIQU TMC2225 V1.0

One Time Programming (OTP) Mode

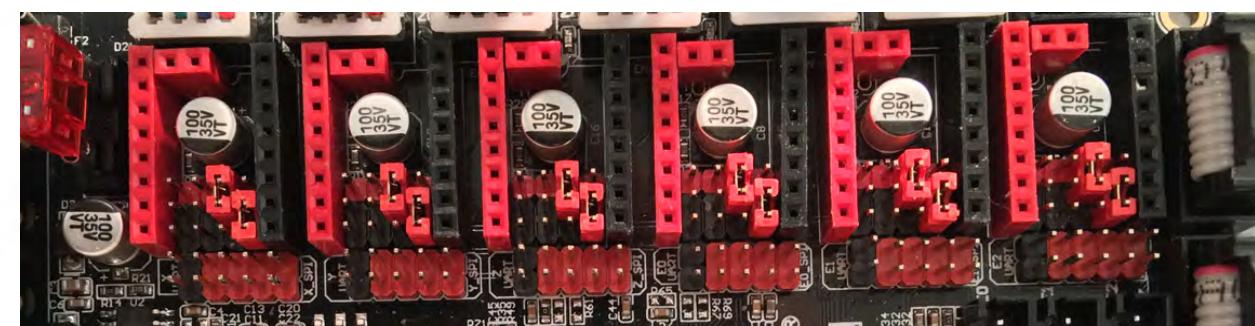
OTP

1 / 16

Interpolation: 1/256 NC or UART

SpreadCycle

| | | | |
|------|---|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | A2 |
| UART | - | MS1 | A1 |
| CLK | - | 9 | B1 |
| STEP | - | 9 8 | B2 |
| DIR | - | 8 | VCC |
| | - | - | GND |



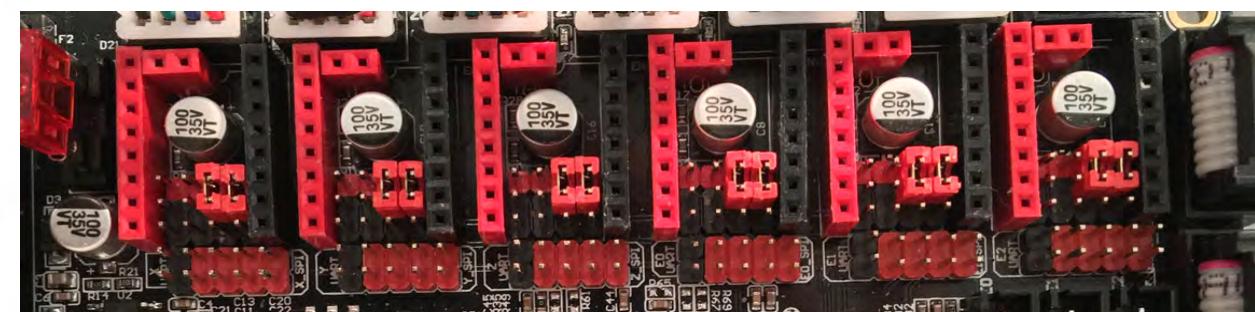
OTP

1 / 32

Interpolation: 1/256 NC or UART

SpreadCycle

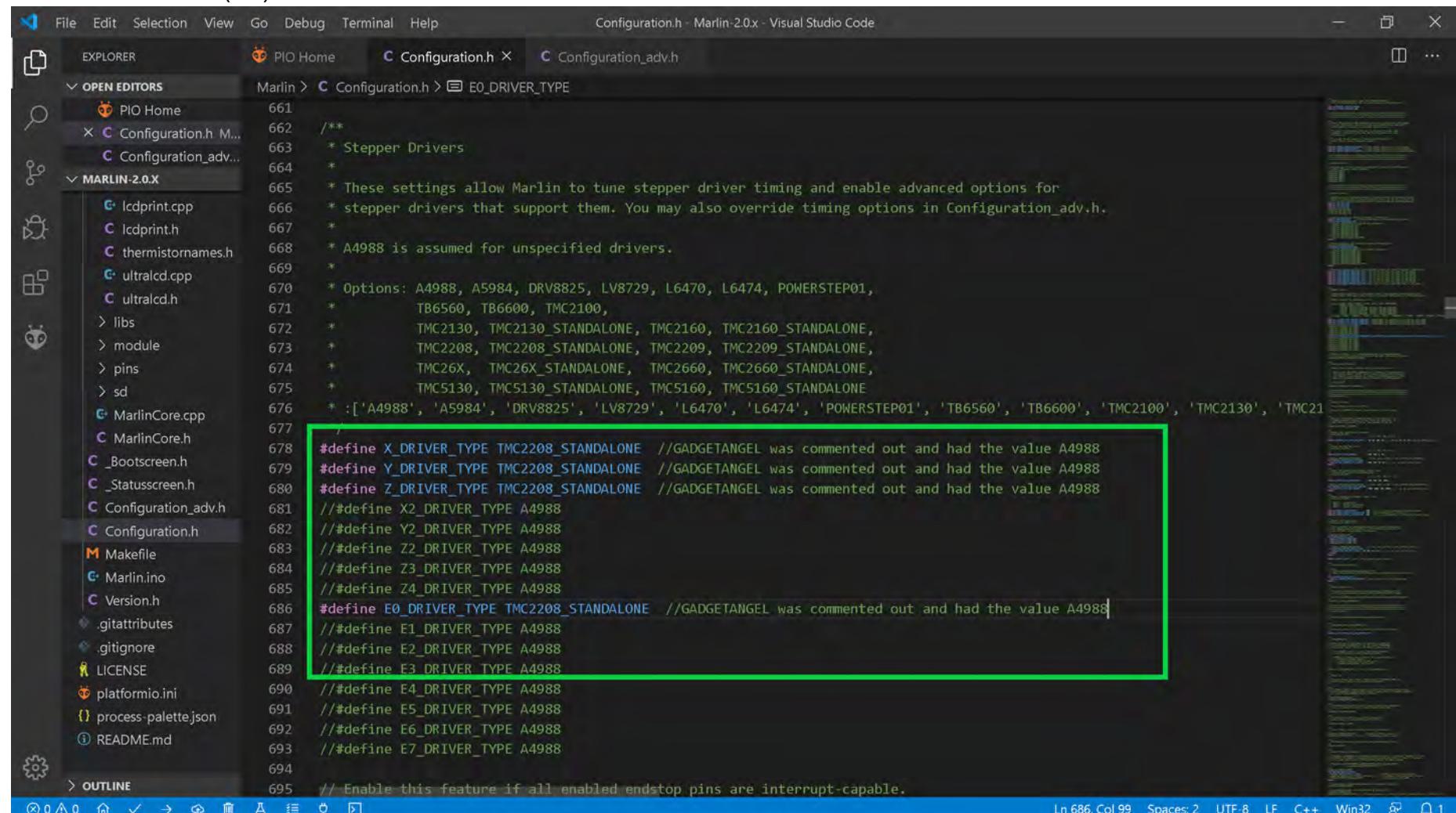
| | | | |
|------|---|-----|-----|
| EN | - | - | VM |
| MS1 | - | - | GND |
| MS2 | - | - | A2 |
| UART | - | MS1 | A1 |
| CLK | - | 9 8 | B1 |
| STEP | - | 9 8 | B2 |
| DIR | - | - | VCC |
| | - | - | GND |



The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in One Time Programming (OTP) Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2225 V1.0 stepper motor drivers in OTP mode.

- Change the stepper motor drivers so that Marlin knows you are using BIQU TMC2225 drivers in OTP mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use BIQU TMC2225 drivers in OTP mode. Since Marlin does not have an option for TMC2225 drivers we will use "TMC2208_STANDALONE" for the DRIVER_TYPE. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0x - Visual Studio Code
EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 * A4988 is assumed for unspecified drivers.
667 *
668 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
669 * TB6560, TB6600, TMC2100,
670 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
671 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
672 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
673 * TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
674 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2
675 */
676 #define X_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
677 #define Y_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
678 #define Z_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
679 //##define X2_DRIVER_TYPE A4988
680 //##define Y2_DRIVER_TYPE A4988
681 //##define Z2_DRIVER_TYPE A4988
682 //##define Z3_DRIVER_TYPE A4988
683 //##define Z4_DRIVER_TYPE A4988
684 #define E0_DRIVER_TYPE TMC2208_STANDALONE //GADGETANGEL was commented out and had the value A4988
685 //##define E1_DRIVER_TYPE A4988
686 //##define E2_DRIVER_TYPE A4988
687 //##define E3_DRIVER_TYPE A4988
688 //##define E4_DRIVER_TYPE A4988
689 //##define E5_DRIVER_TYPE A4988
690 //##define E6_DRIVER_TYPE A4988
691 //##define E7_DRIVER_TYPE A4988
692 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in One Time Programming (OTP) Mode

- Since I desire to use 1/4 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to TMC2225 (which are exactly like the TMC2208) stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/4 stepping. So we are cutting our STEPS by one quarter. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {20, 20, 100, 23.25}, as seen in the GREEN box below.

The screenshot shows the Visual Studio Code interface with the following details:

- File Menu:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Title Bar:** Configuration.h - Marlin 2.0.x - Visual Studio Code.
- Sidebar (Left):** Explorer, Open Editors, MARLIN-2.0.X, Configuration.h, Configuration_adv.h, MarlinCore.cpp, MarlinCore.h, _Bootscreen.h, _Statusscreen.h, Configuration_adv.h, Configuration.h, Makefile, Marlin.ino, Version.h, .gitattributes, .gitignore, Configurations-release 2.0.3.zip, LICENSE, platformio.ini, process-palette.json, README.md, Outline.
- Editor Area (Center):** The code editor displays the Configuration.h file for Marlin 2.0.x. A green box highlights the following code block:

```
726  /**
727   * With this option each E stepper can have its own factors for the
728   * following movement settings. If fewer factors are given than the
729   * total number of extruders, the last value applies to the rest.
730   */
731 //##define DISTINCT_E_FACTORS

733 /**
734  * Default Axis Steps Per Unit (steps/mm)
735  * Override with M92
736  *
737  *          X, Y, Z, E0 [, E1[, E2...]]
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 20, 20, 100, 23.25 }      //GADGETANGEL was
739                                         // {80, 80, 400, 93} for A4988 on Ender 3
740                                         // want 1/4 steps, so divide each number by 4 since going from
741                                         // 1/16 to 1/4 steps

744 /**
745  * Default Max Feed Rate (mm/s)
746  * Override with M203
747  *
748  *          X, Y, Z, E0 [, E1[, E2...]]
749 #define DEFAULT_MAX_FEEDRATE { 500, 500, 5, 25 }

751 //##define LIMITED_MAX_FR_EDITING      // Limit edit via M203 or LCD to DEFAULT_MAX_FEEDRATE * 2
752 #if ENABLED(LIMITED_MAX_FR_EDITING)
753   #define MAX_FEEDRATE_EDIT_VALUES { 600, 600, 10, 50 } // ...or, set your own edit limits
754 #endif

756 /**
757  * Default Max Acceleration (change/s) change = mm/s
758  * (Maximum start speed for accelerated moves)
759  * Override with M201
```
- Bottom Status Bar:** In 738 Col 62 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in One Time Programming (OTP) Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2225 drivers, I must invert the stepper motor direction because the TMC2225 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below

```
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS MARLIN-2.0.X
  Configuration.h Marlin
  Configuration_adv.h Marlin
  sanguino
  stm32
  teensy2
  teensy3
  pins.h
  pinsDebug.list.h
  pinsDebug.h
  sensitive_pins.h
  sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  Configurations-release-2.0.3.zip
  LICENSE
  platformio.ini
  process-palettejson
  README.md

OUTLINE

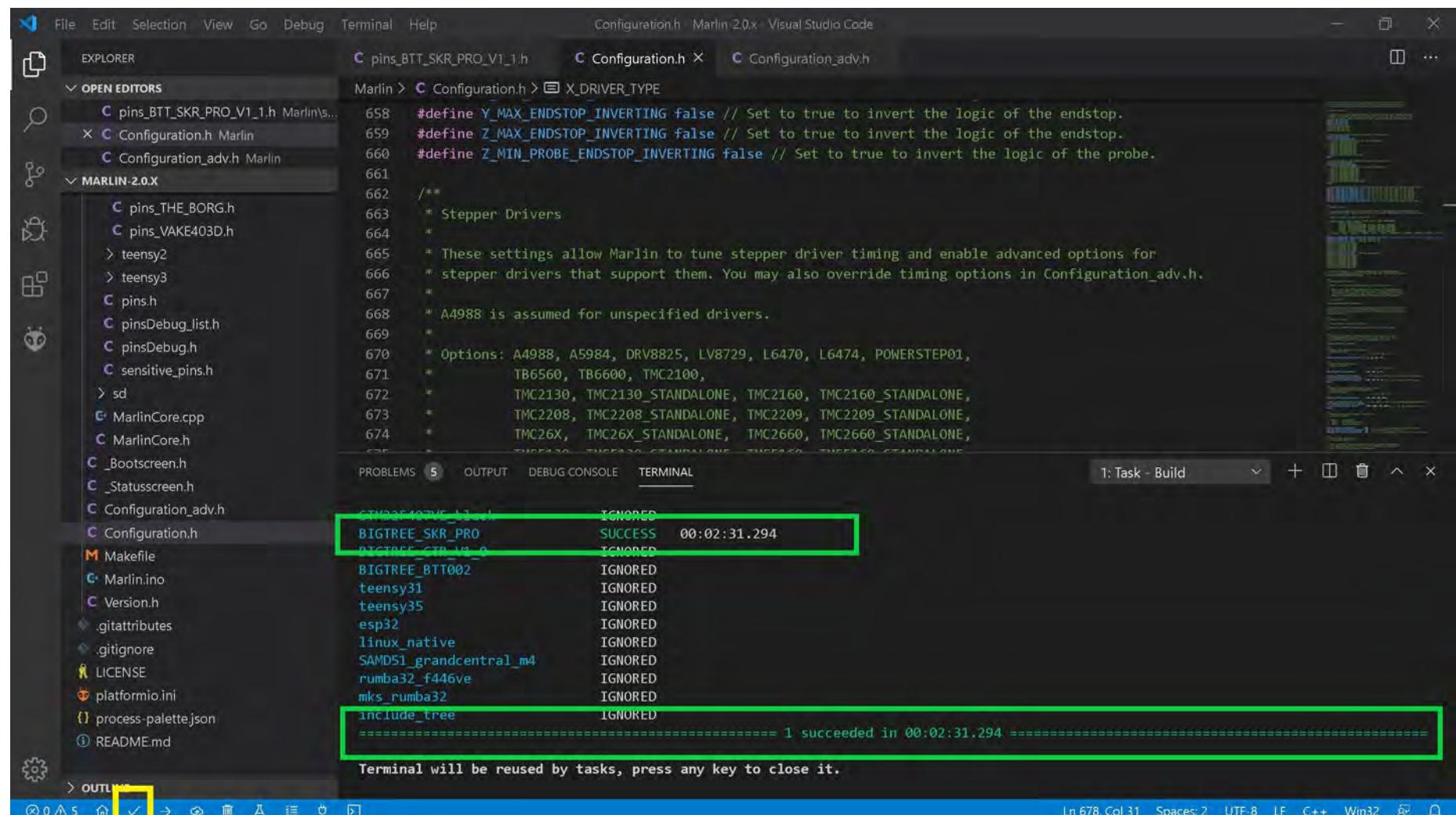
C Configuration.h X C Configuration_adv.h

Marlin > C Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false          // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in One Time Programming (OTP) Mode

- The end of Marlin setup for BIQU TMC2225 V1.0 drivers in OTP mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



```

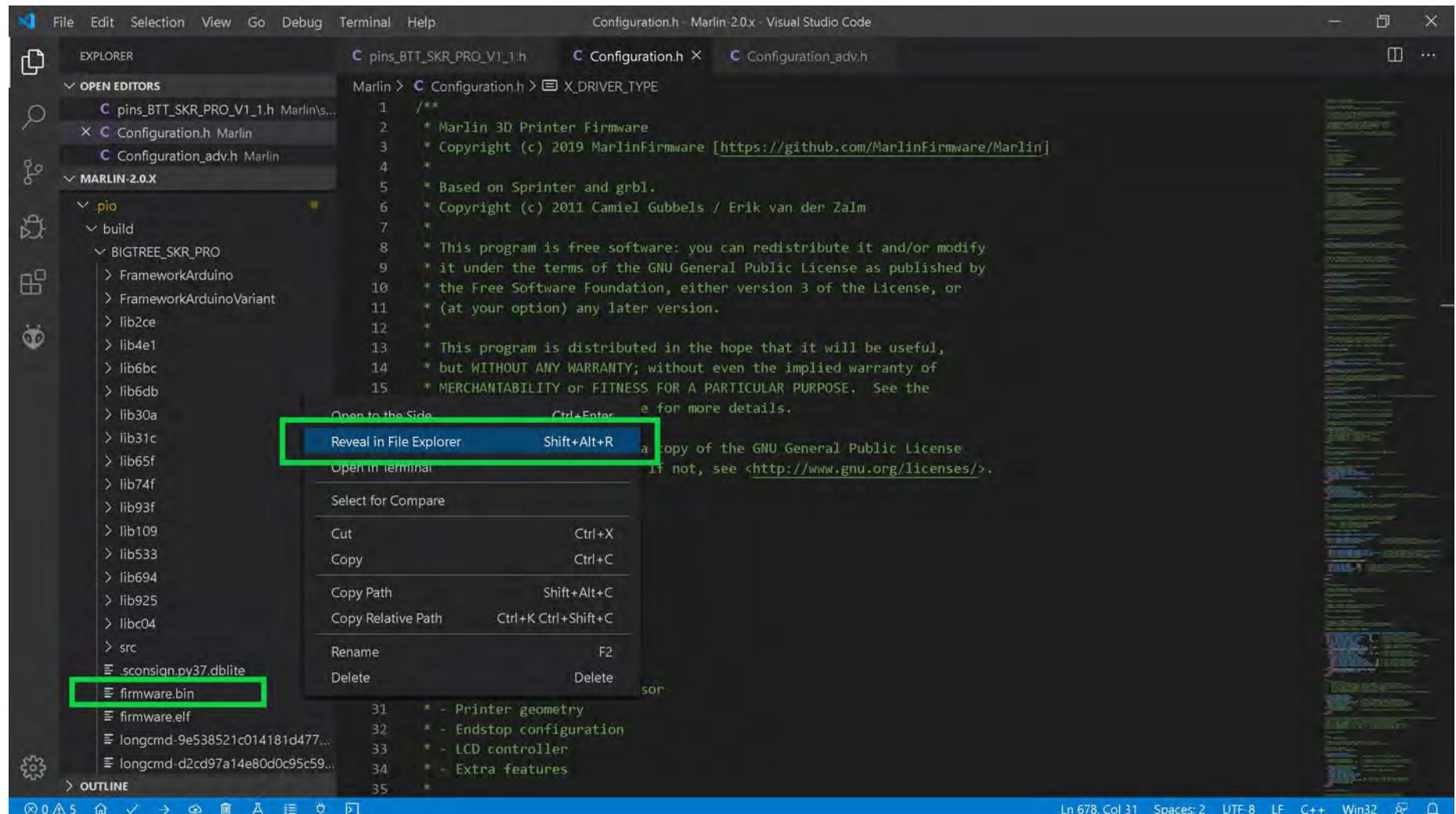
Configuration.h Marlin 2.0.x Visual Studio Code
File Edit Selection View Go Debug Terminal Help Configuration.h X_DRIVER_TYPE
pins_BTT_SKR_PRO_V1_1.h Configuration.h Configuration_adv.h
Marlin > Configuration.h > X_DRIVER_TYPE
658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 * TB6560, TB6600, TMC2100,
672 * TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 * TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 * TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 * TMC2661, TMC2661_STANDALONE, TMC2662, TMC2662_STANDALONE
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
1: Task - Build + ×
TMC2225_1.1.1 BIGTREE_SKR_PRO 00:02:31.294
BIGTREE_BTT002 IGNORED
teensy31 IGNORED
teensy35 IGNORED
esp32 IGNORED
linux_native IGNORED
SAMD51_grandcentral_m4 IGNORED
rumba32_f446ve IGNORED
mks_rumba32 IGNORED
include_tree IGNORED
=====
1 succeeded in 00:02:31.294
Terminal will be reused by tasks, press any key to close it.
Ln 678, Col 31 Spaces: 2 UTF-8 LF C++ Win32

```

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in One Time Programming (OTP) Mode

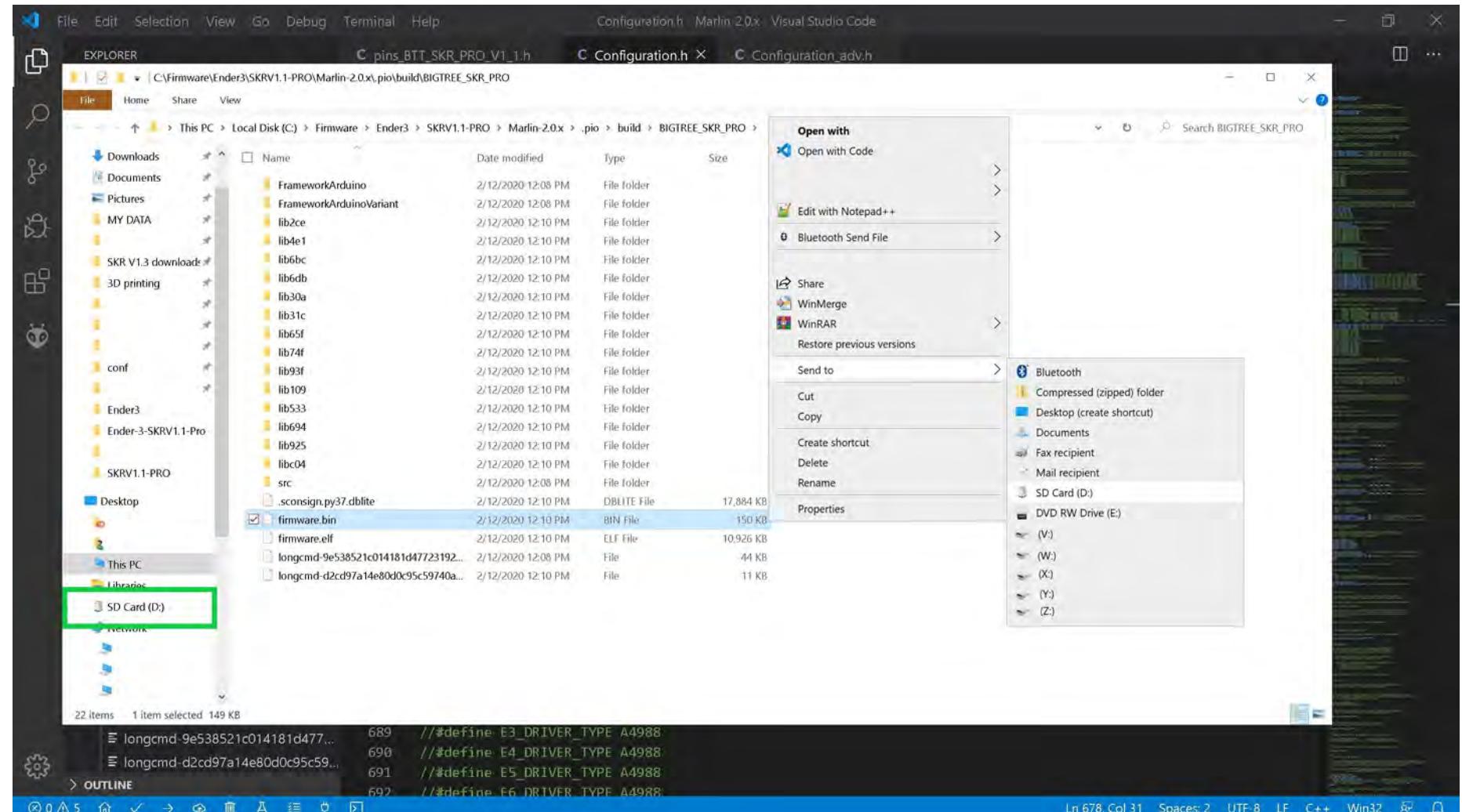
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



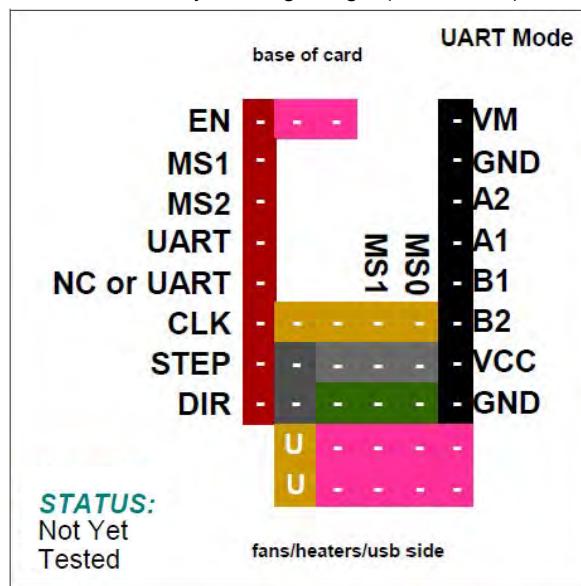
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in One Time Programming (OTP) Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



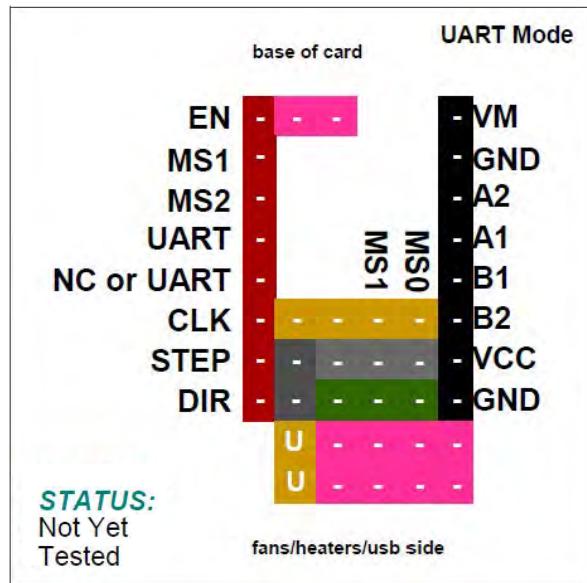
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

**BIQU TMC2225 V1.0****UART Mode**

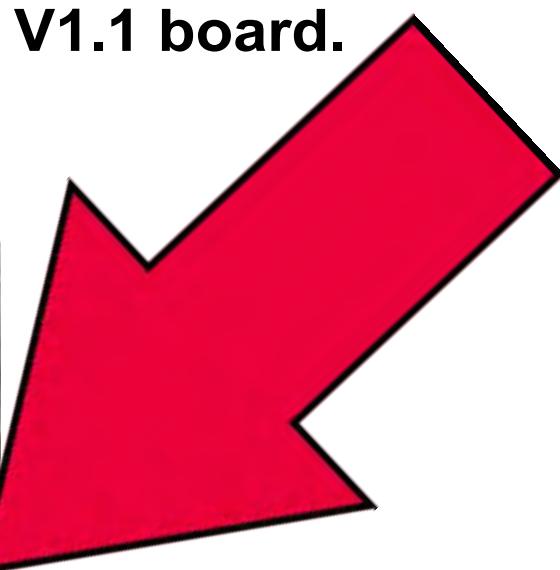
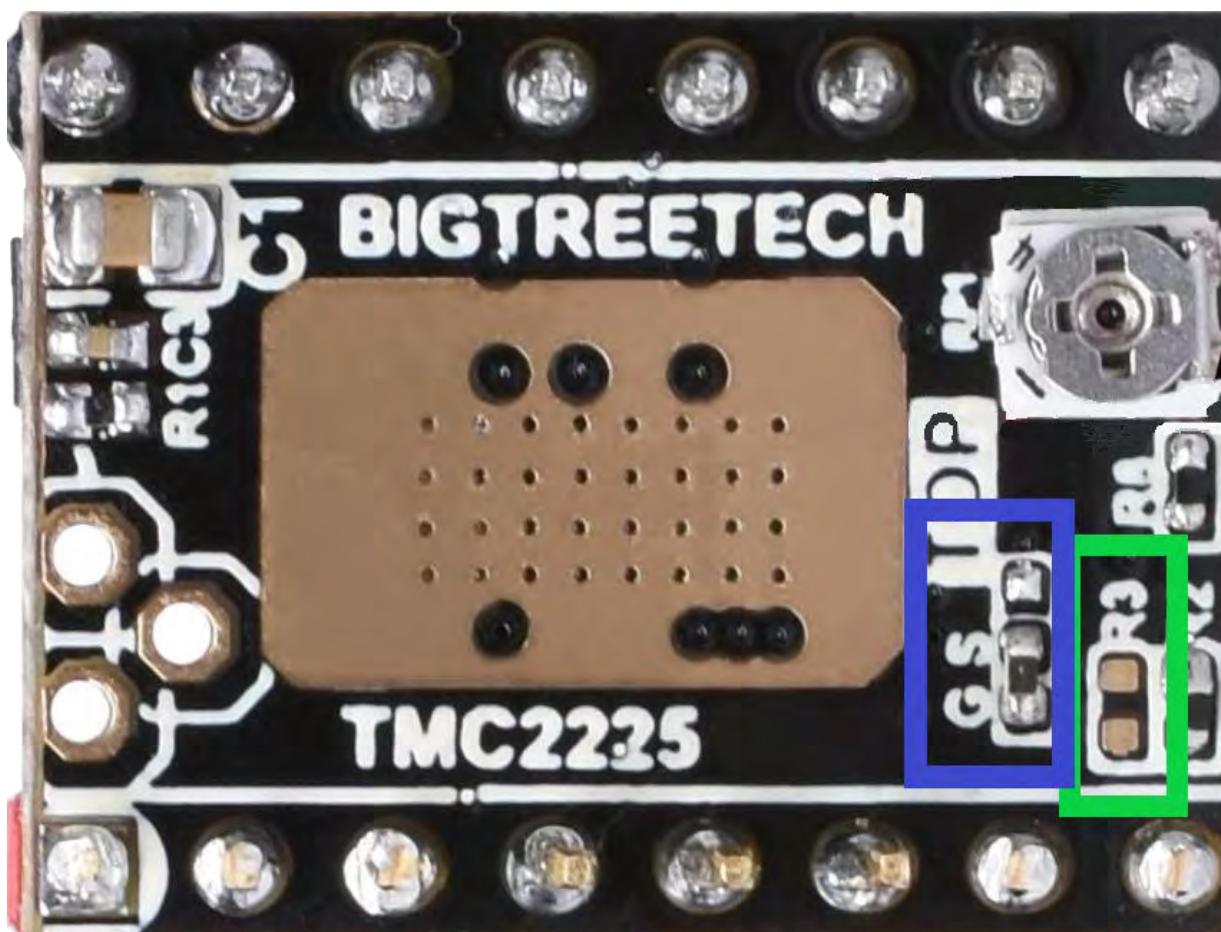
Note: You can use 50% to 90% of the calculated I_{RMS} ($I_{MAX}/1.414$) when tuning ("X_CURRENT", "Y_CURRENT", etc. the stepper motor driver in the firmware.

See the next page for further information.

| Driver Chip | Steps are set inside of your Firmware | |
|---|--|--|
| BIQU® TMC2225 UART Mode Maximum 256 Subdivision 35V DC 2A (peak) | | |
| Driving Current Calculation Formula R_S (Typical Sense Resistor) = 0.15Ω | $I_{MAX} = V_{ref} * 0.7647$ See Appendix B #7. Use 50% to 90% as shown below: $I_{MAX} = (V_{ref} * 0.7647) * 0.90$ | $V_{ref} = I_{MAX} * 1.3077$ See Appendix B #7. Use 50% to 90% as shown below: $V_{ref} = (I_{MAX} * 1.3077) * 0.90$ |

**BIQU TMC2225 V1.0****UART Mode**

Important: To ensure that the BIQU TMC2225 V1.0 is in UART Mode, check to see if the two pads located at R3 have a gap between them, as seen in **GREEN** below. Ensure the "U" jumper is in place on the SKR PRO V1.1 board.



The **BLUE** box show the device has StealthChop capability.

UART Mode**UART Mode**

Note: The location of the current sense resistors are shown in **GREEN**. Use the current sense resistors' value in the Marlin Firmware ("X_RSENSE", "Y_RSENSE", "Z_RSENSE" and/or "E0_RSENSE") so that the appropriate current limit can be sent to the driver board. If you do not want to use V_{ref} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT", and/or "E0_CURRENT".

R_s = R050 is 0.05 Ohms

R_s = R062 is 0.062 Ohms

R_s = R068 is 0.068 Ohms

R_s = R075 is 0.075 Ohms

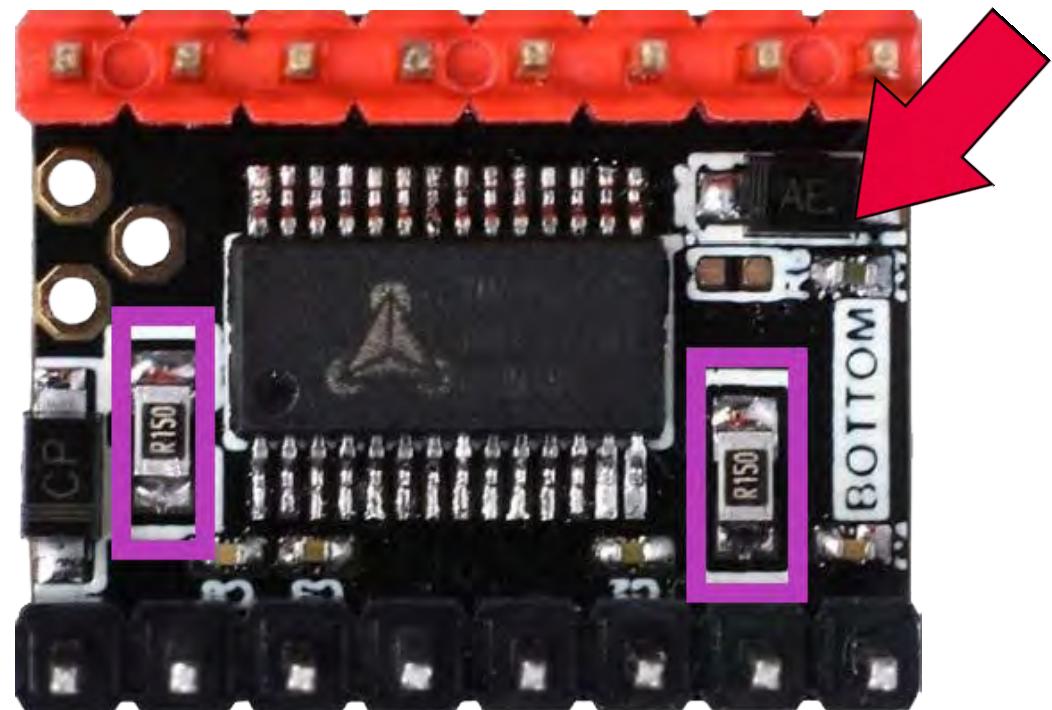
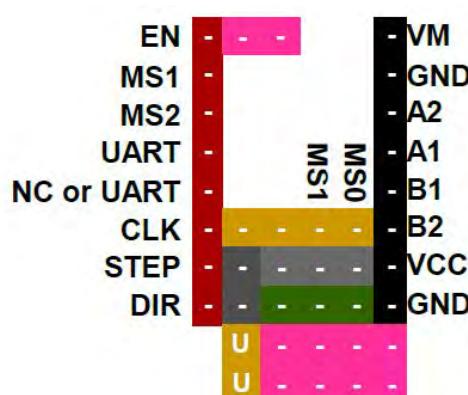
R_s = R100 is 0.1 Ohms

R_s = R110 is 0.11 Ohms

R_s = R150 is 0.15 Ohms

R_s = R200 is 0.2 Ohms

R_s = R220 is 0.22 Ohms

**UART**

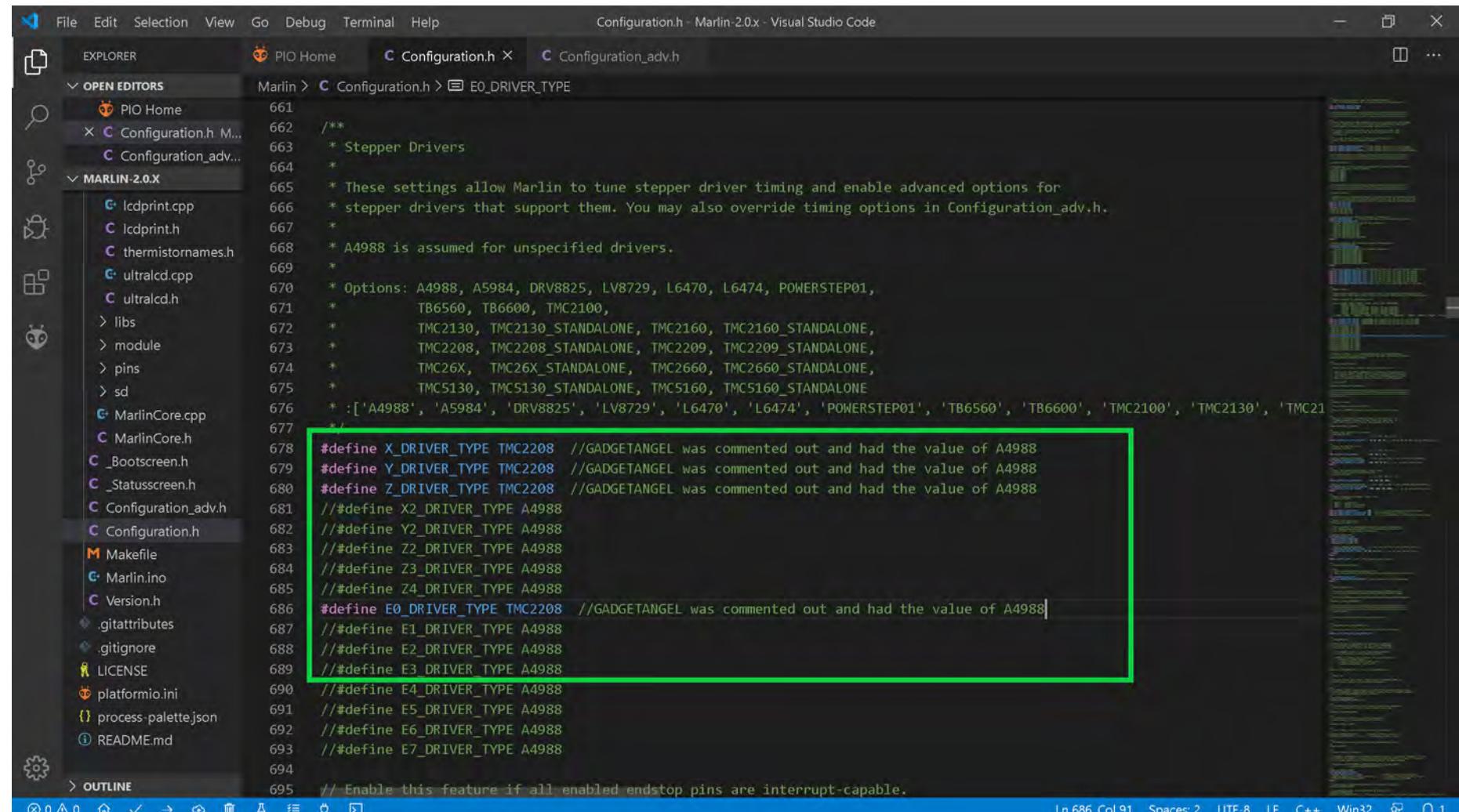
Note: Set Jumper "U" for UART MODE!!



The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

NOTE: [Go to Appendix C](#), and then come back here for the changes to Marlin for BIQU TMC2225 V1.0 stepper motor drivers in UART mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2225 drivers in UART mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2225 drivers in UART mode. Since Marlin does not have an option for TMC2225 drivers we will use "TMC2208" for the DRIVER_TYPE. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0x - Visual Studio Code
EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
  PIO Home
  Configuration.h M...
  Configuration_adv.h
MARLIN-2.0.X
  Lcdprint.cpp
  Lcdprint.h
  thermistornames.h
  ultralcd.cpp
  ultralcd.h
  libs
  module
  pins
  sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  LICENSE
  platformio.ini
  process-palette.json
  README.md
  OUTLINE
Ln 686, Col 91  Spaces: 2  UTF-8  LF  C++  Win32  ⚡  1

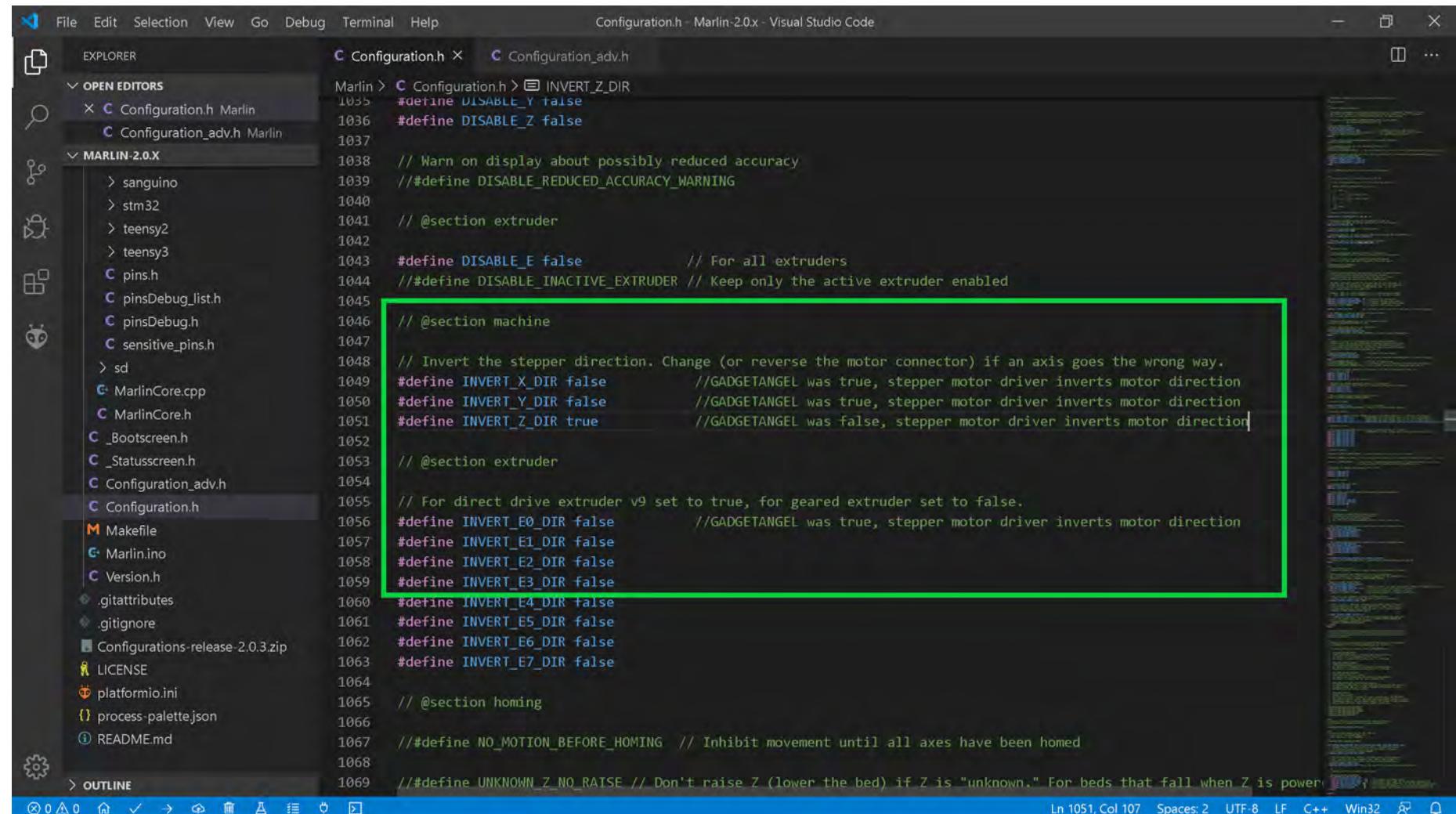
661 /**
662 * Stepper Drivers
663 *
664 */
665 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
666 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
667 *
668 * A4988 is assumed for unspecified drivers.
669 *
670 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
671 *           TB6560, TB6600, TMC2100,
672 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
673 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
674 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
675 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
676 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC2660', 'TMC5130', 'TMC5160']
677 */
678 #define X_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
679 #define Y_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
680 #define Z_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2208 //GADGETANGEL was commented out and had the value of A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2225 drivers, I must invert the stepper motor direction because the TMC2225 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2225 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



Configuration.h - Marlin-2.0.x - Visual Studio Code

```

File Edit Selection View Go Debug Terminal Help Configuration.h Configuration_adv.h
Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- Next you want to set your V_{ref} in the Marlin firmware for each axis that has the TMC2225 driver, as seen in the **GREEN** box below. I changed the "X_CURRENT" to be the calculated V_{ref} for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated V_{ref} for my Y-Axis, which is 760mV on the Ender 3.
- Ensure "X_RSENSE" is set to 0.15. Ensure "Y_RSENSE" is set to 0.15.
- If you **do not want to use V_{ref}** as the value for "X_CURRENT" and/or "Y_CURRENT", you should **use I_{RMS} instead**. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "X_CURRENT" and/or "Y_CURRENT".

```

File Edit Selection View Go Debug Terminal Help
Configuration_adv.h - Marlin 2.0.x - Visual Studio Code

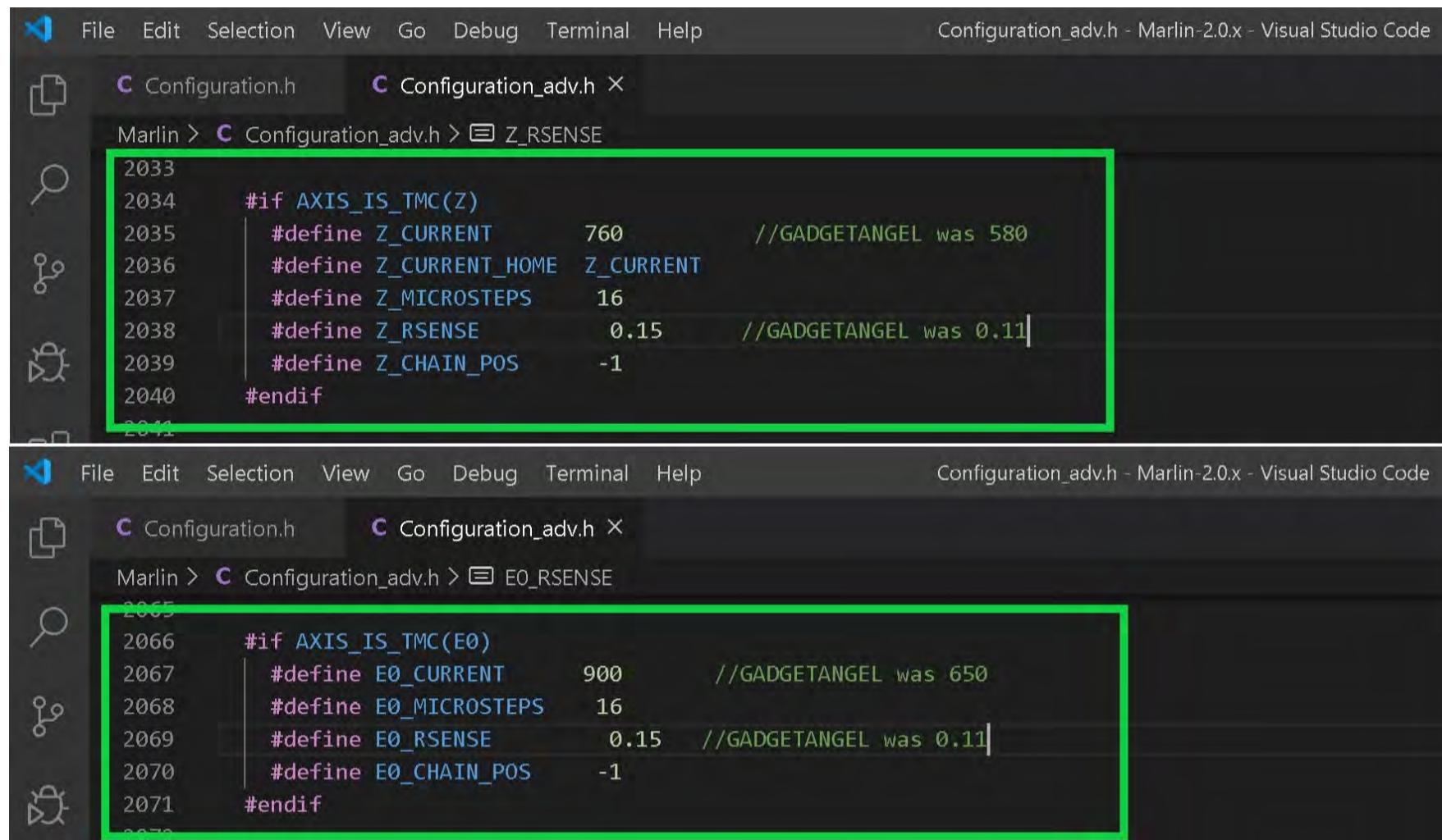
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > X_RSENSE
1993 *
1994 * TMCStepper library is required to use TMC stepper drivers.
1995 * https://github.com/teemuatlut/TMCStepper
1996 */
1997 #if HAS_TRINAMIC
1998
1999 #define HOLD_MULTIPLIER 0.5 // Scales down the holding current from run current
2000 #define INTERPOLATE true // Interpolate X/Y/Z_MICROSTEPS to 256
2001
2002 #if AXIS_IS_TMC(X)
2003     #define X_CURRENT 760 // (mA) RMS current. Multiply by 1.414 for peak current. //GADGETANGEL was 580
2004     #define X_CURRENT_HOME X_CURRENT // (mA) RMS current for sensorless homing
2005     #define X_MICROSTEPS 16 // 0..256
2006     #define X_RSENSE 0.15 //GADGETANGEL was 0.11
2007     #define X_CHAIN_POS -1 // <=0 : Not chained. 1 : MCU MOSI connected. 2 : Next in chain, ...
2008 #endif
2009
2010 #if AXIS_IS_TMC(X2)
2011     #define X2_CURRENT 800
2012     #define X2_CURRENT_HOME X2_CURRENT
2013     #define X2_MICROSTEPS 16
2014     #define X2_RSENSE 0.11
2015     #define X2_CHAIN_POS -1
2016 #endif
2017
2018 #if AXIS_IS_TMC(Y)
2019     #define Y_CURRENT 760 //GADGETANGEL was 580
2020     #define Y_CURRENT_HOME Y_CURRENT
2021     #define Y_MICROSTEPS 16
2022     #define Y_RSENSE 0.15 //GADGETANGEL was 0.11
2023     #define Y_CHAIN_POS -1
2024 #endif
2025
2026 /* MISC TS_TMC2225 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- Now, I am setting the V_{ref} for Z-Axis and the extruder, as seen in the **GREEN** boxes below. I changed the "Z_CURRENT" to be the calculated V_{ref} for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated V_{ref} for my Extruder, which is 900mV on the Ender 3.
- Ensure "Z_RSENSE" is set to 0.15. Ensure "E0_RSENSE" is set to 0.15.
- If you **do not want to use V_{ref}** as the value for "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "Z_CURRENT" and/or "E0_CURRENT".



```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > Z_RSENSE
2033
2034 #if AXIS_IS_TMC(Z)
2035     #define Z_CURRENT      760          //GADGETANGEL was 580
2036     #define Z_CURRENT_HOME Z_CURRENT
2037     #define Z_MICROSTEPS   16
2038     #define Z_RSENSE        0.15         //GADGETANGEL was 0.11
2039     #define Z_CHAIN_POS    -1
2040 #endif
2041

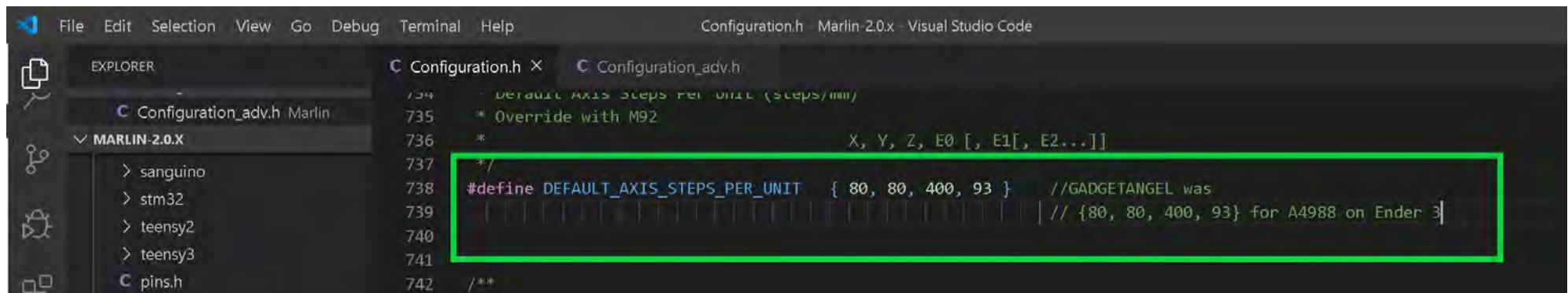
File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > E0_RSENSE
2065
2066 #if AXIS_IS_TMC(E0)
2067     #define E0_CURRENT      900          //GADGETANGEL was 650
2068     #define E0_MICROSTEPS   16
2069     #define E0_RSENSE        0.15         //GADGETANGEL was 0.11
2070     #define E0_CHAIN_POS    -1
2071 #endif
2072

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



File Edit Selection View Go Debug Terminal Help Configuration.h Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

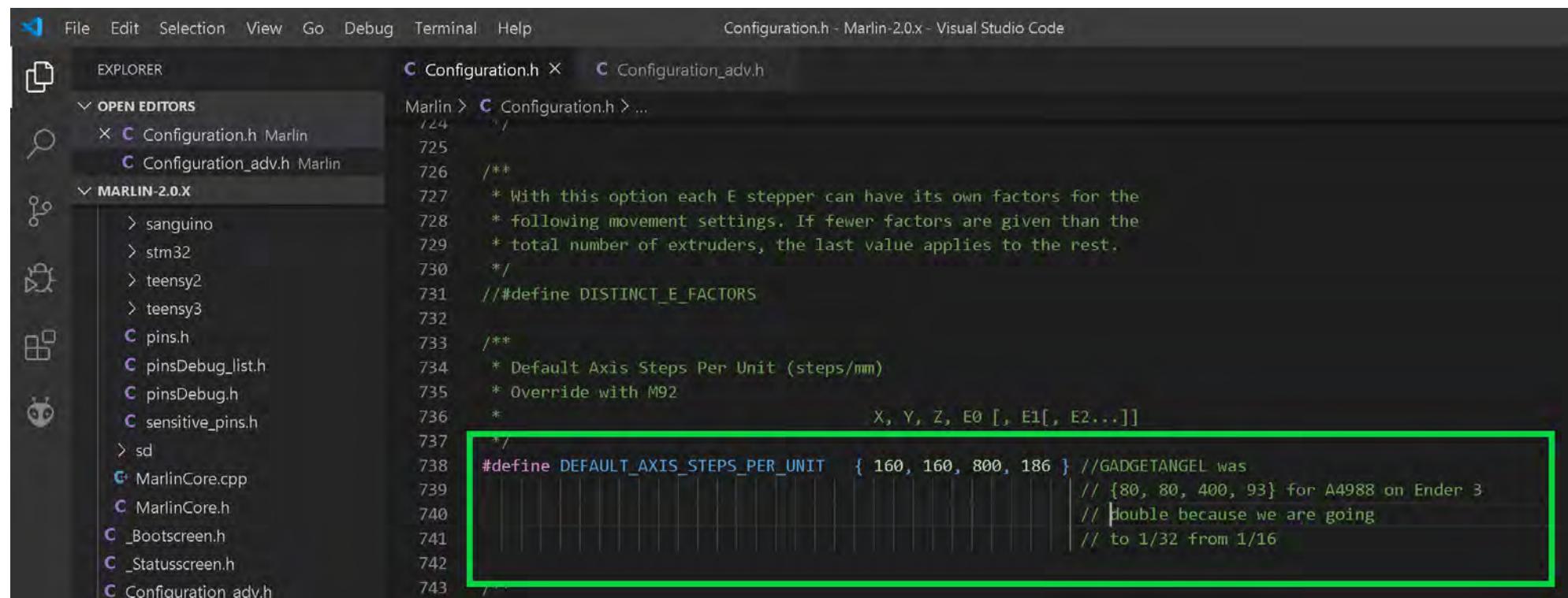
MARLIN-2.0.X

```

734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 80, 80, 400, 93 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740
741 /**
742 */

```

- FOR EXAMPLE if you wanted to use 1/32 stepping instead of the default 1/16, you would be **doubling** your STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X

```

724 */
725
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 *
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // Double because we are going
741 // to 1/32 from 1/16
742
743 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- By default stealthChop is enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

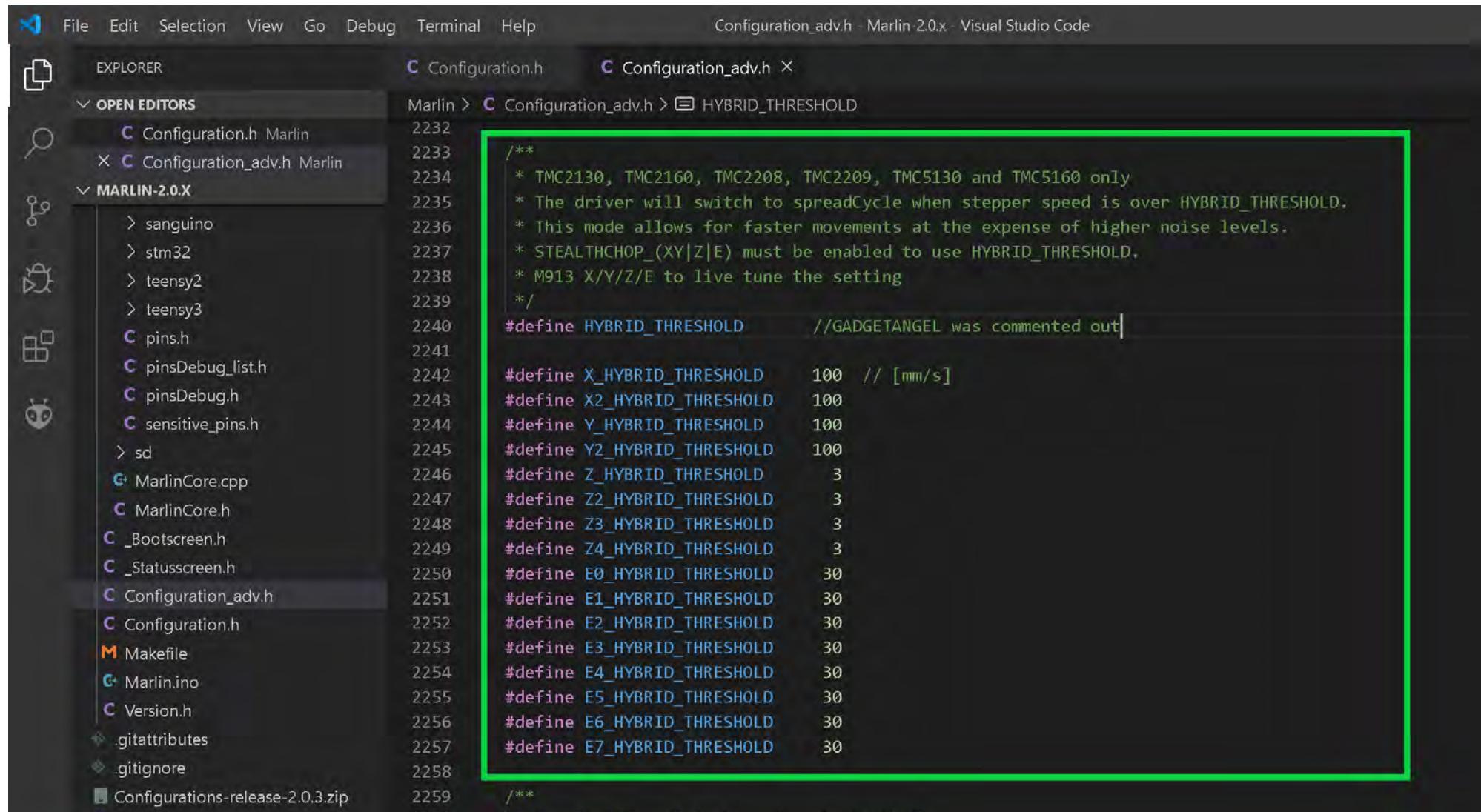
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin
MARLIN-2.0.X
  > sanguino
  > stm32
  > teensy2
  > teensy3
  C pins.h
  C pinsDebug_list.h
  C pinsDebug.h
  C sensitive_pins.h
  > sd
  C MarlinCore.cpp
  C MarlinCore.h
  C _Bootscreen.h
  C _Statusscreen.h
  C Configuration_adv.h
  C Configuration.h
Marlin > C Configuration_adv.h > STEALTHCHOP_XY
2193 /**
2194 #define STEALTHCHOP_XY
2195 #define STEALTHCHOP_Z
2196 #define STEALTHCHOP_E
2197
2198 /**
2199 * Optimize spreadCycle chopper parameters by using predefined parameter sets
2200 * or with the help of an example included in the library.
2201 * Provided parameter sets are
2202 * CHOPPER_DEFAULT_12V
2203 * CHOPPER_DEFAULT_19V
2204 * CHOPPER_DEFAULT_24V
2205 * CHOPPER_DEFAULT_36V
2206 * CHOPPER_PRUSAMK3_24V // Imported parameters from the official Prusa firmware for MK3 (24V)
2207 * CHOPPER_MARLIN_119 // Old defaults from Marlin v1.1.9
2208 *
2209 * Define your own with
2210 * { <off_time[1..15]>, <hysteresis_end[-3..12]>, hysteresis_start[1..8] }
2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213 /**

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- Now you either enable "HYBRID_THRESHOLD" or disable it. By default, it is disabled. "HYBRID_THRESHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Title Bar:** Configuration_adv.h - Marlin 2.0.x - Visual Studio Code
- Left Sidebar (EXPLORER):**
 - OPEN EDITORS: Configuration.h Marlin, Configuration_adv.h Marlin
 - MARLIN-2.0.X:
 - > sanguino
 - > stm32
 - > teensy2
 - > teensy3
 - C pins.h
 - C pinsDebug_list.h
 - C pinsDebug.h
 - C sensitive_pins.h
 - > sd
 - G MarlinCore.cpp
 - C MarlinCore.h
 - C _Bootscreen.h
 - C _Statusscreen.h
 - C Configuration_adv.h
 - C Configuration.h
 - M Makefile
 - C Marlin.ino
 - C Version.h
 - .gitattributes
 - .gitignore
 - Configurations-release-2.0.3.zip
- Right Editor Area:** Shows the content of Configuration_adv.h. A specific section is highlighted with a green border:


```
/*
 * TMC2130, TMC2160, TMC2208, TMC2209, TMC5130 and TMC5160 only
 * The driver will switch to spreadCycle when stepper speed is over HYBRID_THRESHOLD.
 * This mode allows for faster movements at the expense of higher noise levels.
 * STEALTHCHOP_(XY|Z|E) must be enabled to use HYBRID_THRESHOLD.
 * M913 X/Y/Z/E to live tune the setting
 */
#define HYBRID_THRESHOLD //GADGETANGEL was commented out

#define X_HYBRID_THRESHOLD 100 // [mm/s]
#define X2_HYBRID_THRESHOLD 100
#define Y_HYBRID_THRESHOLD 100
#define Y2_HYBRID_THRESHOLD 100
#define Z_HYBRID_THRESHOLD 3
#define Z2_HYBRID_THRESHOLD 3
#define Z3_HYBRID_THRESHOLD 3
#define Z4_HYBRID_THRESHOLD 3
#define E0_HYBRID_THRESHOLD 30
#define E1_HYBRID_THRESHOLD 30
#define E2_HYBRID_THRESHOLD 30
#define E3_HYBRID_THRESHOLD 30
#define E4_HYBRID_THRESHOLD 30
#define E5_HYBRID_THRESHOLD 30
#define E6_HYBRID_THRESHOLD 30
#define E7_HYBRID_THRESHOLD 30
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- Now I want to enable some statements that allow me access to debugging the TMC drivers. I will uncomment "MONITOR_DRIVER_STATUS" and "TMC_DEBUG". "MONITOR_DRIVER_STATUS" will enable the following G-codes: M906, M911, and M912, "TMC_DEBUG" will enable the M122 G-code command. You can read about these from the comments in the firmware and in [Marlin's documentation located on-line.](#)

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration_adv.h > MONITOR_DRIVER_STATUS
Configuration.h Marlin Configuration_adv.h Marlin
Configuration.h Marlin Configuration_adv.h Marlin
MARLIN-2.0.X
> sanguino
> stm32
> teensy2
> teensy3
pins.h
pinsDebug_list.h
pinsDebug.h
sensitive_pins.h
> sd
MarlinCore.cpp
MarlinCore.h
Bootscreen.h
2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213
2214 /**
2215 * Monitor Trinamic drivers for error conditions,
2216 * like overtemperature and short to ground.
2217 * In the case of overtemperature Marlin can decrease the driver current until error condition clears.
2218 * Other detected conditions can be used to stop the current print.
2219 * Relevant g-codes:
2220 * M906 - Set or get motor current in millamps using axis codes X, Y, Z, E. Report values if no axis codes given.
2221 * M911 - Report stepper driver overtemperature pre-warn condition.
2222 * M912 - Clear stepper driver overtemperature pre-warn condition flag.
2223 * M122 - Report driver parameters (Requires TMC_DEBUG)
2224 */
2225 #define MONITOR_DRIVER_STATUS //GADGETANGEL was commented out
2226
2227 #if ENABLED(MONITOR_DRIVER_STATUS)

```

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration_adv.h > TMC_DEBUG
Configuration.h Marlin Configuration_adv.h Marlin
Configuration.h Marlin Configuration_adv.h Marlin
MARLIN-2.0.X
> sanguino
> stm32
> teensy2
2307
2308 /**
2309 * Enable M122 debugging command for TMC stepper drivers.
2310 * M122 S0/1 will enable continuous reporting.
2311 */
2312 #define TMC_DEBUG //GADGETANGEL was commented out
2313

```

- Go to the next page.

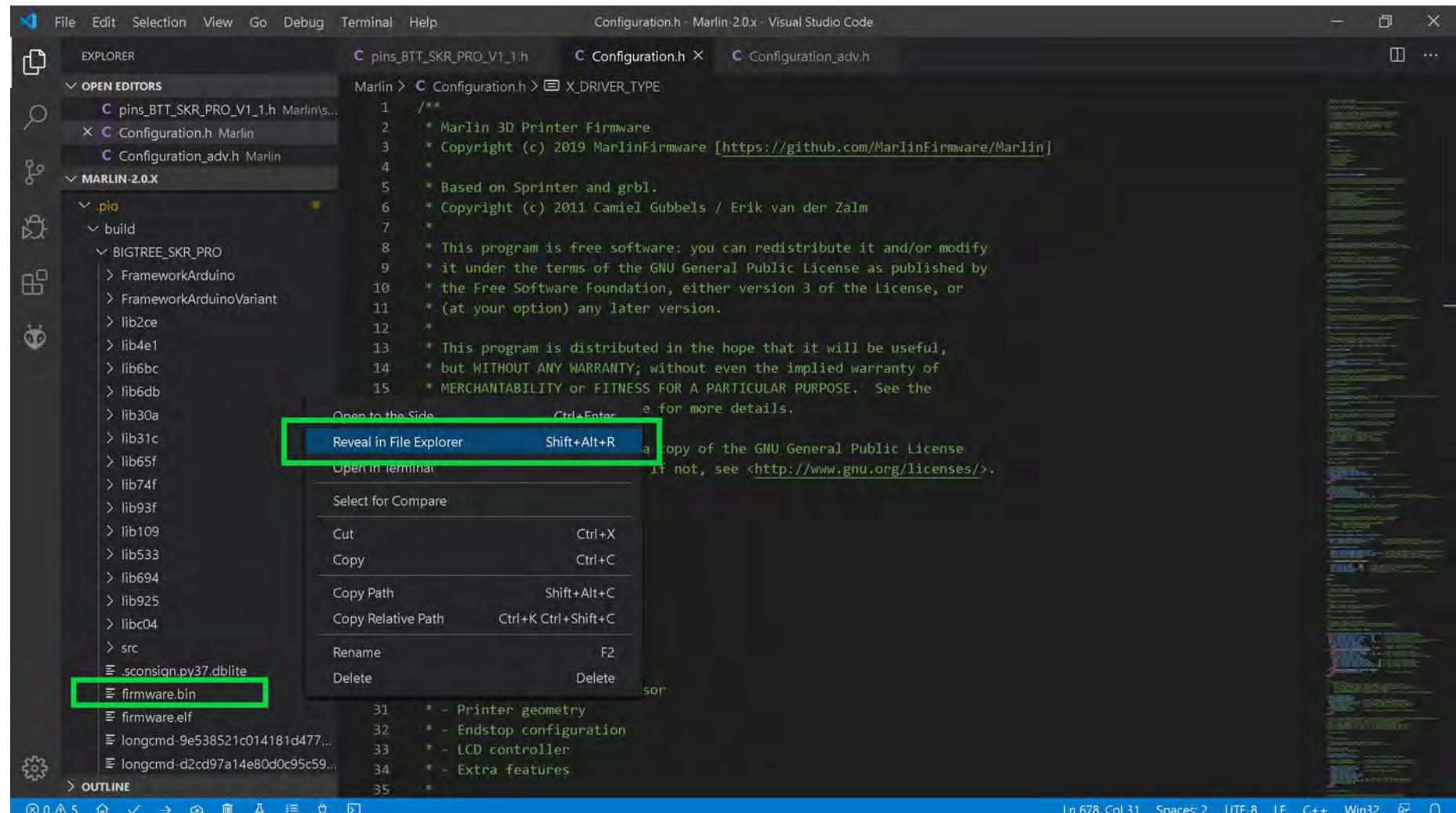
The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- The end of Marlin setup for BIQU TMC2225 V1.0 drivers in UART mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

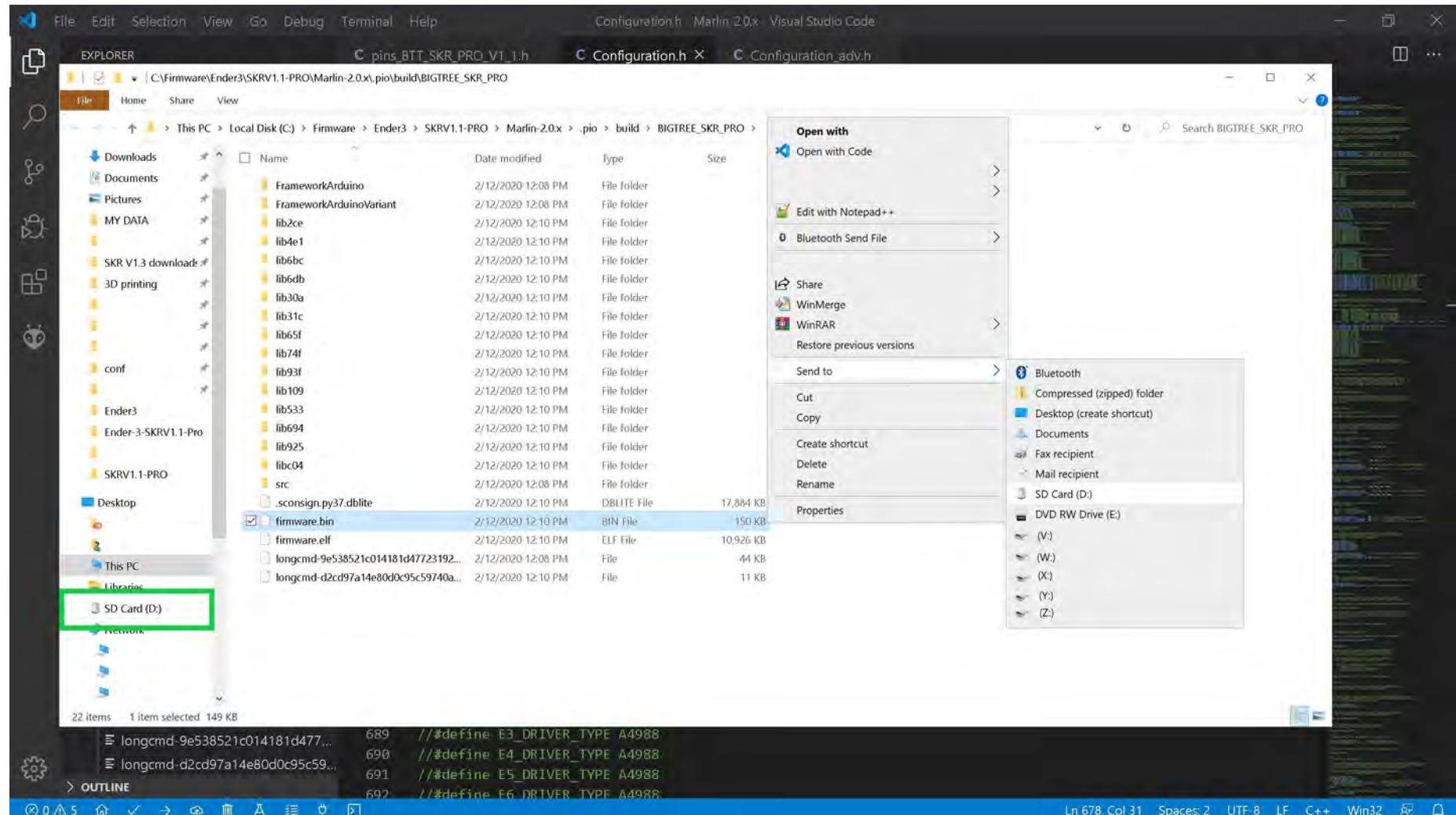
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



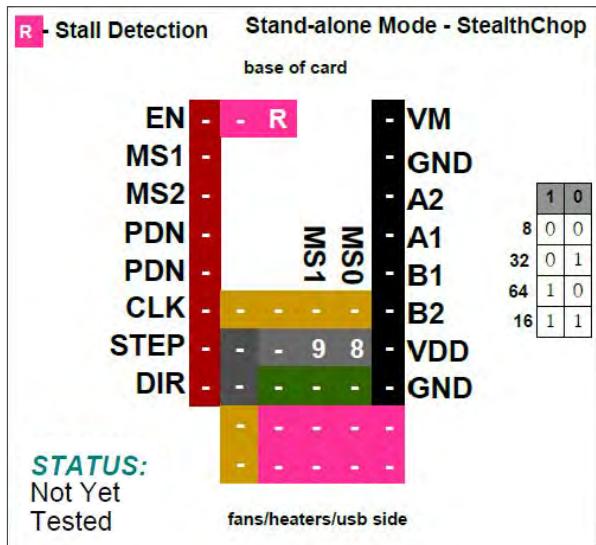
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2225 V1.0 Drivers in UART Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.



BIQU TMC2209 V1.2

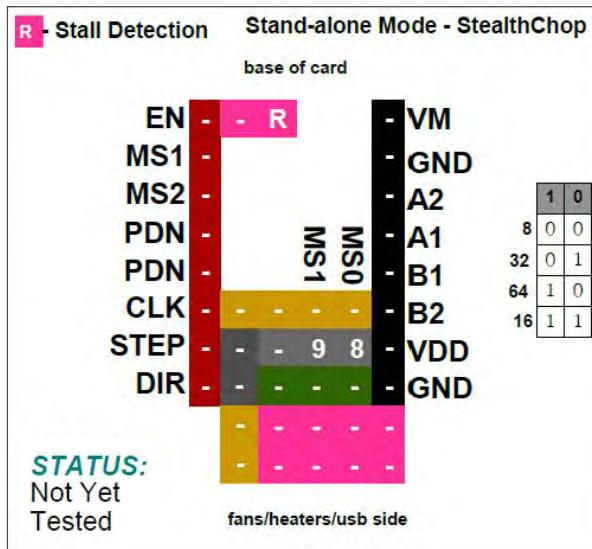
Stand-alone Mode for StealthChop

NOTE: Use the potentiometer (POT) on the top of the board, as shown in **RED**; or use the board's "V_{ref} Test point" location, as shown in **BLUE**, to set your V_{ref}. See **Appendix A** for instructions on how to set the V_{ref} on a driver board.



Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|---|--|-----|--------|--|-------------|
| BIQU® TMC2209 Stand Alone Mode Maximum 64 Subdivision 28V DC 2.8A (peak) | GND | GND | 1 / 8 | 1 / 256 | stealthChop |
| | GND | VIO | 1 / 32 | 1 / 256 | stealthChop |
| | VIO | GND | 1 / 64 | 1 / 256 | stealthChop |
| | VIO | VIO | 1 / 16 | 1 / 256 | stealthChop |
| Driving Current Calculation Formula R_S (Typical Sense Resistor)= 0.11Ω | $I_{MAX} = V_{ref}$ See Appendix B #5. Use 50% to 90% as shown below: | | | $V_{ref} = I_{MAX}$ See Appendix B #5. Use 50% to 90% as shown below: | |
| | $I_{MAX} = I_{MAX} * 0.90$ | | | $V_{ref} = V_{ref} * 0.90$ | |



BIQU TMC2209 V1.2

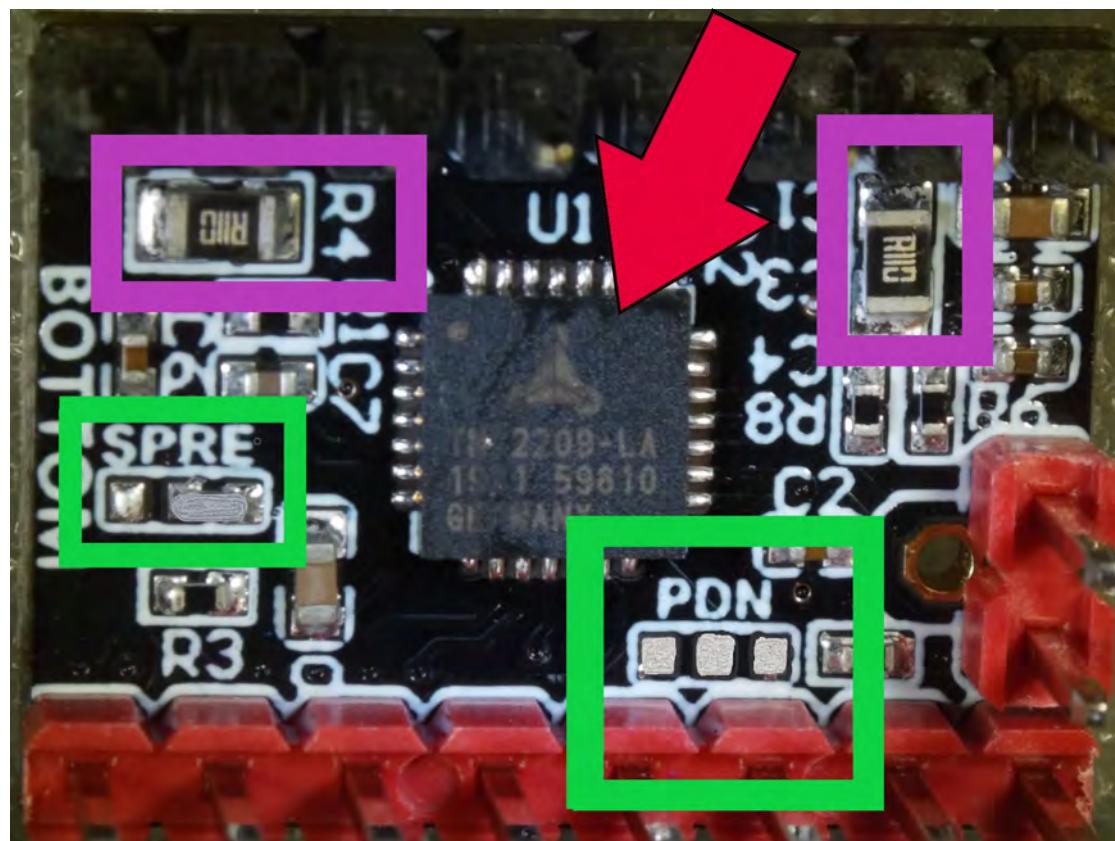
Stand-alone Mode for StealthChop

NOTE: The SPRE jumper is located on the bottom of the driver board. In stand-alone mode, the default setting is wired for StealthChop; i.e. the SPRE jumper is set to GND. To switch to Standalone with SpreadCycle, one needs to change the SPRE jumper on the bottom of the driver board. The **PURPLE boxes** below show the location of the current sense resistors (R_s) for the TMC2209.

Note: To switch to stand-alone mode, none of the PDN pads should be bridged. The picture below, as seen in the **GREEN** boxes, shows stand-alone mode with StealthChop.

Note: When the stall-guard function is **not used**, the stall-guard pin ("R") of the TMC2209 must be removed (desoldered) or use long pin header risers so that the "R" pin does not connect to the SKR PRO V1.1 board.

MOST BIQU TMC2209 V1.2 driver boards, when purchased for UART mode, will have the correct PDN pads already soldered together, located on the bottom of the driver board.



BIQU TMC2209 V1.2

Stand-alone Mode for StealthChop

Stand-alone Mode - StealthChop

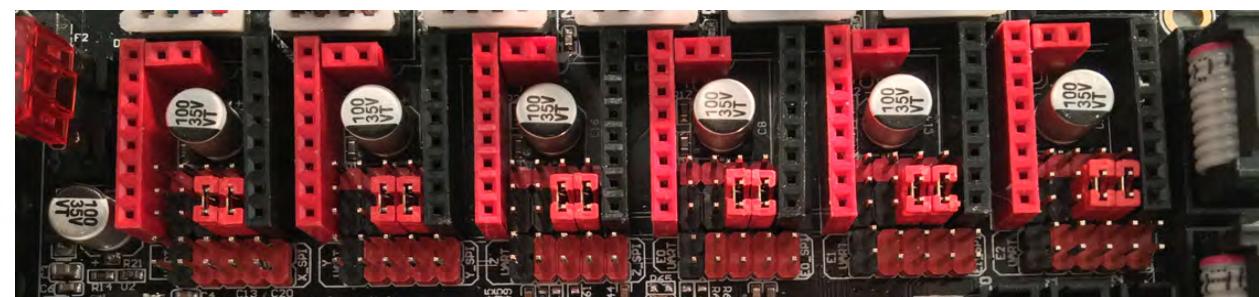
Stand-alone Mode

1 / 8

Interpolation: **1/256**

StealthChop

| | | | | |
|------|---|-----|-----|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | MS0 | B1 |
| CLK | - | - | - | B2 |
| STEP | - | 9 | 8 | VDD |
| DIR | - | 9 | 8 | GND |



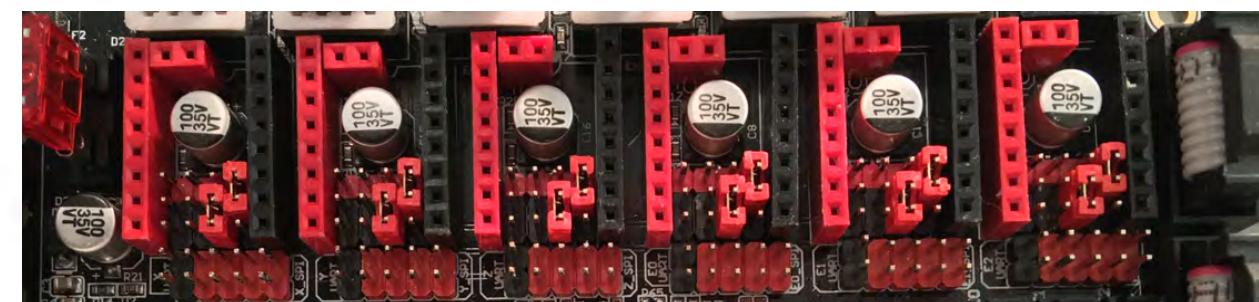
Stand-alone Mode

1 / 32

Interpolation: **1/256**

StealthChop

| | | | | |
|------|---|-----|-----|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | MS0 | B1 |
| CLK | - | - | 8 | B2 |
| STEP | - | - | 9 | VDD |
| DIR | - | 9 | - | GND |



Stand-alone Mode - StealthChop

BIQU TMC2209 V1.2

Stand-alone Mode for StealthChop

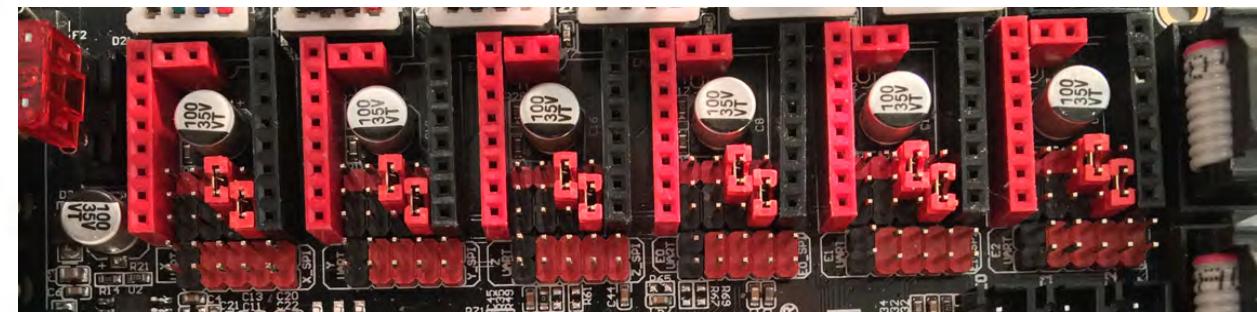
Stand-alone Mode

1 / 64

Interpolation: 1/256

StealthChop

| | | | | |
|------|---|-----|-----|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | MS0 | |
| CLK | - | 9 | - | B1 |
| STEP | - | 9 | 8 | B2 |
| DIR | - | 8 | - | VDD |
| | - | | - | GND |



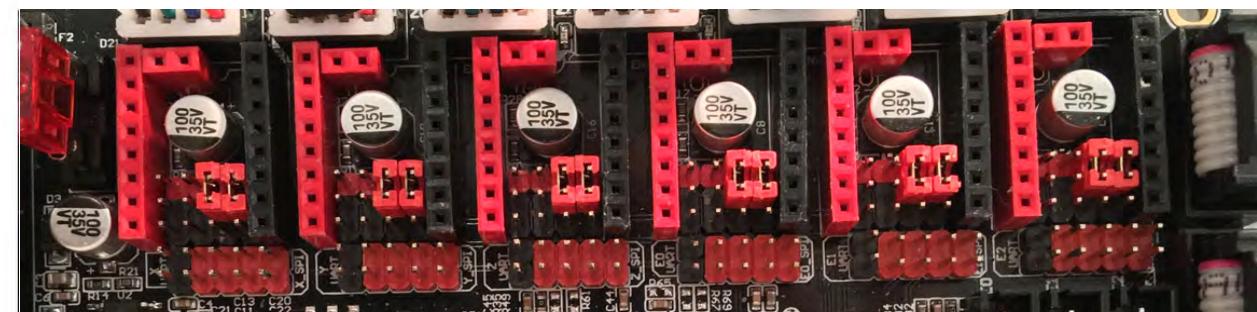
Stand-alone Mode

1 / 16

Interpolation: 1/256

StealthChop

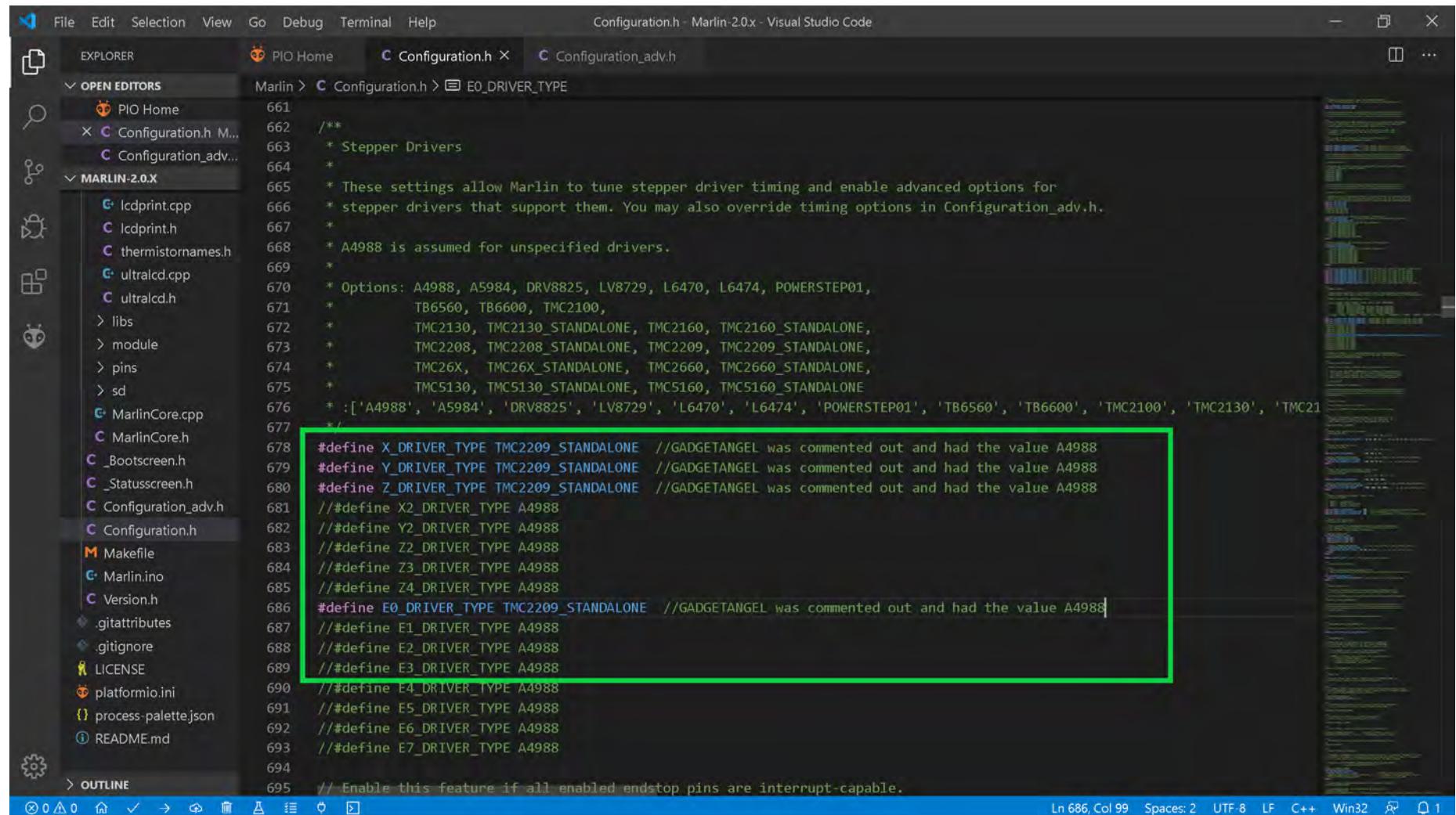
| | | | | |
|------|---|-----|-----|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | MS0 | |
| CLK | - | 9 | 8 | B1 |
| STEP | - | 9 | 8 | B2 |
| DIR | - | 8 | - | VDD |
| | - | | - | GND |



The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for StealthChop

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2209 V1.2 stepper motor drivers in stand-alone mode for stealthChop.

- Change the stepper motor drivers so that Marlin knows you are using TMC2209 drivers in stand-alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2209 drivers in stand-alone mode. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the following configuration for stepper drivers:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC26X', 'TMC5130']
676 */
677 #define X_DRIVER_TYPE TMC2209_STANDALONE //GADGETANGEL was commented out and had the value A4988
678 #define Y_DRIVER_TYPE TMC2209_STANDALONE //GADGETANGEL was commented out and had the value A4988
679 #define Z_DRIVER_TYPE TMC2209_STANDALONE //GADGETANGEL was commented out and had the value A4988
680 //##define X2_DRIVER_TYPE A4988
681 //##define Y2_DRIVER_TYPE A4988
682 //##define Z2_DRIVER_TYPE A4988
683 //##define Z3_DRIVER_TYPE A4988
684 //##define Z4_DRIVER_TYPE A4988
685 //##define E0_DRIVER_TYPE TMC2209_STANDALONE //GADGETANGEL was commented out and had the value A4988
686 //##define E1_DRIVER_TYPE A4988
687 //##define E2_DRIVER_TYPE A4988
688 //##define E3_DRIVER_TYPE A4988
689 //##define E4_DRIVER_TYPE A4988
690 //##define E5_DRIVER_TYPE A4988
691 //##define E6_DRIVER_TYPE A4988
692 //##define E7_DRIVER_TYPE A4988
693 //##define E8_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

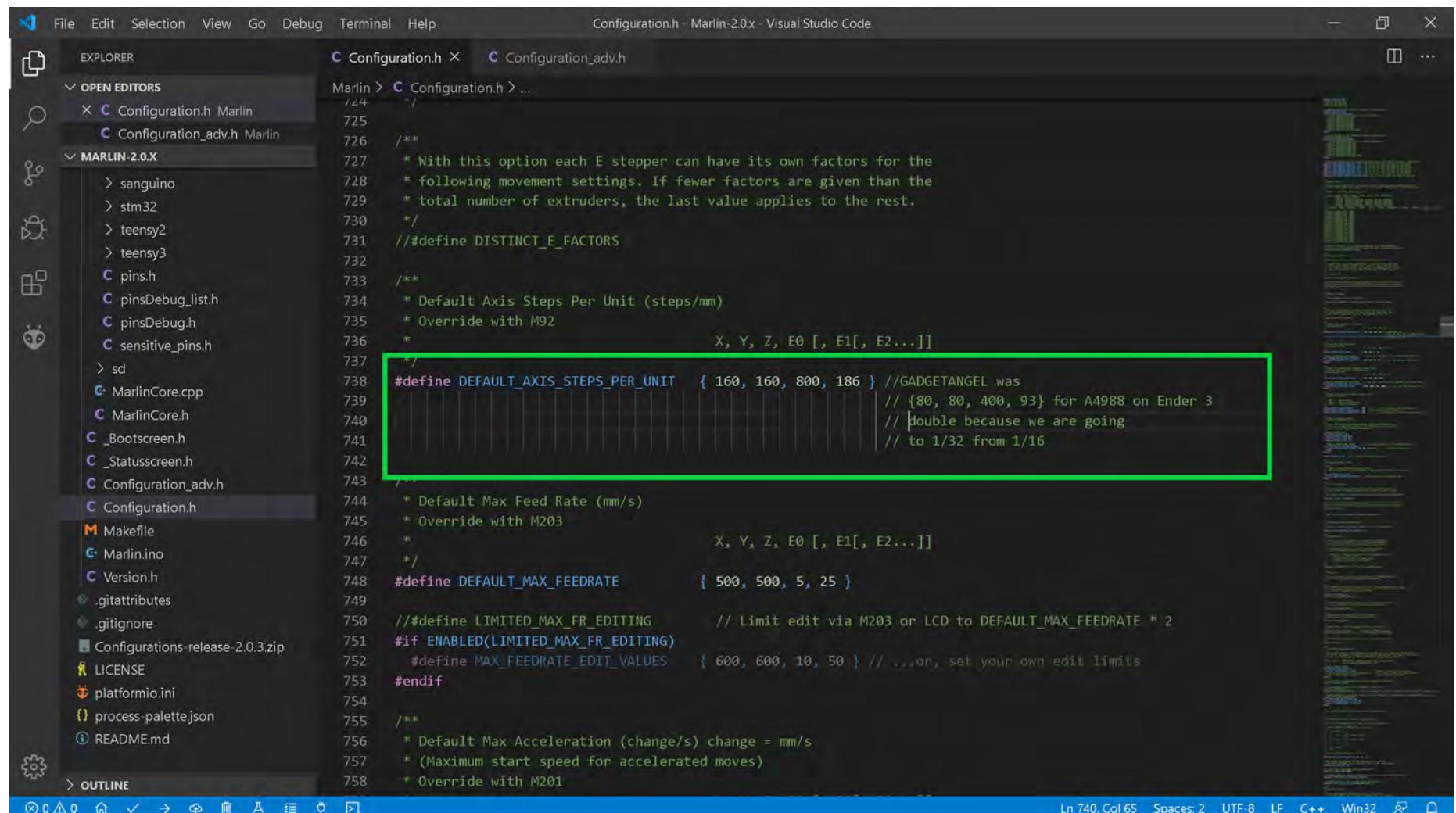
```

A green rectangular box highlights the driver type definitions for X, Y, Z, and E0 axes, showing that GADGETANGEL's values (A4988) were commented out and replaced with TMC2209_STANDALONE.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for StealthChop

- Since I desire to use 1/32 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to TMC2209 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the GREEN box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin configuration header. A green rectangular box highlights the following line of code:

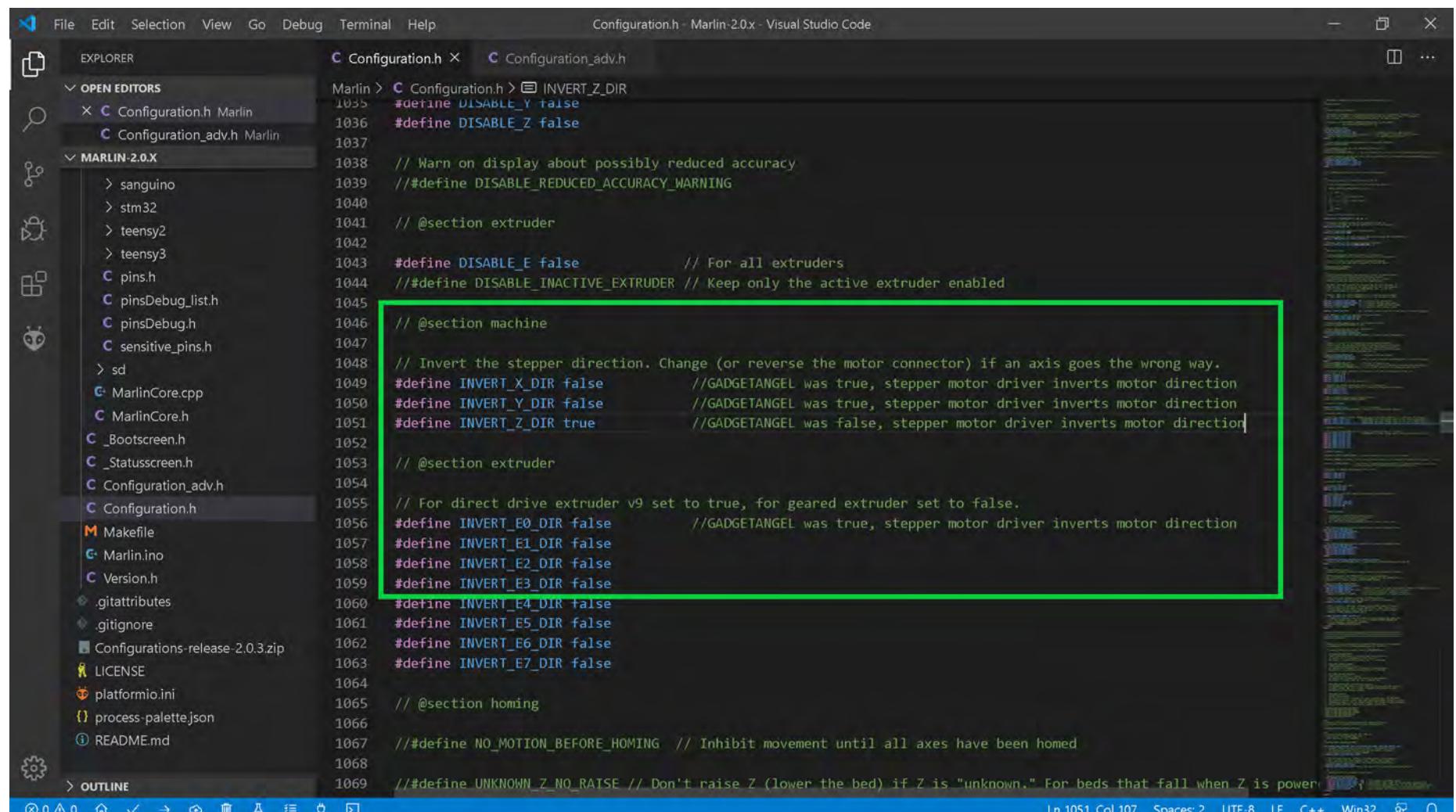
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// Double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom indicates the current line (Ln 740), column (Col 65), and other settings like spaces (Spaces: 2), encoding (UTF-8), line endings (LF), and file type (C++). The left sidebar shows the project structure with files like Configuration.h, Configuration_adv.h, MarlinCore.cpp, and MarlinCore.h.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for StealthChop

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2209 drivers, I must invert the stepper motor direction because the TMC2209 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2209 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following snippet of C++ code:

```

Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered

```

A green rectangular box highlights the following lines of code:

```

1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction

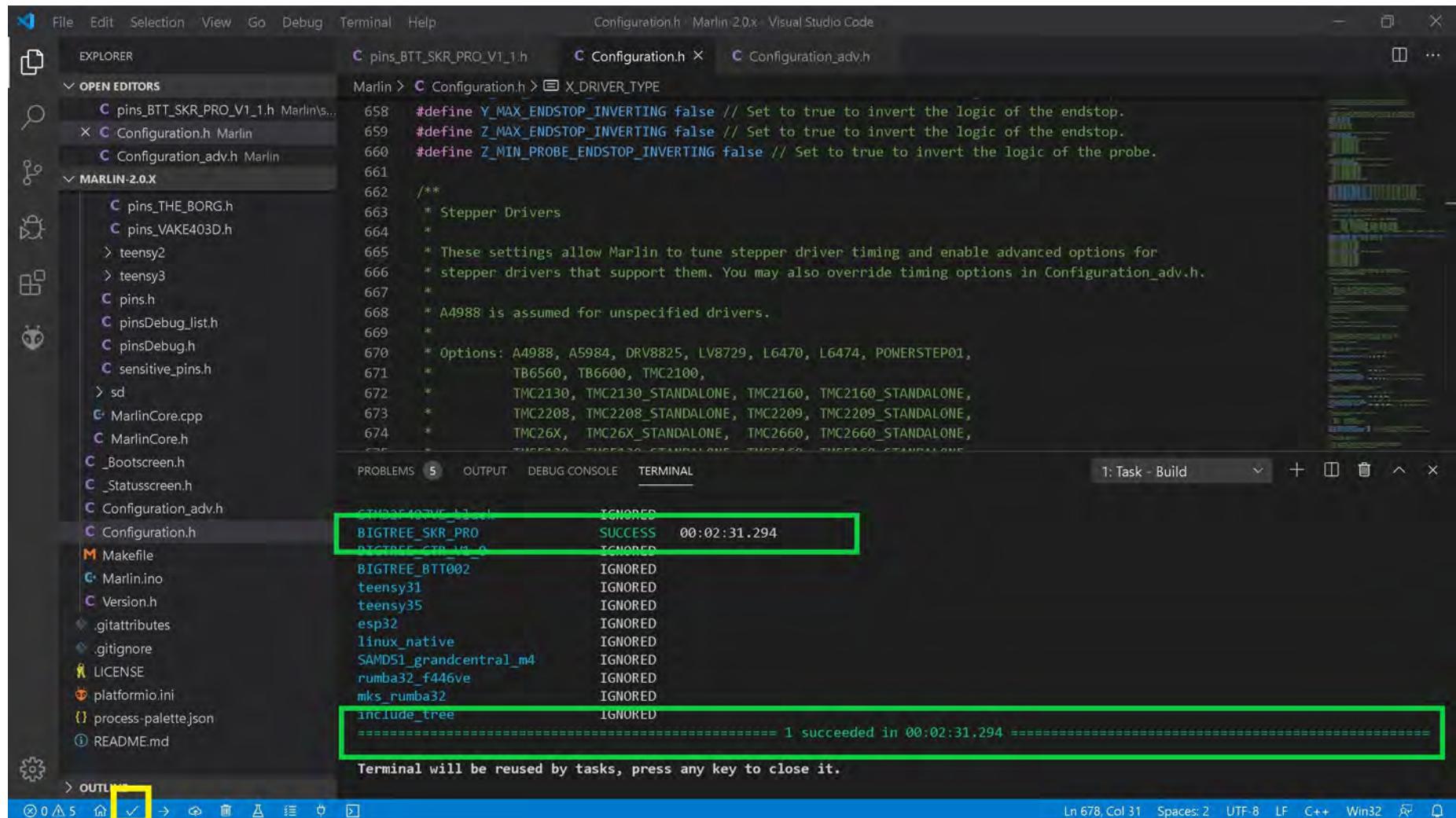
```

The status bar at the bottom of the code editor shows: Ln 1051, Col 107 Spaces: 2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for StealthChop

- The end of Marlin setup for BIQU TMC2209 V1.2 drivers in stand-alone mode for stealthChop. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the following details:

- File Menu:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Open Editors:** pins_BTT_SKR_PRO_V1_1.h, Configuration.h (highlighted in yellow), Configuration_adv.h.
- MARLIN-2.0.X:** pins_THE_BORG.h, pins_VAKE403D.h, teensy2, teensy3, pins.h, pinsDebug_list.h, pinsDebug.h, sensitive_pins.h, sd, MarlinCore.cpp, MarlinCore.h, Bootscreen.h, Statusscreen.h, Configuration_adv.h, Configuration.h, Makefile, Marlin.ino, Version.h, .gitattributes, .gitignore, LICENSE, platformio.ini, process-palette.json, README.md.
- Terminal Tab:** Configuration.h > X_DRIVER_TYPE
- Build Output:**

```

STM32F103VE_L1_01      IGNORED
BIGTREE_SKR_PRO          SUCCESS 00:02:31.294
BIGTREE_SKR_V1_0          IGNORED
BIGTREE_BTT002           IGNORED
teensy31                 IGNORED
teensy35                 IGNORED
esp32                     IGNORED
linux_native              IGNORED
SAMDS1_grandcentral_m4   IGNORED
rumba32_f446ve            IGNORED
mks_rumba32               IGNORED
include_tree               IGNORED
=====
===== 1 succeeded in 00:02:31.294 =====

```

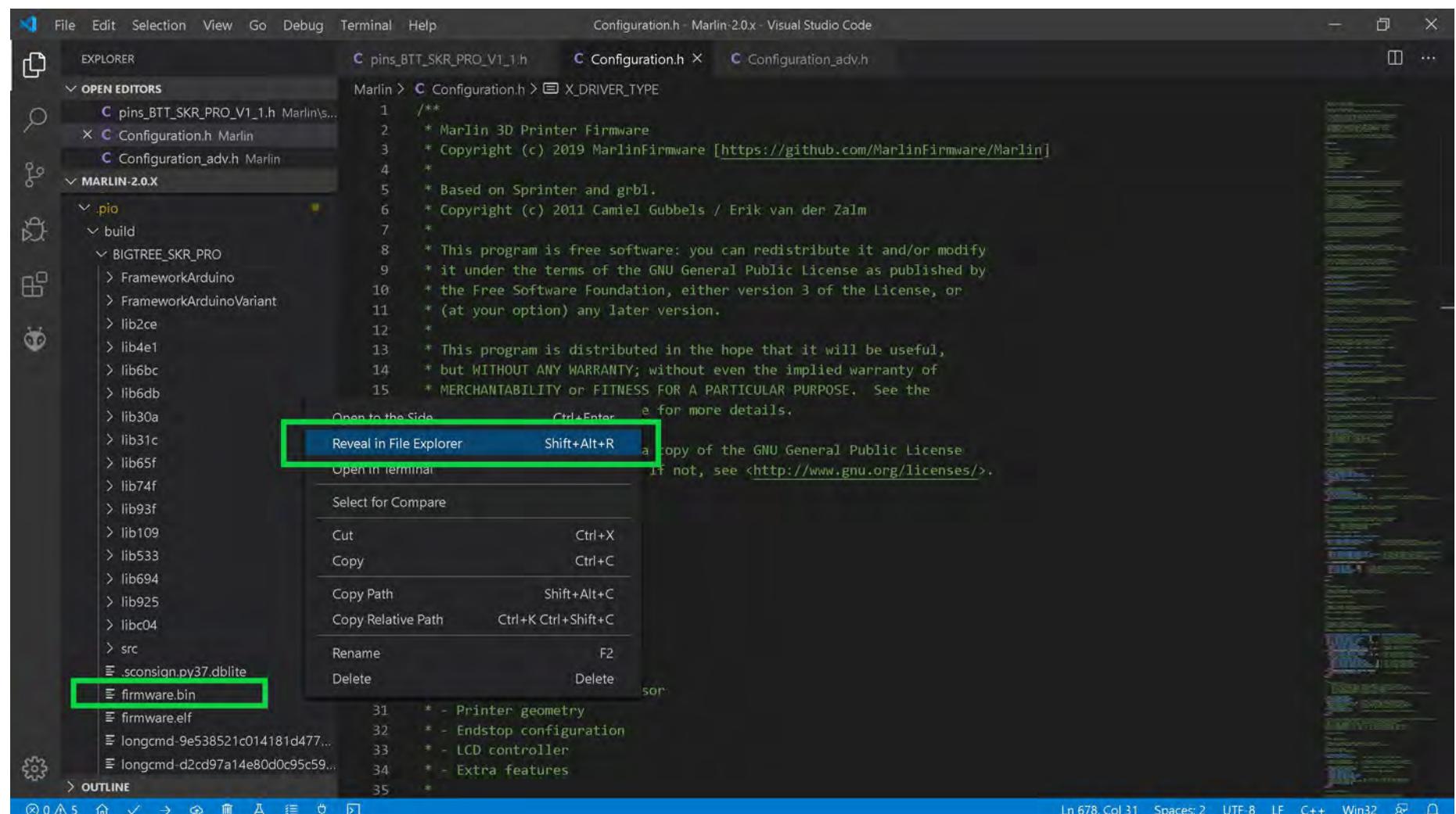
The terminal message "1 succeeded in 00:02:31.294" is highlighted in green.

- Bottom Status Bar:** Ln 678, Col 31, Spaces: 2, UTF-8, LF, C++, Win32, etc.
- Terminal Status:** Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for StealthChop

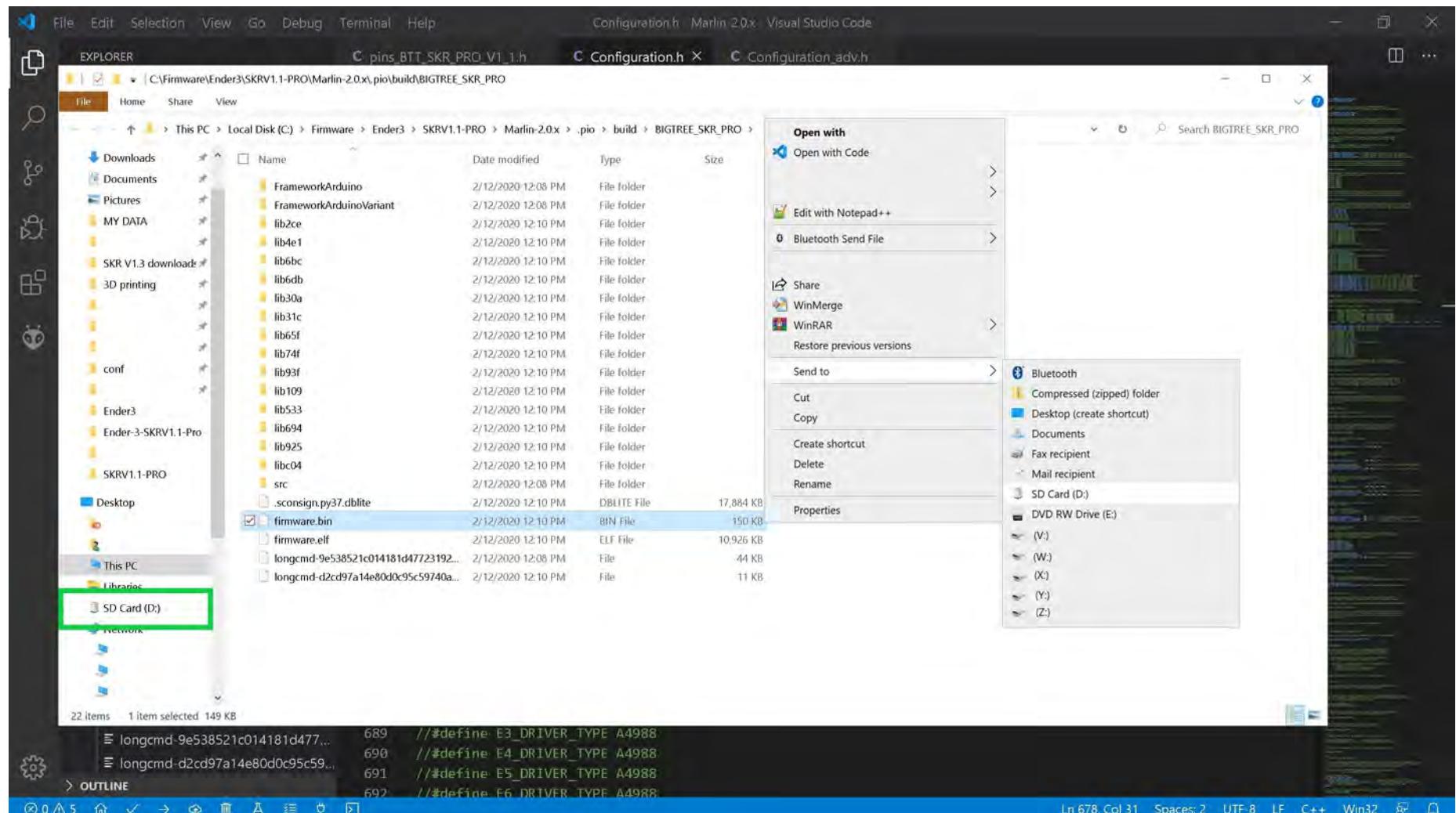
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer window.



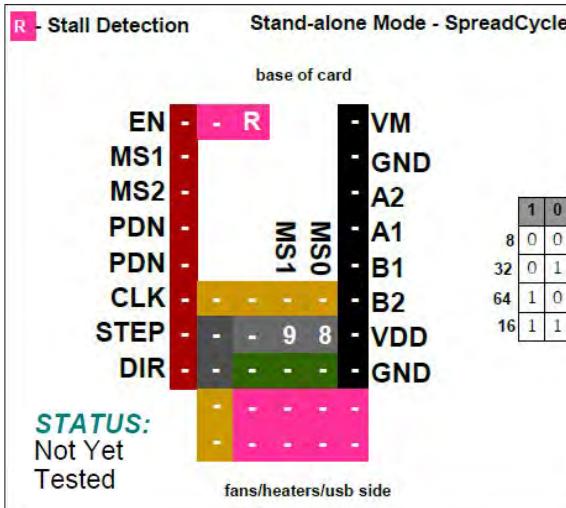
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for StealthChop

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
 - From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



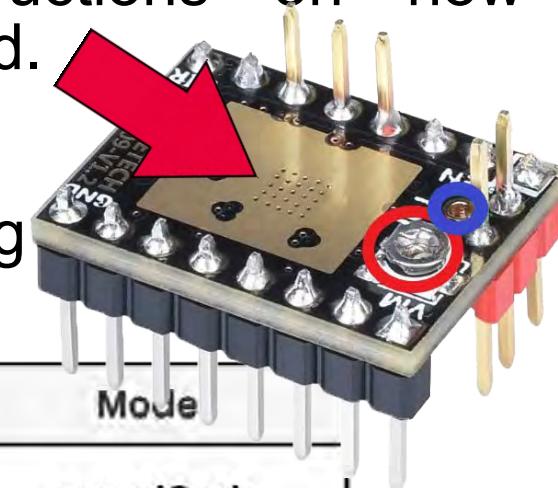
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.



BIQU TMC2209 V1.2

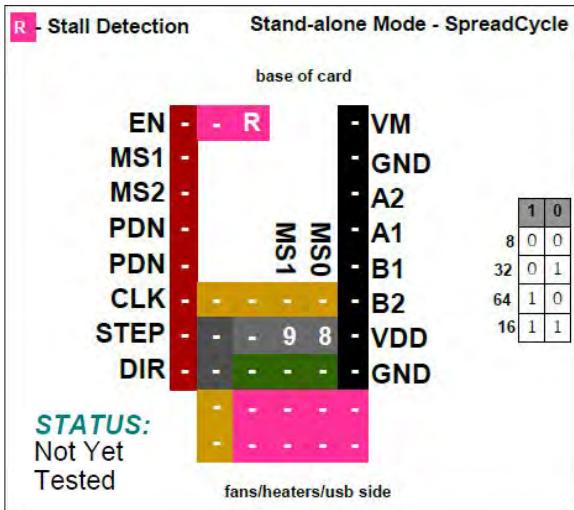
Stand-alone Mode for SpreadCycle

NOTE: Use the potentiometer (POT) on the top of the board, as shown in **RED**; or use the board's " V_{ref} Test point" location, as shown in **BLUE**, to set your V_{ref} . See [Appendix A](#) for instructions on how to set the V_{ref} on a driver board.



Note: Use 90% of the calculated V_{ref} when tuning the stepper driver board.

| Driver Chip | MS1 | MS0 | Steps | Interpolation | Mode |
|---|--|-----|--------|--|-------------|
| BIQU® TMC2209 <small>Stand Alone Mode Maximum 64 Subdivision 28V DC 2.8A (peak)</small> | GND | GND | 1 / 8 | 1 / 256 | spreadCycle |
| | GND | VIO | 1 / 32 | 1 / 256 | spreadCycle |
| | VIO | GND | 1 / 64 | 1 / 256 | spreadCycle |
| | VIO | VIO | 1 / 16 | 1 / 256 | spreadCycle |
| Driving Current Calculation Formula <small>R_S(Typical Sense Resistor)= 0.11Ω</small> | $I_{MAX} = V_{ref}$ See Appendix B #5. Use 50% to 90% as shown below: $I_{MAX} = I_{MAX} * 0.90$ | | | $V_{ref} = I_{MAX}$ See Appendix B #5. Use 50% to 90% as shown below: $V_{ref} = V_{ref} * 0.90$ | |



BIQU TMC2209 V1.2

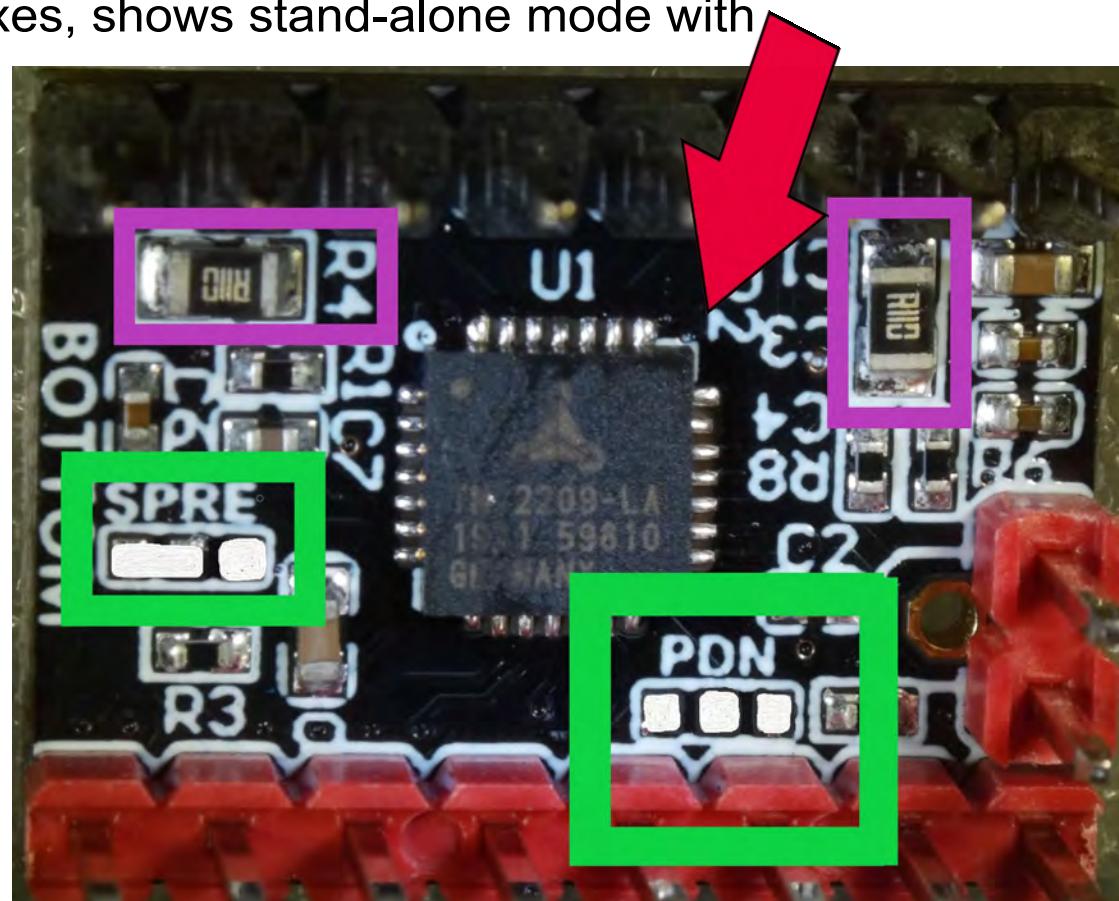
Stand-alone Mode for SpreadCycle

NOTE: The SPRE jumper is located on the bottom of the driver board. In Standalone Mode, the default setting is wired for StealthChop; i.e. the SPRE jumper is set to GND. To switch to Standalone with SpreadCycle, one needs to change the SPRE jumper on the bottom of the driver board. The **PURPLE boxes** below show the location of the current sense resistors (R_s) for the TMC2209.

Note: To switch to stand-alone mode, none of the PDN pads should be bridged. The picture below, as seen in the **GREEN** boxes, shows stand-alone mode with SpreadCycle.

Note: When the stall-guard function is **not used**, the stall-guard pin ("R") of the TMC2209 must be removed (desoldered) or use long pin header risers so that the "R" pin does not connect to the SKR PRO V1.1 board.

MOST BIQU TMC2209 V1.2 driver boards, when purchased for UART mode, will have the correct PDN pads already soldered together, located on the bottom of the driver board.



Stand-alone Mode - SpreadCycle

BIQU TMC2209 V1.2

Stand-alone Mode for SpreadCycle

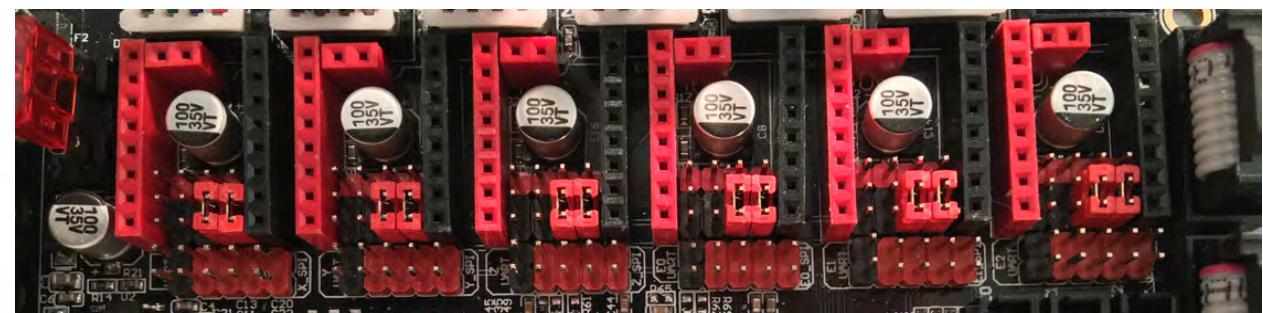
Stand-alone Mode

1 / 8

Interpolation: **1/256**

SpreadCycle

| | | | | |
|------|---|-----|-----|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | MS0 | B1 |
| CLK | - | - | - | B2 |
| STEP | - | - | 9 8 | VDD |
| DIR | - | 9 | 8 | GND |
| | | | | |



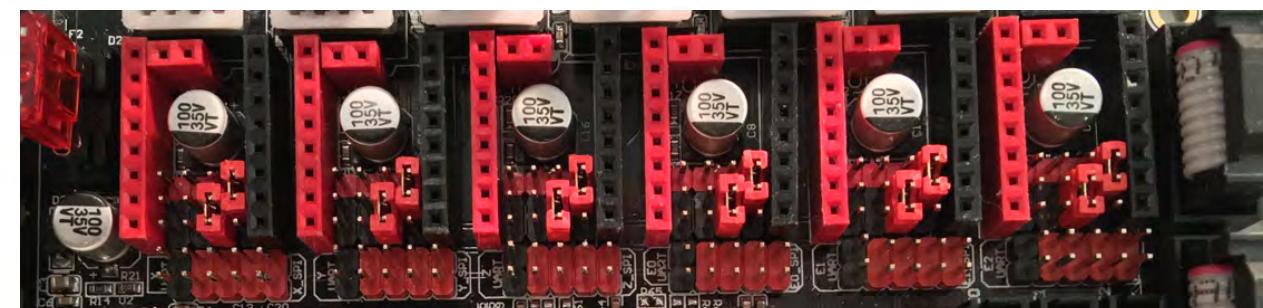
Stand-alone Mode

1 / 32

Interpolation: **1/256**

SpreadCycle

| | | | | |
|------|---|-----|-----|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | MS0 | B1 |
| CLK | - | - | 8 | B2 |
| STEP | - | - | 9 8 | VDD |
| DIR | - | 9 | - | GND |
| | | | | |



Stand-alone Mode - SpreadCycle

Stand-alone Mode

1 / 64

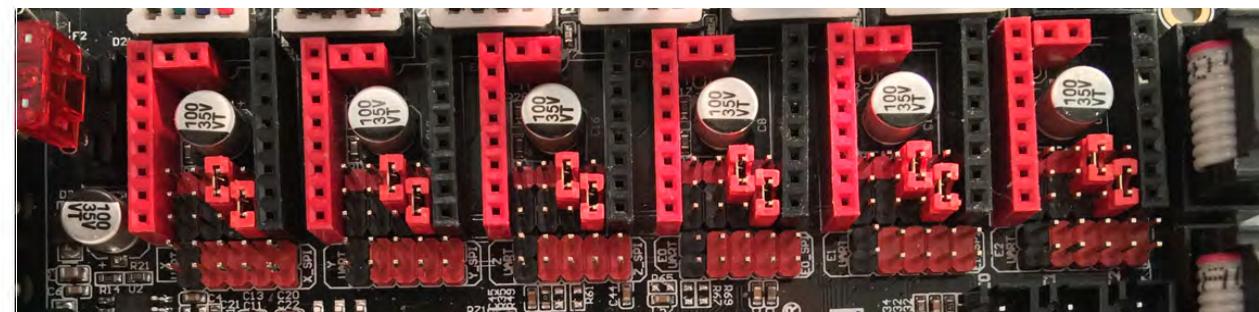
Interpolation: 1/256

SpreadCycle

| | | | | |
|------|---|-----|-----|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | MS0 | B1 |
| CLK | - | 9 | - | B2 |
| STEP | - | 9 | 8 | VDD |
| DIR | - | - | 8 | GND |

BIQU TMC2209 V1.2

Stand-alone Mode for SpreadCycle



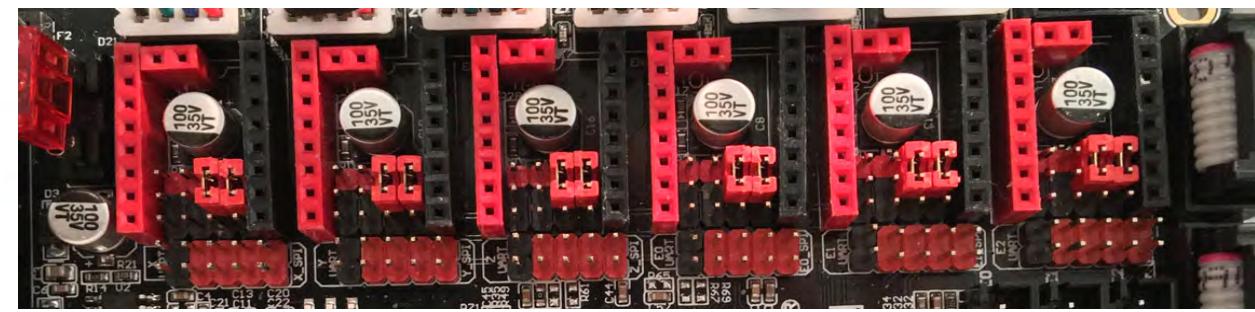
Stand-alone Mode

1 / 16

Interpolation: 1/256

SpreadCycle

| | | | | |
|------|---|-----|-----|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | MS0 | B1 |
| CLK | - | 9 | 8 | B2 |
| STEP | - | 9 | 8 | VDD |
| DIR | - | - | - | GND |



The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for SpreadCycle

NOTE: [Go to Appendix C](#), and then come back here for the changes to Marlin for BIQU TMC2209 V1.2 stepper motor drivers in stand-alone mode for spreadCycle.

- Change the stepper motor drivers so that Marlin knows you are using TMC2209 drivers in stand-alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2209 drivers in stand-alone mode. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

```

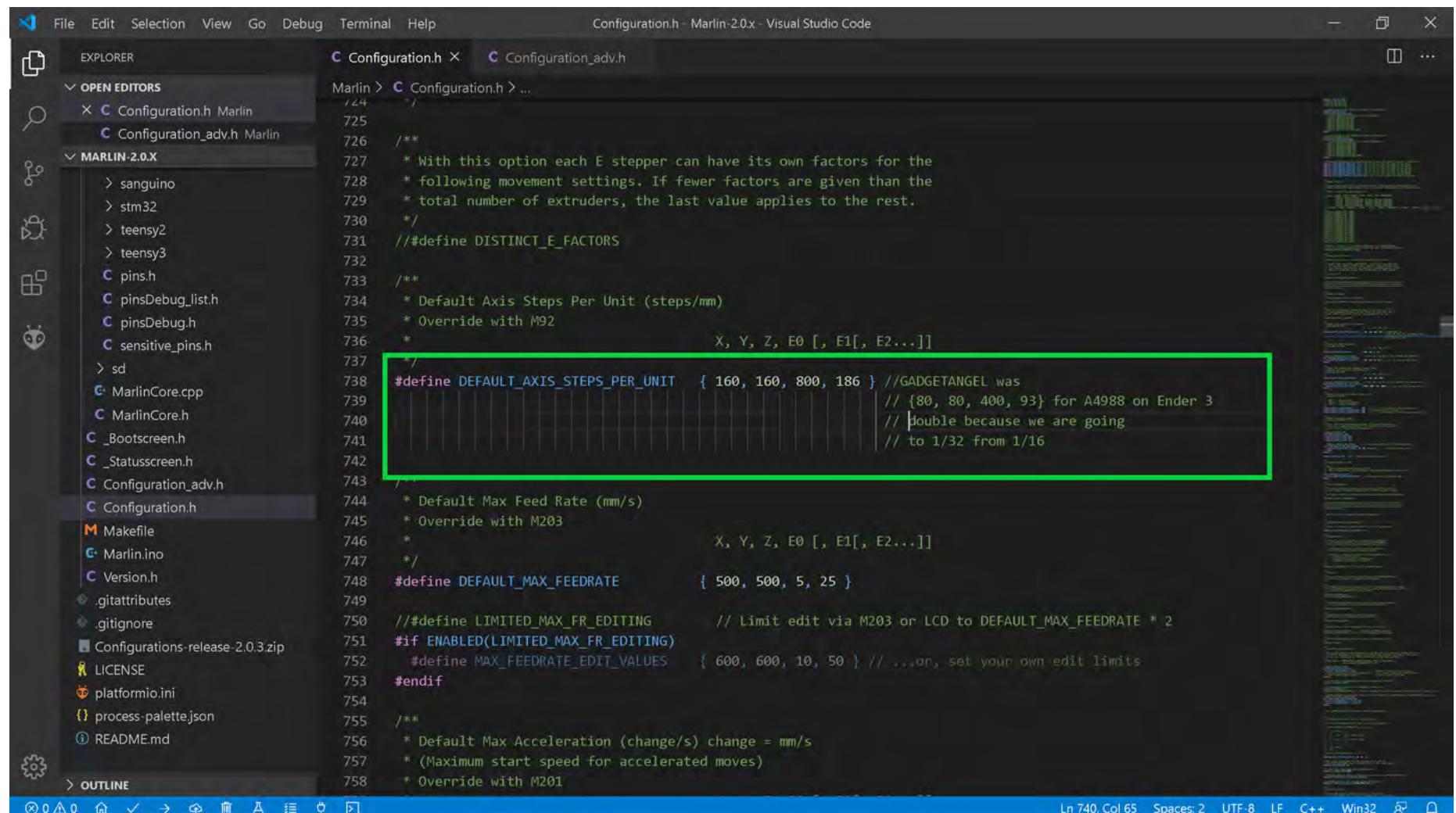
File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
  PIO Home Configuration.h M...
  Configuration_adv.h
MARLIN-2.0.X
  LCDprint.cpp
  LCDprint.h
  thermistornames.h
  ultralcd.cpp
  ultralcd.h
  libs
  module
  pins
  sd
  MarlinCore.cpp
  MarlinCore.h
  _Bootscreen.h
  _Statusscreen.h
  Configuration_adv.h
  Configuration.h
  Makefile
  Marlin.ino
  Version.h
  .gitattributes
  .gitignore
  LICENSE
  platformio.ini
  process-palette.json
  README.md
OUTLINE
Ln 686, Col 99 Spaces: 2 UTF-8 LF C++ Win32 1
661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC2209', 'TMC26X', 'TMC5130']
676 */
677 #define X_DRIVER_TYPE TMC2209_STANDALONE //GADGETANGEL was commented out and had the value A4988
678 #define Y_DRIVER_TYPE TMC2209_STANDALONE //GADGETANGEL was commented out and had the value A4988
679 #define Z_DRIVER_TYPE TMC2209_STANDALONE //GADGETANGEL was commented out and had the value A4988
680 //#define X2_DRIVER_TYPE A4988
681 //#define Y2_DRIVER_TYPE A4988
682 //#define Z2_DRIVER_TYPE A4988
683 //#define Z3_DRIVER_TYPE A4988
684 //#define Z4_DRIVER_TYPE A4988
685 #define E0_DRIVER_TYPE TMC2209_STANDALONE //GADGETANGEL was commented out and had the value A4988
686 //#define E1_DRIVER_TYPE A4988
687 //#define E2_DRIVER_TYPE A4988
688 //#define E3_DRIVER_TYPE A4988
689 //#define E4_DRIVER_TYPE A4988
690 //#define E5_DRIVER_TYPE A4988
691 //#define E6_DRIVER_TYPE A4988
692 //#define E7_DRIVER_TYPE A4988
693
694 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for SpreadCycle

- Since I desire to use 1/32 stepping, and we are changing from A4988 stepper motor drivers on the Ender 3 to TMC2209 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the GREEN box below.



The screenshot shows the Visual Studio Code interface with the 'Configuration.h' file open. The code editor displays the Marlin configuration header. A green rectangular box highlights the following line of code:

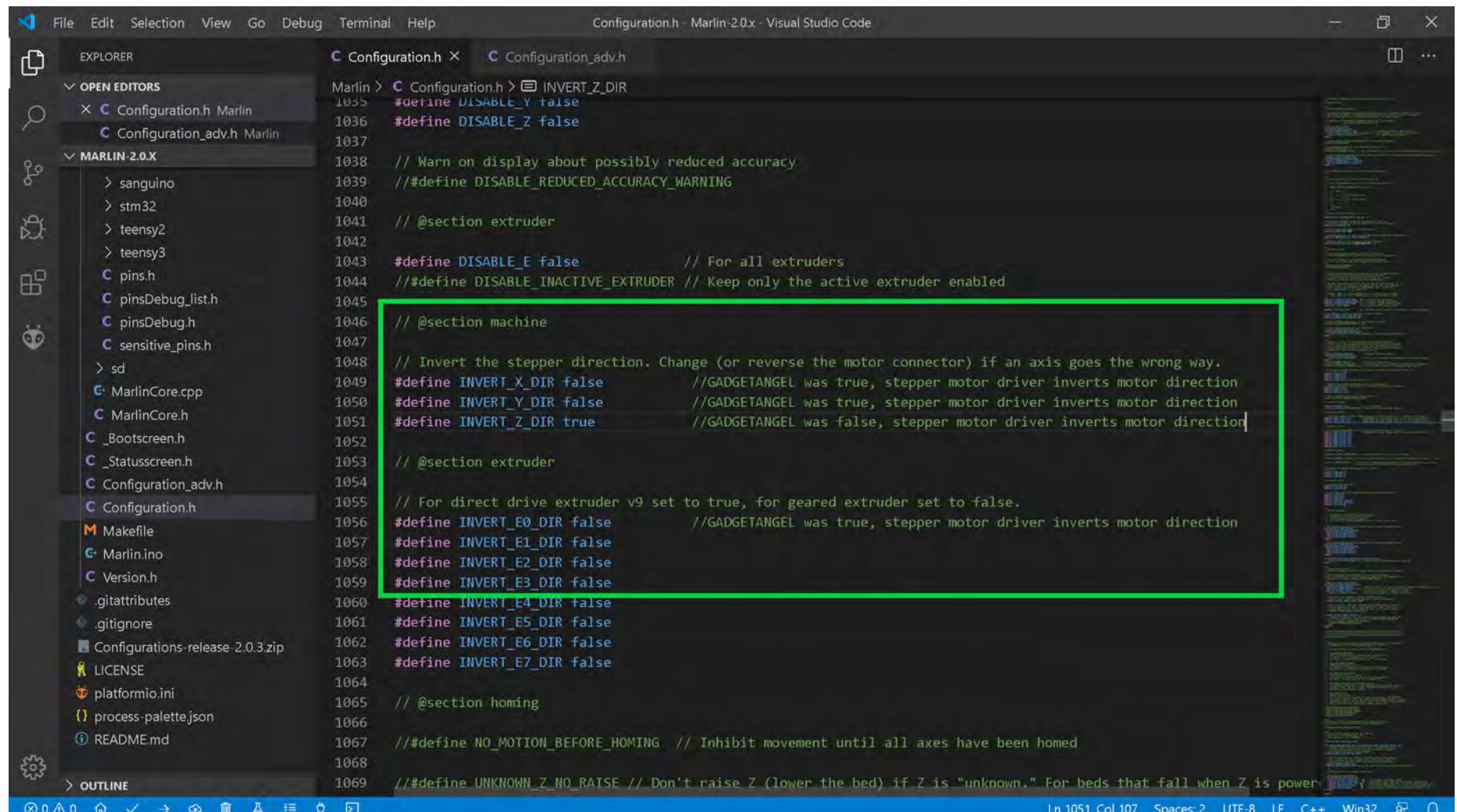
```
#define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
// {80, 80, 400, 93} for A4988 on Ender 3
// Double because we are going
// to 1/32 from 1/16
```

The code editor's status bar at the bottom right indicates: Ln 740, Col 65, Spaces: 2, UTF-8, LF, C++, Win32.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for SpreadCycle

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2209 drivers, I must invert the stepper motor direction because the TMC2209 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2209 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below



The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following snippet of C++ code:

```

1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false           // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false        // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true         // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false       // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is power

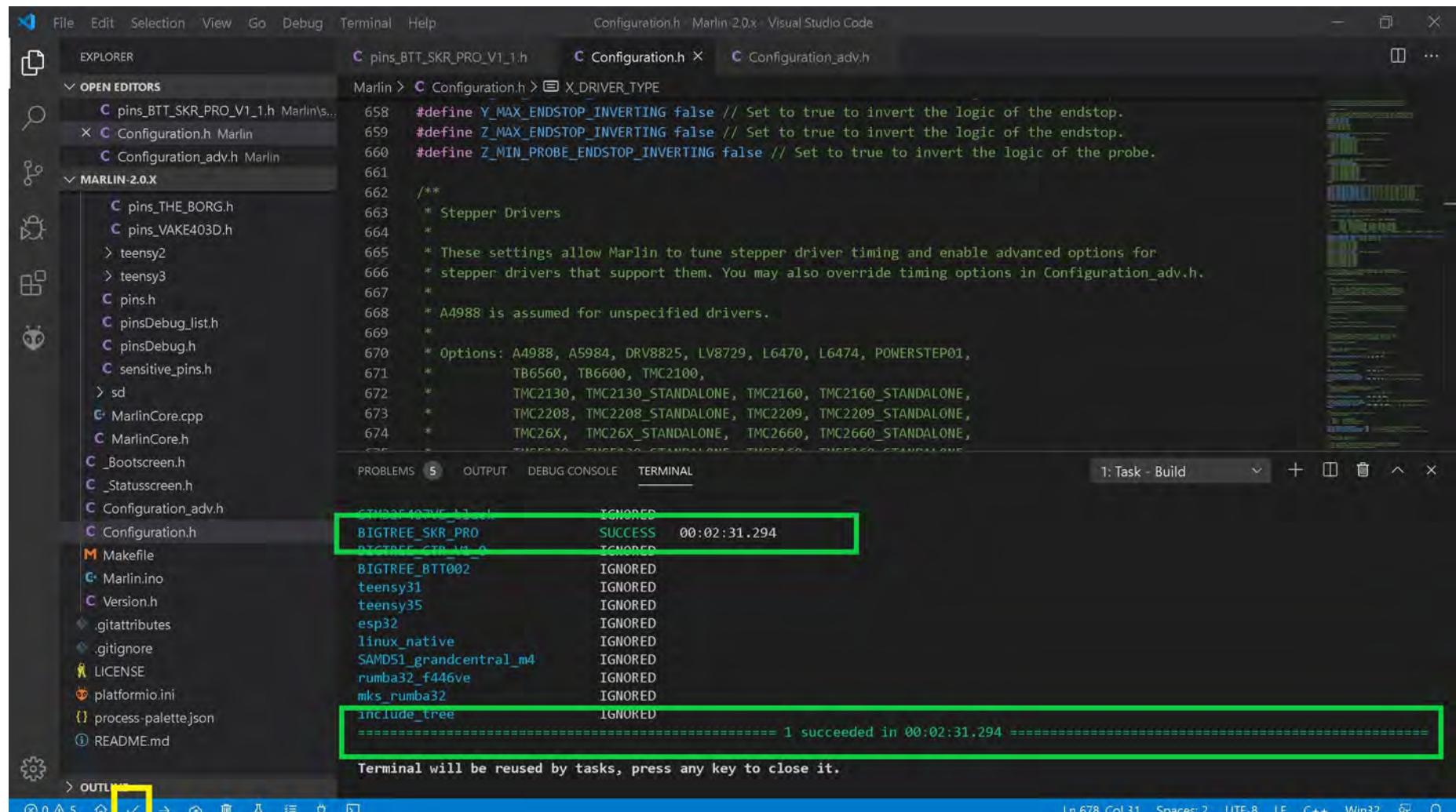
```

A green rectangular box highlights the line `#define INVERT_Z_DIR true`, indicating that the setting for the Z-axis has been changed from its original value.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for SpreadCycle

- The end of Marlin setup for BIQU TMC2209 V1.2 drivers in stand-alone mode for spreadCycle. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows files in the project structure, including `pins_BTT_SKR_PRO_V1_1.h`, `Configuration.h` (marked with a yellow box), and `Configuration_adv.h`.
- Code Editor:** Displays the `Configuration.h` file with code related to endstop and probe settings.
- Terminal:** Shows the build output for the `BIGTREE_SKR_PRO` target, which completed successfully in 00:02:31.294. Other targets listed include `BIGTREE_BTT002`, `teensy31`, `teensy35`, `esp32`, `linux_native`, `SAMD51_grandcentral_m4`, `rumba32_f446ve`, `mks_rumba32`, and `include_tree`. The output ends with "1 succeeded in 00:02:31.294".

```

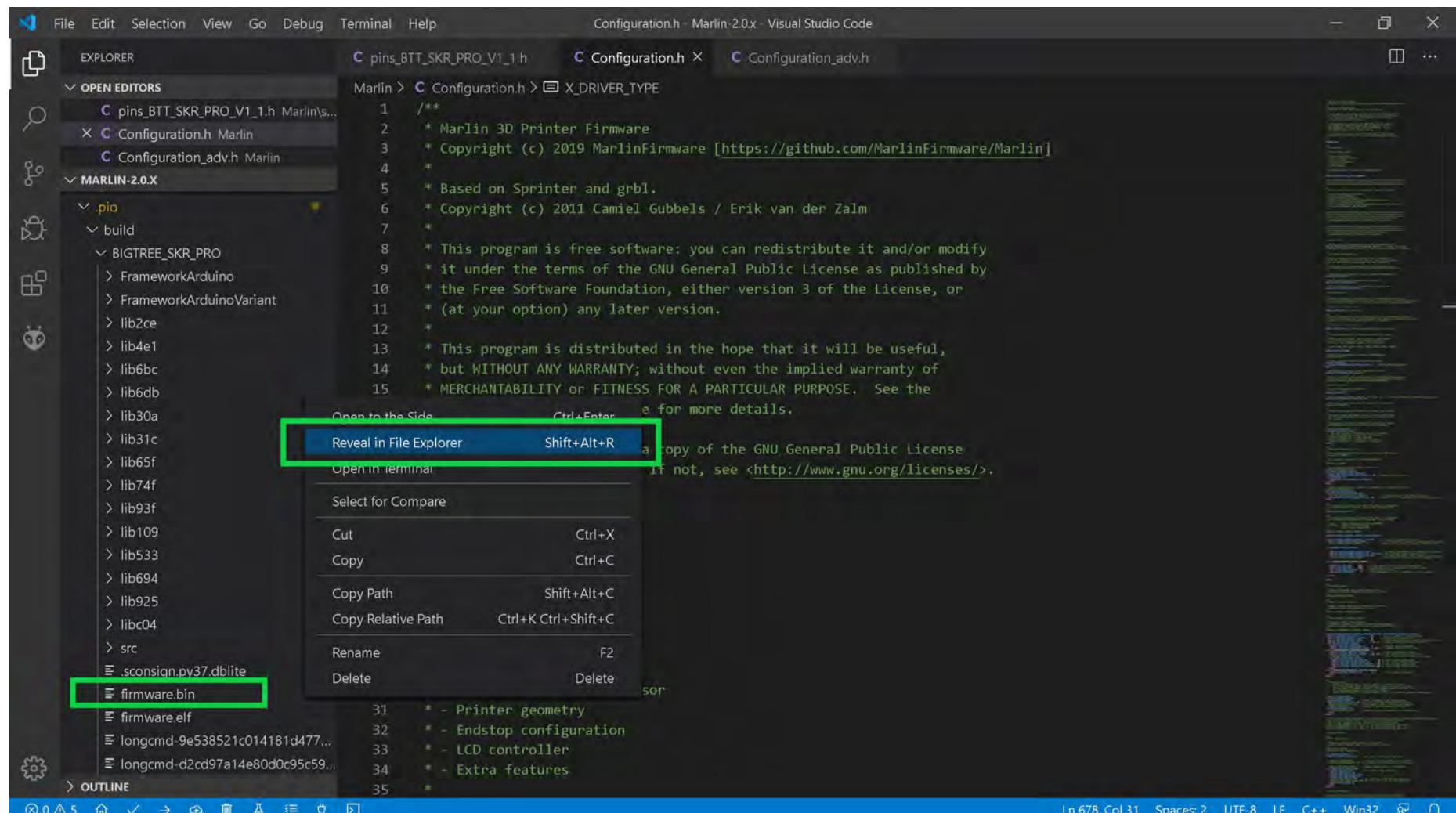
BIGTREE_SKR_PRO           IGNORED
BIGTREE_BTT002            IGNORED
teensy31                  IGNORED
teensy35                  IGNORED
esp32                     IGNORED
linux_native               IGNORED
SAMD51_grandcentral_m4   IGNORED
rumba32_f446ve             IGNORED
mks_rumba32                IGNORED
include_tree                IGNORED
=====
===== 1 succeeded in 00:02:31.294 =====

```
- Status Bar:** Shows the terminal reused message and file statistics (Ln 678, Col 31, Spaces: 2, UTF-8, LF, C++, Win32).

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for SpreadCycle

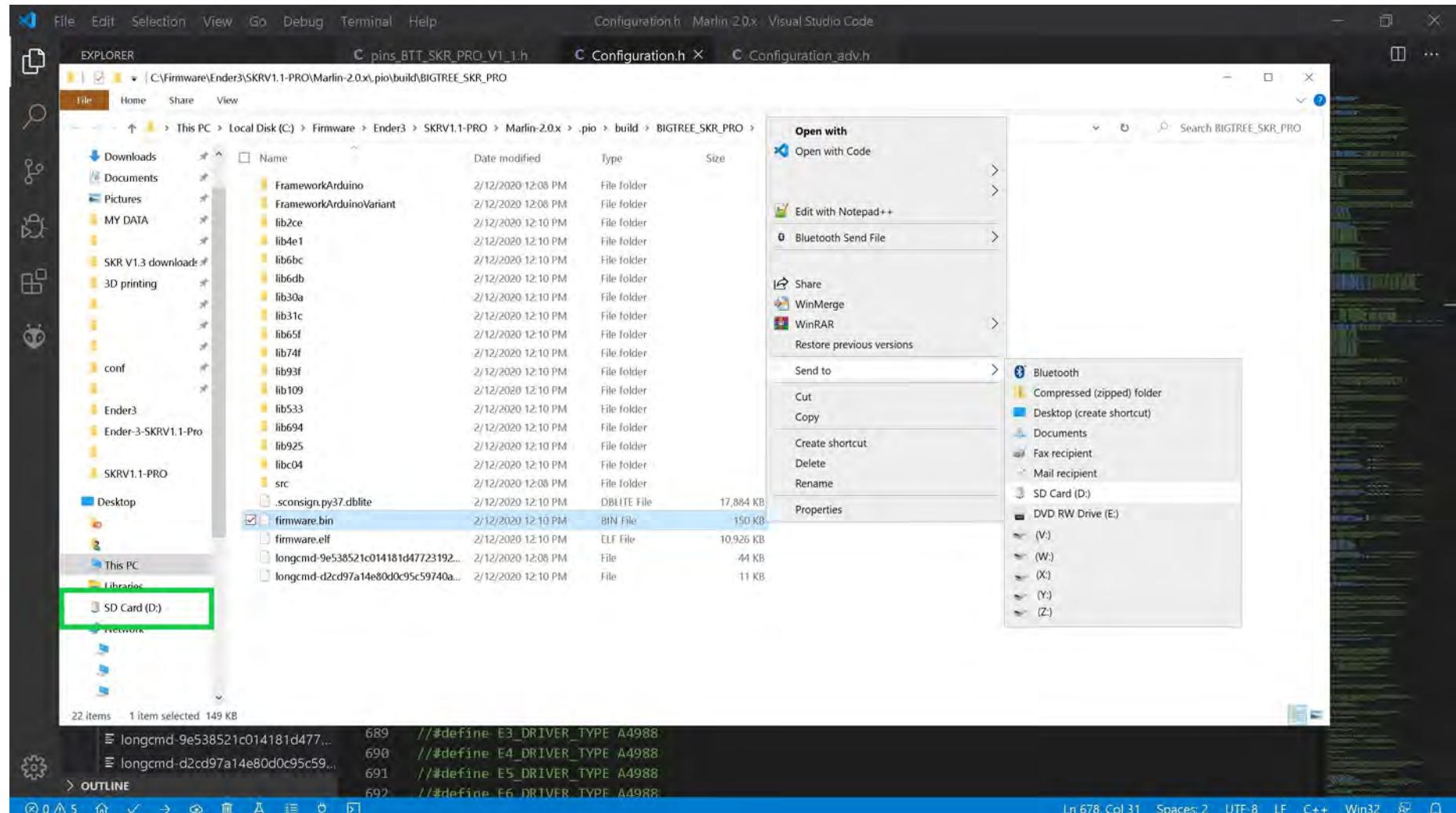
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer window.



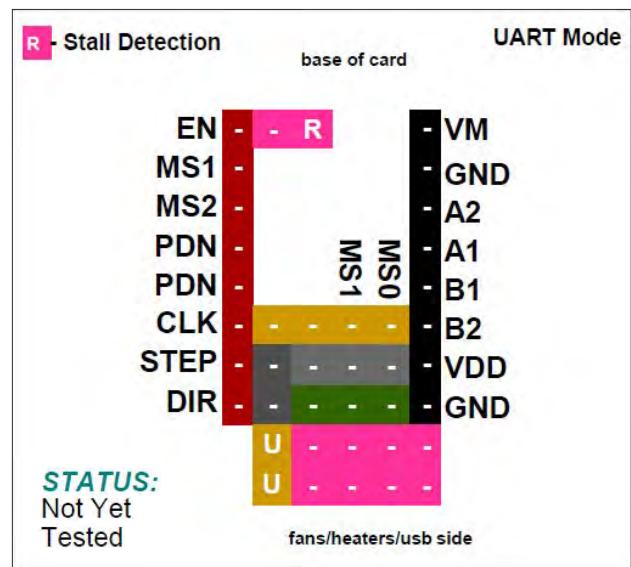
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand-alone Mode for SpreadCycle

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".

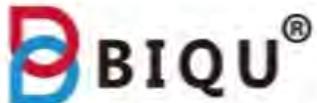


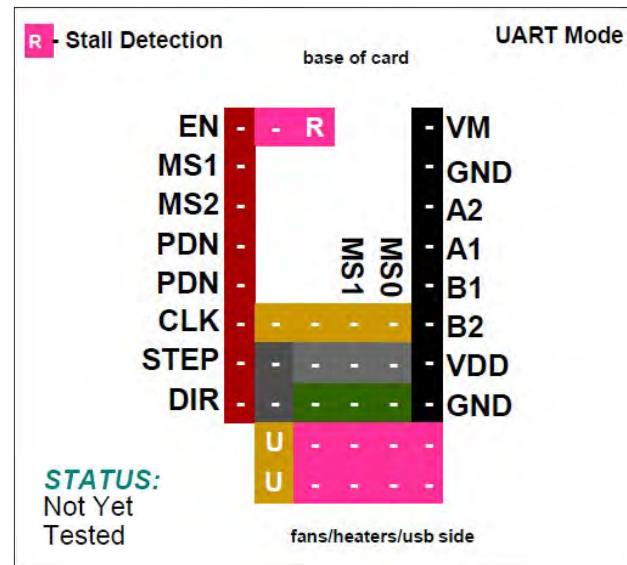
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

**BIQU TMC2209 V1.2****UART Mode**

Note: You can use 50% to 90% of the calculated I_{RMS} ($I_{MAX}/1.414$) when tuning ("X_CURRENT", "Y_CURRENT", etc. the stepper motor driver in the firmware.

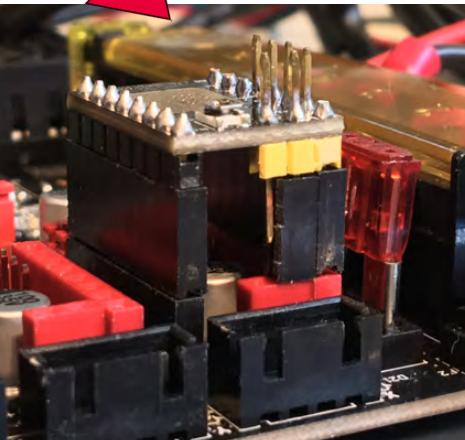
See the next page for further information.

| | | |
|--|--|--|
| Driver Chip  TMC2209 UART Mode Maximum 256 Subdivision 28V DC 2.8A (peak) | Steps are set inside of your Firmware | |
| Driving Current Calculation Formula R_S (Typical Sense Resistor) = 0.11Ω | $I_{MAX} = V_{ref}$ See Appendix B #6. Use 50% to 90% as shown below: $I_{MAX} = I_{MAX} * 0.90$ | $V_{ref} = I_{MAX}$ See Appendix B #6. Use 50% to 90% as shown below: $V_{ref} = V_{ref} * 0.90$ |



MOST BIQU TMC2209 V1.2 driver boards, when purchased for UART mode, will have the correct PDN pads already soldered together, located on the bottom of the driver board.

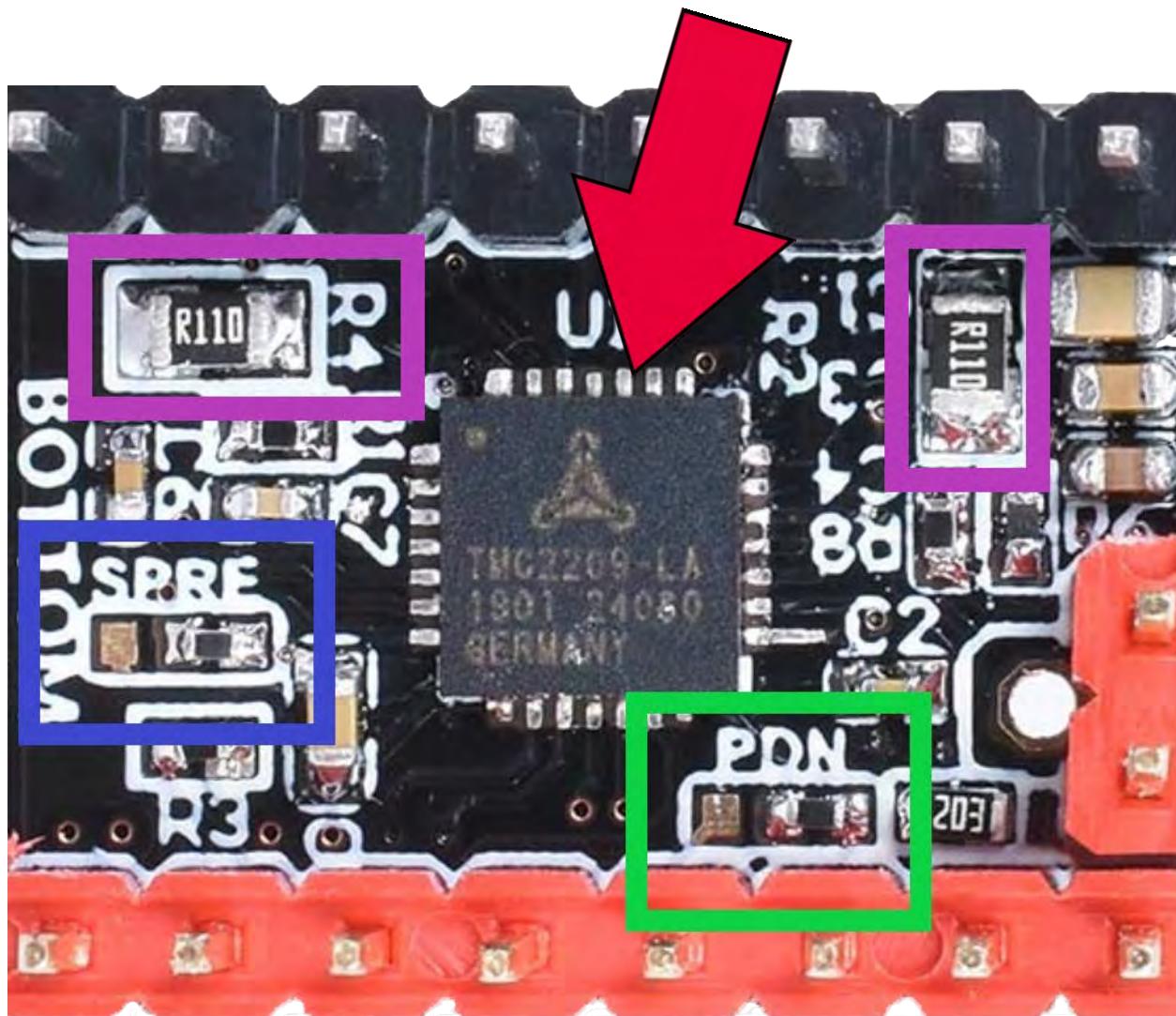
Note: When the stall-guard function is **not used**, the stall-guard pin ("R") of the TMC2209 must be removed (desoldered) or use long pin header risers so that the "R" pin does not connect to the SKR PRO V1.1 board



The **PURPLE** boxes show the location of the current sense resistors (R_s).

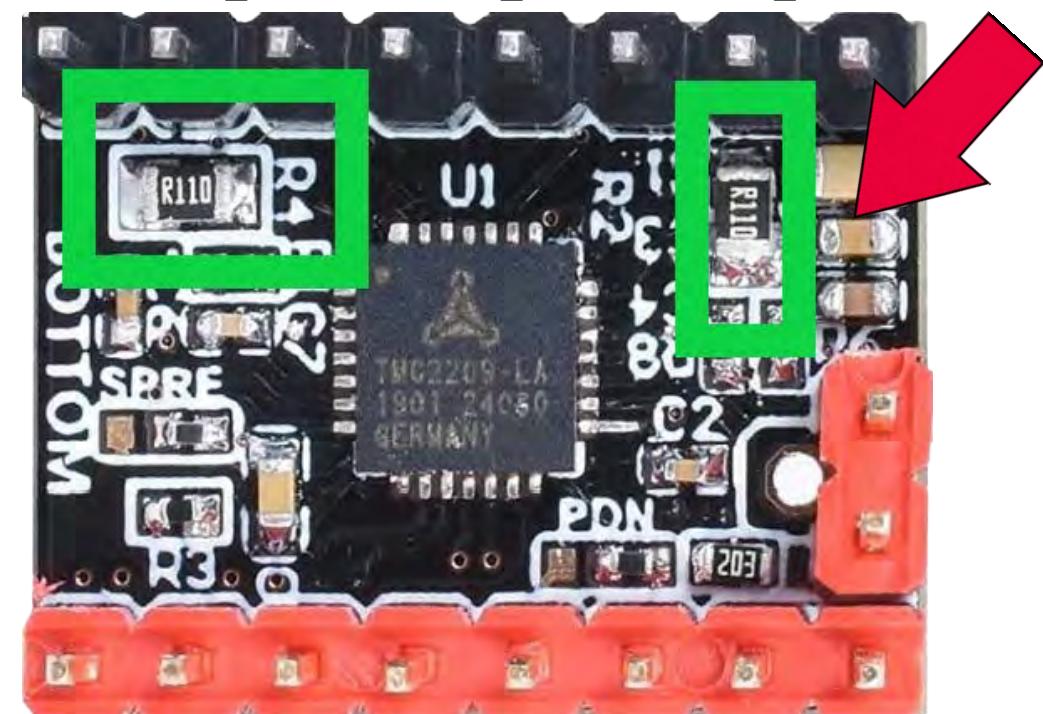
Note: To ensure your TMC2209 is in UART mode, look on the bottom of the driver board for the PDN pads. Two of the three pads should be bridged together. **If a bridge exists then the device is in UART Mode, as seen in the GREEN box.**

The **BLUE** box shows the device has StealthChop capability.



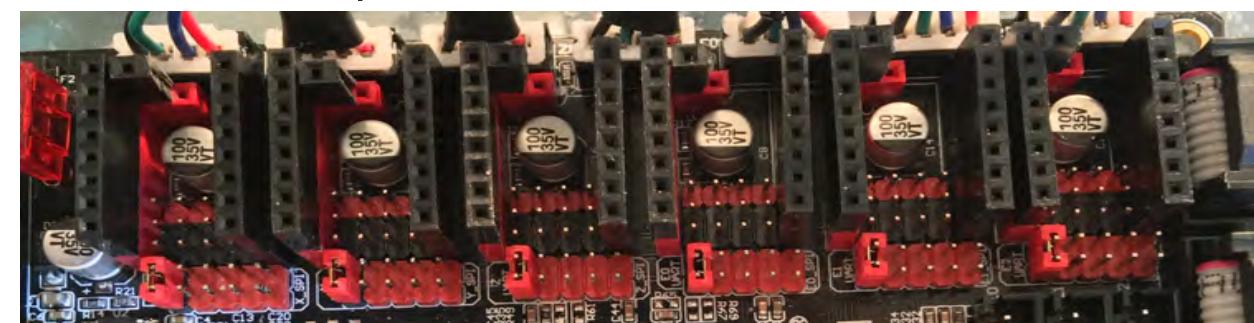
UART Mode**R - Stall Detection**

Note: The location of the current sense resistors are shown in **GREEN**. Use the current sense resistors' value in the Marlin Firmware ("X_RSENSE", "Y_RSENSE", "Z_RSENSE" and/or "E0_RSENSE") so that the appropriate current limit can be sent to the driver board. If you do not want to use V_{ref} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS} = I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT", and/or "E0_CURRENT".

 $R_s = R050$ is 0.05 Ohms **$R_s = R062$ is 0.062 Ohms** **$R_s = R068$ is 0.068 Ohms** **$R_s = R075$ is 0.075 Ohms** **$R_s = R100$ is 0.1 Ohms** **$R_s = R110$ is 0.11 Ohms** **$R_s = R150$ is 0.15 Ohms** **$R_s = R200$ is 0.2 Ohms** **$R_s = R220$ is 0.22 Ohms****UART**

| | | | | |
|------|---|-----|---|-----|
| EN | - | R | - | VM |
| MS1 | - | | - | GND |
| MS2 | - | | - | A2 |
| PDN | - | | - | A1 |
| PDN | - | MS1 | - | B1 |
| CLK | - | | - | B2 |
| STEP | - | | - | VDD |
| DIR | - | | - | GND |
| | U | - | - | |
| | U | - | - | |

Note: Set Jumper "U" for UART MODE!!



The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

NOTE: Go to Appendix C, and then come back here for the changes to Marlin for BIQU TMC2209 V1.2 stepper motor drivers in UART mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC2209 drivers in UART mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2209 drivers in UART mode. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

The screenshot shows the Visual Studio Code interface with the file `Configuration.h` open. The code editor displays the following relevant section of the configuration file:

```

661 /**
662 * Stepper Drivers
663 *
664 * These settings allow Marlin to tune stepper driver timing and enable advanced options for
665 * stepper drivers that support them. You may also override timing options in Configuration_adv.h.
666 *
667 * A4988 is assumed for unspecified drivers.
668 *
669 * Options: A4988, A5984, DRV8825, LV8729, L6470, L6474, POWERSTEP01,
670 *           TB6560, TB6600, TMC2100,
671 *           TMC2130, TMC2130_STANDALONE, TMC2160, TMC2160_STANDALONE,
672 *           TMC2208, TMC2208_STANDALONE, TMC2209, TMC2209_STANDALONE,
673 *           TMC26X, TMC26X_STANDALONE, TMC2660, TMC2660_STANDALONE,
674 *           TMC5130, TMC5130_STANDALONE, TMC5160, TMC5160_STANDALONE
675 *           :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'TMC2100', 'TMC2130', 'TMC2208', 'TMC26X', 'TMC5130']
676 */
677
678 #define X_DRIVER_TYPE TMC2209 //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE TMC2209 //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE TMC2209 //GADGETANGEL was commented out and had the value A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC2209 //GADGETANGEL was commented out and had the value A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

A green rectangular box highlights the driver type definitions for all axes (X, Y, Z, E0-E7), specifically the lines starting with `#define` and containing the value `TMC2209`. The rest of the code in the file is shown in a standard monospaced font.

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2209 drivers, I must invert the stepper motor direction because the TMC2209 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2209 driver on was "true" change it to "false", as shown in the **GREEN** box below. If the setting was "false", now set it to "true", as shown in the **GREEN** box below

```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h X Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > INVERT_Z_DIR
1035 #define DISABLE_Y false
1036 #define DISABLE_Z false
1037
1038 // Warn on display about possibly reduced accuracy
1039 // #define DISABLE_REDUCED_ACCURACY_WARNING
1040
1041 // @section extruder
1042
1043 #define DISABLE_E false          // For all extruders
1044 // #define DISABLE_INACTIVE_EXTRUDER // Keep only the active extruder enabled
1045
1046 // @section machine
1047
1048 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
1049 #define INVERT_X_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1050 #define INVERT_Y_DIR false      // GADGETANGEL was true, stepper motor driver inverts motor direction
1051 #define INVERT_Z_DIR true       // GADGETANGEL was false, stepper motor driver inverts motor direction
1052
1053 // @section extruder
1054
1055 // For direct drive extruder v9 set to true, for geared extruder set to false.
1056 #define INVERT_E0_DIR false     // GADGETANGEL was true, stepper motor driver inverts motor direction
1057 #define INVERT_E1_DIR false
1058 #define INVERT_E2_DIR false
1059 #define INVERT_E3_DIR false
1060 #define INVERT_E4_DIR false
1061 #define INVERT_E5_DIR false
1062 #define INVERT_E6_DIR false
1063 #define INVERT_E7_DIR false
1064
1065 // @section homing
1066
1067 // #define NO_MOTION_BEFORE_HOMING // Inhibit movement until all axes have been homed
1068
1069 // #define UNKNOWN_Z_NO_RAISE // Don't raise Z (lower the bed) if Z is "unknown." For beds that fall when Z is powered up

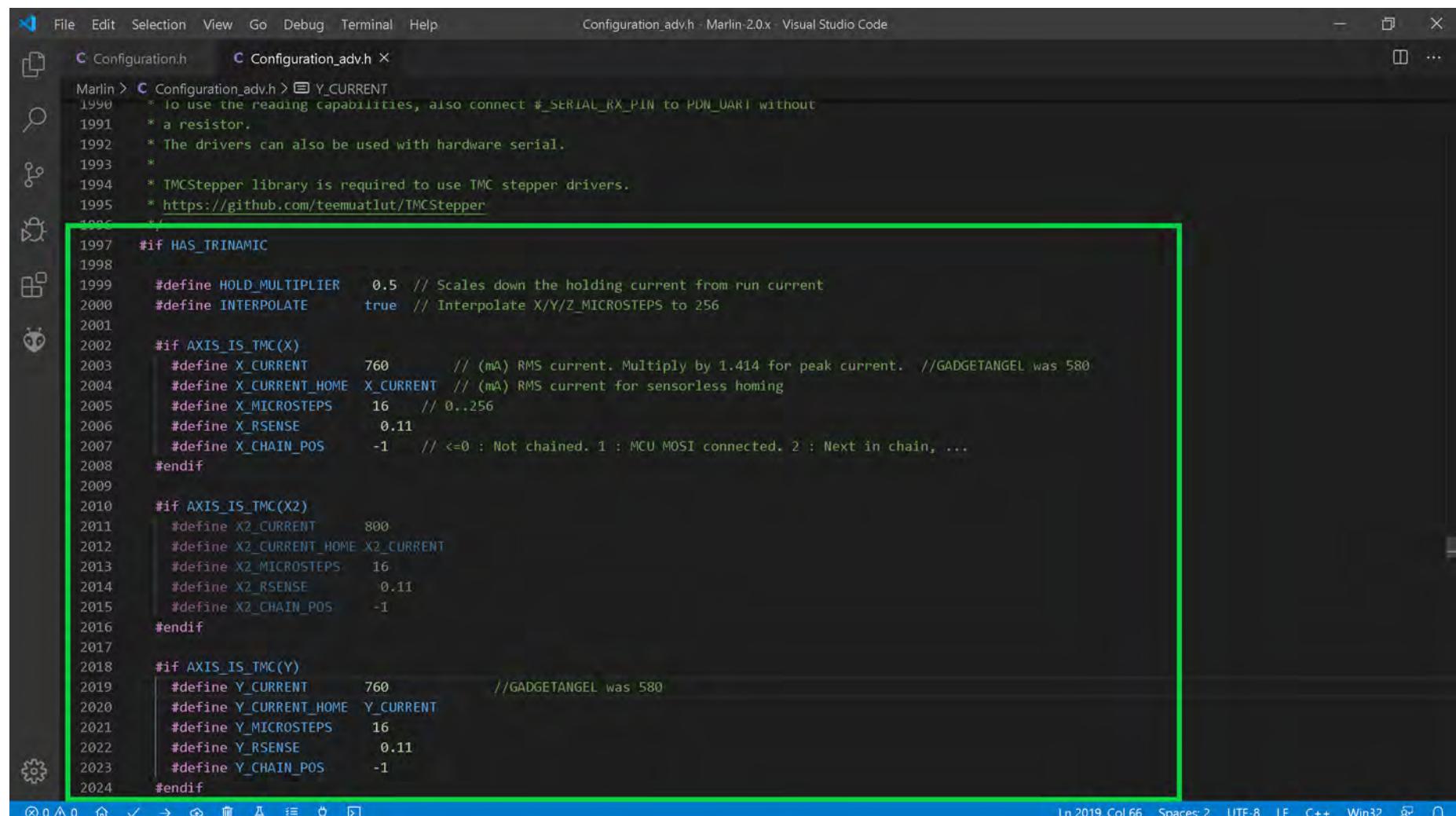
```

Ln 1051, Col 107 Spaces:2 UTF-8 LF C++ Win32

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Next you want to set your V_{ref} in the Marlin firmware for each axis that has the TMC2209 driver, as seen in the **GREEN** box below. I changed the "X_CURRENT" to be the calculated V_{ref} for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated V_{ref} for my Y-Axis, which is 760mV on the Ender 3.
- Ensure "X_RSENSE" is set to 0.11. Ensure "Y_RSENSE" is set to 0.11.
- If you **do not want to use V_{ref}** as the value for "X_CURRENT" and/or "Y_CURRENT", you should **use I_{RMS} instead**. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "X_CURRENT" and/or "Y_CURRENT".



```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > Y_CURRENT
1990 * To use the reading capabilities, also connect #_SERIAL_RX_PIN to PDN_UART without
1991 * a resistor.
1992 * The drivers can also be used with hardware serial.
1993 *
1994 * TMCStepper library is required to use TMC stepper drivers.
1995 * https://github.com/teemuatlut/TMCStepper
1996 */
1997 #if HAS_TRINAMIC
1998
1999 #define HOLD_MULTIPLIER    0.5 // Scales down the holding current from run current
2000 #define INTERPOLATE        true // Interpolate X/Y/Z_MICROSTEPS to 256
2001
2002 #if AXIS_IS_TMC(X)
2003     #define X_CURRENT        760      // (mA) RMS current. Multiply by 1.414 for peak current. //GADGETANGEL was 580
2004     #define X_CURRENT_HOME   X_CURRENT // (mA) RMS current for sensorless homing
2005     #define X_MICROSTEPS     16       // 0..256
2006     #define X_RSENSE          0.11
2007     #define X_CHAIN_POS       -1      // <=0 : Not chained. 1 : MCU MOSI connected. 2 : Next in chain, ...
2008 #endif
2009
2010 #if AXIS_IS_TMC(X2)
2011     #define X2_CURRENT        800
2012     #define X2_CURRENT_HOME   X2_CURRENT
2013     #define X2_MICROSTEPS     16
2014     #define X2_RSENSE          0.11
2015     #define X2_CHAIN_POS       -1
2016 #endif
2017
2018 #if AXIS_IS_TMC(Y)
2019     #define Y_CURRENT        760      //GADGETANGEL was 580
2020     #define Y_CURRENT_HOME   Y_CURRENT
2021     #define Y_MICROSTEPS     16
2022     #define Y_RSENSE          0.11
2023     #define Y_CHAIN_POS       -1
2024 #endif

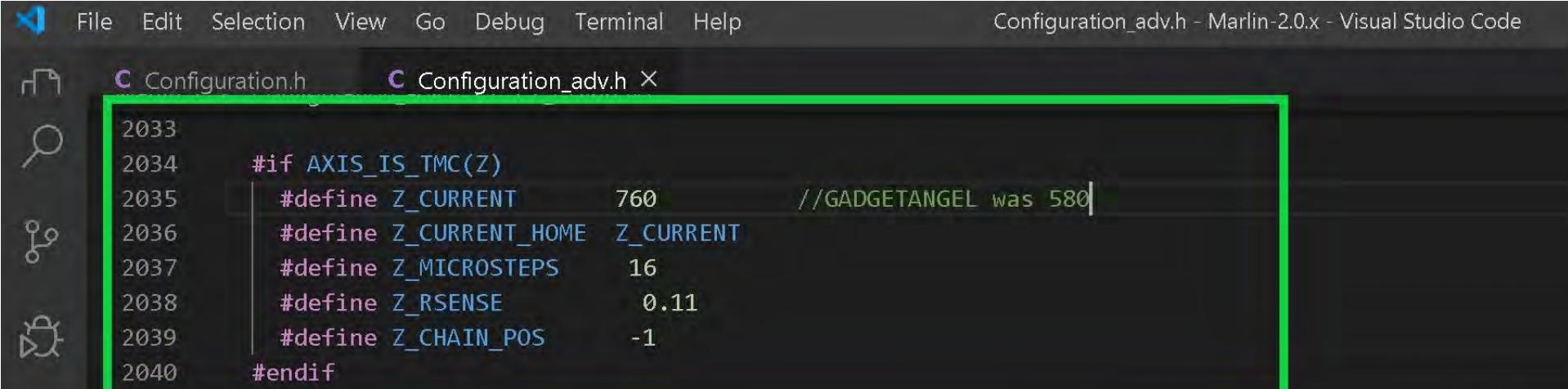
```

Ln 199, Col 66 Spaces: 2 UTF-8 LF C++ Win32 ⚡ 🔍

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Now, I am setting the V_{ref} for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated V_{ref} for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated V_{ref} for my Extruder, which is 900mV on the Ender 3.
- Ensure "Z_RSENSE" is set to 0.11. Ensure "E0_RSENSE" is set to 0.11.
- If you do not want to use V_{ref} as the value for "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS} = I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "Z_CURRENT" and/or "E0_CURRENT".



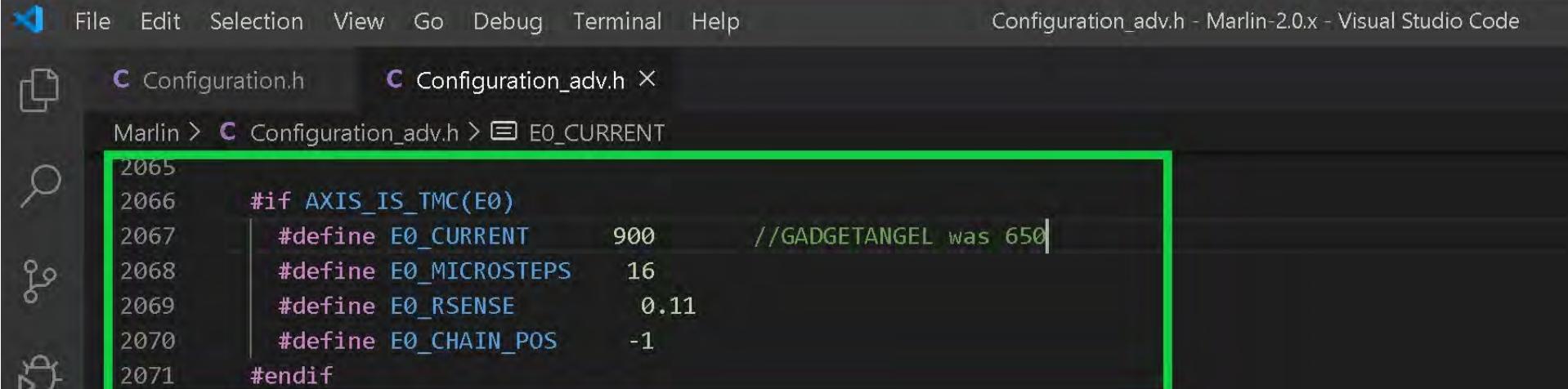
```

File Edit Selection View Go Debug Terminal Help
Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

Configuration.h Configuration_adv.h X

2033
2034 #if AXIS_IS_TMC(Z)
2035   #define Z_CURRENT      760           //GADGETANGEL was 580
2036   #define Z_CURRENT_HOME Z_CURRENT
2037   #define Z_MICROSTEPS    16
2038   #define Z_RSENSE        0.11
2039   #define Z_CHAIN_POS     -1
2040 #endif

```



```

File Edit Selection View Go Debug Terminal Help
Configuration.h Configuration_adv.h X
Marlin > Configuration_adv.h > E0_CURRENT

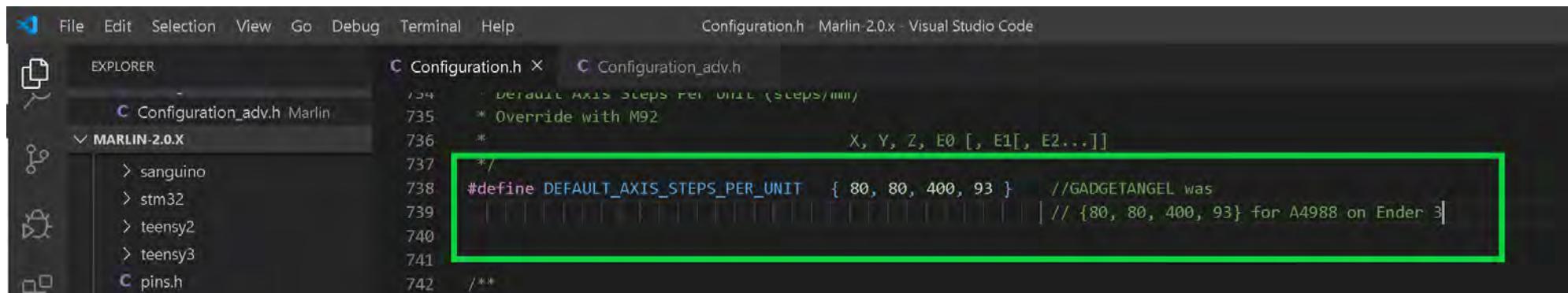
2065
2066 #if AXIS_IS_TMC(E0)
2067   #define E0_CURRENT      900           //GADGETANGEL was 650
2068   #define E0_MICROSTEPS   16
2069   #define E0_RSENSE        0.11
2070   #define E0_CHAIN_POS     -1
2071 #endif

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



File Edit Selection View Go Debug Terminal Help Configuration.h Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

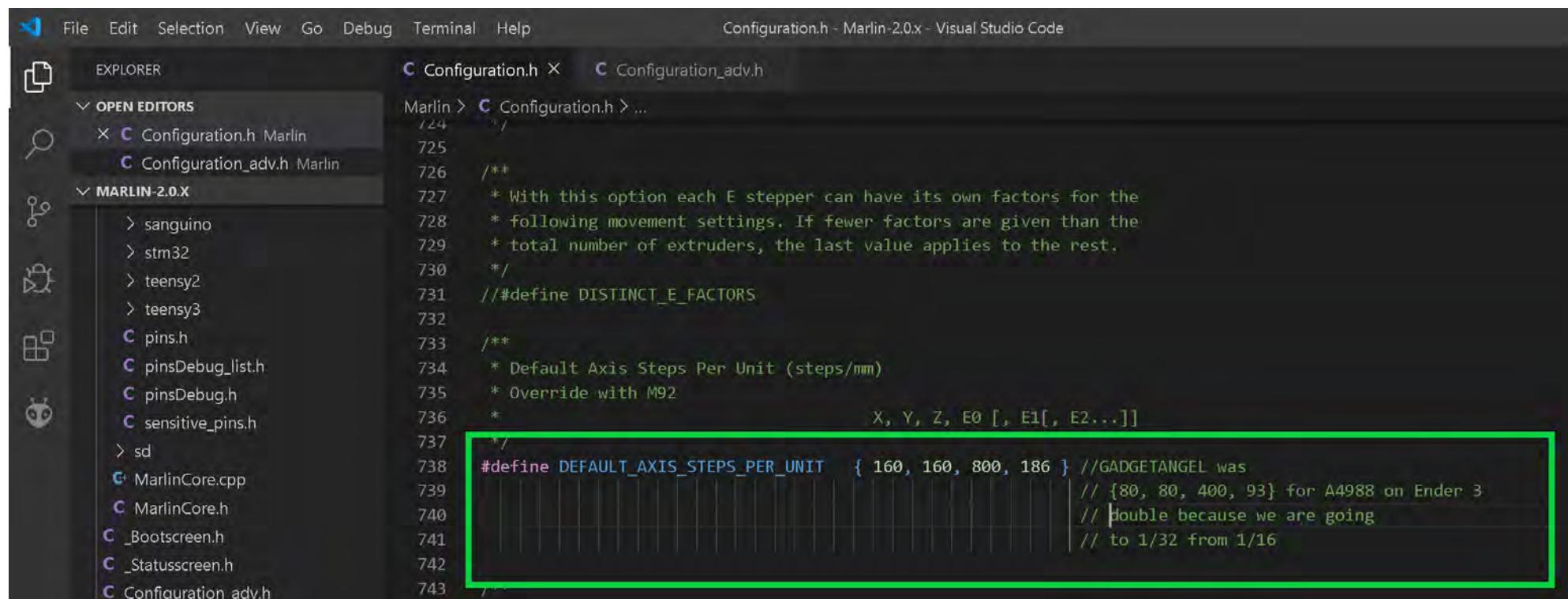
MARLIN-2.0.X

```

734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 80, 80, 400, 93 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740
741 /**
742 */

```

- FOR EXAMPLE if you wanted to use 1/32 stepping instead of the default 1/16, you would be **doubling** your STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X

```

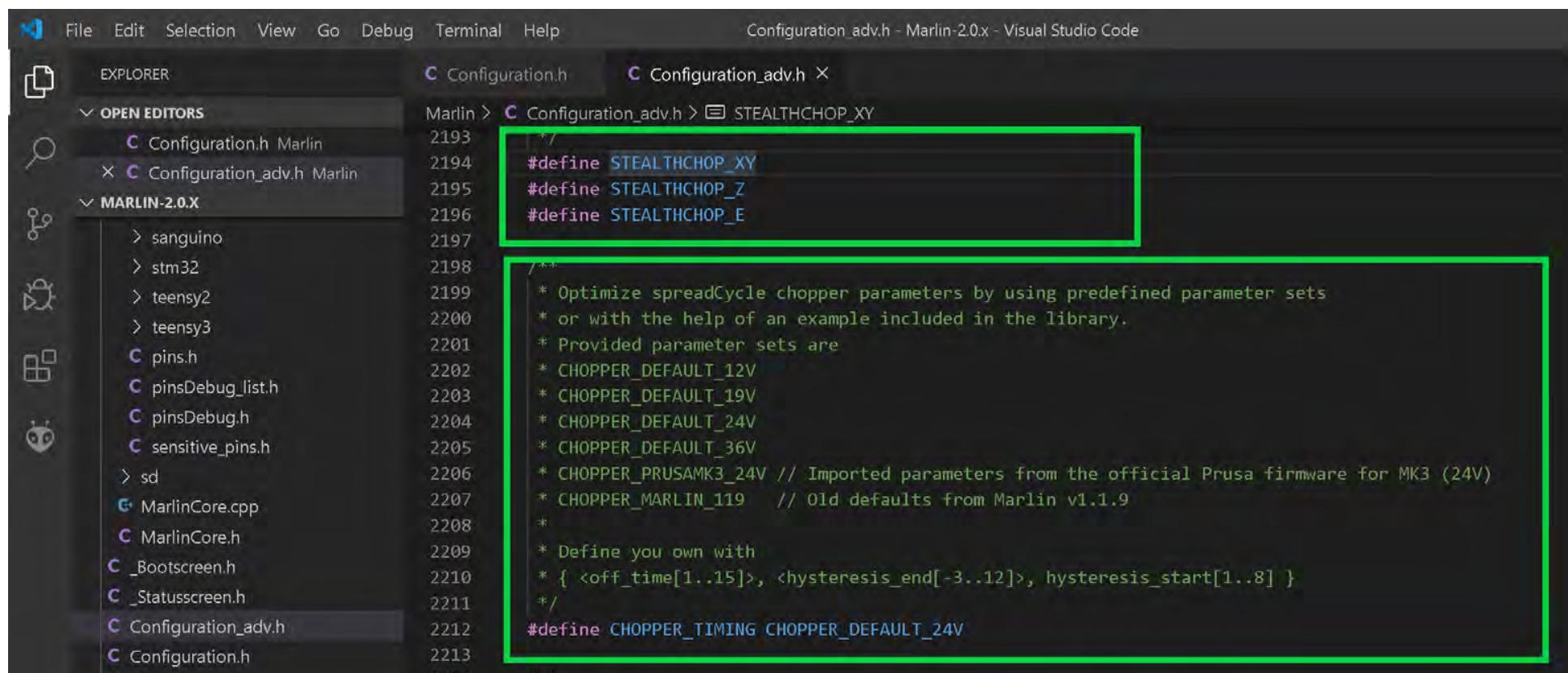
724 */
725
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 *
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // Double because we are going
741 // to 1/32 from 1/16
742
743 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- By default stealthChop is enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.



```

File Edit Selection View Go Debug Terminal Help
Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

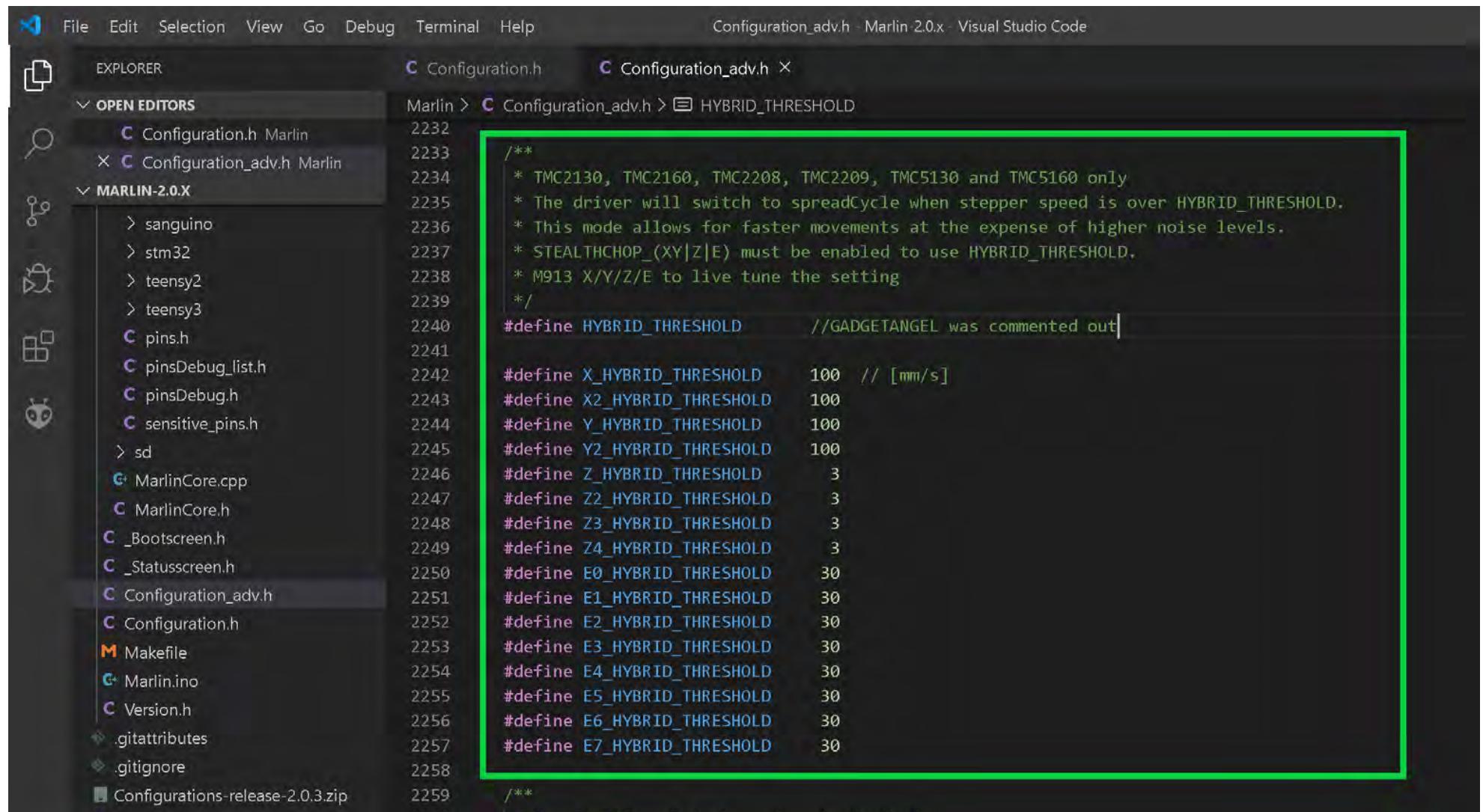
EXPLORER Configuration.h Configuration_adv.h X
Marlin > Configuration_adv.h > STEALTHCHOP_XY
2193 /**
2194 #define STEALTHCHOP_XY
2195 #define STEALTHCHOP_Z
2196 #define STEALTHCHOP_E
2197
2198 /**
2199 * Optimize spreadCycle chopper parameters by using predefined parameter sets
2200 * or with the help of an example included in the library.
2201 * Provided parameter sets are
2202 * CHOPPER_DEFAULT_12V
2203 * CHOPPER_DEFAULT_19V
2204 * CHOPPER_DEFAULT_24V
2205 * CHOPPER_DEFAULT_36V
2206 * CHOPPER_PRUSAMK3_24V // Imported parameters from the official Prusa firmware for MK3 (24V)
2207 * CHOPPER_MARLIN_119 // Old defaults from Marlin v1.1.9
2208 *
2209 * Define your own with
2210 * { <off_time[1..15]>, <hysteresis_end[-3..12]>, hysteresis_start[1..8] }
2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213
2214 /**

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Now you either enable "HYBRID_THRESHOLD" or disable it. By default, it is disabled. "HYBRID_THRESHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Debug, Terminal, Help
- Title Bar:** Configuration_adv.h - Marlin 2.0.x - Visual Studio Code
- Explorer:** Shows the project structure under 'OPEN EDITORS' and 'MARLIN-2.0.X'.
- Editor:** Displays the 'Configuration_adv.h' file content. A green box highlights the 'HYBRID_THRESHOLD' section.

```

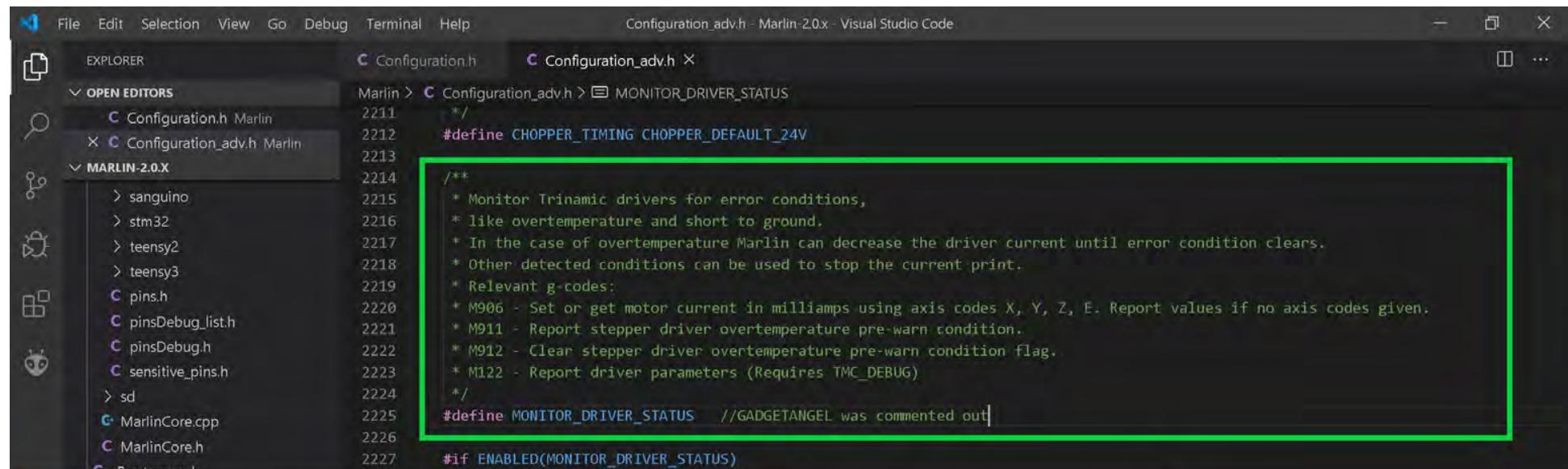
2232 /**
2233 * TMC2130, TMC2160, TMC2208, TMC2209, TMC5130 and TMC5160 only
2234 * The driver will switch to spreadCycle when stepper speed is over HYBRID_THRESHOLD.
2235 * This mode allows for faster movements at the expense of higher noise levels.
2236 * STEALTHCHOP_(XY|Z|E) must be enabled to use HYBRID_THRESHOLD.
2237 * M913 X/Y/Z/E to live tune the setting
2238 */
2239 #define HYBRID_THRESHOLD //GADGETANGEL was commented out
2240
2241 #define X_HYBRID_THRESHOLD 100 // [mm/s]
2242 #define X2_HYBRID_THRESHOLD 100
2243 #define Y_HYBRID_THRESHOLD 100
2244 #define Y2_HYBRID_THRESHOLD 100
2245 #define Z_HYBRID_THRESHOLD 3
2246 #define Z2_HYBRID_THRESHOLD 3
2247 #define Z3_HYBRID_THRESHOLD 3
2248 #define Z4_HYBRID_THRESHOLD 3
2249 #define E0_HYBRID_THRESHOLD 30
2250 #define E1_HYBRID_THRESHOLD 30
2251 #define E2_HYBRID_THRESHOLD 30
2252 #define E3_HYBRID_THRESHOLD 30
2253 #define E4_HYBRID_THRESHOLD 30
2254 #define E5_HYBRID_THRESHOLD 30
2255 #define E6_HYBRID_THRESHOLD 30
2256 #define E7_HYBRID_THRESHOLD 30
2257
2258 /**
2259 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Now I want to enable some statements that allow me access to debugging the TMC drivers. I will uncomment "MONITOR_DRIVER_STATUS" and "TMC_DEBUG". "MONITOR_DRIVER_STATUS" will enable the following G-codes: M906, M911, and M912, "TMC_DEBUG" will enable the M122 G-code command. You can read about these from the comments in the firmware and in [Marlin's documentation located on-line.](#)



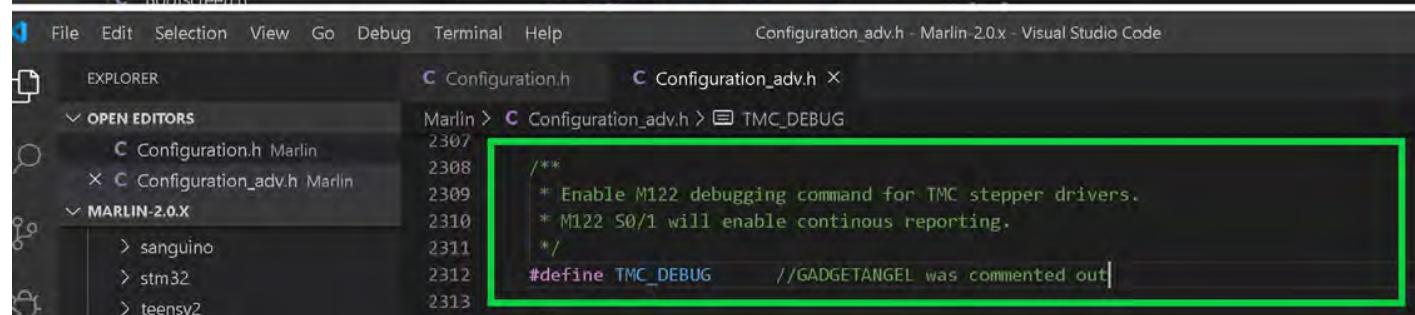
File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS MARLIN-2.0.X

```

Marlin > C Configuration_adv.h > MONITOR_DRIVER_STATUS
2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213
2214 /**
2215 * Monitor Trinamic drivers for error conditions,
2216 * like overtemperature and short to ground.
2217 * In the case of overtemperature Marlin can decrease the driver current until error condition clears.
2218 * Other detected conditions can be used to stop the current print.
2219 * Relevant g-codes:
2220 * M906 - Set or get motor current in milliamps using axis codes X, Y, Z, E. Report values if no axis codes given.
2221 * M911 - Report stepper driver overtemperature pre-warn condition.
2222 * M912 - Clear stepper driver overtemperature pre-warn condition flag.
2223 * M122 - Report driver parameters (Requires TMC_DEBUG)
2224 */
2225 #define MONITOR_DRIVER_STATUS //GADGETANGEL was commented out
2226
2227 #if ENABLED(MONITOR_DRIVER_STATUS)

```



File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS MARLIN-2.0.X

```

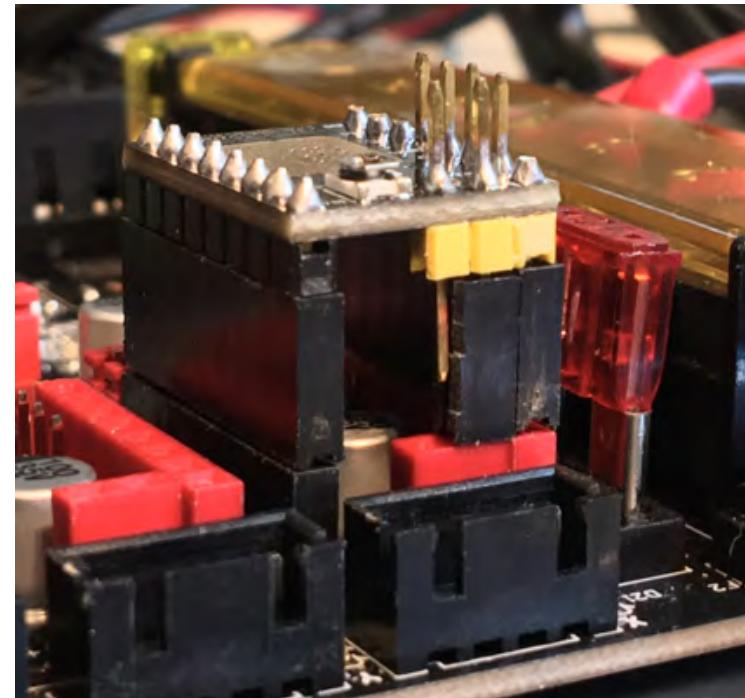
Marlin > C Configuration_adv.h > TMC_DEBUG
2307
2308 /**
2309 * Enable M122 debugging command for TMC stepper drivers.
2310 * M122 S0/1 will enable continuous reporting.
2311 */
2312 #define TMC_DEBUG //GADGETANGEL was commented out
2313

```

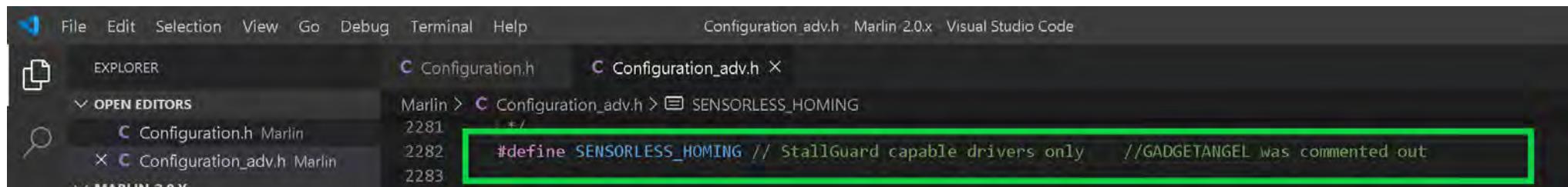
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- This next section covers sensor-less homing which is available for the TMC2209 in UART mode. I want to enable it so I will be covering sensor-less homing for the X and Y axis only. I will not be using sensor-less homing on my Z axis on my Ender 3 printer. For sensor-less homing to work the DIAG pin on the TMC2209 driver has to be plugged into the SKR PRO V1.1 board. Since I am not using sensor-less homing on my Z axis I will need to ensure that my DIAG pin on the Z axis' TMC2209 is NOT connected to the board. I plan to plug my Z axis TMC2209 into my SKR PRO V1.1 board by using long stackable header pin risers, as seen in the picture below.



- Sensor-less homing is commented out by default. So I remove the two leading "//" to un-comment "SENSORLESS_HOMING"



```

File Edit Selection View Go Debug Terminal Help
Configuration_adv.h Marlin 2.0.x Visual Studio Code

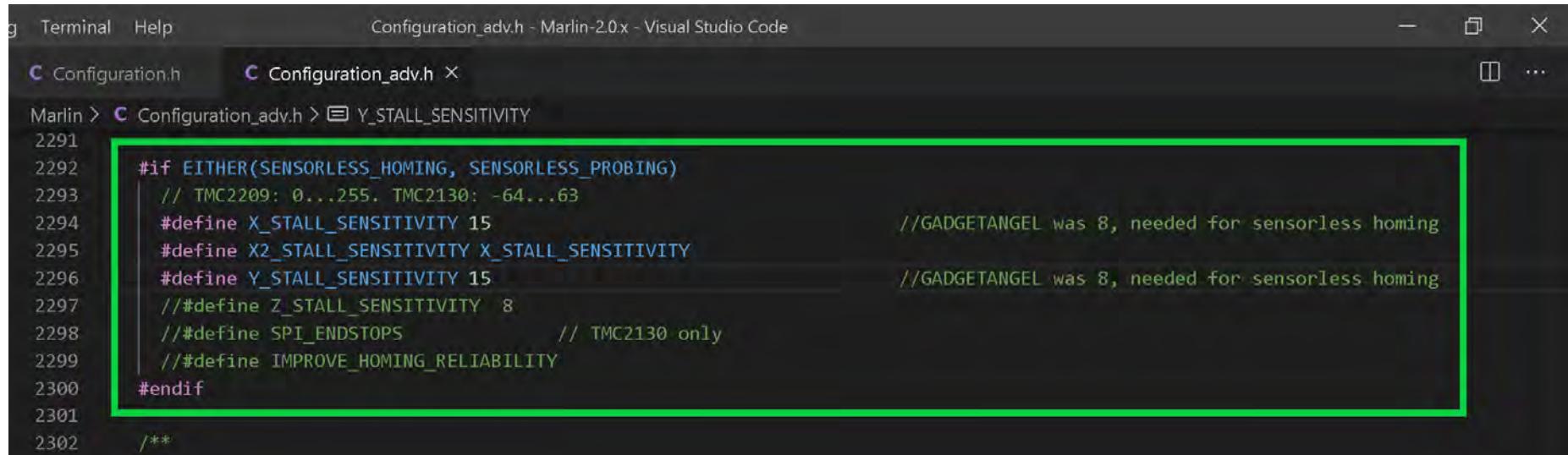
EXPLORER Configuration.h Configuration_adv.h X
OPEN EDITORS Marlin > Configuration_adv.h > SENSORLESS_HOMING
2281 */
2282 #define SENSORLESS_HOMING // StallGuard capable drivers only //GADGETANGEL was commented out
2283

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Next we set the "starting" stall sensitivity for sensor-less homing. I choose to make it 15. If the stall sensitivity is too high your motor will grind and not stop when it hits the end of travel on the axis. If the stall sensitivity is too low then the motor will barely move because it thinks it has hit the end of travel for the axis. Notice I only uncommented the "X_STALL_SENSITIVITY" and the "Y_STALL_SENSITIVITY". If you want sensor-less homing on the Z axis, then you will have to uncomment "Z_STALL_SENSITIVITY".

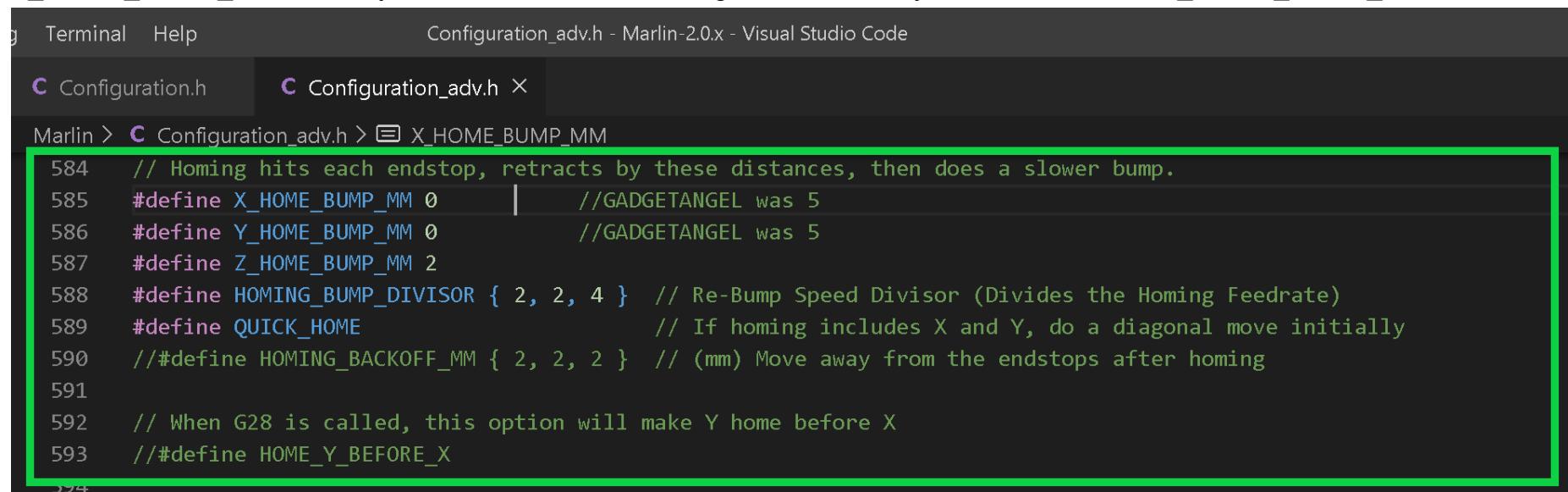


```

g Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > Y_STALL_SENSITIVITY
2291
2292 #if EITHER(SENSORLESS_HOMING, SENSORLESS_PROBING)
2293 // TMC2209: 0...255. TMC2130: -64...63
2294 #define X_STALL_SENSITIVITY 15 //GADGETANGEL was 8, needed for sensorless homing
2295 #define X2_STALL_SENSITIVITY X_STALL_SENSITIVITY
2296 #define Y_STALL_SENSITIVITY 15 //GADGETANGEL was 8, needed for sensorless homing
2297 //#define Z_STALL_SENSITIVITY 8
2298 //">#define SPI_ENDSTOPS // TMC2130 only
2299 //">#define IMPROVE_HOMING_RELIABILITY
2300 #endif
2301
2302 /**

```

- We now have to set our home bump to 0 for each axis with sensor-less homing enabled. So I will set "X_HOME_BUMP_MM" to 0 and "Y_HOME_BUMP_MM" to 0. If you want sensor-less homing on Z axis then you will need to set "Z_HOME_BUMP_MM" to 0.



```

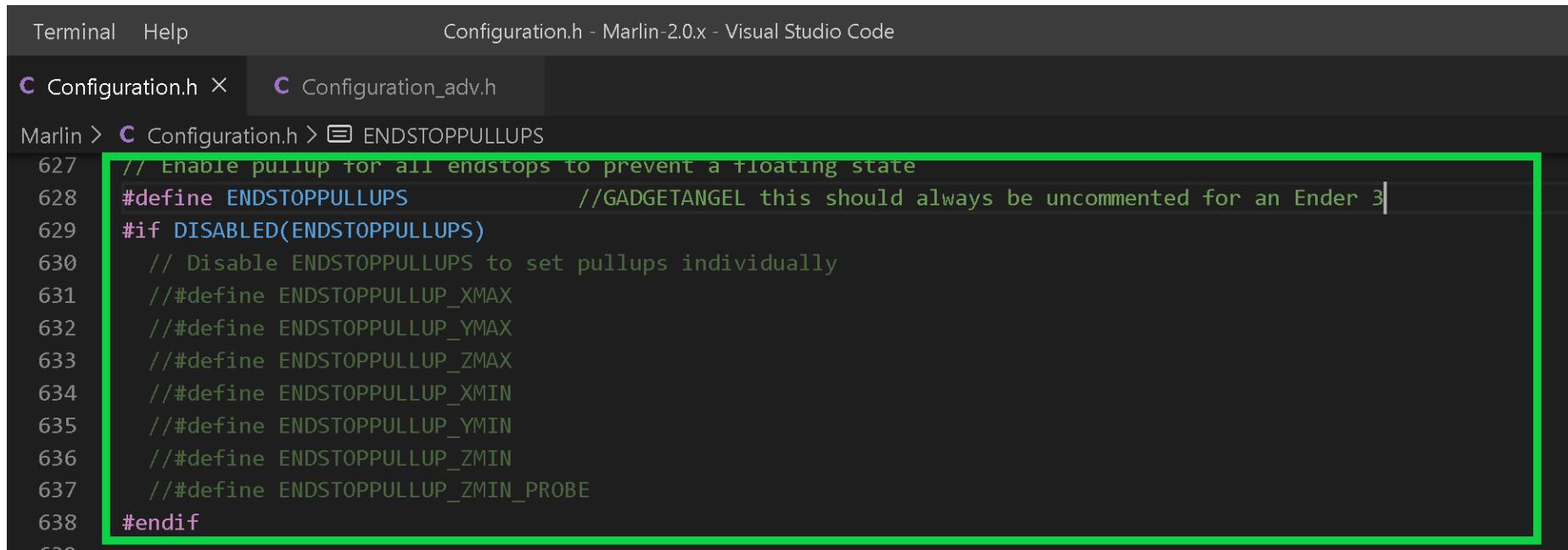
g Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > X_HOME_BUMP_MM
584 // Homing hits each endstop, retracts by these distances, then does a slower bump.
585 #define X_HOME_BUMP_MM 0 //GADGETANGEL was 5
586 #define Y_HOME_BUMP_MM 0 //GADGETANGEL was 5
587 #define Z_HOME_BUMP_MM 2
588 #define HOMING_BUMP_DIVISOR { 2, 2, 4 } // Re-Bump Speed Divisor (Divides the Homing Feedrate)
589 #define QUICK_HOME // If homing includes X and Y, do a diagonal move initially
590 //">#define HOMING_BACKOFF_MM { 2, 2, 2 } // (mm) Move away from the endstops after homing
591
592 // When G28 is called, this option will make Y home before X
593 //">#define HOME_Y_BEFORE_X
594

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Let's check the firmware to ensure that "ENDSTOPPULLUPS" is enabled. It is by default. I also want to check to see how our MIN_ENDSTOP_INVERTINGs are set the right way. For an Ender 3 using TMC2209 drivers the "X_MIN_ENDSTOP_INVERTING" should be false, the "Y_MIN_ENDSTOP_INVERTING" should be false, and the "Z_MIN_ENDSTOP_INVERTING" should be false.



Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

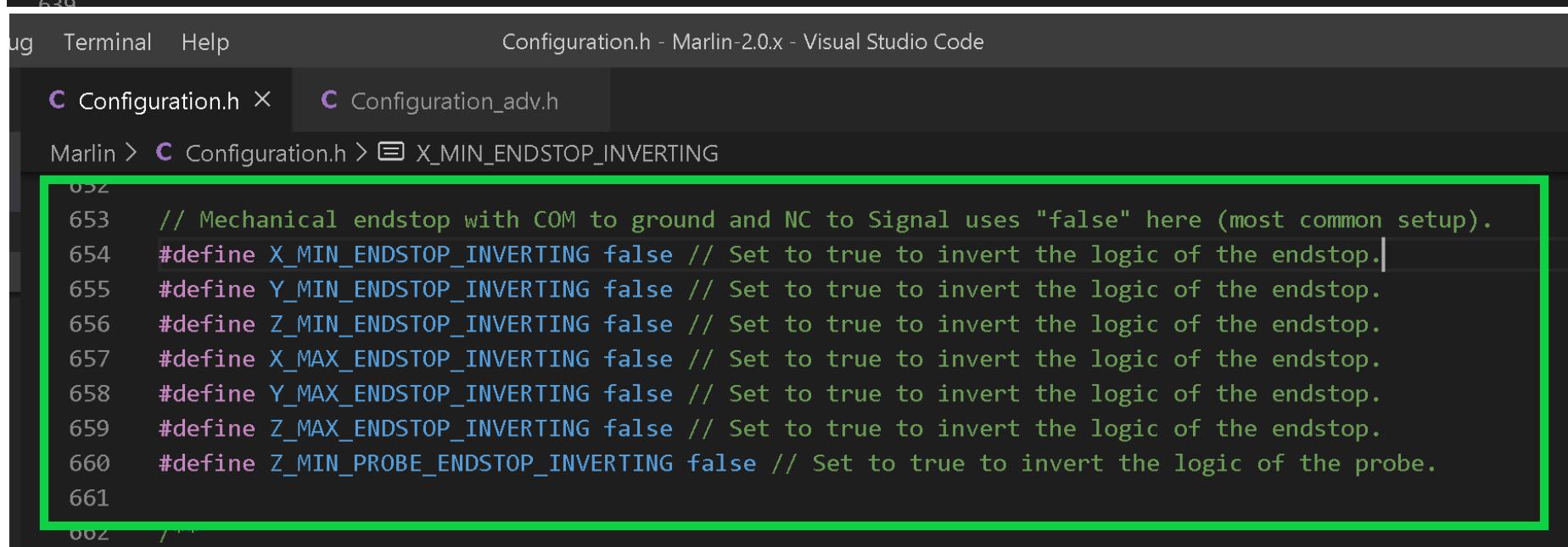
C Configuration.h X C Configuration_adv.h

Marlin > C Configuration.h > ENDSTOPPULLUPS

```

627 // Enable pullup for all endstops to prevent a floating state
628 #define ENDSTOPPULLUPS //GADGETANGEL this should always be uncommented for an Ender 3
629 #if DISABLED(ENDSTOPPULLUPS)
630     // Disable ENDSTOPPULLUPS to set pullups individually
631     //#define ENDSTOPPULLUP_XMAX
632     //#define ENDSTOPPULLUP_YMAX
633     //#define ENDSTOPPULLUP_ZMAX
634     //#define ENDSTOPPULLUP_XMIN
635     //#define ENDSTOPPULLUP_YMIN
636     //#define ENDSTOPPULLUP_ZMIN
637     //#define ENDSTOPPULLUP_ZMIN_PROBE
638 #endif
639

```



Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

C Configuration.h X C Configuration_adv.h

Marlin > C Configuration.h > X_MIN_ENDSTOP_INVERTING

```

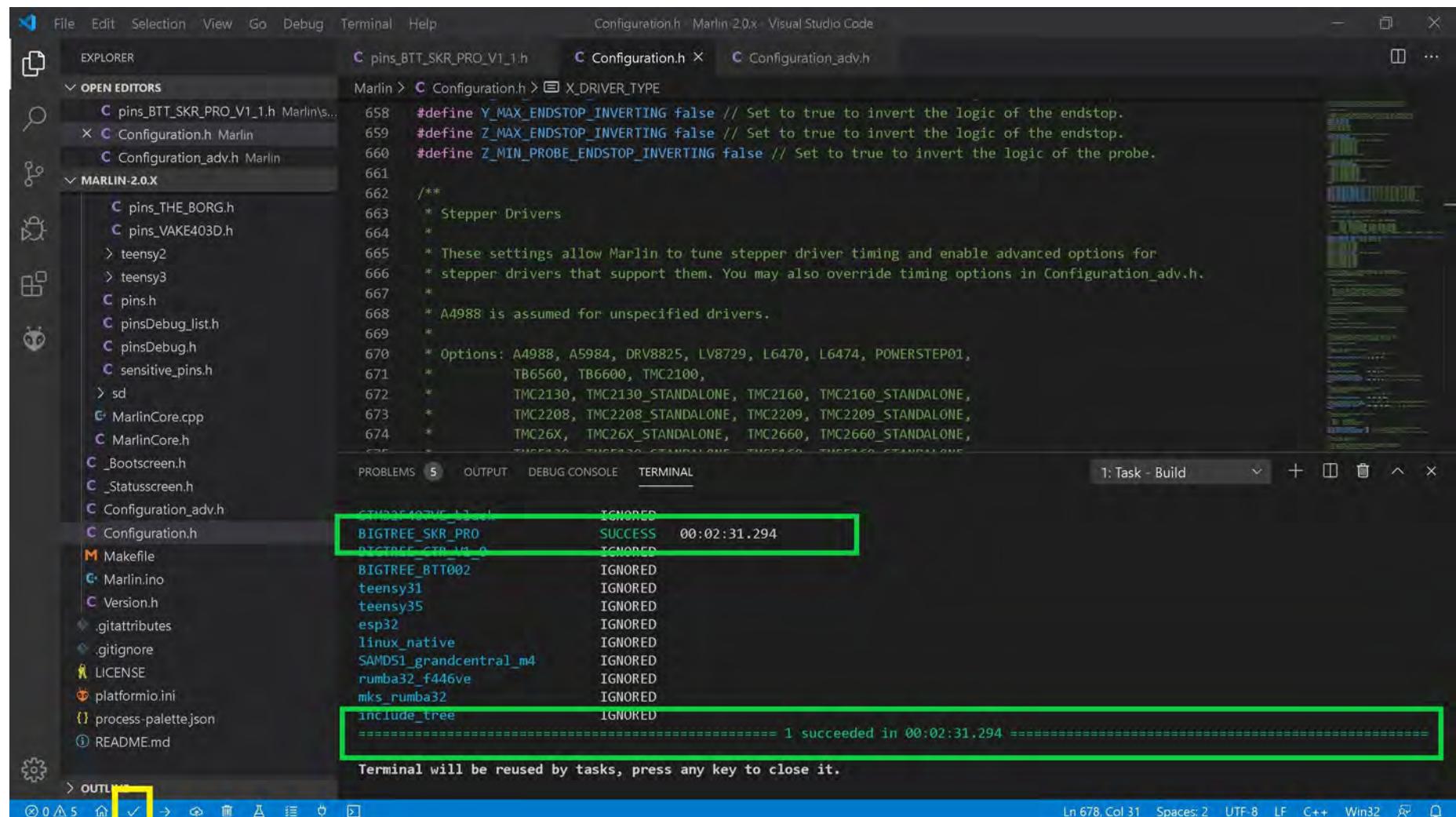
652
653 // Mechanical endstop with COM to ground and NC to Signal uses "false" here (most common setup).
654 #define X_MIN_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
655 #define Y_MIN_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
656 #define Z_MIN_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
657 #define X_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
661
662 /**

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- The end of Marlin setup for BIQU TMC2209 drivers in UART mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows the project structure under "OPEN EDITORS" and "MARLIN-2.0.X".
- Code Editor:** Displays the Configuration.h file with code related to endstop inversion and stepper driver timing.
- Terminal:** Shows the build log output. A yellow box highlights the "COMPILED FIRMWARE" section, which includes the following entries:

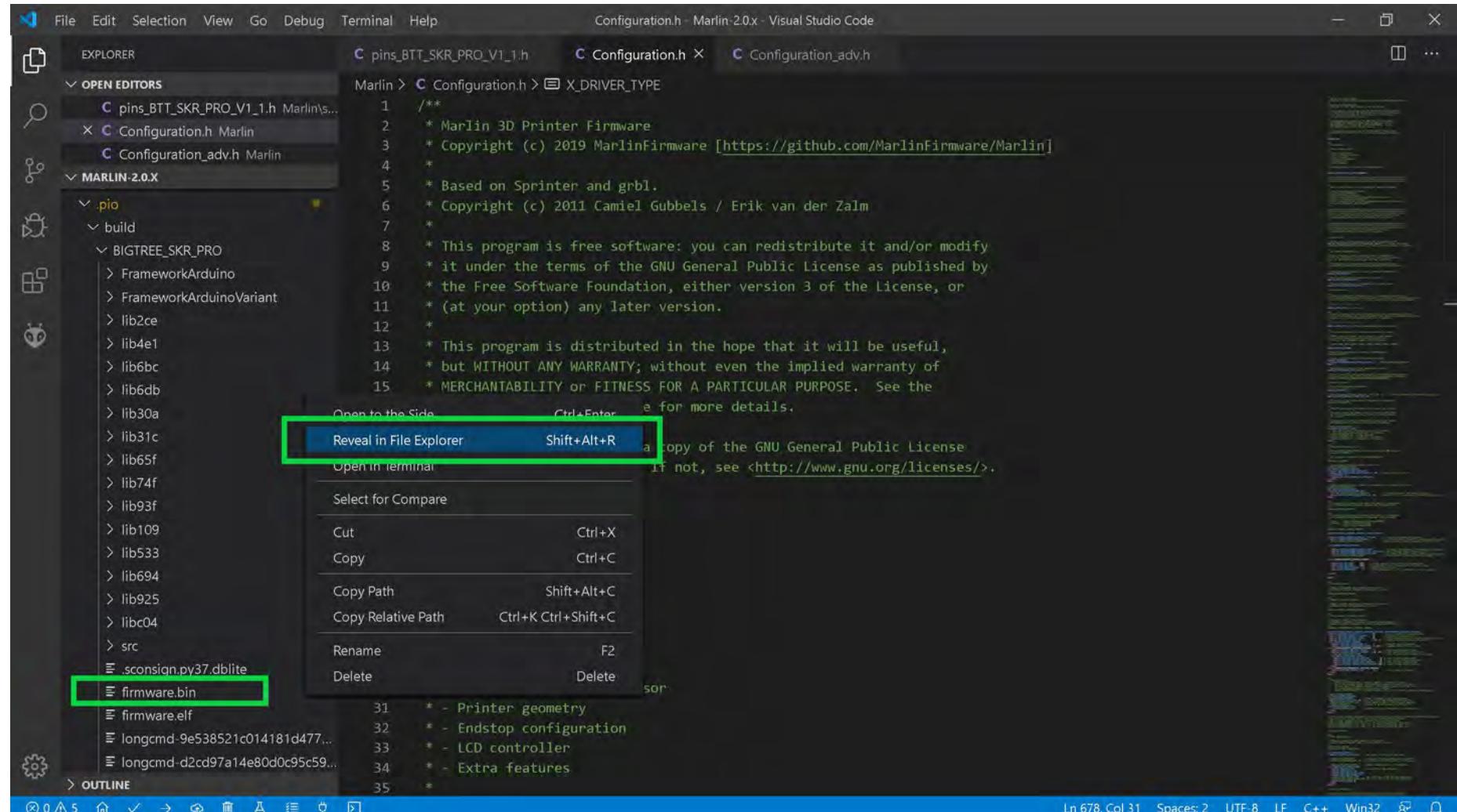
| | | |
|------------------------|---------|--------------|
| BIGTREE_SKR_PRO | SUCCESS | 00:02:31.294 |
| BIGTREE_BTT002 | IGNORED | |
| teensy31 | IGNORED | |
| teensy35 | IGNORED | |
| esp32 | IGNORED | |
| linux_native | IGNORED | |
| SAMD51_grandcentral_m4 | IGNORED | |
| rumba32_f446ve | IGNORED | |
| mks_rumba32 | IGNORED | |
| include_tree | IGNORED | |

 Below this, a green box highlights the message: "===== 1 succeeded in 00:02:31.294 =====".
- Bottom Status Bar:** Shows the terminal status as "Terminal will be reused by tasks, press any key to close it." and the current file status as "0 A 5" with a yellow checkmark icon.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

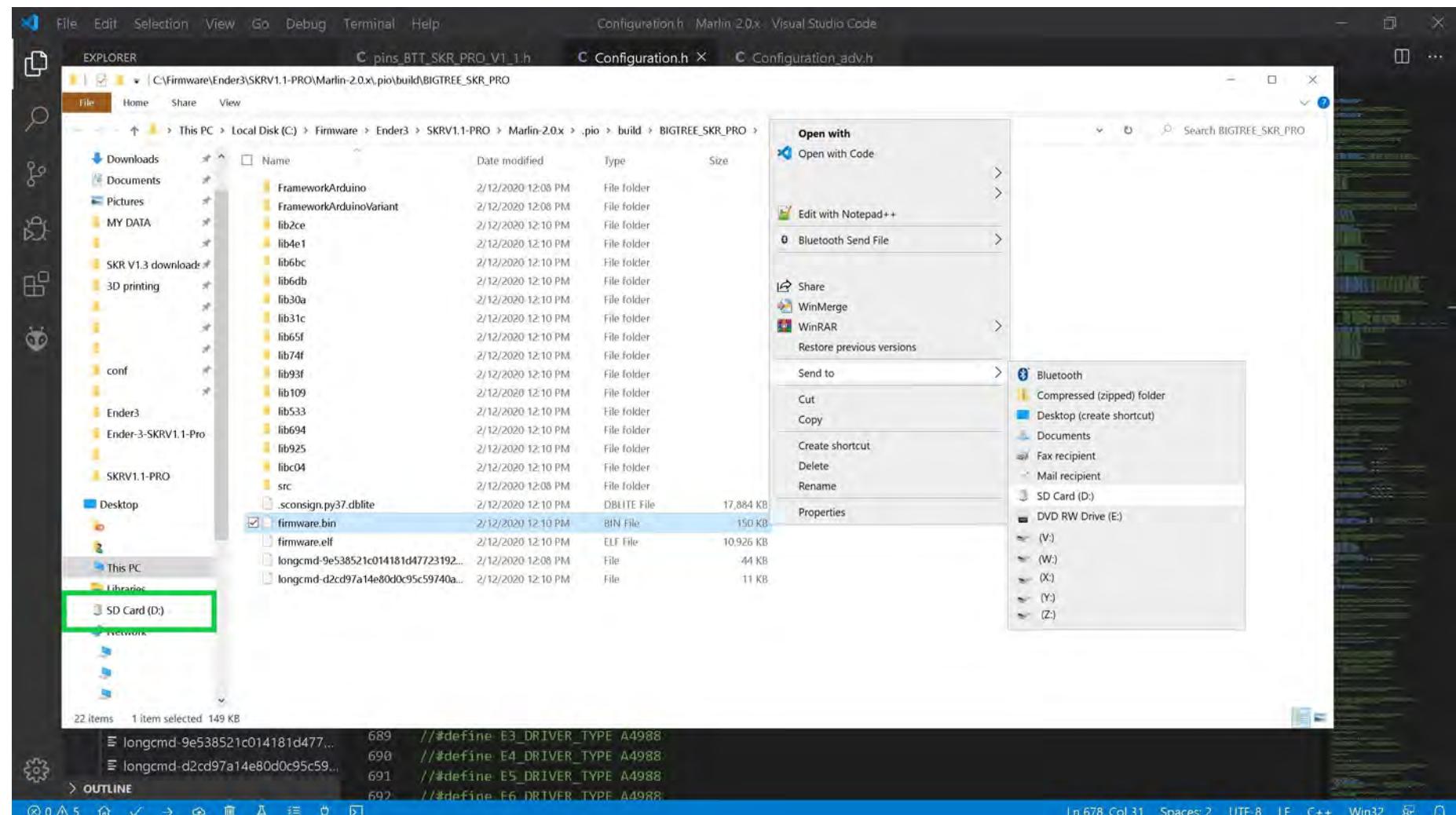
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



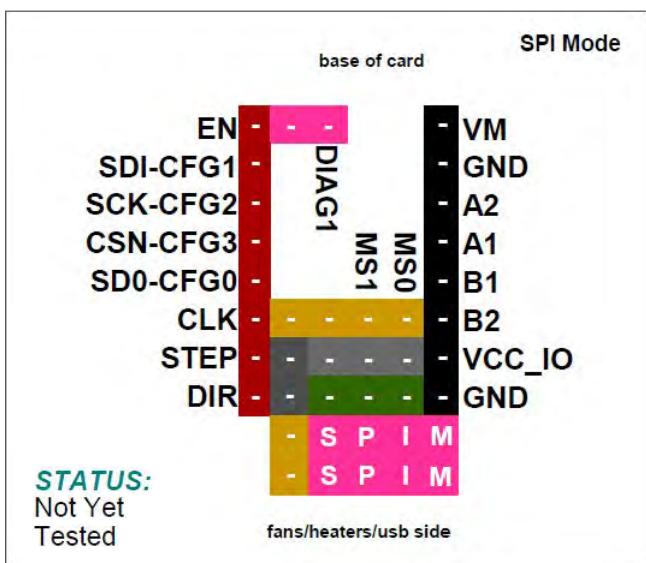
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



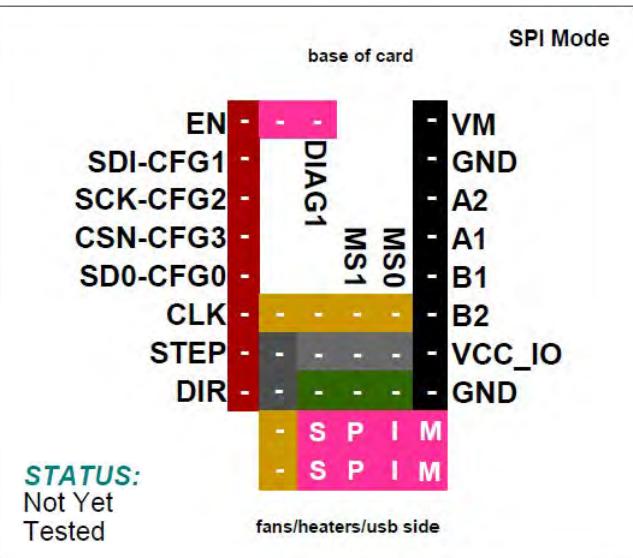
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

**BIQU TMC5160 V1.2**SPI Mode

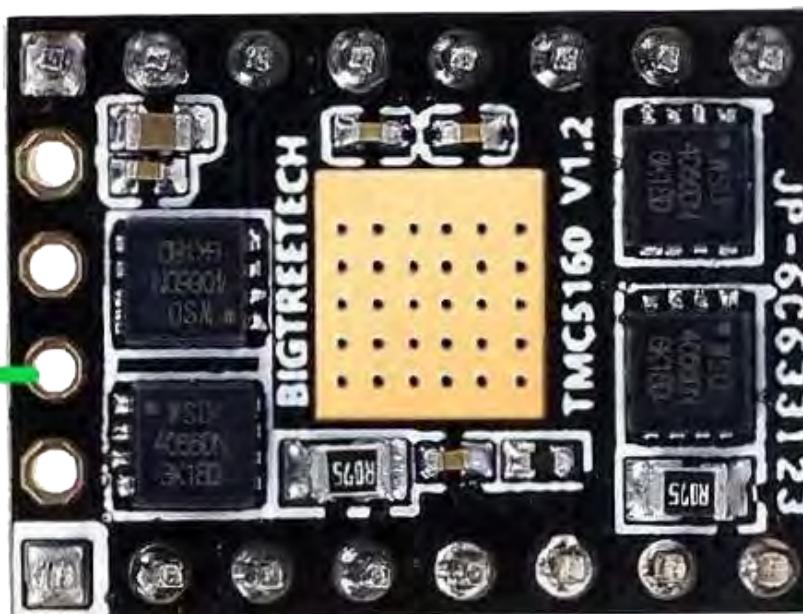
Note: You can use 50% to 90% of the calculated I_{RMS} ($I_{MAX}/1.414$) when tuning ("X_CURRENT", "Y_CURRENT", etc. the stepper motor driver in the firmware.

See the next page for further information.

| | | |
|---|--|---|
| Driver Chip | <h1>Steps are set inside of your Firmware</h1> | |
| BBIQU® TMC5160 SPI Mode Maximum 256 Subdivision 40V DC 4.3A (peak) | | |
| Driving Current Calculation Formula R_S (Typical Sense Resistor) = 0.075 Ω | $I_{MAX} = 4.333$ See Appendix B #8. Use 50% to 90% as shown below: $I_{MAX} = I_{MAX} * 0.90 = 3.900$ | Current Limit is set by the current sense resistors (R_s). Use 50% - 90% of I_{MAX}. |

BIQU TMC5160 V1.2SPI Mode

Note: The TMC5160 V1.2 by default comes in SPI mode. The BIQU TMC5160 does NOT come with a POT or "V_{ref} Test point" location because the IRMS is set inside of the Firmware.



NOTE: BIQU TMC5160 has the ability to do sensor-less homing. By default the DIAG1 pin is **NOT** soldered onto the driver board. Therefore, for any axis you want sensor-less homing enabled, YOU WILL HAVE to solder on the DIAG1 pin.

SPI Mode

Note: The location of the current sense resistors are shown in **GREEN**. Use the current sense resistors' value in the Marlin Firmware ("X_RSENSE", "Y_RSENSE", "Z_RSENSE" and/or "E0_RSENSE") so that the appropriate current limit can be sent to the driver board. If you do not want to use V_{ref} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT", and/or "E0_CURRENT".

$R_s = R050$ is 0.05 Ohms

$R_s = R062$ is 0.062 Ohms

$R_s = R068$ is 0.068 Ohms

$R_s = R075$ is 0.075 Ohms

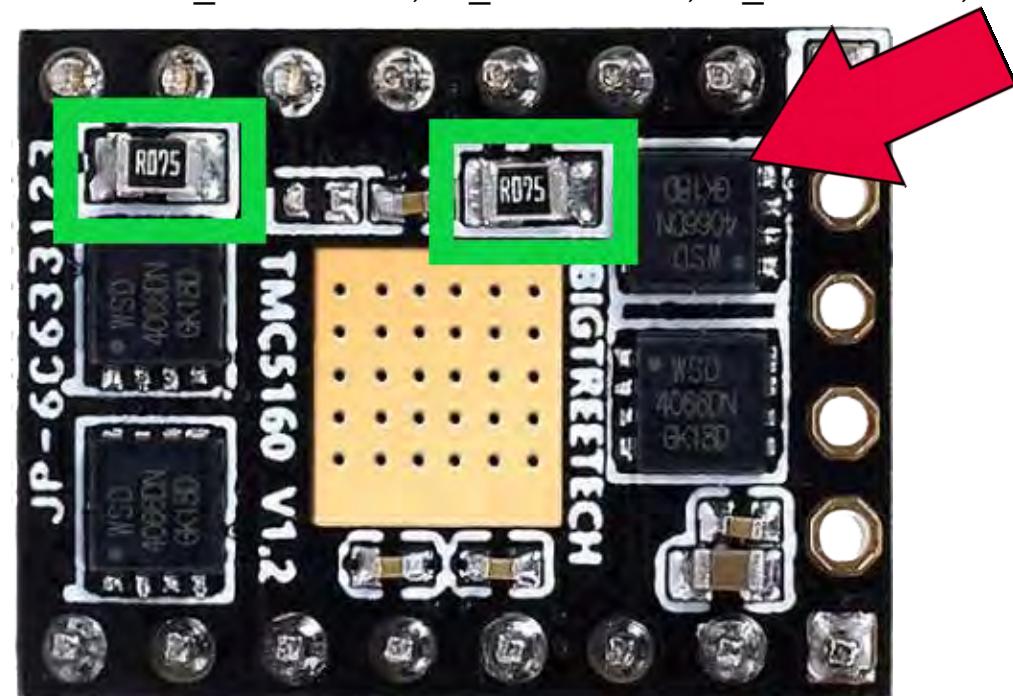
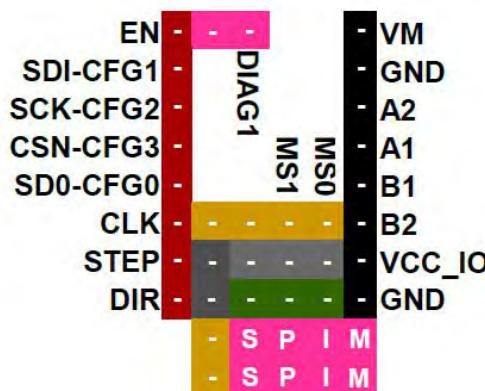
$R_s = R100$ is 0.1 Ohms

$R_s = R110$ is 0.11 Ohms

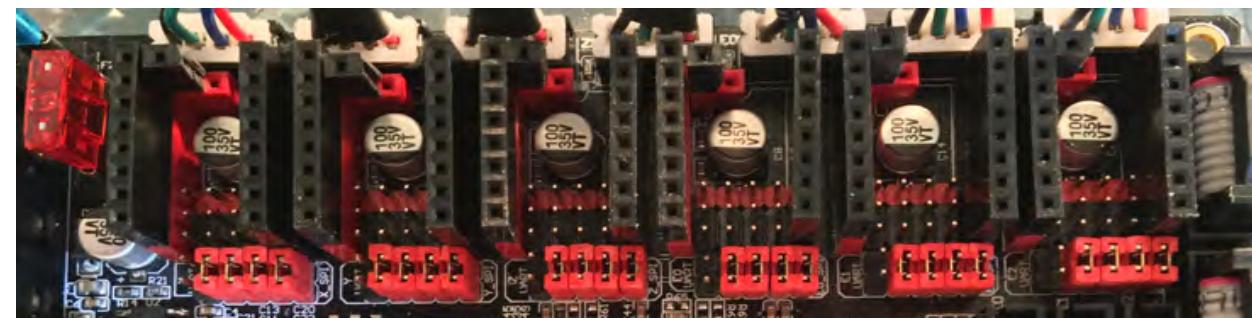
$R_s = R150$ is 0.15 Ohms

$R_s = R200$ is 0.2 Ohms

$R_s = R220$ is 0.22 Ohms

**SPI**

Note: Set JUMPERS "S","P","I","M" on the board!!



The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

NOTE: [Go to Appendix C](#), and then come back here for the changes to Marlin for BIQU TMC5160 V1.2 stepper motor drivers in SPI mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC5160 drivers in SPI mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC5160 drivers in SPI mode. When two "/" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").

```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code
EXPLORER PIO Home Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration.h > E0_DRIVER_TYPE
MarlinCore.cpp
MarlinCore.h
_Bootscreen.h
_Statusscreen.h
Configuration_adv.h
Configuration.h
Makefile
Marlin.ino
Version.h
.gitattributes
.gitignore
LICENSE
platformio.ini
process-palette.json
README.md
> OUTLINE
Ln 686, Col 1
676 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'T
677 "
678 #define X_DRIVER_TYPE TMC5160 //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE TMC5160 //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE TMC5160 //GADGETANGEL was commented out and had the value A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC5160 //GADGETANGEL was commented out and had the value A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- Next you want to set your V_{ref} in the Marlin firmware for each axis that has the TMC5160 driver, as seen in the **GREEN** box below. I changed the "X_CURRENT" to be the calculated V_{ref} for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated V_{ref} for my Y-Axis, which is 760mV on the Ender 3.
 - Ensure "X_RSENSE" is set to 0.075. Ensure "Y_RSENSE" is set to 0.075.
 - If you **do not want to use V_{ref}** as the value for "X_CURRENT" and/or "Y_CURRENT", you should **use I_{RMS} instead**. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS} = I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "X_CURRENT" and/or "Y_CURRENT".

The screenshot shows the Visual Studio Code interface with the following details:

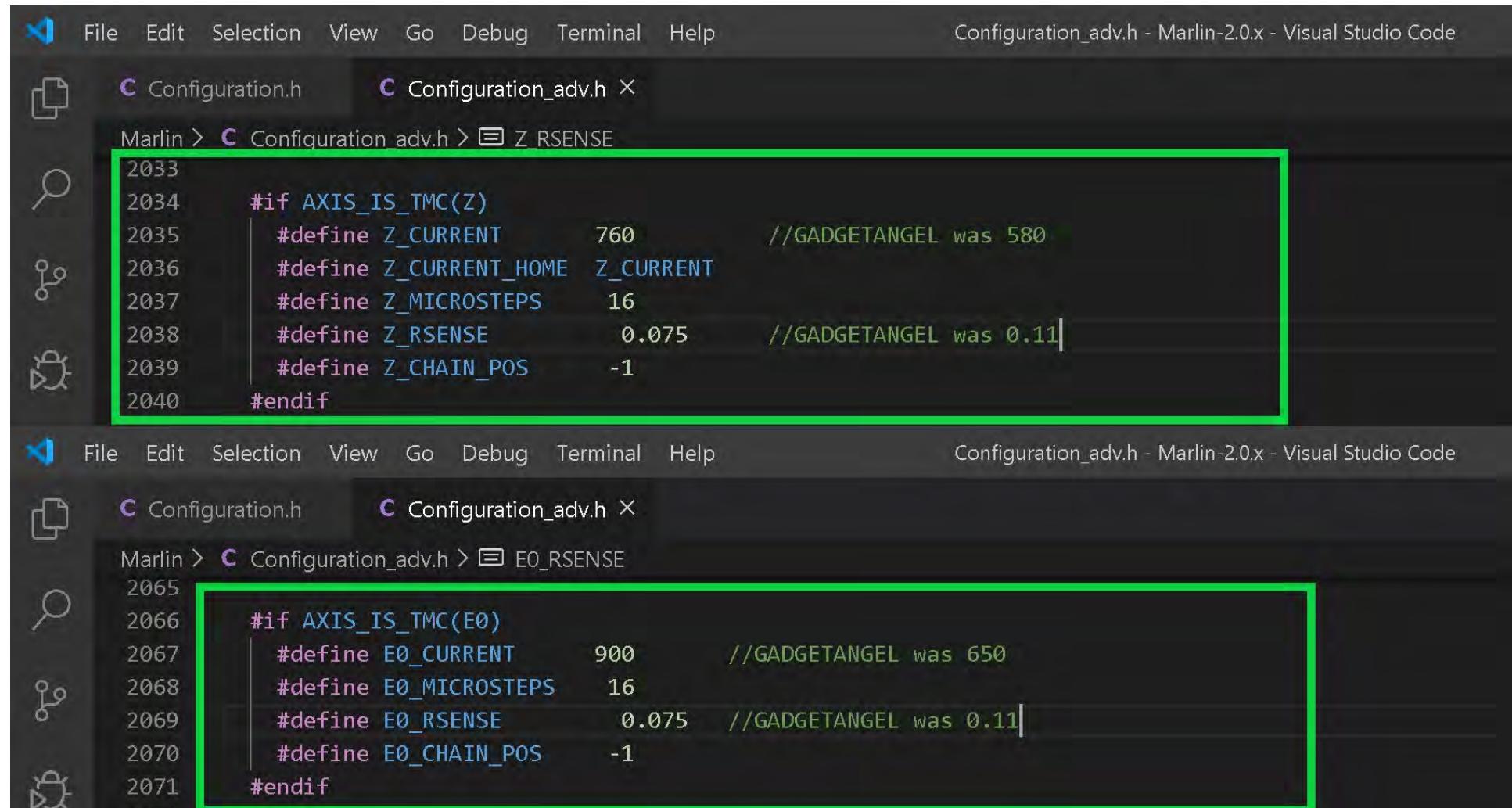
- File Bar:** File, Edit, Selection, View, Go, Debug, Terminal, Help.
- Title Bar:** Configuration_adv.h - Marlin-2.0.x - Visual Studio Code.
- Left Sidebar:** Includes icons for File, Find, Replace, Undo, Redo, and others.
- Current File:** Configuration_adv.h (highlighted with a green box).
- Content Area:** The code for Configuration_adv.h, specifically the X_RSENSE section, is highlighted with a green box. The code defines various constants for the X axis based on the TMC driver configuration.
- Bottom Status Bar:** Line 2006, Col 62, Spaces: 2, UTF-8, LF, C++, Win32.

```
1996  */
1997  #if HAS_TRINAMIC
1998
1999  #define HOLD_MULTIPLIER    0.5 // Scales down the holding current from run current
2000  #define INTERPOLATE        true // Interpolate X/Y/Z_MICROSTEPS to 256
2001
2002  #if AXIS_IS_TMC(X)
2003      #define X_CURRENT        760      // (mA) RMS current. Multiply by 1.414 for peak current. //GADGETANGEL was 580
2004      #define X_CURRENT_HOME   X_CURRENT // (mA) RMS current for sensorless homing
2005      #define X_MICROSTEPS     16       // 0..256
2006      #define X_RSENSE          0.075    //GADGETANGEL was 0.11
2007      #define X_CHAIN_POS       -1       // <=0 : Not chained. 1 : MCU MOSI connected. 2 : Next in chain, ...
2008  #endif
2009
2010 #if AXIS_IS_TMC(X2)
2011     #define X2_CURRENT        800
2012     #define X2_CURRENT_HOME   X2_CURRENT
2013     #define X2_MICROSTEPS     16
2014     #define X2_RSENSE          0.11
2015     #define X2_CHAIN_POS       -1
2016 #endif
2017
2018 #if AXIS_IS_TMC(Y)
2019     #define Y_CURRENT        760      //GADGETANGEL was 580
2020     #define Y_CURRENT_HOME   Y_CURRENT
2021     #define Y_MICROSTEPS     16
2022     #define Y_RSENSE          0.075    //GADGETANGEL was 0.11
2023     #define Y_CHAIN_POS       -1
2024 #endif
2025
2026 #if AXIS_IS_TMC(Y2)
2027     #define Y2_CURRENT        800
2028     #define Y2_CURRENT_HOME   Y2_CURRENT
2029     #define Y2_MICROSTEPS     16
2030     #define Y2_RSENSE          0.11
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- Now, I am setting the V_{ref} for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated V_{ref} for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated V_{ref} for my Extruder, which is 900mV on the Ender 3.
- Ensure "Z_RSENSE" is set to 0.075. Ensure "E0_RSENSE" is set to 0.075.
- If you do not want to use V_{ref} as the value for "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS} = I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "Z_CURRENT" and/or "E0_CURRENT".



```

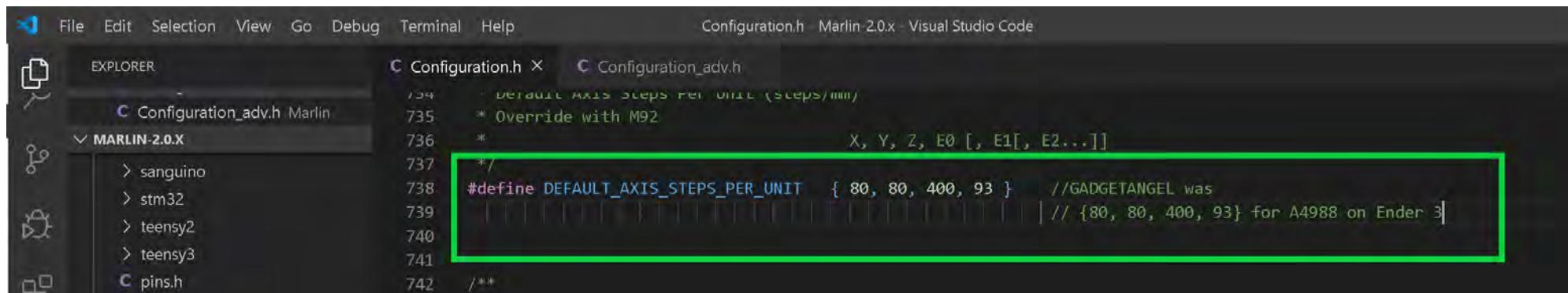
File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > Z RSENSE
2033
2034     #if AXIS_IS_TMC(Z)
2035         #define Z_CURRENT      760          //GADGETANGEL was 580
2036         #define Z_CURRENT_HOME Z_CURRENT
2037         #define Z_MICROSTEPS   16
2038         #define Z_RSENSE        0.075        //GADGETANGEL was 0.11
2039         #define Z_CHAIN_POS    -1
2040     #endif
File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > E0_RSENSE
2065
2066     #if AXIS_IS_TMC(E0)
2067         #define E0_CURRENT      900          //GADGETANGEL was 650
2068         #define E0_MICROSTEPS   16
2069         #define E0_RSENSE        0.075        //GADGETANGEL was 0.11
2070         #define E0_CHAIN_POS    -1
2071     #endif

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



File Edit Selection View Go Debug Terminal Help Configuration.h Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

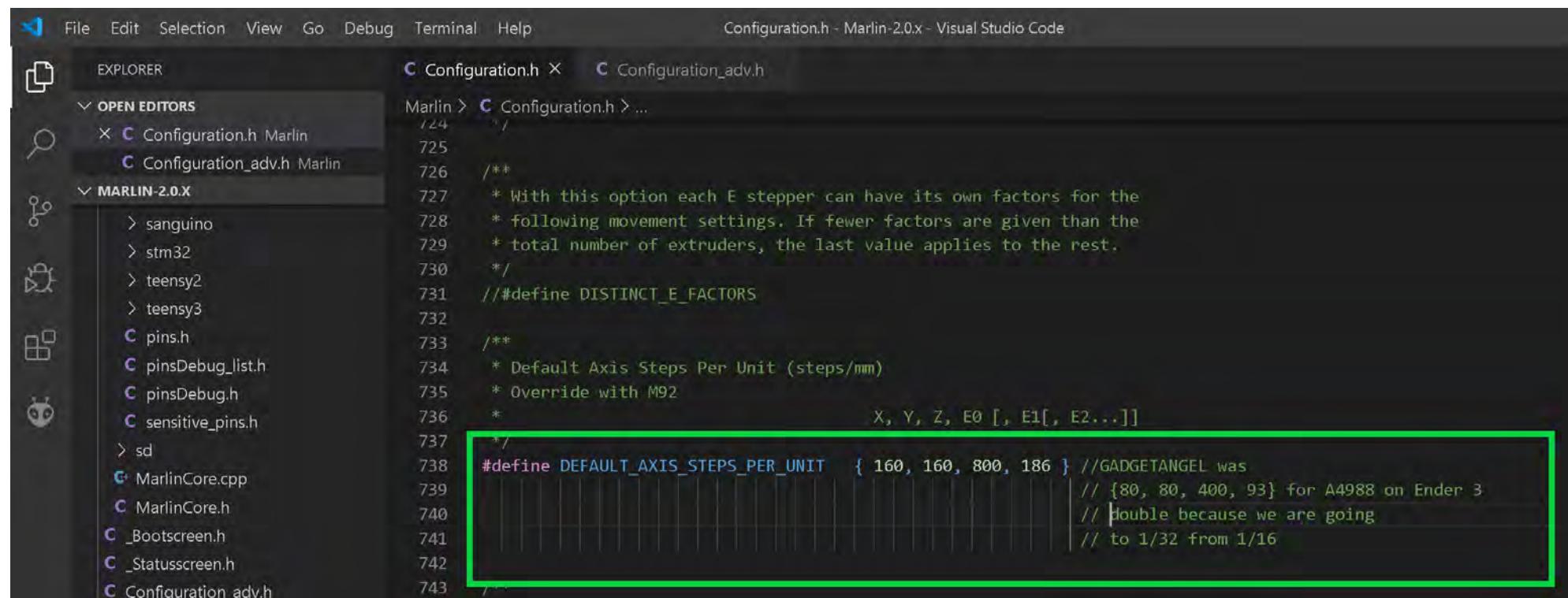
MARLIN-2.0.X

```

734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 80, 80, 400, 93 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740
741 /**
742 */

```

- FOR EXAMPLE if you wanted to use 1/32 stepping instead of the default 1/16, you would be **doubling** your STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X

```

724 */
725
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 *
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // Double because we are going
741 // to 1/32 from 1/16
742
743 /**

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- We need to uncomment out the "TMC_USE_SW_SPI" because the SKR PRO V1.1 pins file depends on this variable to define its SPI pins

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

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OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X sanguino

```
Marlin > Configuration_adv.h > TMC_USE_SW_SPI
2144 * The default SW SPI pins are defined the respective pins files,
2145 * but you can override or define them here.
2146 */
2147 #define TMC_USE_SW_SPI //GADGETANGEL was commented out
2148 //#define TMC_SW_MOST -1
```

- By default stealthChop is enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I **want stealthChop enabled** so I want to make sure the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h ×

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X sanguino stm32 teensy2 teensy3 pins.h pinsDebug_list.h pinsDebug.h sensitive_pins.h sd MarlinCore.cpp MarlinCore.h _Bootscreen.h _Statusscreen.h Configuration_adv.h Configuration.h

```
Marlin > Configuration_adv.h > STEALTHCHOP_XY
2193 */
2194 #define STEALTHCHOP_XY
2195 #define STEALTHCHOP_Z
2196 #define STEALTHCHOP_E
2197
2198 /**
2199 * Optimize spreadCycle chopper parameters by using predefined parameter sets
2200 * or with the help of an example included in the library.
2201 * Provided parameter sets are
2202 * CHOPPER_DEFAULT_12V
2203 * CHOPPER_DEFAULT_19V
2204 * CHOPPER_DEFAULT_24V
2205 * CHOPPER_DEFAULT_36V
2206 * CHOPPER_PRUSAMK3_24V // Imported parameters from the official Prusa firmware for MK3 (24V)
2207 * CHOPPER_MARLIN_119 // Old defaults from Marlin v1.1.9
2208 *
2209 * Define your own with
2210 * { <off_time[1..15]>, <hysteresis_end[-3..12]>, hysteresis_start[1..8] }
2211 */
2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
2213 */
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- Now you either enable "HYBRID_THRESHOLD" or disable it. By default, it is disabled. "HYBRID_THRESHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin 2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h X
OPEN EDITORS Marlin > Configuration_adv.h > HYBRID_THRESHOLD
Configuration.h Marlin 2232
Configuration_adv.h Marlin 2233
MARLIN-2.0.X 2234
sanguino 2235
stm32 2236
teensy2 2237
teensy3 2238
pins.h 2239
pinsDebug_list.h 2240
pinsDebug.h 2241
sensitive_pins.h 2242
sd 2243
MarlinCore.cpp 2244
MarlinCore.h 2245
Bootscreen.h 2246
_Statusscreen.h 2247
Configuration_adv.h 2248
Configuration.h 2249
Makefile 2250
Marlin.ino 2251
Version.h 2252
.gitattributes 2253
.gitignore 2254
Configurations-release-2.0.3.zip 2255
2256
2257
2258
2259

/*
 * TMC2130, TMC2160, TMC2208, TMC2209, TMC5130 and TMC5160 only
 * The driver will switch to spreadCycle when stepper speed is over HYBRID_THRESHOLD.
 * This mode allows for faster movements at the expense of higher noise levels.
 * STEALTHCHOP_(XY|Z|E) must be enabled to use HYBRID_THRESHOLD.
 * M913 X/Y/Z/E to live tune the setting
 */
#define HYBRID_THRESHOLD //GADGETANGEL was commented out

#define X_HYBRID_THRESHOLD 100 // [mm/s]
#define X2_HYBRID_THRESHOLD 100
#define Y_HYBRID_THRESHOLD 100
#define Y2_HYBRID_THRESHOLD 100
#define Z_HYBRID_THRESHOLD 3
#define Z2_HYBRID_THRESHOLD 3
#define Z3_HYBRID_THRESHOLD 3
#define Z4_HYBRID_THRESHOLD 3
#define E0_HYBRID_THRESHOLD 30
#define E1_HYBRID_THRESHOLD 30
#define E2_HYBRID_THRESHOLD 30
#define E3_HYBRID_THRESHOLD 30
#define E4_HYBRID_THRESHOLD 30
#define E5_HYBRID_THRESHOLD 30
#define E6_HYBRID_THRESHOLD 30
#define E7_HYBRID_THRESHOLD 30

/*
 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

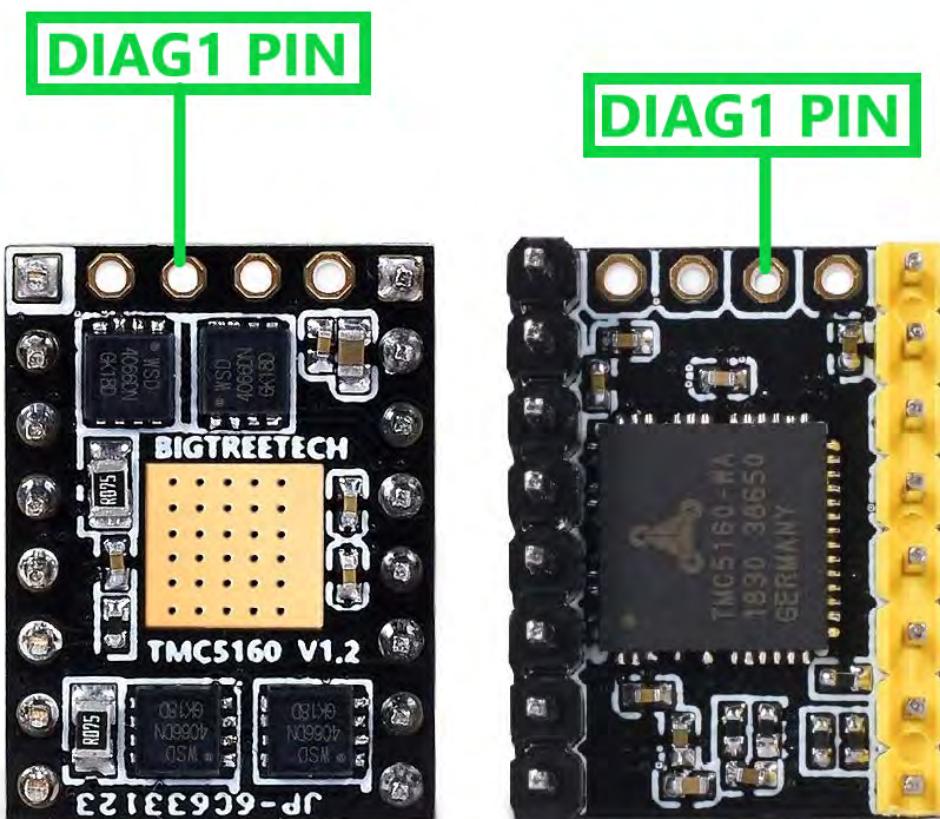
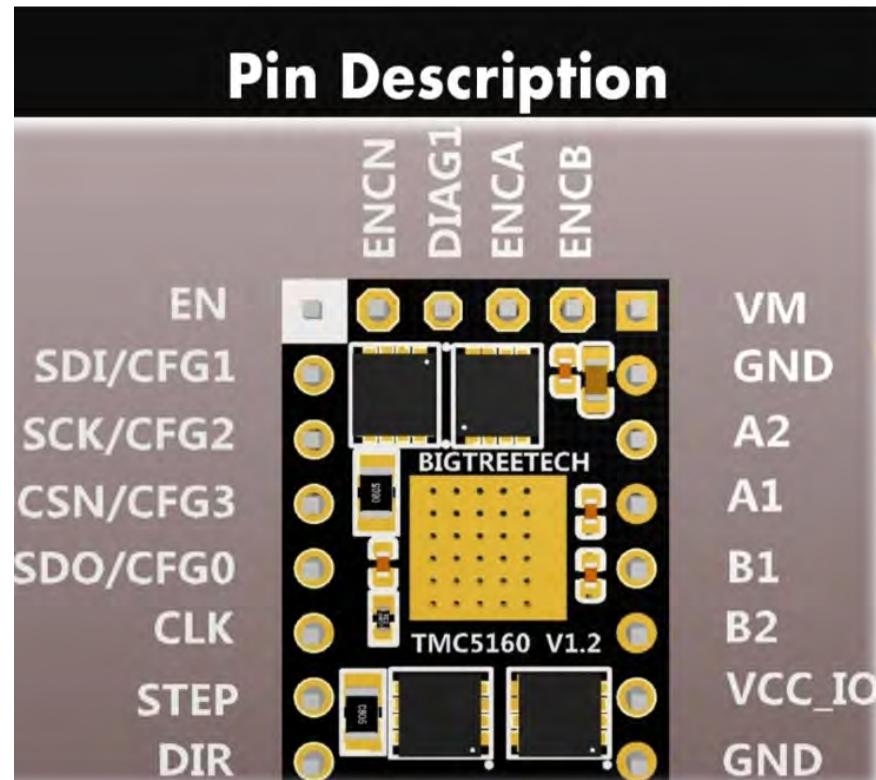
- Now I want to enable some statements that allow me access to debugging the TMC drivers. I will uncomment "MONITOR_DRIVER_STATUS" and "TMC_DEBUG". "MONITOR_DRIVER_STATUS" will enable the following G-codes: M906, M911, and M912, "TMC_DEBUG" will enable the M122 G-code command. You can read about these from the comments in the firmware and in [Marlin's documentation located on-line](#).

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration_adv.h > MONITOR_DRIVER_STATUS
  2211 */
  2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
  2213
  2214 /**
  2215 * Monitor Trinamic drivers for error conditions,
  2216 * like overtemperature and short to ground.
  2217 * In the case of overtemperature Marlin can decrease the driver current until error condition clears.
  2218 * Other detected conditions can be used to stop the current print.
  2219 * Relevant g-codes:
  2220 * M906 - Set or get motor current in millamps using axis codes X, Y, Z, E. Report values if no axis codes given.
  2221 * M911 - Report stepper driver overtemperature pre-warn condition.
  2222 * M912 - Clear stepper driver overtemperature pre-warn condition flag.
  2223 * M122 - Report driver parameters (Requires TMC_DEBUG)
  2224 */
  2225 #define MONITOR_DRIVER_STATUS //GADGETANGEL was commented out
  2226
  2227 #if ENABLED(MONITOR_DRIVER_STATUS)
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```

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

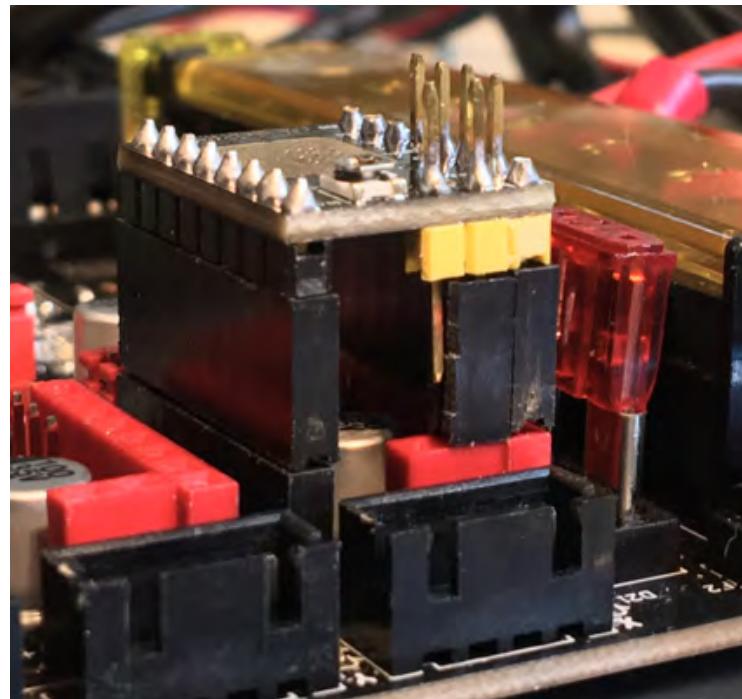
- This next section covers sensor-less homing which is available for the TMC5160 in SPI mode. I want to enable it BUT for the TMC5160 I first have to solder on the DIAG1 pin onto each TMC5160 driver that will be on an axis with sensor-less homing enabled. Therefore, I want sensor-less homing for X and Y axes only. So I need to solder in a DIAG1 pin for two TMC5160 drivers. Here is a picture of the TMC5160 V1.2 pin-out.



- The third pin position starting from the left on the top of the chip is where I need to solder in a header pin. I need it to face down so when I plug in the TMC5160 into the SKR PRO V1.1 board the DIAG1 pin will be seated in the SKR PRO V1.1 board.
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- I will be covering sensor-less homing for the X and Y axis only. I will not be using sensor-less homing on my Z axis on my Ender 3 printer. For sensor-less homing to work the DIAG1 pin on the TMC5160 driver has to be plugged into the SKR PRO V1.1 board. Since I am **not using sensor-less homing on my Z axis I will need to ensure that my DIAG1 pin on the Z axis TMC516 is NOT connected to the board.** I plan to plug my Z axis' TMC5160 by using long stackable header pin risers, as seen in the picture below.



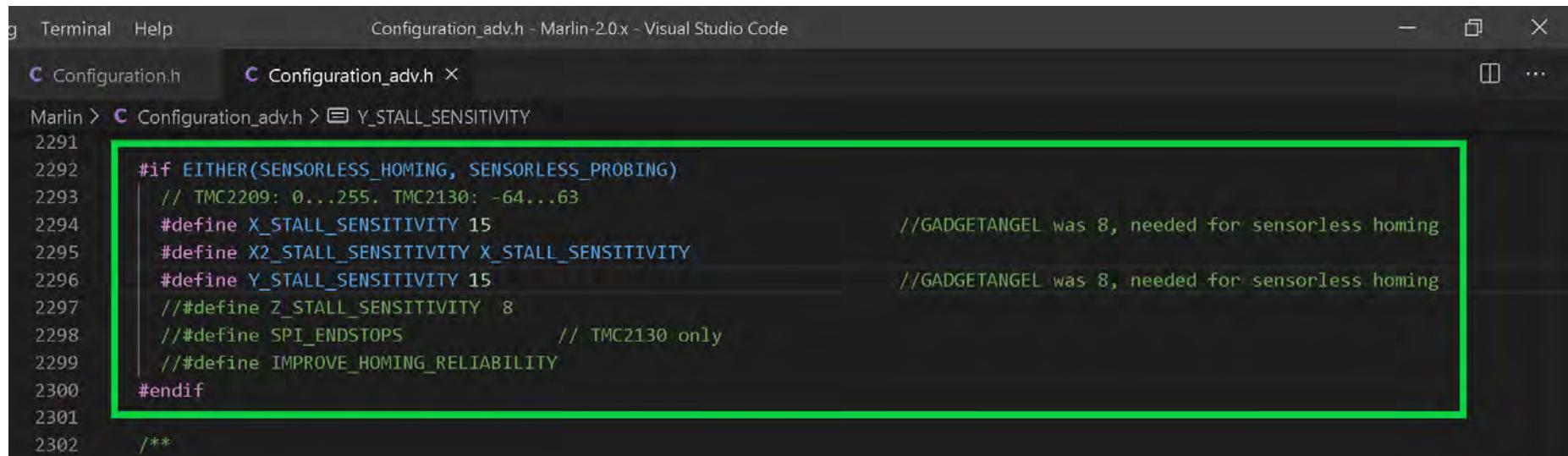
- Sensor-less homing is commented out by default. So I remove the two leading "//" to un-comment "SENSORLESS_HOMING"

```
File Edit Selection View Go Debug Terminal Help Configuration_adv.h Marlin 2.0.x Visual Studio Code  
EXPLORER Configuration.h Configuration_adv.h X  
OPEN EDITORS Marlin > Configuration_adv.h > SENSORLESS_HOMING  
2281 */  
2282 #define SENSORLESS_HOMING // StallGuard capable drivers only //GADGETANGEL was commented out  
2283
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- Next we set the "starting" stall sensitivity for sensor-less homing. I choose to make it 15. If the stall sensitivity is too high your motor will grind and not stop when it hits the end of travel on the axis. If the stall sensitivity is too low then the motor will barely move because it thinks it has hit the end of travel for the axis. Notice I only uncommented the "X_STALL_SENSITIVITY" and the "Y_STALL_SENSITIVITY". If you want sensor-less homing on the Z axis, then you will have to uncomment "Z_STALL_SENSITIVITY".

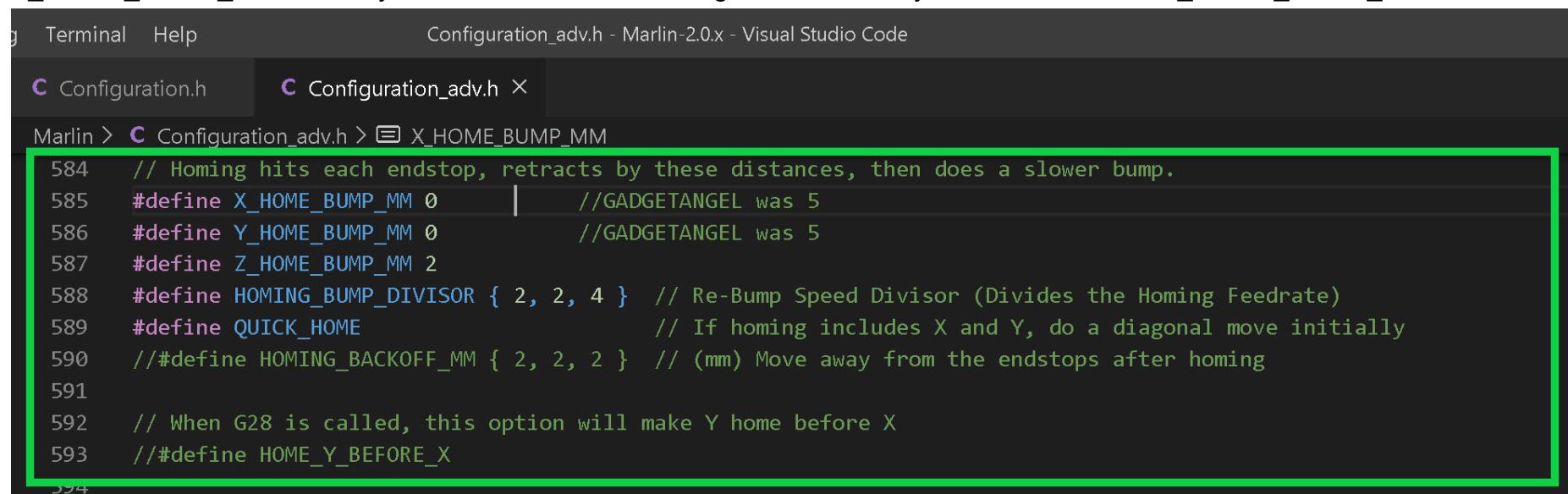


```

g Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > Y_STALL_SENSITIVITY
2291
2292 #if EITHER(SENSORLESS_HOMING, SENSORLESS_PROBING)
2293 // TMC2209: 0...255. TMC2130: -64...63
2294 #define X_STALL_SENSITIVITY 15 //GADGETANGEL was 8, needed for sensorless homing
2295 #define X2_STALL_SENSITIVITY X_STALL_SENSITIVITY
2296 #define Y_STALL_SENSITIVITY 15 //GADGETANGEL was 8, needed for sensorless homing
2297 //#define Z_STALL_SENSITIVITY 8
2298 //">#define SPI_ENDSTOPS // TMC2130 only
2299 //">#define IMPROVE_HOMING_RELIABILITY
2300 #endif
2301
2302 /**

```

- We now have to set our home bump to 0 for each axis with sensor-less homing enabled. So I will set "X_HOME_BUMP_MM" to 0 and "Y_HOME_BUMP_MM" to 0. If you want sensor-less homing on Z axis then you will need to set "Z_HOME_BUMP_MM" to 0.



```

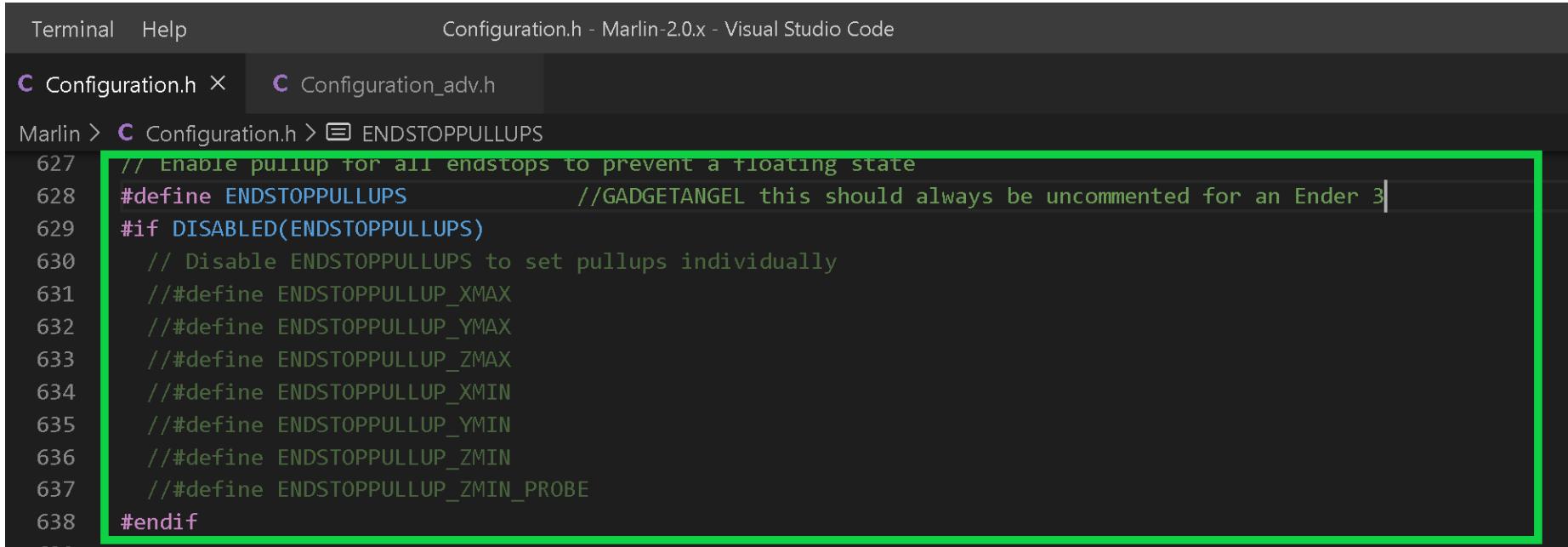
g Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > X_HOME_BUMP_MM
584 // Homing hits each endstop, retracts by these distances, then does a slower bump.
585 #define X_HOME_BUMP_MM 0 //GADGETANGEL was 5
586 #define Y_HOME_BUMP_MM 0 //GADGETANGEL was 5
587 #define Z_HOME_BUMP_MM 2
588 #define HOMING_BUMP_DIVISOR { 2, 2, 4 } // Re-Bump Speed Divisor (Divides the Homing Feedrate)
589 #define QUICK_HOME // If homing includes X and Y, do a diagonal move initially
590 //">#define HOMING_BACKOFF_MM { 2, 2, 2 } // (mm) Move away from the endstops after homing
591
592 // When G28 is called, this option will make Y home before X
593 //">#define HOME_Y_BEFORE_X
594

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- Let's check the firmware to ensure that "ENDSTOPPULLUPS" is enabled. It is by default.



Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

Configuration.h X Configuration_adv.h

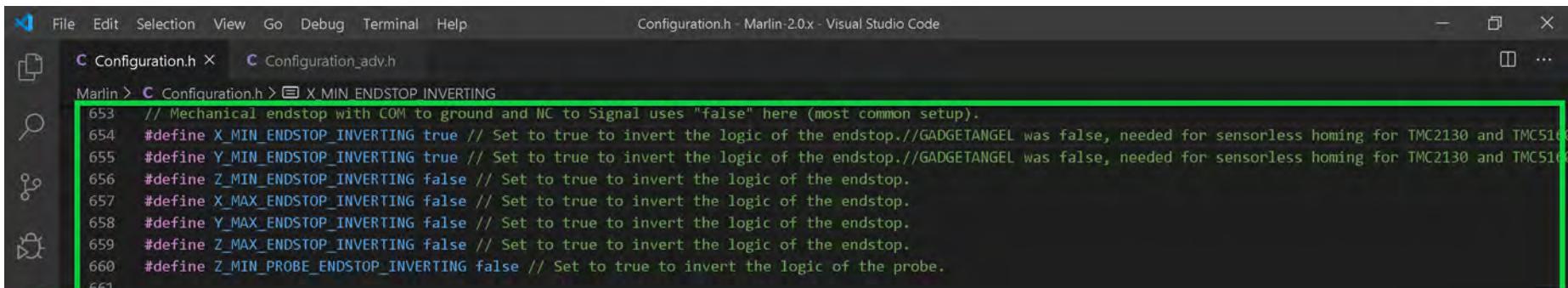
Marlin > Configuration.h > ENDSTOPPULLUPS

```

627 // Enable pullup for all endstops to prevent a floating state
628 #define ENDSTOPPULLUPS //GADGETANGEL this should always be uncommented for an Ender 3
629 #if DISABLED(ENDSTOPPULLUPS)
630     // Disable ENDSTOPPULLUPS to set pullups individually
631     //#define ENDSTOPPULLUP_XMAX
632     //#define ENDSTOPPULLUP_YMAX
633     //#define ENDSTOPPULLUP_ZMAX
634     //#define ENDSTOPPULLUP_XMIN
635     //#define ENDSTOPPULLUP_YMIN
636     //#define ENDSTOPPULLUP_ZMIN
637     //#define ENDSTOPPULLUP_ZMIN_PROBE
638 #endif
639

```

- Next to allow sensor-less homing to work (while using the BIQU TMC5160) we need to change our end stop logic. Therefore I set "X_MIN_ENDSTOP_INVERTING" to true and "Y_MIN_ENSTOP_INVERTING" to true. If you want sensor-less homing on the Z axis, you will need to set "Z_MIN_ENDSTOP_INVERTING" to true. But since I do not want sensor-less homing on the Z axis I will leave "Z_MIN_ENDSTOP_INVERTING" set to false.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

Configuration.h X Configuration_adv.h

Marlin > Configuration.h > X MIN ENDSTOP INVERTING

```

653 // Mechanical endstop with COM to ground and NC to Signal uses "false" here (most common setup).
654 #define X_MIN_ENDSTOP_INVERTING true // Set to true to invert the logic of the endstop.//GADGETANGEL was false, needed for sensorless homing for TMC2130 and TMC5160
655 #define Y_MIN_ENDSTOP_INVERTING true // Set to true to invert the logic of the endstop.//GADGETANGEL was false, needed for sensorless homing for TMC2130 and TMC5160
656 #define Z_MIN_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
657 #define X_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
661

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- The end of Marlin setup for BIQU TMC5160 drivers in SPI mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

File Edit Selection View Go Debug Terminal Help Configuration.h Marlin 2.0.x - Visual Studio Code

EXPLORER OPEN EDITORS Marlin > Configuration.h > X_DRIVER_TYPE

C pins_BTT_SKR_PRO_V1_1.h C Configuration.h C Configuration_adv.h

Marlin > Configuration.h > X_DRIVER_TYPE

pins_BTT_SKR_PRO_V1_1.h Marlin's... Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X

C pins_THE_BORG.h C pins_VAKE403D.h

> teensy2 > teensy3

C pins.h C pinsDebug_list.h C pinsDebug.h C sensitive_pins.h

> sd

C MarlinCore.cpp C MarlinCore.h

C _Bootscreen.h C _Statusscreen.h

C Configuration_adv.h C Configuration.h

M Makefile

C Marlin.ino

C Version.h

.gitattributes .gitignore LICENSE platformio.ini process-palette.json README.md

PROBLEMS 5 OUTPUT DEBUG CONSOLE TERMINAL

1: Task - Build

BIGTREETECH_BTT002 SUCCESS 00:02:31.294

BIGTREETECH_BTT002 IGNORED

teensy31 IGNORED

teensy35 IGNORED

esp32 IGNORED

linux_native IGNORED

SAMD51_grandcentral_m4 IGNORED

rumba32_f446ve IGNORED

mks_rumba32 IGNORED

include_tree IGNORED

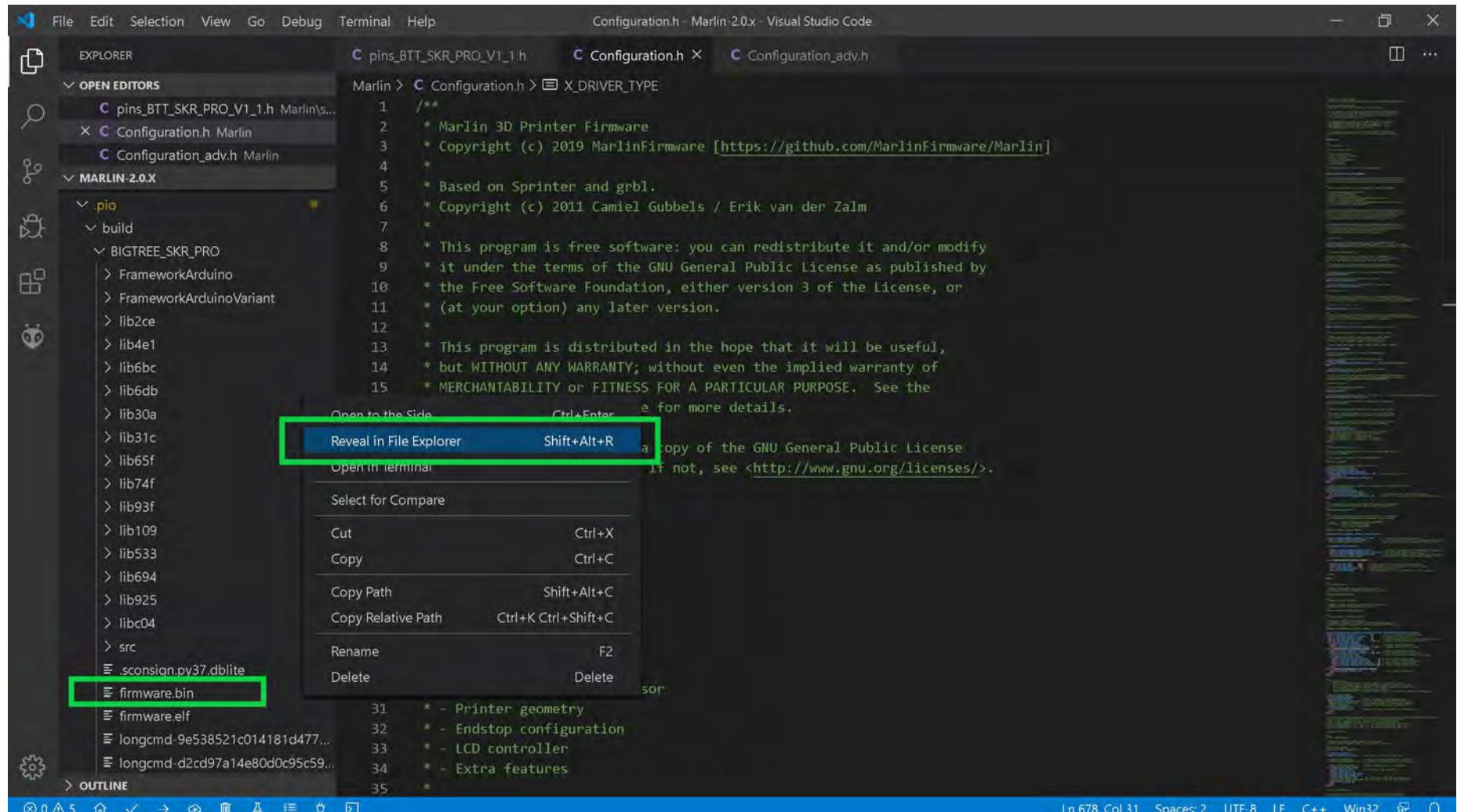
===== 1 succeeded in 00:02:31.294 =====

Terminal will be reused by tasks, press any key to close it.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

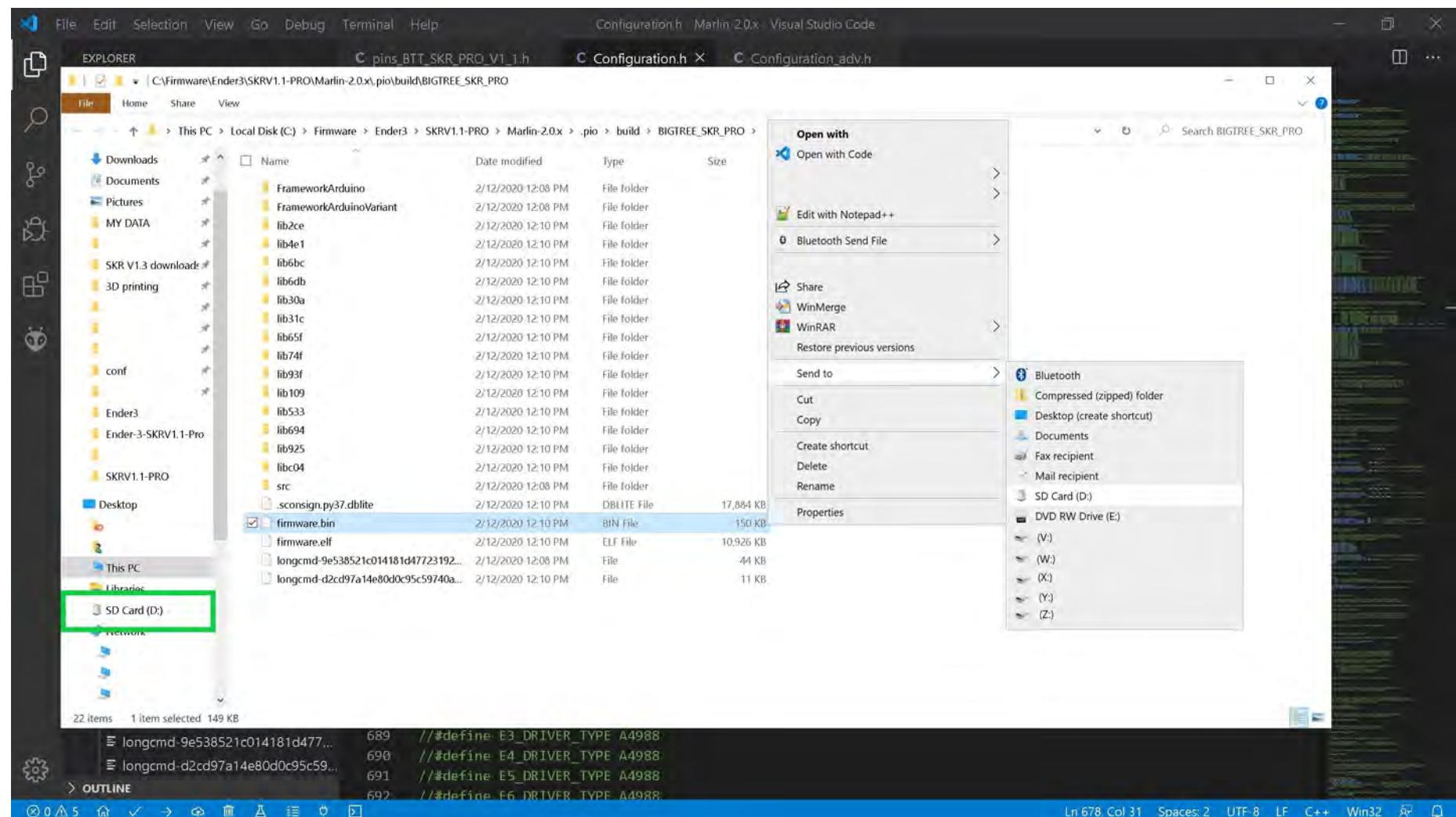
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and **right clicking** on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer window.



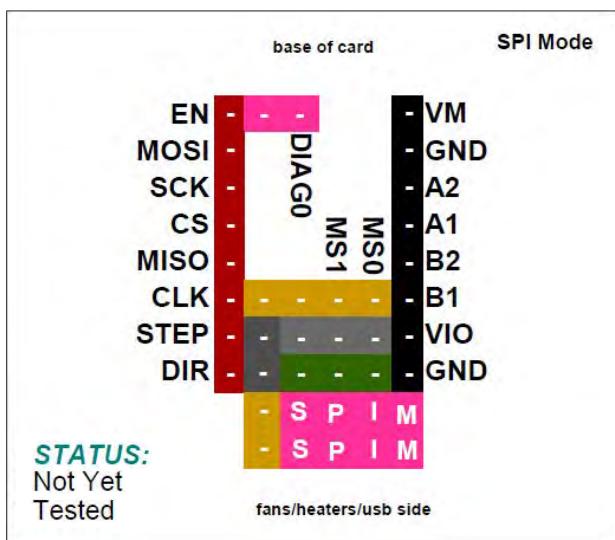
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



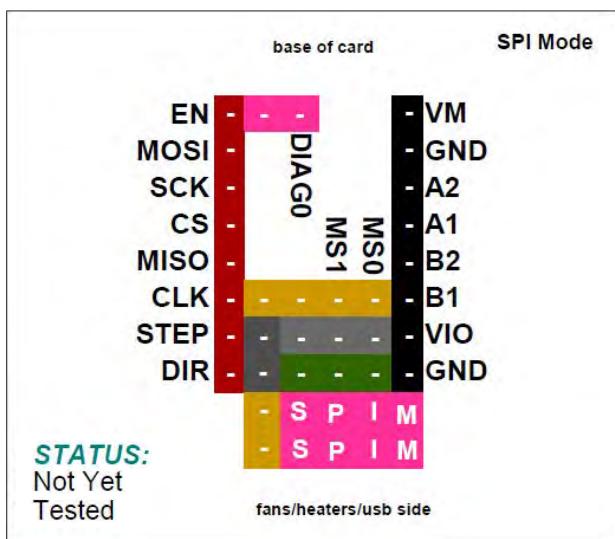
- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

**BIQU TMC5161 V1.0****SPI Mode**

Note: You can use 50% to 90% of the calculated I_{RMS} ($I_{MAX}/1.414$) when tuning ("X_CURRENT", "Y_CURRENT", etc. the stepper motor driver in the firmware.

See the next page for further information.

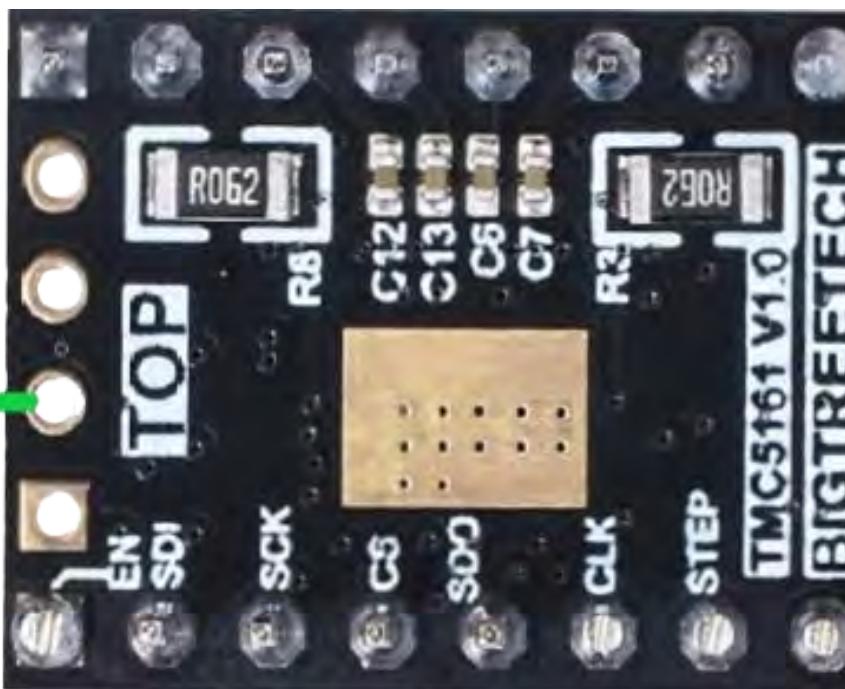
| | |
|--|--|
| <p>Driver Chip</p> <p>BIQU® TMC5161</p> <p>SPI Mode Maximum 256 Subdivision 40V DC 5.2A (peak)</p> | <p>Steps are set inside of your Firmware</p> |
| <p>Driving Current Calculation Formula</p> <p>R_S(Typical Sense Resistor)=0.062Ω</p> | <p>$I_{MAX}=5.2419$ See Appendix B #9. Use 50% to 90% as shown below: $I_{MAX}=I_{MAX} * 0.90=4.718$</p> |



BIQU TMC5161 V1.0

SPI Mode

Note: The TMC5161 V1.0 by default comes in SPI mode. The BIQU TMC5161 does NOT come with a POT or "V_{ref} Test point" location because the IRMS is set inside of the Firmware.



NOTE: BIQU TMC5161 has the ability to do sensor-less homing. By default the DIAG0 pin is **NOT** soldered onto the driver board. Therefore, for any axis you want sensor-less homing enabled, **YOU WILL HAVE** to solder on the DIAG0 pin.

BIQU TMC5161 V1.0SPI Mode**SPI Mode**

Note: The location of the current sense resistors are shown in **GREEN**. Use the current sense resistors' value in the Marlin Firmware ("X_RSENSE", "Y_RSENSE", "Z_RSENSE" and/or "E0_RSENSE") so that the appropriate current limit can be sent to the driver board. If you do not want to use V_{ref} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "X_CURRENT", "Y_CURRENT", "Z_CURRENT", and/or "E0_CURRENT".

$R_s = R050$ is 0.05 Ohms

$R_s = R062$ is 0.062 Ohms

$R_s = R068$ is 0.068 Ohms

$R_s = R075$ is 0.075 Ohms

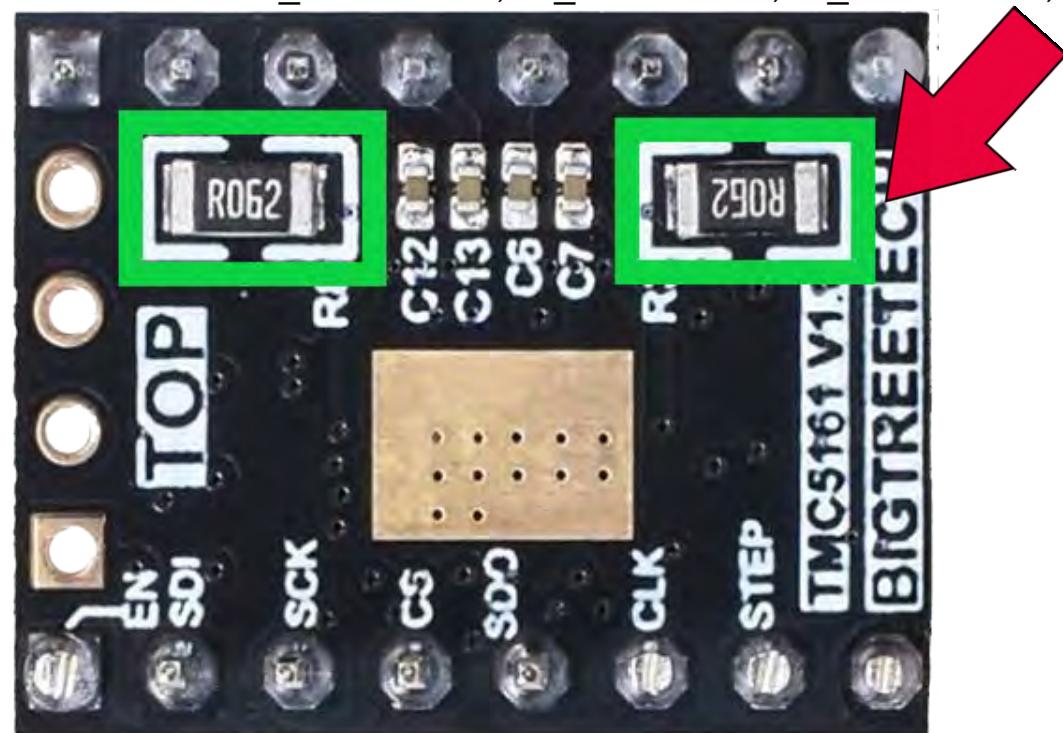
$R_s = R100$ is 0.1 Ohms

$R_s = R110$ is 0.11 Ohms

$R_s = R150$ is 0.15 Ohms

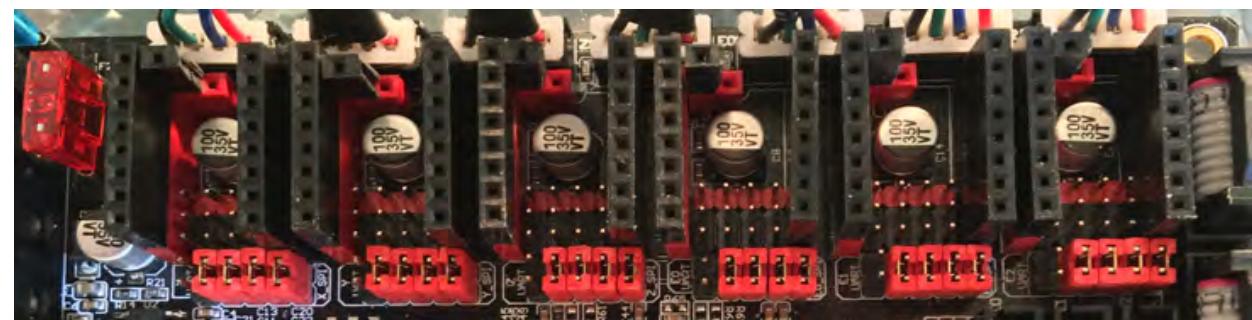
$R_s = R200$ is 0.2 Ohms

$R_s = R220$ is 0.22 Ohms

**SPI**

| | | | |
|------|---|---------|-----|
| EN | - | - | VM |
| MOSI | - | DIG0 | GND |
| SCK | - | - | A2 |
| CS | - | - | A1 |
| MISO | - | MS1 | B2 |
| CLK | - | MS0 | B1 |
| STEP | - | - | VIO |
| DIR | - | - | GND |
| | - | S P I M | |
| | - | S P I M | |

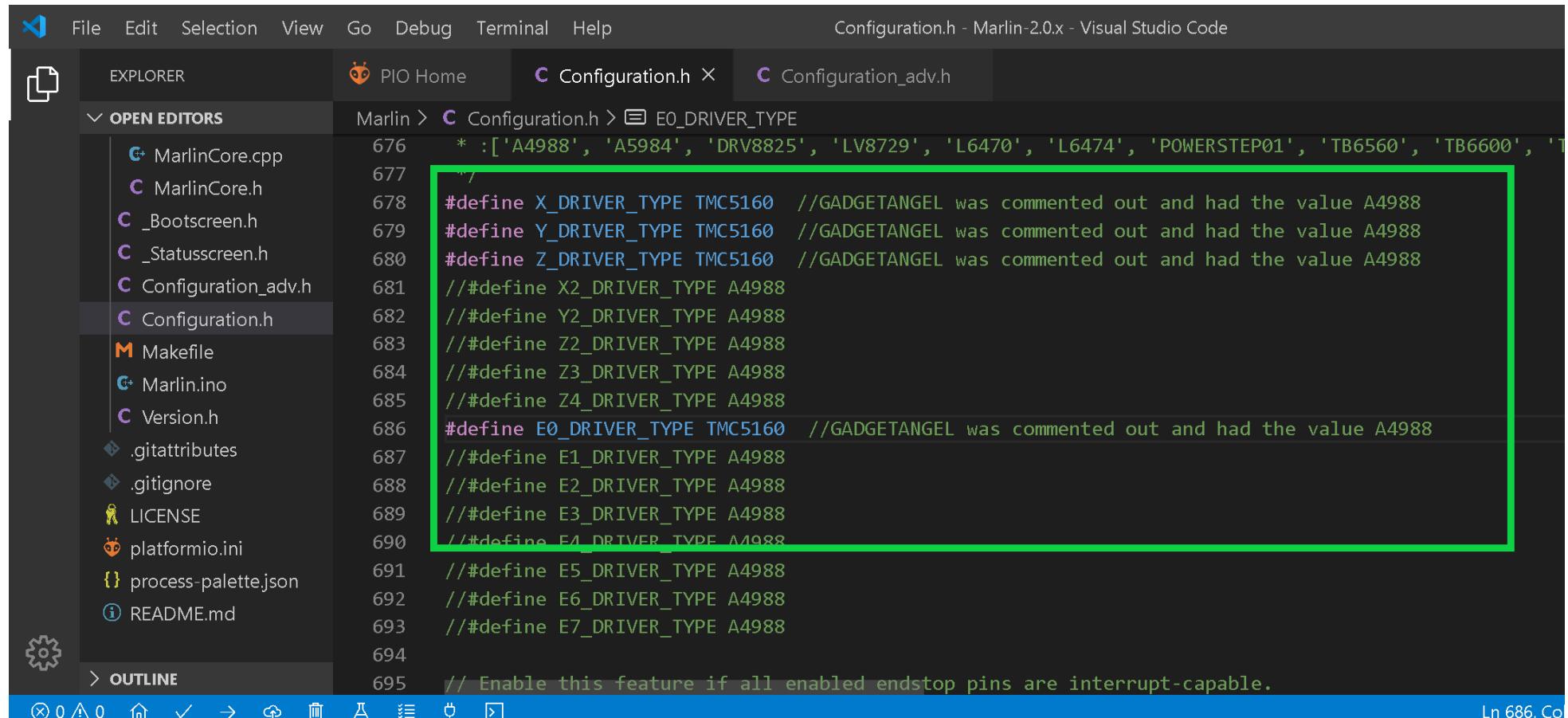
Note: Set JUMPERS "S","P","I","M" on the board!!



The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

NOTE: [Go to Appendix C](#), and then come back here for the changes to Marlin for BIQU TMC5161 V1.0 stepper motor drivers in SPI mode.

- Change the stepper motor drivers so that Marlin knows you are using TMC5161 drivers in SPI mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC5161 drivers in SPI mode. When two "://" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER PIO Home Configuration.h X Configuration_adv.h
Marlin > Configuration.h > E0_DRIVER_TYPE
676 * :['A4988', 'A5984', 'DRV8825', 'LV8729', 'L6470', 'L6474', 'POWERSTEP01', 'TB6560', 'TB6600', 'T
677 "
678 #define X_DRIVER_TYPE TMC5160 //GADGETANGEL was commented out and had the value A4988
679 #define Y_DRIVER_TYPE TMC5160 //GADGETANGEL was commented out and had the value A4988
680 #define Z_DRIVER_TYPE TMC5160 //GADGETANGEL was commented out and had the value A4988
681 //#define X2_DRIVER_TYPE A4988
682 //#define Y2_DRIVER_TYPE A4988
683 //#define Z2_DRIVER_TYPE A4988
684 //#define Z3_DRIVER_TYPE A4988
685 //#define Z4_DRIVER_TYPE A4988
686 #define E0_DRIVER_TYPE TMC5160 //GADGETANGEL was commented out and had the value A4988
687 //#define E1_DRIVER_TYPE A4988
688 //#define E2_DRIVER_TYPE A4988
689 //#define E3_DRIVER_TYPE A4988
690 //#define E4_DRIVER_TYPE A4988
691 //#define E5_DRIVER_TYPE A4988
692 //#define E6_DRIVER_TYPE A4988
693 //#define E7_DRIVER_TYPE A4988
694
695 // Enable this feature if all enabled endstop pins are interrupt-capable.
Ln 686, Col 1

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- Next you want to set your V_{ref} in the Marlin firmware for each axis that has the TMC5161 driver, as seen in the **GREEN** box below. I changed the "X_CURRENT" to be the calculated V_{ref} for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated V_{ref} for my Y-Axis, which is 760mV on the Ender 3.
- Ensure "X_RSENSE" is set to 0.062. Ensure "Y_RSENSE" is set to 0.062.
- If you **do not want to use V_{ref}** as the value for "X_CURRENT" and/or "Y_CURRENT", you should **use I_{RMS} instead**. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS}=I_{MAX}/1.414$). You use **50% to 90% of the calculated I_{RMS}** as the value for "X_CURRENT" and/or "Y_CURRENT".

```

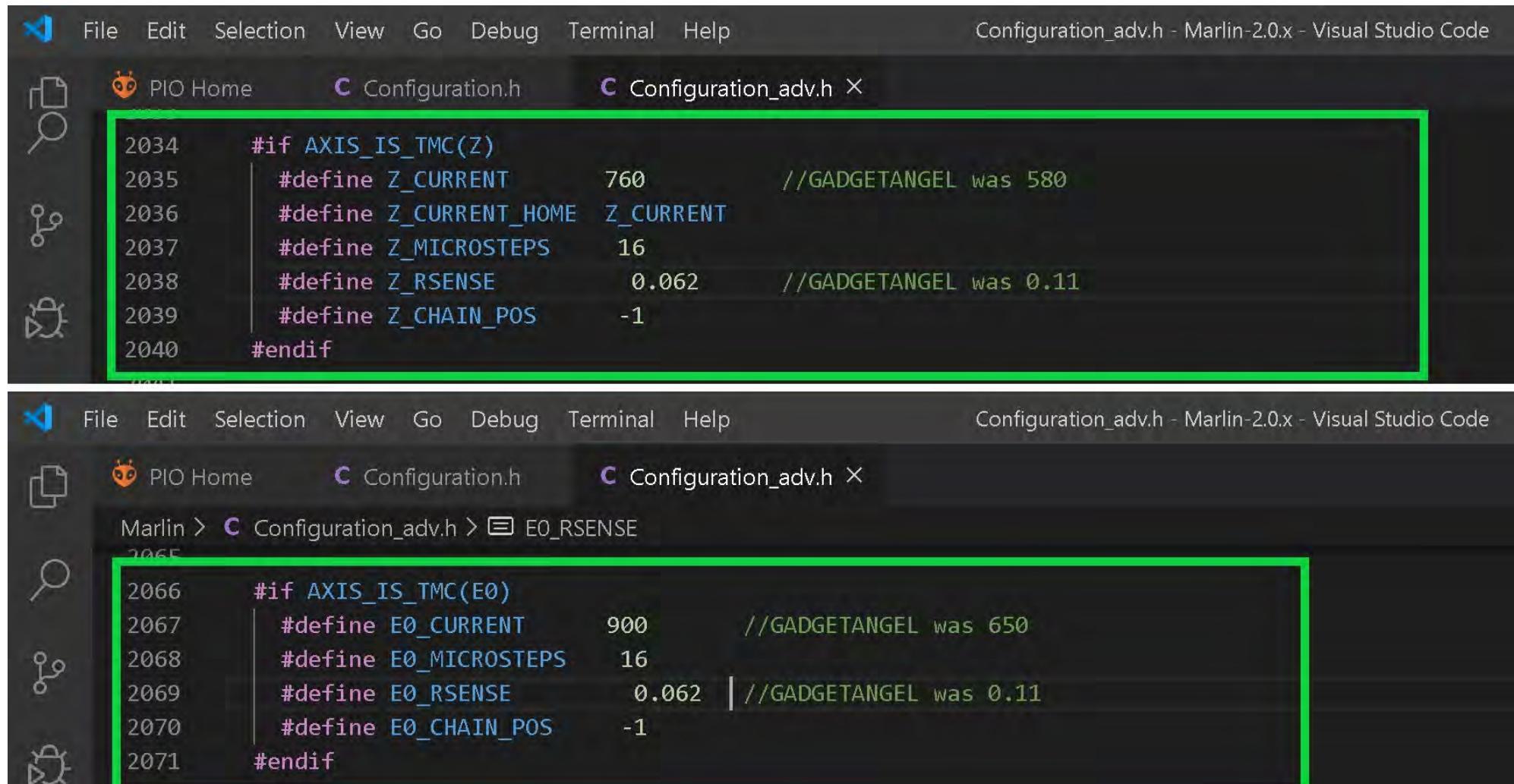
File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
PIO Home Configuration.h Configuration_adv.h X
Marlin > C Configuration_adv.h > EO_RSENSE
1990 * To use the reading capabilities, also connect #_SERIAL_RX_PIN to PDN_UART without
1991 * a resistor.
1992 * The drivers can also be used with hardware serial.
1993 *
1994 * TMCStepper library is required to use TMC stepper drivers.
1995 * https://github.com/teemuatlut/TMCStepper
1996 */
1997 #if HAS_TRINAMIC
1998
1999 #define HOLD_MULTIPLIER 0.5 // Scales down the holding current from run current
2000 #define INTERPOLATE true // Interpolate X/Y/Z_MICROSTEPS to 256
2001
2002 #if AXIS_IS_TMC(X)
2003 #define X_CURRENT 760 // (mA) RMS current. Multiply by 1.414 for peak current. //GADGETANGEL was 580
2004 #define X_CURRENT_HOME X_CURRENT // (mA) RMS current for sensorless homing
2005 #define X_MICROSTEPS 16 // 0..256
2006 #define X_RSENSE 0.062 //GADGETANGEL was 0.11
2007 #define X_CHAIN_POS -1 // <=0 : Not chained, 1 : MCU MOSI connected, 2 : Next in chain, ...
2008 #endif
2009
2010 #if AXIS_IS_TMC(X2)
2011 #define X2_CURRENT 800
2012 #define X2_CURRENT_HOME X2_CURRENT
2013 #define X2_MICROSTEPS 16
2014 #define X2_RSENSE 0.11
2015 #define X2_CHAIN_POS -1
2016 #endif
2017
2018 #if AXIS_IS_TMC(Y)
2019 #define Y_CURRENT 760 //GADGETANGEL was 580
2020 #define Y_CURRENT_HOME Y_CURRENT
2021 #define Y_MICROSTEPS 16
2022 #define Y_RSENSE 0.062 //GADGETANGEL was 0.11
2023 #define Y_CHAIN_POS -1
2024 #endif

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- Now, I am setting the V_{ref} for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated V_{ref} for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated V_{ref} for my Extruder, which is 900mV on the Ender 3.
- Ensure "Z_RSENSE" is set to 0.062. Ensure "E0_RSENSE" is set to 0.062.
- If you do not want to use V_{ref} as the value for "Z_CURRENT" and/or "E0_CURRENT", you should use I_{RMS} instead. You find I_{RMS} by taking I_{MAX} and dividing it by 1.414 ($I_{RMS} = I_{MAX}/1.414$). You use 50% to 90% of the calculated I_{RMS} as the value for "Z_CURRENT" and/or "E0_CURRENT".



```

2034 #if AXIS_IS_TMC(Z)
2035   #define Z_CURRENT      760          //GADGETANGEL was 580
2036   #define Z_CURRENT_HOME Z_CURRENT
2037   #define Z_MICROSTEPS    16
2038   #define Z_RSENSE        0.062        //GADGETANGEL was 0.11
2039   #define Z_CHAIN_POS     -1
2040 #endif

```



```

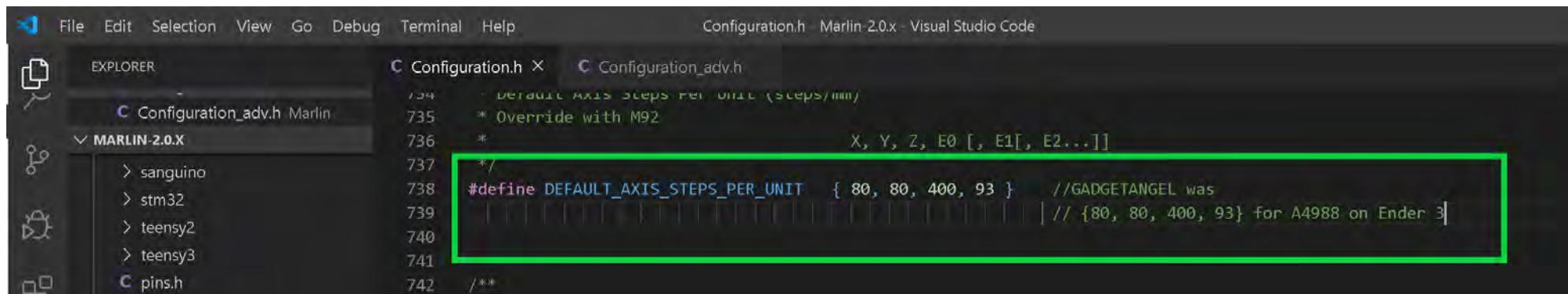
2066 #if AXIS_IS_TMC(E0)
2067   #define E0_CURRENT      900          //GADGETANGEL was 650
2068   #define E0_MICROSTEPS    16
2069   #define E0_RSENSE        0.062        //GADGETANGEL was 0.11
2070   #define E0_CHAIN_POS     -1
2071 #endif

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



File Edit Selection View Go Debug Terminal Help Configuration.h Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

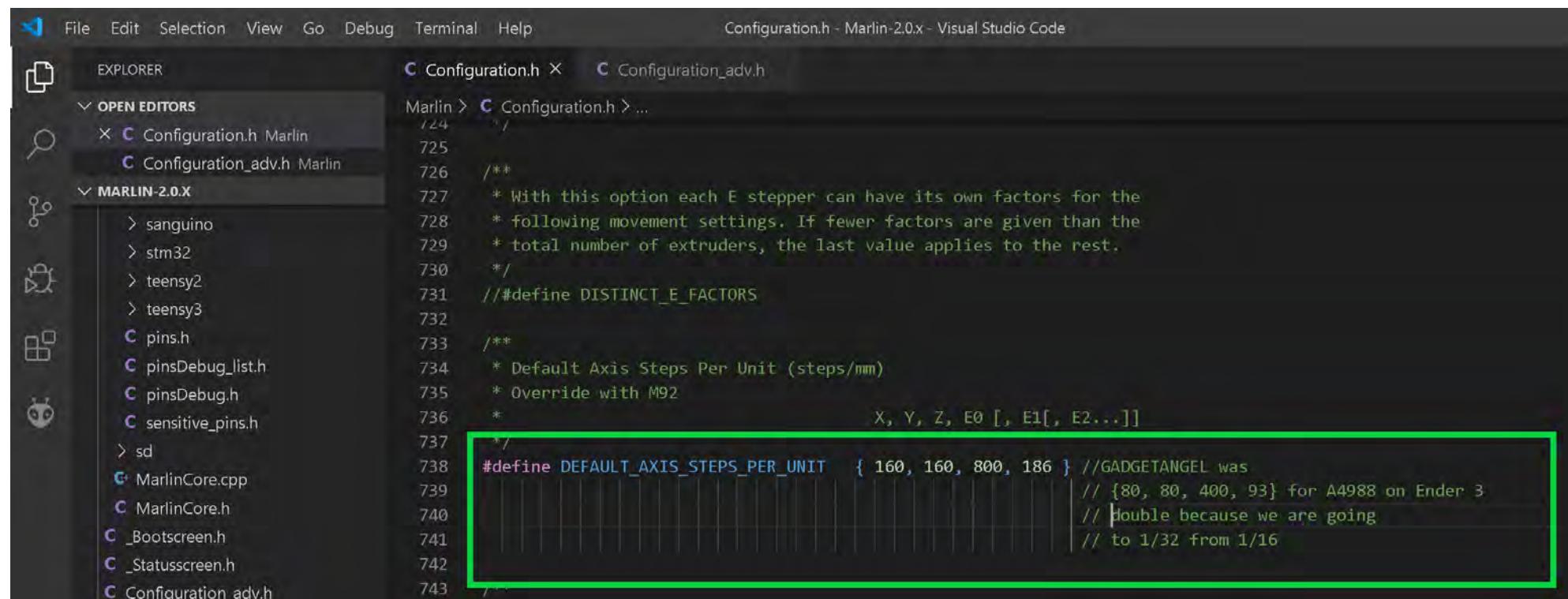
MARLIN-2.0.X Configuration.h Marlin Configuration_adv.h Marlin

```

734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 * X, Y, Z, E0 [, E1[, E2...]]
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 80, 80, 400, 93 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740
741 /**
742 */

```

- FOR EXAMPLE if you wanted to use 1/32 stepping instead of the default 1/16, you would be **doubling** your STEPS. Therefore, **we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" anytime our STEPS are NOT 1/16**. So change "DEFAULT_AXIS_STEPS_PER_UNIT" to {160, 160, 800, 186}, as seen in the **GREEN** box below.



File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h X Configuration_adv.h

OPEN EDITORS Configuration.h Marlin Configuration_adv.h Marlin

MARLIN-2.0.X Configuration.h Marlin Configuration_adv.h Marlin

```

724 */
725
726 /**
727 * With this option each E stepper can have its own factors for the
728 * following movement settings. If fewer factors are given than the
729 * total number of extruders, the last value applies to the rest.
730 */
731 // #define DISTINCT_E_FACTORS
732
733 /**
734 * Default Axis Steps Per Unit (steps/mm)
735 * Override with M92
736 *
737 */
738 #define DEFAULT_AXIS_STEPS_PER_UNIT { 160, 160, 800, 186 } //GADGETANGEL was
739 // {80, 80, 400, 93} for A4988 on Ender 3
740 // Double because we are going
741 // to 1/32 from 1/16
742
743 */

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- We need to uncomment out the "TMC_USE_SW_SPI" because the SKR PRO V1.1 pins file depends on this variable to define its SPI pins

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration_adv.h > TMC_USE_SW_SPI
  Configuration.h Marlin 2144 * The default SW SPI pins are defined the respective pins files,
  Configuration_adv.h Marlin 2145 * but you can override or define them here.
  2146 */
  2147 #define TMC_USE_SW_SPI //GADGETANGEL was commented out
  2148 // #define TMC_SW_MOST -1
  
```

- By default stealthChop is enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.

```

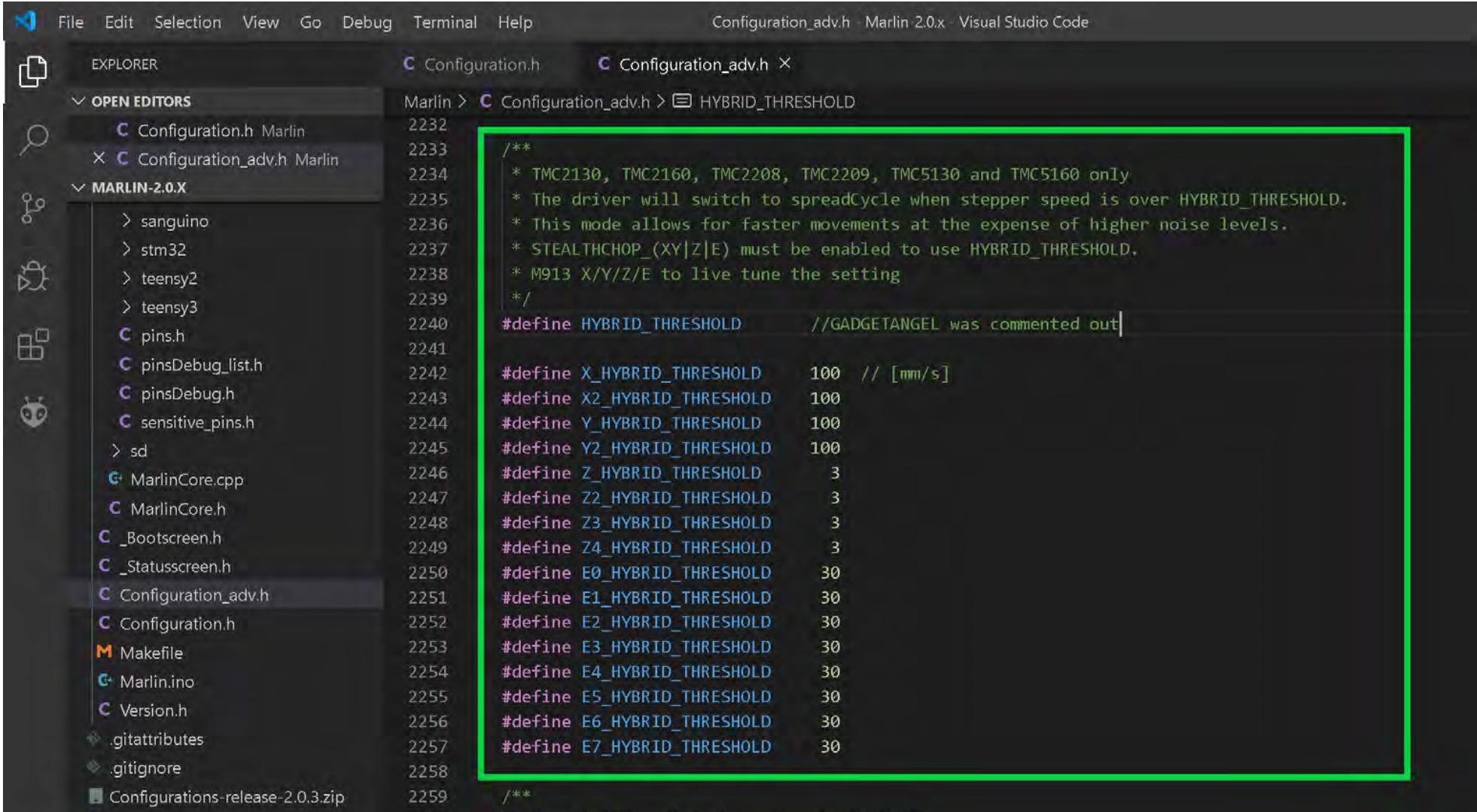
File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration_adv.h > STEALTHCHOP_XY
  Configuration.h Marlin 2193 */
  Configuration_adv.h Marlin 2194 #define STEALTHCHOP_XY
  2195 #define STEALTHCHOP_Z
  2196 #define STEALTHCHOP_E
  2197
  2198 */
  2199 * Optimize spreadCycle chopper parameters by using predefined parameter sets
  2200 * or with the help of an example included in the library.
  2201 * Provided parameter sets are
  2202 * CHOPPER_DEFAULT_12V
  2203 * CHOPPER_DEFAULT_19V
  2204 * CHOPPER_DEFAULT_24V
  2205 * CHOPPER_DEFAULT_36V
  2206 * CHOPPER_PRUSAMK3_24V // Imported parameters from the official Prusa firmware for MK3 (24V)
  2207 * CHOPPER_MARLIN_119 // Old defaults from Marlin v1.1.9
  2208 *
  2209 * Define your own with
  2210 * { <off_time[1..15]>, <hysteresis_end[-3..12]>, hysteresis_start[1..8] }
  2211 */
  2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
  2213 */
  
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- Now you either enable "HYBRID_THRESHOLD" or disable it. By default, it is disabled. "HYBRID_THRESHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin 2.0.x - Visual Studio Code

EXPLORER Configuration.h Configuration_adv.h

OPEN EDITORS Marlin > Configuration_adv.h > HYBRID_THRESHOLD

```

2232
2233 /**
2234 * TMC2130, TMC2160, TMC2208, TMC2209, TMC5130 and TMC5160 only
2235 * The driver will switch to spreadCycle when stepper speed is over HYBRID_THRESHOLD.
2236 * This mode allows for faster movements at the expense of higher noise levels.
2237 * STEALTHCHOP_(XY|Z|E) must be enabled to use HYBRID_THRESHOLD.
2238 * M913 X/Y/Z/E to live tune the setting
2239 */
2240 #define HYBRID_THRESHOLD //GADGETANGEL was commented out
2241
2242 #define X_HYBRID_THRESHOLD 100 // [mm/s]
2243 #define X2_HYBRID_THRESHOLD 100
2244 #define Y_HYBRID_THRESHOLD 100
2245 #define Y2_HYBRID_THRESHOLD 100
2246 #define Z_HYBRID_THRESHOLD 3
2247 #define Z2_HYBRID_THRESHOLD 3
2248 #define Z3_HYBRID_THRESHOLD 3
2249 #define Z4_HYBRID_THRESHOLD 3
2250 #define E0_HYBRID_THRESHOLD 30
2251 #define E1_HYBRID_THRESHOLD 30
2252 #define E2_HYBRID_THRESHOLD 30
2253 #define E3_HYBRID_THRESHOLD 30
2254 #define E4_HYBRID_THRESHOLD 30
2255 #define E5_HYBRID_THRESHOLD 30
2256 #define E6_HYBRID_THRESHOLD 30
2257 #define E7_HYBRID_THRESHOLD 30
2258
2259 /**
2260 * H S1 S2 S3 S4 S5 S6 S7

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

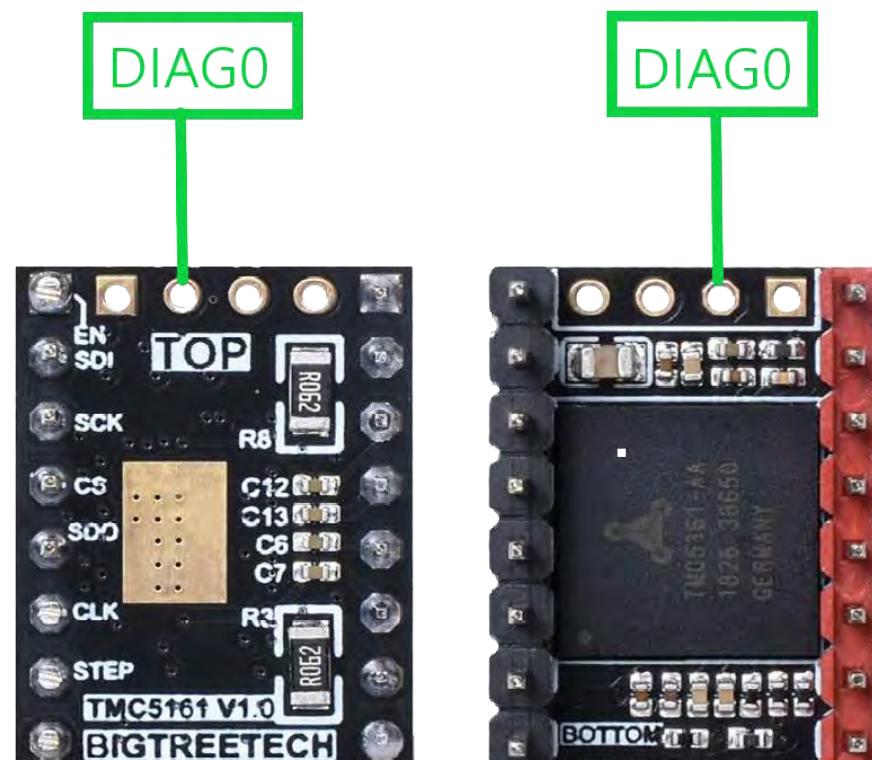
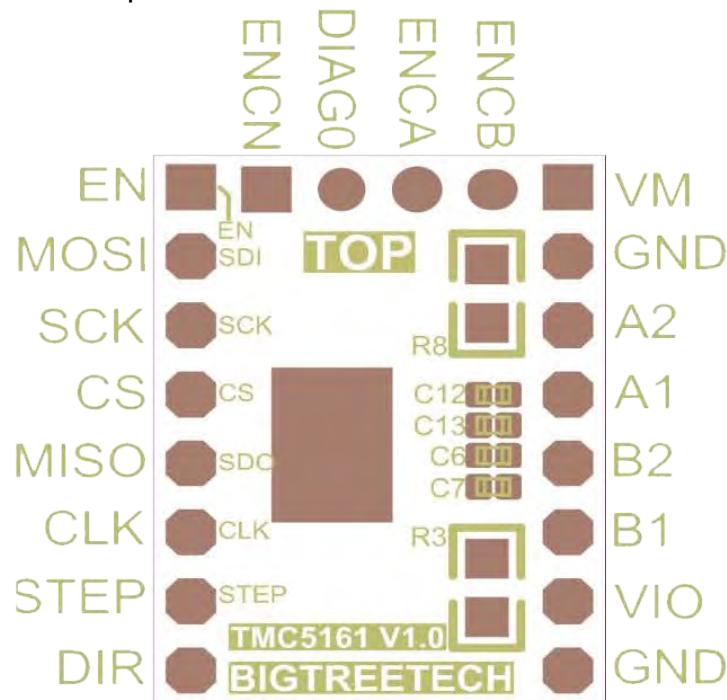
- Now I want to enable some statements that allow me access to debugging the TMC drivers. I will uncomment "MONITOR_DRIVER_STATUS" and "TMC_DEBUG". "MONITOR_DRIVER_STATUS" will enable the following G-codes: M906, M911, and M912, "TMC_DEBUG" will enable the M122 G-code command. You can read about these from the comments in the firmware and in [Marlin's documentation located on-line.](#)

```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
EXPLORER Configuration.h Configuration_adv.h
OPEN EDITORS Marlin > Configuration_adv.h > MONITOR_DRIVER_STATUS
  2211 */
  2212 #define CHOPPER_TIMING CHOPPER_DEFAULT_24V
  2213
  2214 /**
  2215 * Monitor Trinamic drivers for error conditions,
  2216 * like overtemperature and short to ground.
  2217 * In the case of overtemperature Marlin can decrease the driver current until error condition clears.
  2218 * Other detected conditions can be used to stop the current print.
  2219 * Relevant g-codes:
  2220 * M906 - Set or get motor current in millamps using axis codes X, Y, Z, E. Report values if no axis codes given.
  2221 * M911 - Report stepper driver overtemperature pre-warn condition.
  2222 * M912 - Clear stepper driver overtemperature pre-warn condition flag.
  2223 * M122 - Report driver parameters (Requires TMC_DEBUG)
  2224 */
  2225 #define MONITOR_DRIVER_STATUS //GADGETANGEL was commented out
  2226
  2227 #if ENABLED(MONITOR_DRIVER_STATUS)
  2228
  2229
  2230
  2231
  2232
  2233
  2234
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The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

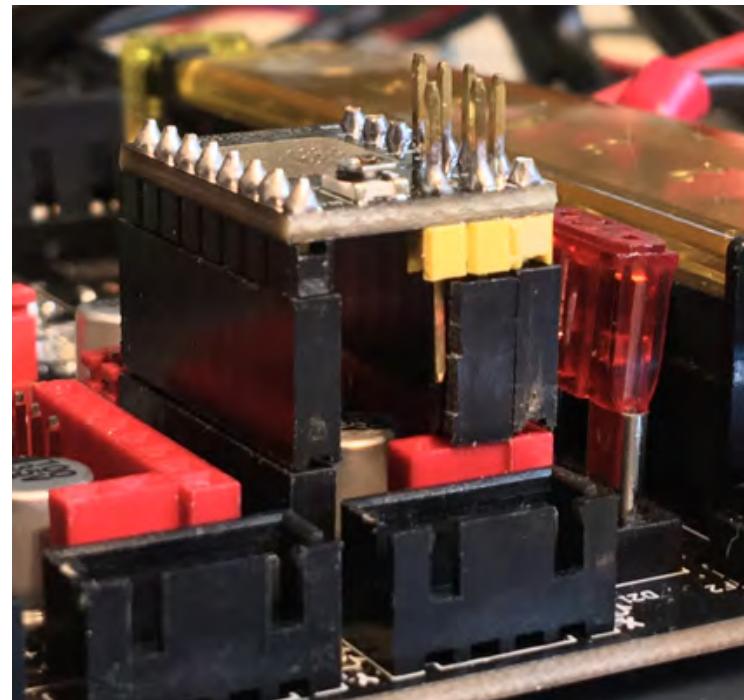
- This next section covers sensor-less homing which is available for the TMC5161 in SPI mode. I want to enable it BUT for the TMC5161 I first have to solder on the DIAG0 pin onto each TMC5161 driver that will be on an axis with sensor-less homing enabled. Therefore, I want sensor-less homing for X and Y axes only. So I need to solder in a DIAG0 pin for two TMC5161 drivers. Here is a picture of the TMC5161 V1.0 pin-out.



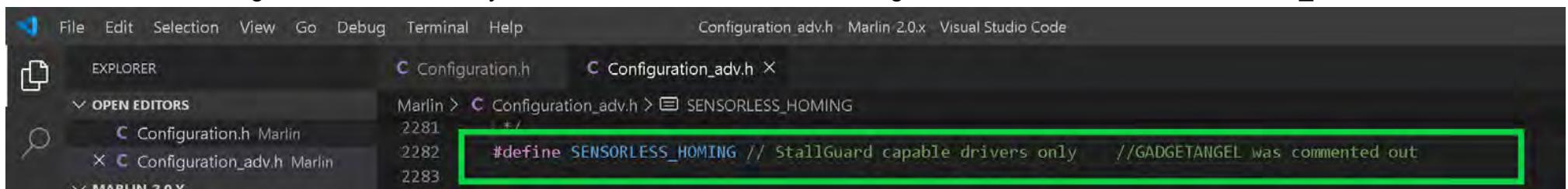
- The third pin position starting from the left on the top of the chip is where I need to solder in a header pin. I need it to face down so when I plug in the TMC5161 into the SKR PRO V1.1 board the DIAG0 pin will be seated in the SKR PRO V1.1 board.
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- I will be covering sensor-less homing for the X and Y axis only. I will not be using sensor-less homing on my Z axis on my Ender 3 printer. For sensor-less homing to work the DIAG0 pin on the TMC5161 driver has to be plugged into the SKR PRO V1.1 board. Since I am **not using sensor-less homing on my Z axis I will need to ensure that my DIAG0 pin on the Z axis TMC5161 is NOT connected to the board.** I plan to plug my Z axis' TMC5161 by using long stackable header pin risers, as seen in the picture below.



- Sensor-less homing is commented out by default. So I remove the two leading "//" to un-comment "SENSORLESS_HOMING"

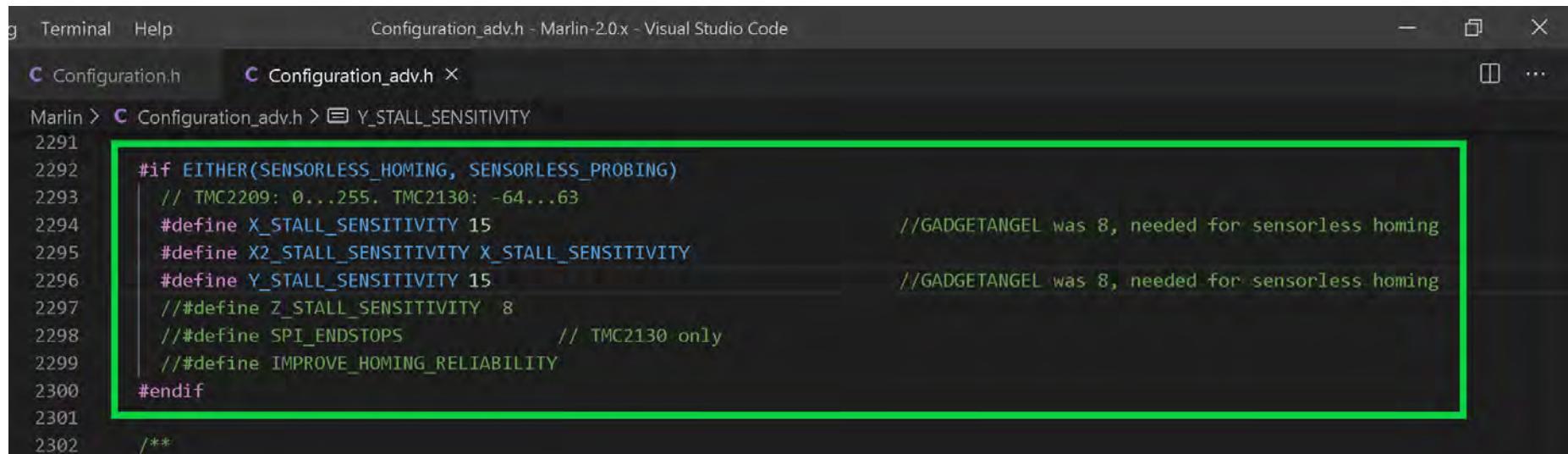


```
File Edit Selection View Go Debug Terminal Help Configuration_adv.h Marlin 2.0.x Visual Studio Code  
EXPLORER C Configuration.h C Configuration_adv.h X  
OPEN EDITORS Marlin > C Configuration_adv.h > SENSORLESS_HOMING  
2281 */  
2282 #define SENSORLESS_HOMING // StallGuard capable drivers only //GADGETANGEL was commented out  
2283
```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- Next we set the "starting" stall sensitivity for sensor-less homing. I choose to make it 15. If the stall sensitivity is too high your motor will grind and not stop when it hits the end of travel on the axis. If the stall sensitivity is too low then the motor will barely move because it thinks it has hit the end of travel for the axis. Notice I only uncommented the "X_STALL_SENSITIVITY" and the "Y_STALL_SENSITIVITY". If you want sensor-less homing on the Z axis, then you will have to uncomment "Z_STALL_SENSITIVITY".

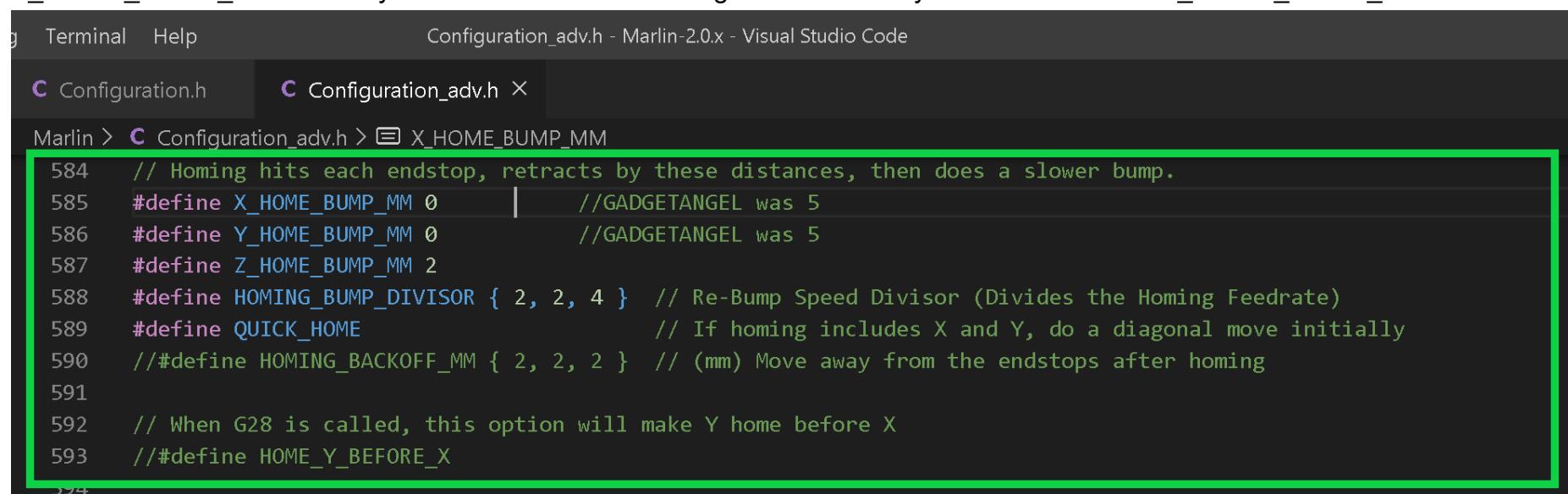


```

g Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > Y_STALL_SENSITIVITY
2291
2292 #if EITHER(SENSORLESS_HOMING, SENSORLESS_PROBING)
2293 // TMC2209: 0...255. TMC2130: -64...63
2294 #define X_STALL_SENSITIVITY 15 //GADGETANGEL was 8, needed for sensorless homing
2295 #define X2_STALL_SENSITIVITY X_STALL_SENSITIVITY
2296 #define Y_STALL_SENSITIVITY 15 //GADGETANGEL was 8, needed for sensorless homing
2297 //#define Z_STALL_SENSITIVITY 8
2298 //">#define SPI_ENDSTOPS // TMC2130 only
2299 //">#define IMPROVE_HOMING_RELIABILITY
2300 #endif
2301
2302 /**

```

- We now have to set our home bump to 0 for each axis with sensor-less homing enabled. So I will set "X_HOME_BUMP_MM" to 0 and "Y_HOME_BUMP_MM" to 0. If you want sensor-less homing on Z axis then you will need to set "Z_HOME_BUMP_MM" to 0.



```

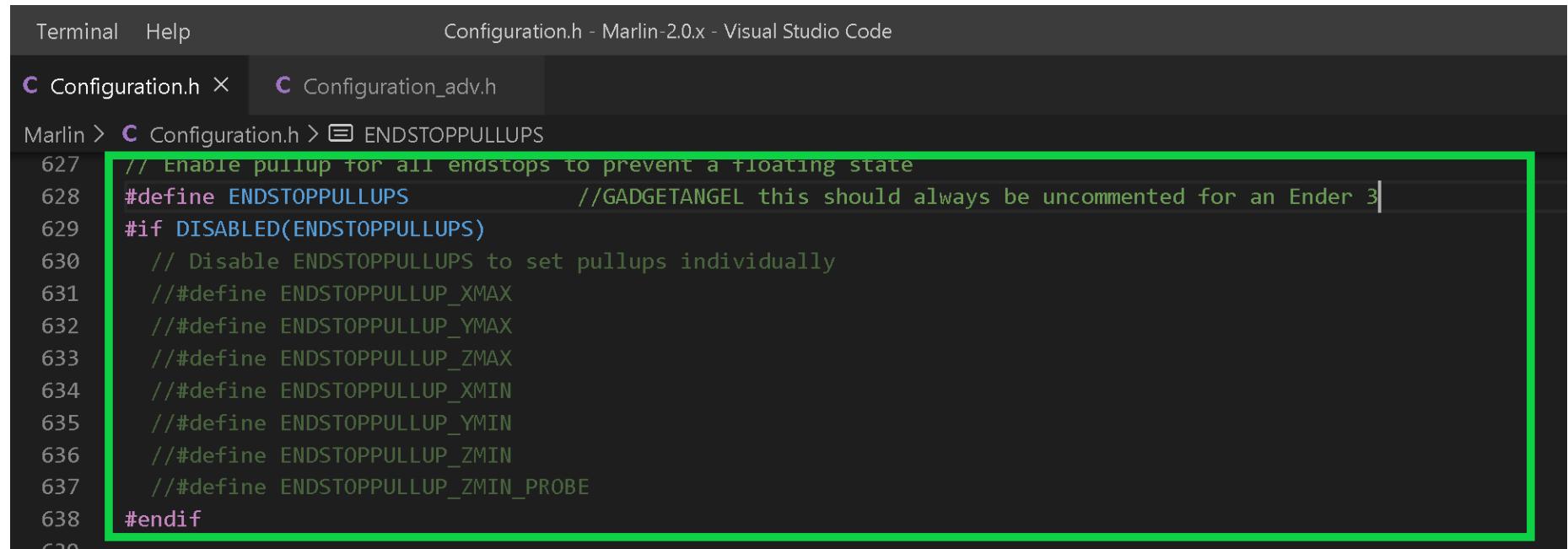
g Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
C Configuration.h C Configuration_adv.h X
Marlin > C Configuration_adv.h > X_HOME_BUMP_MM
584 // Homing hits each endstop, retracts by these distances, then does a slower bump.
585 #define X_HOME_BUMP_MM 0 //GADGETANGEL was 5
586 #define Y_HOME_BUMP_MM 0 //GADGETANGEL was 5
587 #define Z_HOME_BUMP_MM 2
588 #define HOMING_BUMP_DIVISOR { 2, 2, 4 } // Re-Bump Speed Divisor (Divides the Homing Feedrate)
589 #define QUICK_HOME // If homing includes X and Y, do a diagonal move initially
590 //">#define HOMING_BACKOFF_MM { 2, 2, 2 } // (mm) Move away from the endstops after homing
591
592 // When G28 is called, this option will make Y home before X
593 //">#define HOME_Y_BEFORE_X
594

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- Let's check the firmware to ensure that "ENDSTOPPULLUPS" is enabled. It is by default.



```

Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

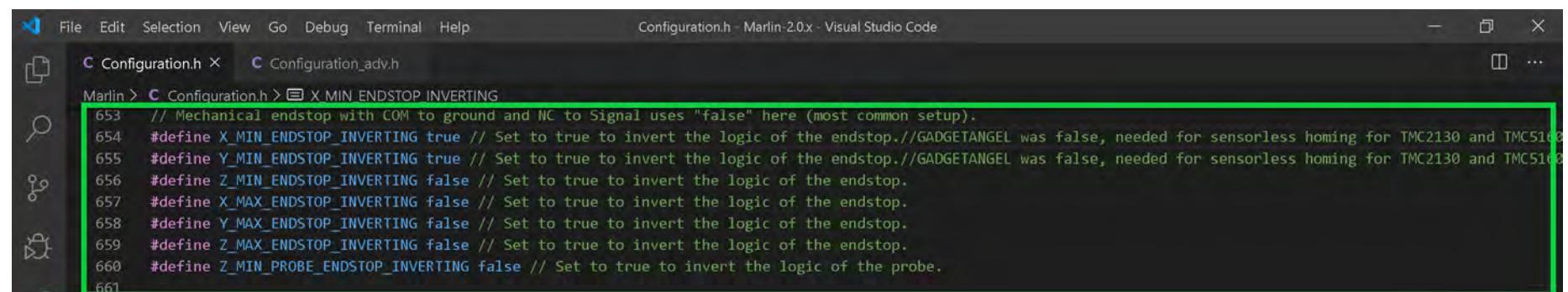
Configuration.h X Configuration_adv.h

Marlin > Configuration.h > ENDSTOPPULLUPS

627 // Enable pullup for all endstops to prevent a floating state
628 #define ENDSTOPPULLUPS //GADGETANGEL this should always be uncommented for an Ender 3
629 #if DISABLED(ENDSTOPPULLUPS)
630     // Disable ENDSTOPPULLUPS to set pullups individually
631     //#define ENDSTOPPULLUP_XMAX
632     //#define ENDSTOPPULLUP_YMAX
633     //#define ENDSTOPPULLUP_ZMAX
634     //#define ENDSTOPPULLUP_XMIN
635     //#define ENDSTOPPULLUP_YMIN
636     //#define ENDSTOPPULLUP_ZMIN
637     //#define ENDSTOPPULLUP_ZMIN_PROBE
638 #endif
639

```

- Next to allow sensor-less homing to work (while using the BIQU TMC5161) we need to change our end stop logic. Therefore I set "X_MIN_ENDSTOP_INVERTING" to true and "Y_MIN_ENSTOP_INVERTING" to true. If you want sensor-less homing on the Z axis, you will need to set "Z_MIN_ENDSTOP_INVERTING" to true. But since I do not want sensor-less homing on the Z axis I will leave "Z_MIN_ENDSTOP_INVERTING" set to false.



```

File Edit Selection View Go Debug Terminal Help Configuration.h - Marlin-2.0.x - Visual Studio Code

Configuration.h X Configuration_adv.h

Marlin > Configuration.h > X MIN ENDSTOP INVERTING

653 // Mechanical endstop with COM to ground and NC to Signal uses "false" here (most common setup).
654 #define X_MIN_ENDSTOP_INVERTING true // Set to true to invert the logic of the endstop.//GADGETANGEL was false, needed for sensorless homing for TMC2130 and TMC5161
655 #define Y_MIN_ENDSTOP_INVERTING true // Set to true to invert the logic of the endstop.//GADGETANGEL was false, needed for sensorless homing for TMC2130 and TMC5161
656 #define Z_MIN_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
657 #define X_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
658 #define Y_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the endstop.
659 #define Z_MAX_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
660 #define Z_MIN_PROBE_ENDSTOP_INVERTING false // Set to true to invert the logic of the probe.
661

```

- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- The end of Marlin setup for BIQU TMC5161 drivers in SPI mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.

The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows files like `pins_BTT_SKR_PRO_V1_1.h`, `Configuration.h` (marked as X), and `Configuration_adv.h`.
- Editor:** Displays the `Configuration.h` file with code related to stepper drivers and endstops.
- Terminal:** Shows the build output for `BIGTREE_SKR_PRO`:

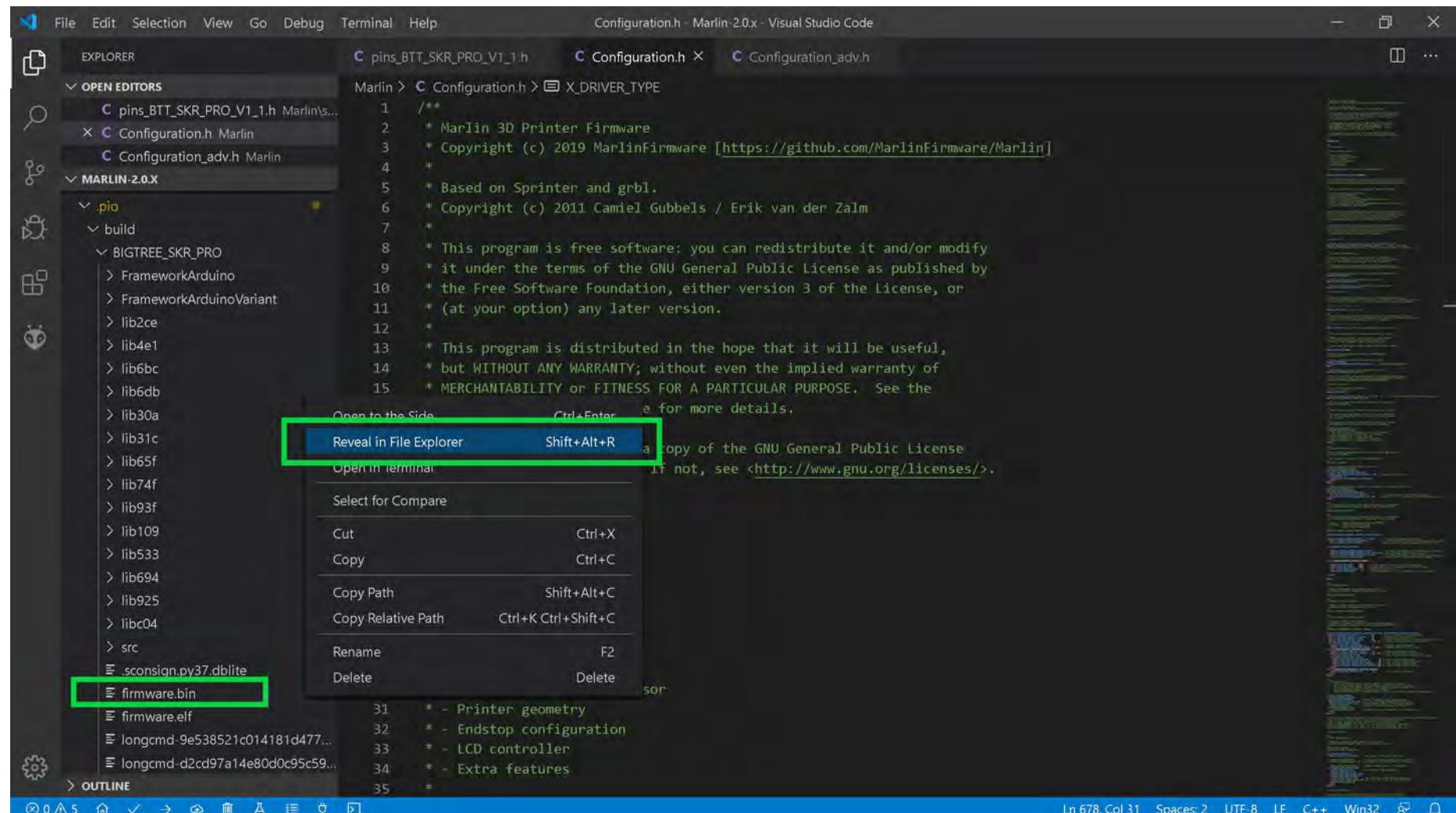
| | |
|------------------------|----------------------|
| STM32F072C-DISCO | IGNORED |
| BIGTREE_SKR_PRO | SUCCESS 00:02:31.294 |
| BIGTREE_BTT002 | IGNORED |
| teensy31 | IGNORED |
| teensy35 | IGNORED |
| esp32 | IGNORED |
| linux_native | IGNORED |
| SAMD51_grandcentral_m4 | IGNORED |
| rumba32_f446ve | IGNORED |
| mks_rumba32 | IGNORED |
| include_tree | IGNORED |

 The terminal also displays the message: "===== 1 succeeded in 00:02:31.294 =====".
- Bottom Bar:** Shows the status bar with "Ln 678, Col 31" and various icons for file operations.

- For the SKR PRO V1.1 board you must save the "firmware.bin" file to the micro SD card then place the micro SD card into the micro SD card reader of the SKR PRO V1.1 board and turn on the power to your printer for the NEW firmware to be automatically applied to the SKR PRO MCU. To locate the "firmware.bin" file, and learn how to transfer it to your micro SD card go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

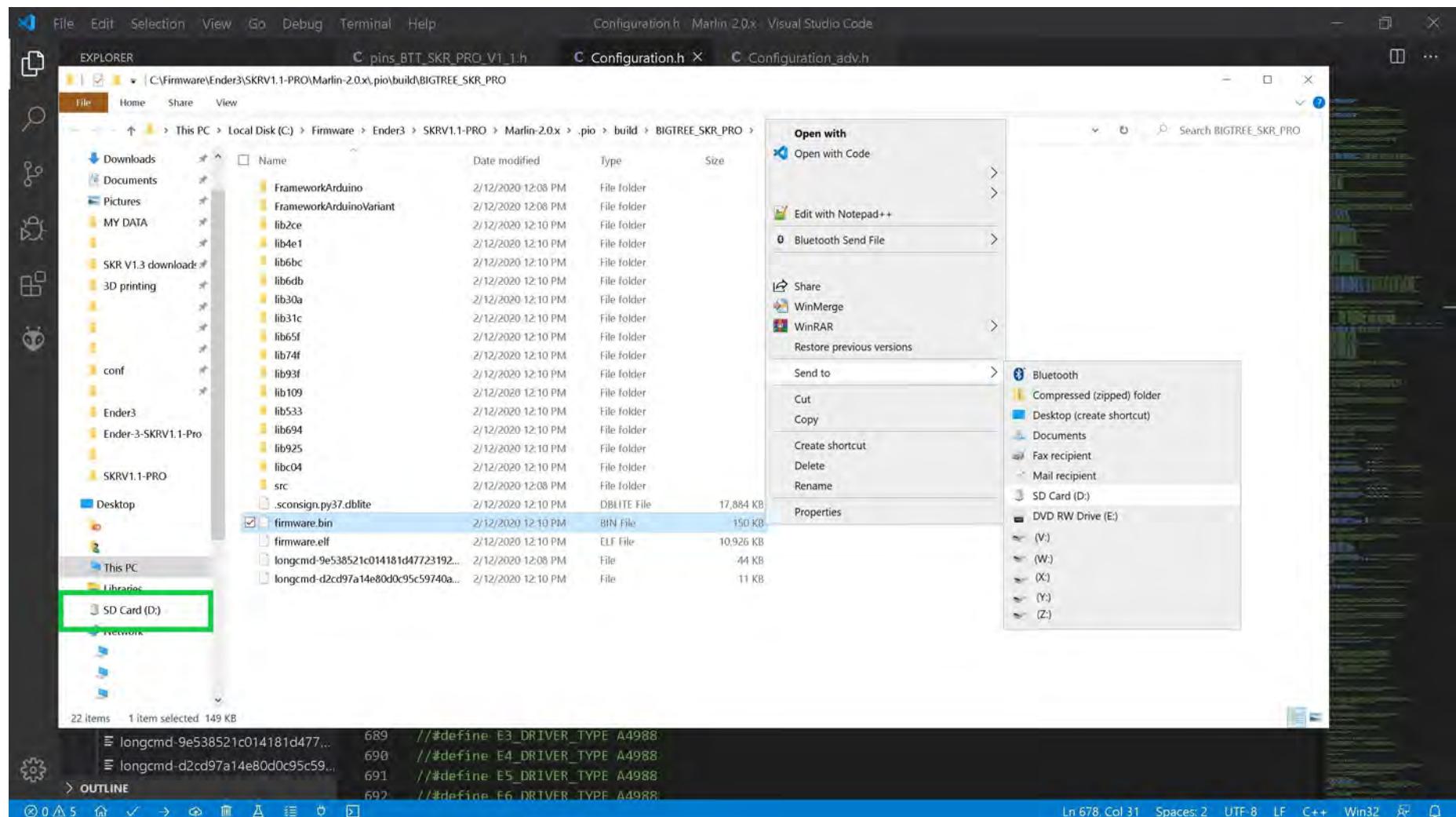
- The "firmware.bin" file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer window.



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5161 V1.0 Drivers in SPI Mode

- Ensure your micro SD card, which came with your SKR PRO V1.1 board, with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
- From the file explorer window **right click** on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- **Right click** on the SD card reader, as seen in the **GREEN** box above, and select "Eject" from the context menu. Take the micro SD card out of the adapter and place it into the micro SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR" file will be uploaded to the board. After the upload the firmware file will be renamed to "firmware.bin" and stored on the micro SD card.

How to adjust the V_{ref} on a Stepper Motor Driver board using the Potentiometer^{1, 2}

Modern 3D printers usually use NEMA17 motors. The first piece of information you will need is the "Rated Current" of your NEMA17 motor. So, write down your motor's part number and pay attention to the Step Angle, Holding Torque, Rated Current, Voltage, and Inductance.

Use the Step Angle to work out your printer's "DEFAULT_AXIS_STEPS_PER_UNIT" for your firmware with:

1. <http://www.prusaprinters.org/calculator/>

How to Tune Stepper Motor Drivers²

1. Turn power off your printer, unplug the stepper motor cables, turn power back on your printer and tune the stepper motor drivers that are already plugged into the SKR PRO V1.1 board.
2. When done, turn power off the printer, plug in the stepper motor cables turn power back on your printer and test motor movement.

NOTE: Don't tune stepper motor drivers with the motors plugged in, if you accidentally set current too high you can fry the motor or the stepper motor driver.

NOTE: Don't plug or unplug stepper motors with the power on the printer (i.e. power on the SKR PRO V1.1 board)

Measure DC voltage between the stepper motor driver's trimpot (POT) or " V_{ref} Test point" and your PSU's (12VDC/24VDC) ground. The ground at the PSU connector to the SKR PRO board is fine to use. Look up the correct current for your motor part number. If you have motors with no part number, assume they have a max of 1.00 amps (I_{MAX}) to be safe. Look up the proper formula for your stepper motor drivers (as show in this document), and find the voltage (but ONLY use 90% of the calculated V_{ref}) which corresponds with the current you want to set. Use a ceramic screw driver to adjust the POT. A ceramic screw driver is nonconductive and if you slip while making the adjustment to the POT you could short circuit the stepper motor driver board (i.e. KILL the driver board) in the process.

Time Saver tip, but more dangerous: Get slip-on alligator clips for your multimeter. Clamp ground to a 12VDC/24VDC ground (PSU Ground) wire and clamp positive to your plastic handle screwdriver. This way you'll measure the voltage as you adjust ("live adjustment") and don't need three hands.

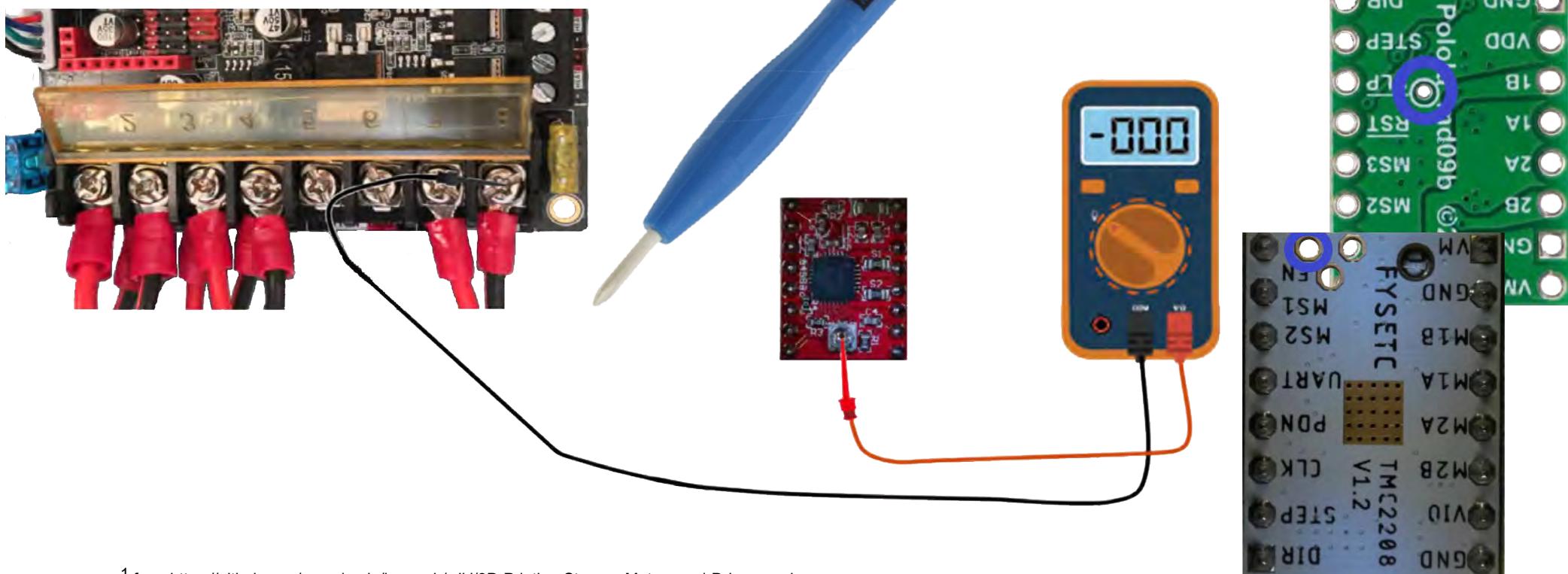
Note: See the next page for a diagram of the setup.

¹ from <https://github.com/superjamie/lazyweb/wiki/3D-Printing-Stepper-Motors-and-Drivers> and

² from <https://github.com/superjamie/lazyweb/wiki/3D-Printing-Stepper-Motors-and-Drivers#how-to-tune-stepper-drivers>

How to adjust the V_{ref} on a Stepper Motor Driver board using the Potentiometer^{1, 2}

Note: A ceramic screw driver is non-conductive. If you use a plastic handle screw driver with alligator clips to your multimeter to make a "live adjustment" of V_{ref} (and you slip while making the adjustment to the POT), you could short circuit the stepper motor driver board (i.e. KILL the board) in the process.



¹ from <https://github.com/superjamie/lazyweb/wiki/3D-Printing-Stepper-Motors-and-Drivers>

² from <https://github.com/superjamie/lazyweb/wiki/3D-Printing-Stepper-Motors-and-Drivers#how-to-tune-stepper-drivers>

APPENDIX B

For the TMC drivers what's the difference between stand-alone mode and ("UART" or "SPI ") modes?

All the TMC driver chips **EXCEPT TMC5160 and TMC5161** have a stand-alone mode. **Stand-alone mode** allows you to just drop the driver into your motherboard to replace your A4988 driver. The **OTP mode** is similar, but you use some software to **PERMANENTLY** change the driver's mode of operation. The **UART or SPI modes** allow you to **dynamically** change the driver in your firmware.

How to Calculate V_{ref} for Non-TMC Stepper Motor Drivers

My machine is an Ender 3, the X, Y, Z stepper motor "Rated Current" is 0.84 Amps, while E (extruder stepper motor "Rated Current" is 1 Amps.

We use the V_{ref} formula (found on the first page of each different stepper motor driver section of this document and do the V_{ref} calculation.

Remember this V_{ref} calculation is just a suggested starting point. If your stepper motors are running **too hot** you will need to adjust the V_{ref} **downward**. If your stepper motors are **skipping steps** when printing then you will need to adjust your V_{ref} **upwards**. Our goal is to find a low enough V_{ref} where our stepper motors are cool enough without the printer missing any steps. For this example, I will use the A4988 stepper motor driver.

1. So, A4988 V_{ref} formula is $V_{ref} = I_{MAX} * (8 * R_s)$, where $R_s = 0.1\Omega$.
2. I take each of my Axis' "Rated Current" and plug it into that equation to get X-Axis V_{ref} is equal to $(0.840 * 8 * 0.100) = 0.672$ volts or 672mV.
3. Now, take 90% of that for a starting point V_{ref} value of $((0.672 * 0.90) = 0.6048)$ 0.605 volts or 605mV or X-Axis $V_{ref} = 0.605V$. Since X, Y and Z stepper motors have the same "Rated Current" we now have the V_{ref} for X, Y and Z stepper motor drivers. Their value is 0.605 volts.
4. For E (extruder) V_{ref} the equation is $(1.0 * 8 * 0.100) = 0.800$ volts. Now, take 90% of that, for a starting point, V_{ref} value of $((0.800 * 0.90) = 0.720)$ 0.720 volts or 720mV. We now have the V_{ref} for E (extruder stepper motor driver) which is 0.72 volts.
5. We use our multimeter and turn the POT on the top of the stepper motor driver until we see the wanted V_{ref} voltage displayed.

APPENDIX B

How to Calculate V_{ref} for TMC Stepper Motor Drivers

My machine is an Ender 3. The X, Y, and Z stepper motors have a "Rated Current" of 0.84 Amps, while E (extruder) stepper motor "Rated Current" is 1 Amp.

We use the I_{MAX} formula and use Algebra to find the V_{ref} formula. The I_{MAX} formula for each TMC Driver is listed on the following pages. But we will use TMC2100 drivers so we will use the below equation:

TMC2100 Stand-alone Mode, (with $R_s=110m\Omega$):

$$I_{RMS} = ((V_{ref} / 2.5) * (1 / 1.41) * ((320mV / (R_s + 20m\Omega))))$$

Since $I_{MAX}=(I_{RMS} * 1.41)$ is a known value then the above equation can be written as follows:

$$(I_{MAX} * (1 / 1.41)) = ((1 / 1.41) * (V_{ref} / 2.5) * ((320 / (110+20))))$$

Since $(1 / 1.41)$ is on both sides of the Algebra equation they cancel each other out leaving the equation as follows:

$$I_{MAX} = (V_{ref} / 2.5) * (2.46 \approx 2 .5),$$

Therefore $I_{MAX} = V_{ref}$, and $V_{ref} = I_{MAX}$.

We use 50% to 90% of V_{ref} (i.e. I_{MAX}) to set the current limit for TMC stepper motor driver. To take 90% we do the following:

Since $V_{ref}=I_{MAX}$ we will use I_{MAX} instead of V_{ref} .

90% of V_{ref} for Ender 3's X, Y or Z $= (I_{MAX} * 0.90) = (0.84 * 0.90) = 0.756$ or 756mA. Since $I_{MAX}=V_{ref}$, then it's also equal to 756mV.

Remember this V_{ref} calculation is just a suggested starting point. If your stepper motors are running **too hot** you will need to adjust the V_{ref} **downward**. If your stepper motors are **skipping steps** when printing then you will need to adjust your V_{ref} **upwards**. Our goal is to find a low enough V_{ref} where our stepper motors are cool enough without the printer missing any steps.

APPENDIX BDriving Current Calculation Formulas for TMC Stepper Motor Drivers**1. TMC2100 with $R_s=0.110\Omega$ (110m Ω) :**

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (V_{ref} / 2.5) * ((320mV / (R_s + 20m\Omega)))) \\ &= ((1 / 1.41) * (V_{ref} / 2.5) * ((320/110+20))) \\ &= ((1/1.41) * (V_{ref}/2.5) * (2.46)) \\ &= (1/1.41) * V_{ref} * 0.99 \\ &= (1/1.41) * V_{ref} * 1 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$

Therefore,

$$I_{MAX} * (1/1.41) = (1/1.41) * V_{ref}$$

$$I_{MAX} = V_{ref}$$

$$V_{ref} = I_{MAX}$$

2. TMC2130 with $R_s=0.110\Omega$ (110m Ω) :

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325mV / (R_s + 20m\Omega)))) \\ &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325/110+20))) \\ &= ((1/1.41) * (V_{ref}/2.5) * (2.5)) \\ &= (1/1.41) * V_{ref} \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$

Therefore,

$$I_{MAX} * (1/1.41) = (1/1.41) * V_{ref}$$

$$I_{MAX} = V_{ref}$$

$$V_{ref} = I_{MAX}$$

3. TMC2208 with $R_s=0.110\Omega$ (110m Ω) for Stand-alone Mode:

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325mV / (R_s + 30m\Omega)))) \\ &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325/110+30))) \\ &= ((1/1.41) * (V_{ref}/2.50) * (2.32143)) \\ &= (1/1.41) * V_{ref} * 0.928572 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$

Therefore,

$$I_{MAX} * (1/1.41) = (1/1.41) * V_{ref} * 0.928572$$

$$I_{MAX} = V_{ref} * 0.9286$$

$$V_{ref} = I_{MAX} * 1.0769$$

See next page for other TMC stepper motor drivers

APPENDIX BDriving Current Calculation Formulas for TMC Stepper Motor Drivers**4. TMC2208 with $R_s=0.110\Omega$ (110mΩ) for UART Mode:**

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325mV / (R_s + 20m\Omega)))) \\ &= ((1 / 1.41) * (V_{ref}/2.5) * ((325/(110+20)))) \\ &= ((1/1.41) * (V_{ref}/2.5) * (2.5)) \\ &= (1/1.41) * V_{ref} * 1 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$

Therefore,

$$I_{MAX} * (1/1.41) = (1/1.41) * V_{ref}$$

$$I_{MAX} = V_{ref}$$

$$V_{ref} = I_{MAX}$$

5. TMC2209 with $R_s=0.110\Omega$ (110mΩ) for Stand-alone Mode:

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325mV / (R_s + 20m\Omega)))) \\ &= ((1/1.41) * (V_{ref}/2.5) * ((325/(110+20)))) \\ &= ((1/1.41) * (V_{ref}/2.5) * (2.5)) \\ &= (1/1.41) * V_{ref} * 1 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$

Therefore,

$$I_{MAX} * (1/1.41) = (1/1.41) * V_{ref}$$

$$I_{MAX} = V_{ref}$$

$$V_{ref} = I_{MAX}$$

See next page for other TMC stepper motor drivers

APPENDIX BDriving Current Calculation Formulas for TMC Stepper Motor Drivers**6. TMC2209 with $R_s=0.110\Omega$ (110mΩ) for UART Mode:**

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325mV / (R_s + 20m\Omega)) \\ &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325/110+20))) \\ &= ((1/1.41) * (V_{ref}/2.5) * (2.5)) \\ &= (1/1.41) * V_{ref} * 1 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$

Therefore,

$$I_{MAX} * (1/1.41) = (1/1.41) * V_{ref}$$

$$I_{MAX} = V_{ref}$$

$$V_{ref} = I_{MAX}$$

7. TMC2225 with $R_s=0.150\Omega$ (150mΩ) for UART Mode:

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325mV / (R_s + 20m\Omega)) \\ &= ((1/1.41) * (V_{ref}/2.5) * ((325/(150+20))) \\ &= ((1/1.41) * (V_{ref}/2.5) * (1.9118)) \\ &= (1/1.41) * V_{ref} * 0.7647 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$

Therefore,

$$I_{MAX} * (1/1.41) = (1/1.41) * V_{ref} * 0.7647$$

$$I_{MAX} = V_{ref} * 0.7647$$

$$V_{ref} = I_{MAX} * 1.3077$$

8. TMC5160 with $R_s=0.075\Omega$ (75mΩ) for SPI Mode:

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (325mV / R_s)) \\ &= ((1/1.41) * (325/75)) \\ &= (1/1.41) * 4.33 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$ Therefore,

$$I_{MAX} * (1/1.41) = (1/1.41) * 4.33$$

$$I_{MAX} = 4.333 \text{ Amps}$$

You will use **50% to 90%** of I_{MAX} ($4.333 * .50$ or $4.333 * .90$) which is **2.1665 Amps (2167 mA)** to **3.8997 Amps (3900 mA)** for the Marlin Firmware.

See next page for other TMC stepper motor drivers

APPENDIX BDriving Current Calculation Formulas for TMC Stepper Motor Drivers**9. TMC5161 with $R_s=0.062\Omega$ (62mΩ) for SPI Mode:**

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (325mV / R_s)) \\ &= ((1/1.41) * (325/62)) \\ &= (1/1.41) * 5.24194 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$ Therefore,

$$I_{MAX}*(1/1.41)=(1/1.41)*5.24194$$

$$I_{MAX}=\mathbf{5.24194 \text{ or } 5.2419}$$

You will use **50% to 90%** of I_{MAX} ($5.2419*.50$ or $5.2419*.90$) which is **2.621 Amps (2621 mA)** to **4.7177 Amps (4718 mA)** for the Marlin Firmware.

10. TMC2225 with $R_s=0.150\Omega$ (150mΩ) for Stand-alone Mode:

$$\begin{aligned} I_{RMS} &= ((1 / 1.41) * (V_{ref} / 2.5) * ((325mV / (R_s + 30m\Omega)))) \\ &= ((1/1.41) * (V_{ref}/2.5) * ((325/(150+30)))) \\ &= ((1/1.41) * (V_{ref}/2.5) * (1.8056)) \\ &= (1/1.41) * V_{ref} * 0.7222 \end{aligned}$$

Since $I_{RMS}=I_{MAX}*(1/1.41)$

Therefore,

$$I_{MAX}*(1/1.41)=(1/1.41)*V_{ref}*0.7222$$

$$I_{MAX}=V_{ref}*\mathbf{0.7222}$$

$$V_{ref}=I_{MAX}*\mathbf{1.3846}$$

APPENDIX C

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

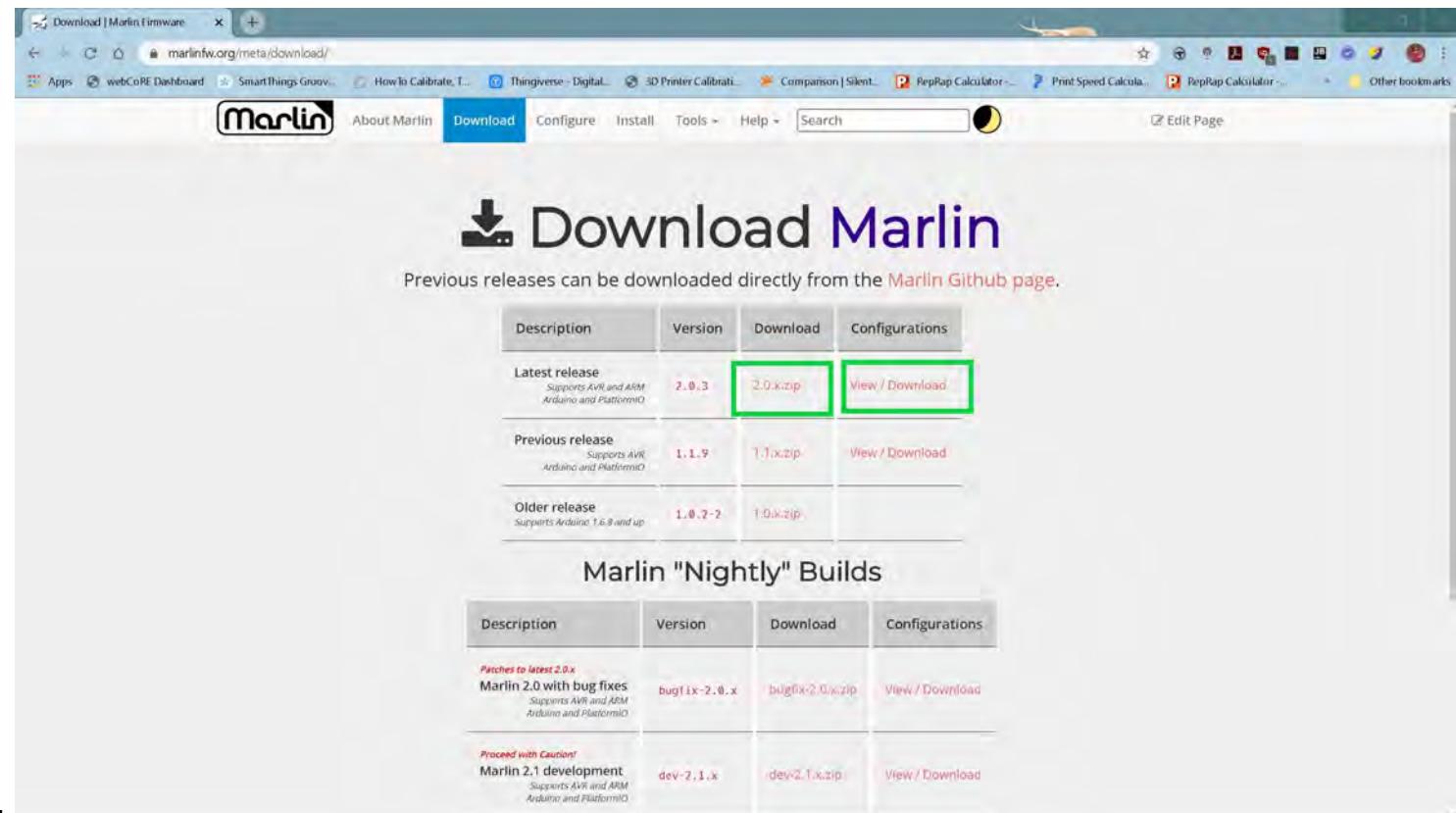
Please follow this guide to install Visual Studio Code with Platformio onto your computer. The link to the instruction are located at: https://marlinfw.org/docs/basics/install_platformio.html

Please refer to the following documents:

- [BIGTREETECH SKR-PRO-V1.1 User Manual.pdf](#)
- [BIGTREETECH SKR-PRO-V1.1 Guide.pdf](#)

This example will use the Creality Ender 3 printer. Select the appropriate default configuration files for your specific printer!

- Download the [latest release of Marlin](https://marlinfw.org/meta/download/) from here: <https://marlinfw.org/meta/download/>
- Unzip the latest release of Marlin onto your hard drive
- Also, download the latest release of the Marlin Configuration files and then unzip the Marlin Configuration files so they reside in the same subdirectory as the Marlin files, see the pictures below for how I organize my file structure for Marlin

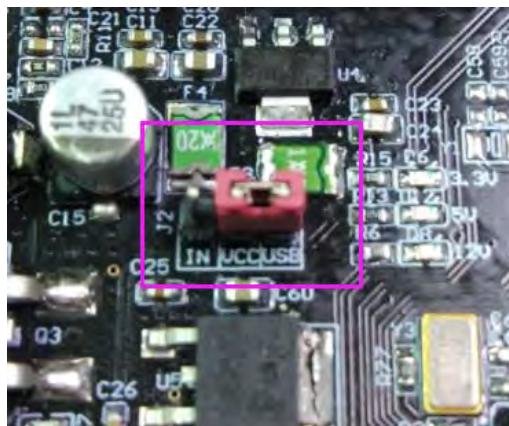


- Go to the next page.

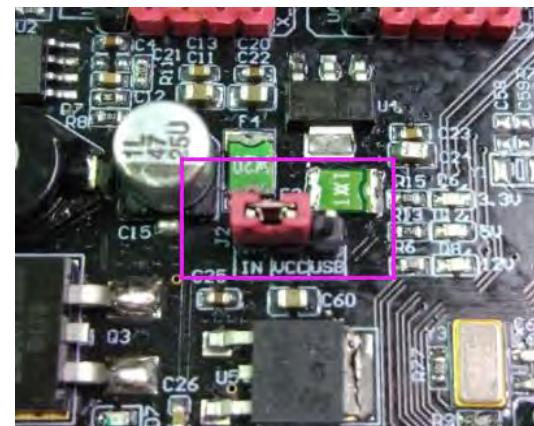
The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

To ensure that any changes I make to my Marlin Firmware are taken as I program it, I do a couple of things to ensure that the parameters are set properly. I will send an M503 by using the **Pronterface software** **BEFORE I change the Marlin Firmware** so I can **write down all the calibrations that I have previously set**.

I ensure that the "Power selection", as defined in "SKR PRO V1.1 user manual v1.1.pdf" to set the correct power input source ②. Even though you can use the USB as the source of power, I prefer to use the 12V/24V power source, as seen below.



① USB power



② 12/24V power

Marlin2.0 Firmware Update Method:

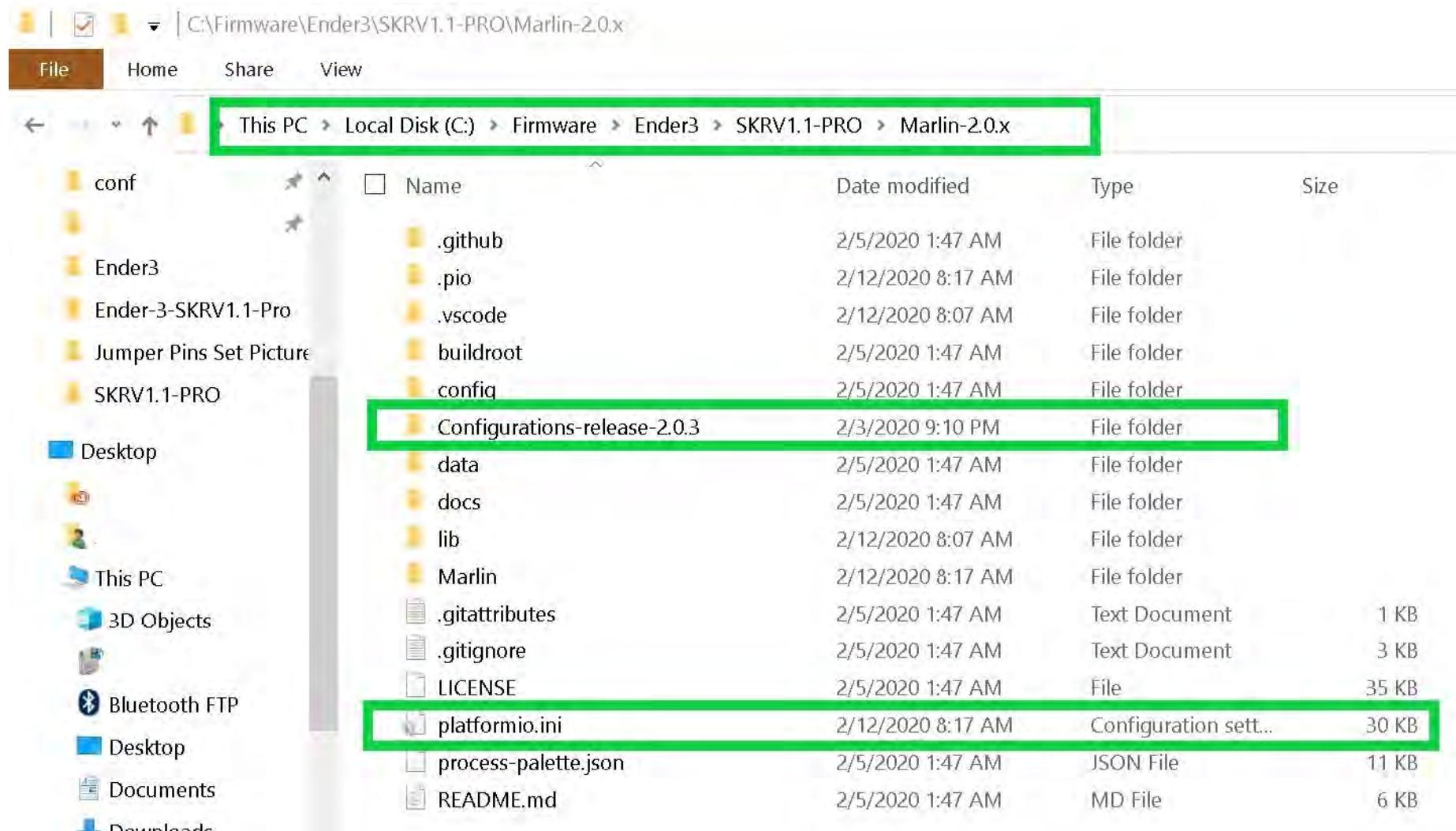
After downloading the files, use Visual Studio Code to open the project for compilation. Customize the firmware and compile it. Check for errors. If there are no errors, find the "firmware.bin" file. Copy it to the SD card and plug the SD card in the board. Reboot the board; wait for about 10 seconds before doing anything else with the board. I then use the **Pronterface software**, to send the following "G-code" commands:

- M502
- M500
- M504

M502 reset all configurable settings to their factory defaults. When you follow a M502 by a M500 the M500 will also reset settings in EEPROM. The M504 command will validate the contents of the EEPROM to ensure that the EEPROM settings have been changed to the factory defaults. If the reset does not show the correct settings, find your compiled "firmware.bin" file and copy it again to the SD card, then plug the SD card into the SKR PRO board. Reboot the board, wait for about 10 seconds and check the settings again.

After uploading new firmware, you will need to **calibrate your 3D printer again. Please see the following document for instructions on how to calibrate your 3D printer: <https://drive.google.com/open?id=19HVpv2jNMkPamIhMGiEaGEmsnmzs0KVe>**

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers



- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

NOTE: This example will use the Creality Ender 3 printer and using the latest release of Marlin firmware which is version 2.0.3. Select the appropriate default configuration files for your specific printer!

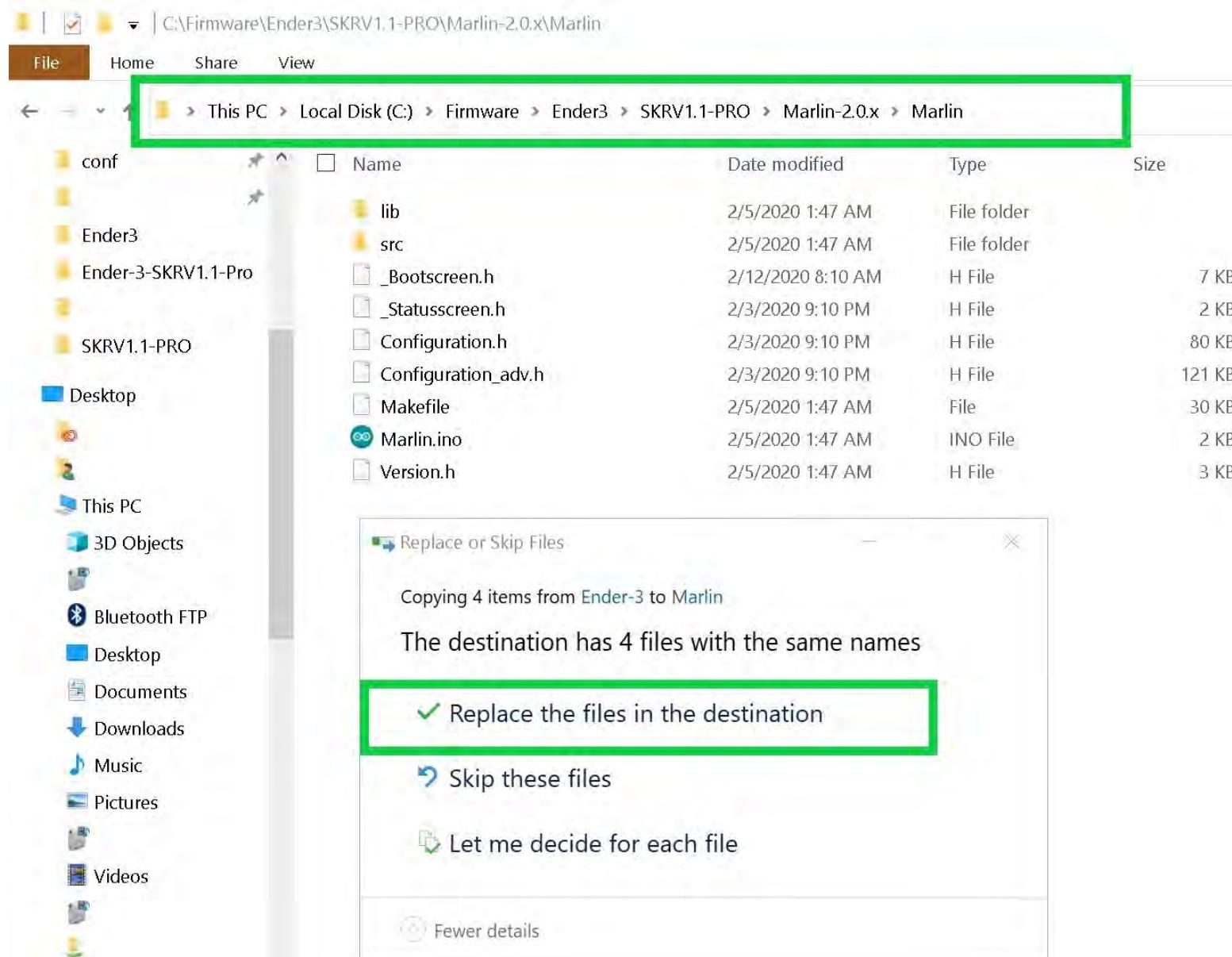
- Copy the below default configuration files (for me Ender 3 files, for you it could be another printer) to the directory where Marlin's Configuration.h and Configuration_adv.h reside. See picture below for which files you will copy. See the next page to see where to place the files.



- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

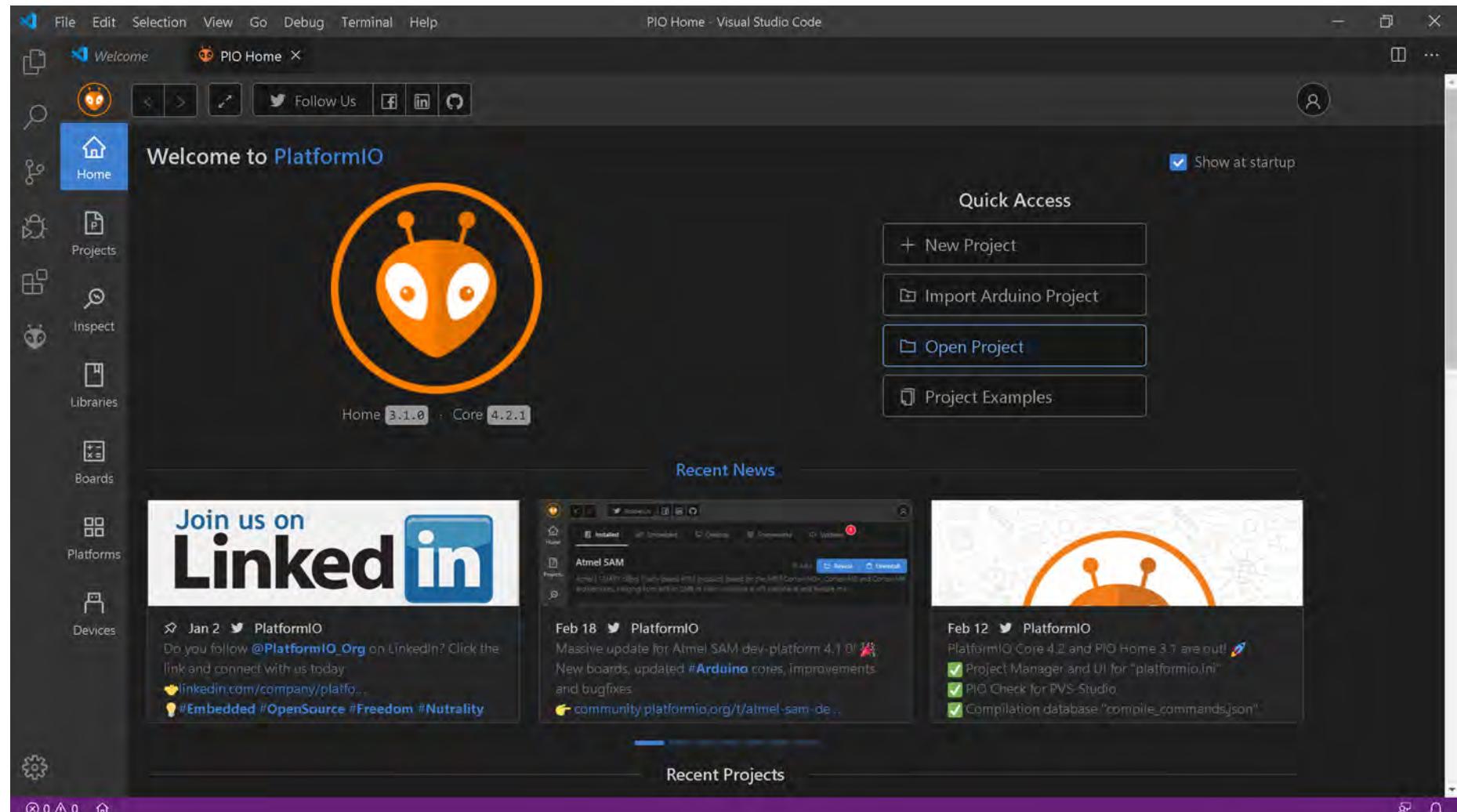
- Copy TO THIS directory so the above files reside in the same directory as Configuration.h and Configuration_adv.h. When prompted allow the files to be overwritten!



- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

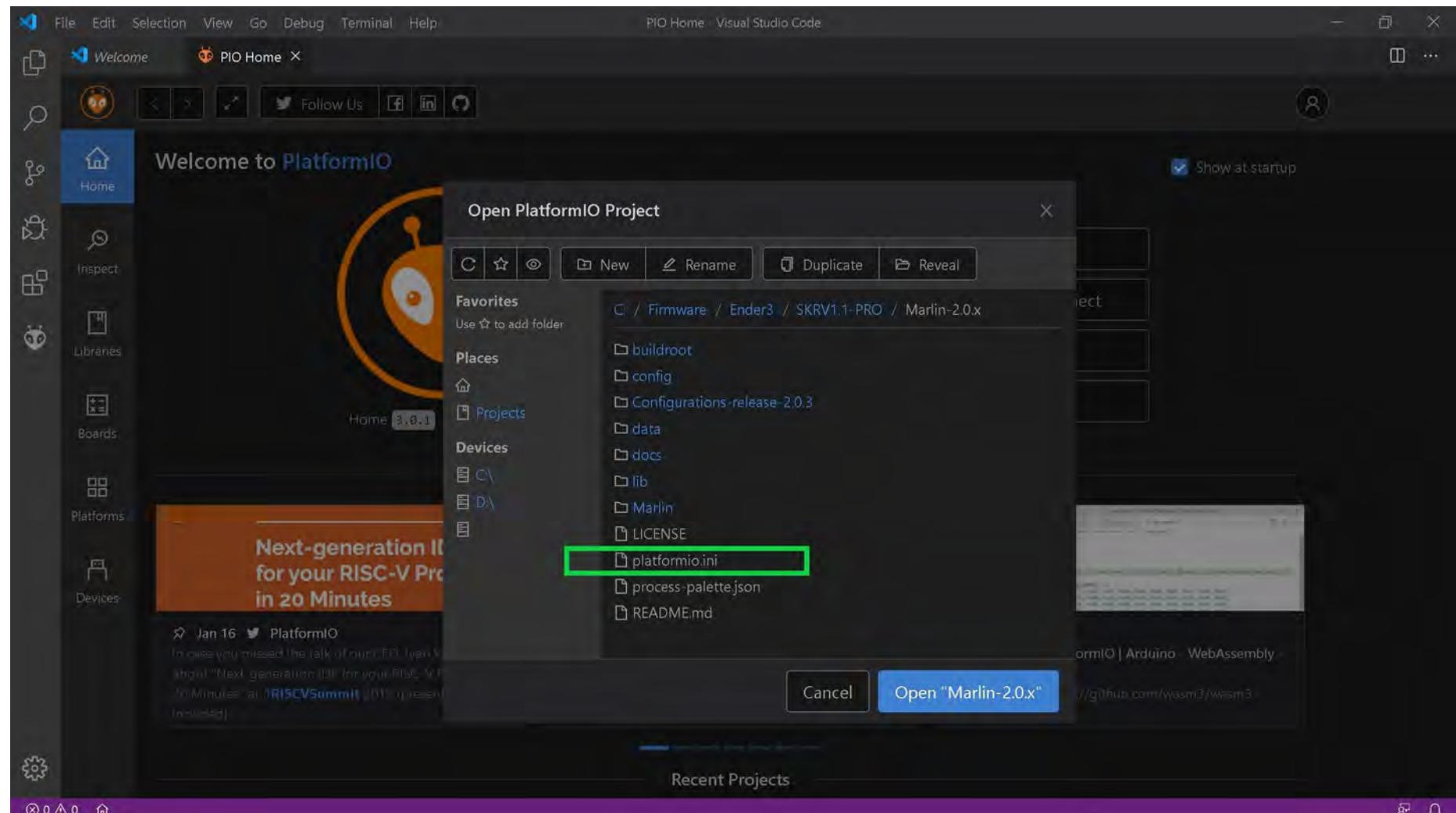
- Open VS code (see picture below) and then select "Open Project".



- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

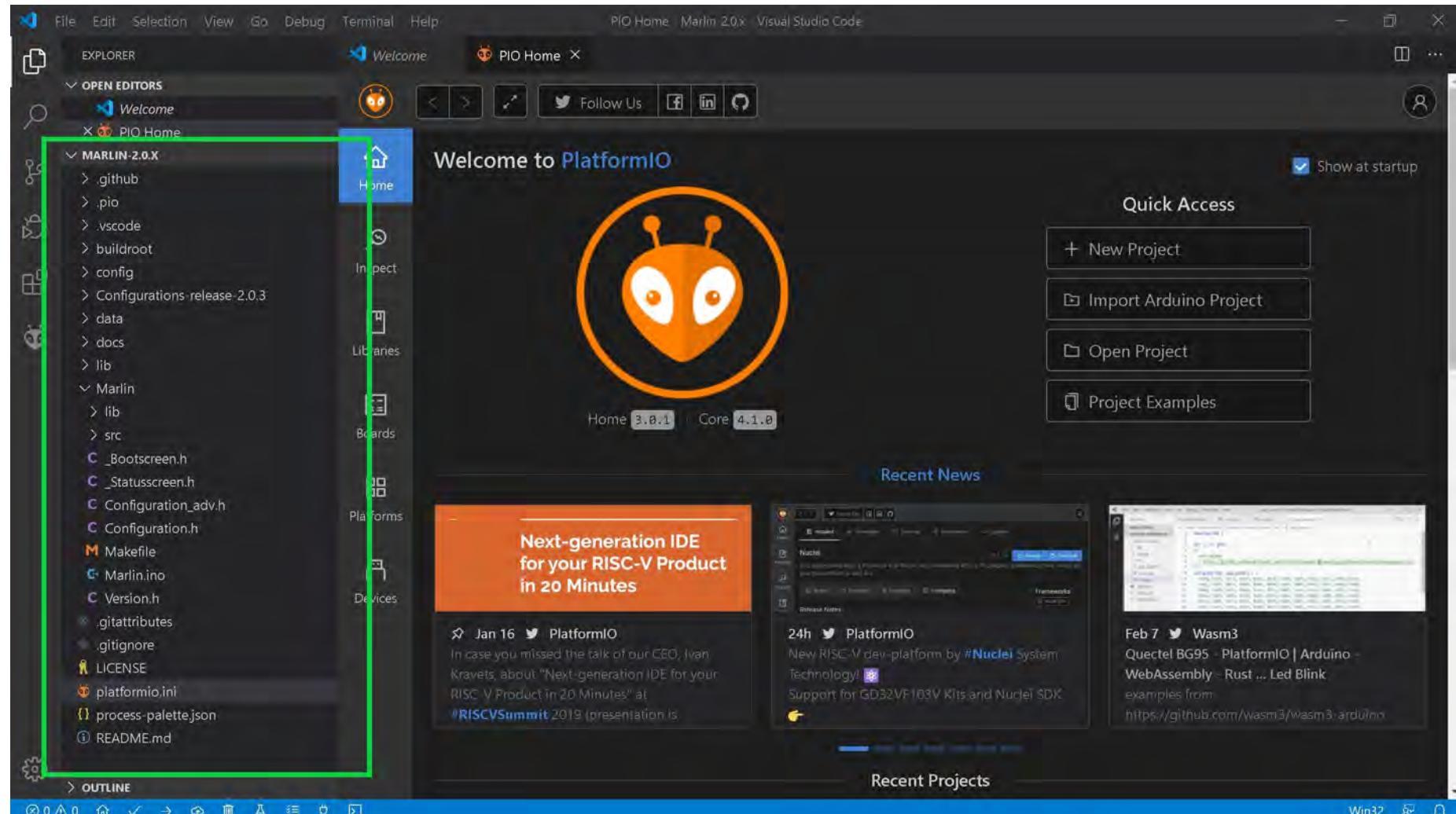
- Go to the directory where the platformio.ini file resides and open that folder (see picture below)



- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

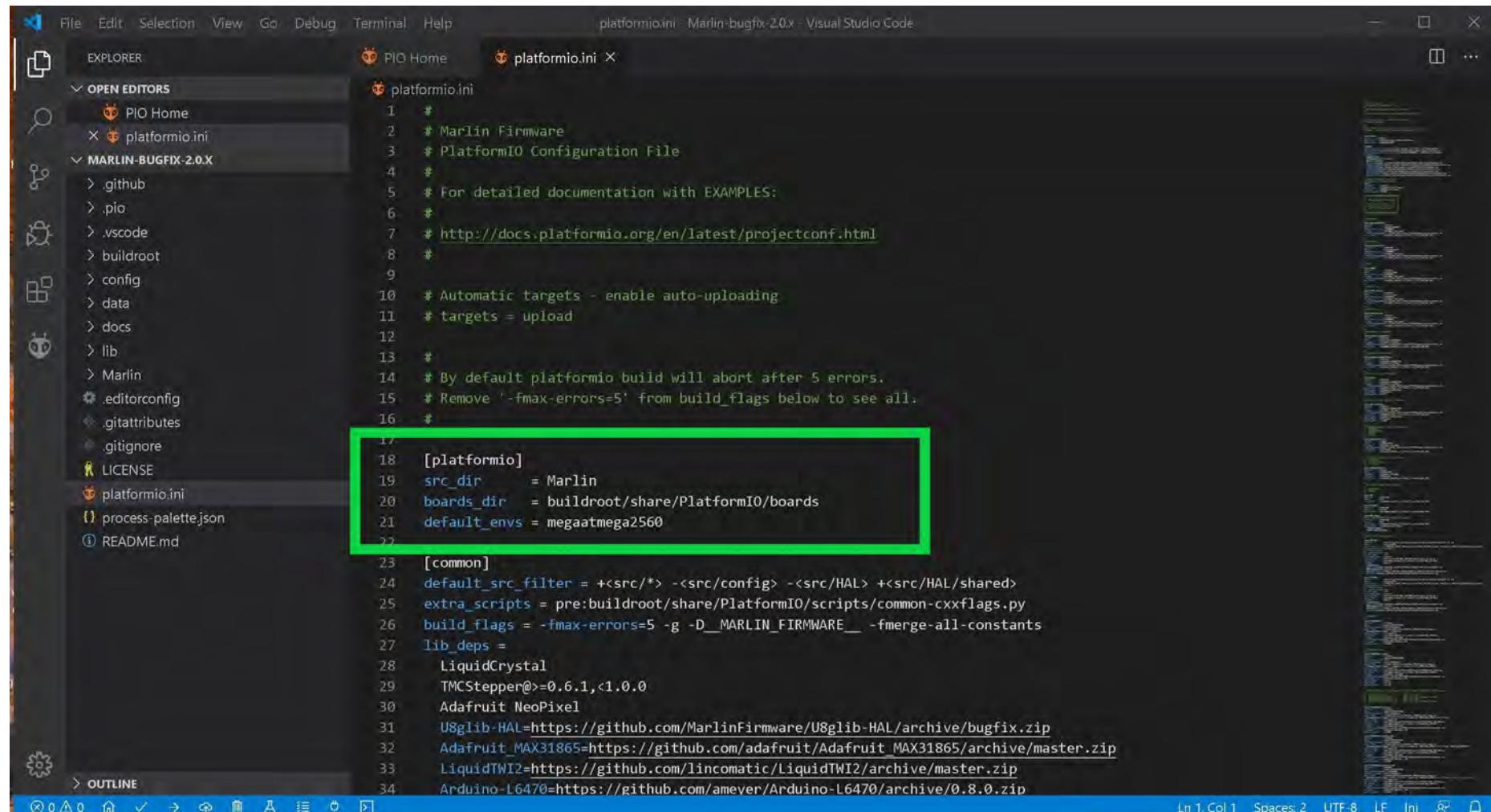
- On the left side you will see the file structure, double click on the "platformio.ini" file to open it up in the editor window.



- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- What you will see when "platformio.ini" is opened up in the VS code editor window



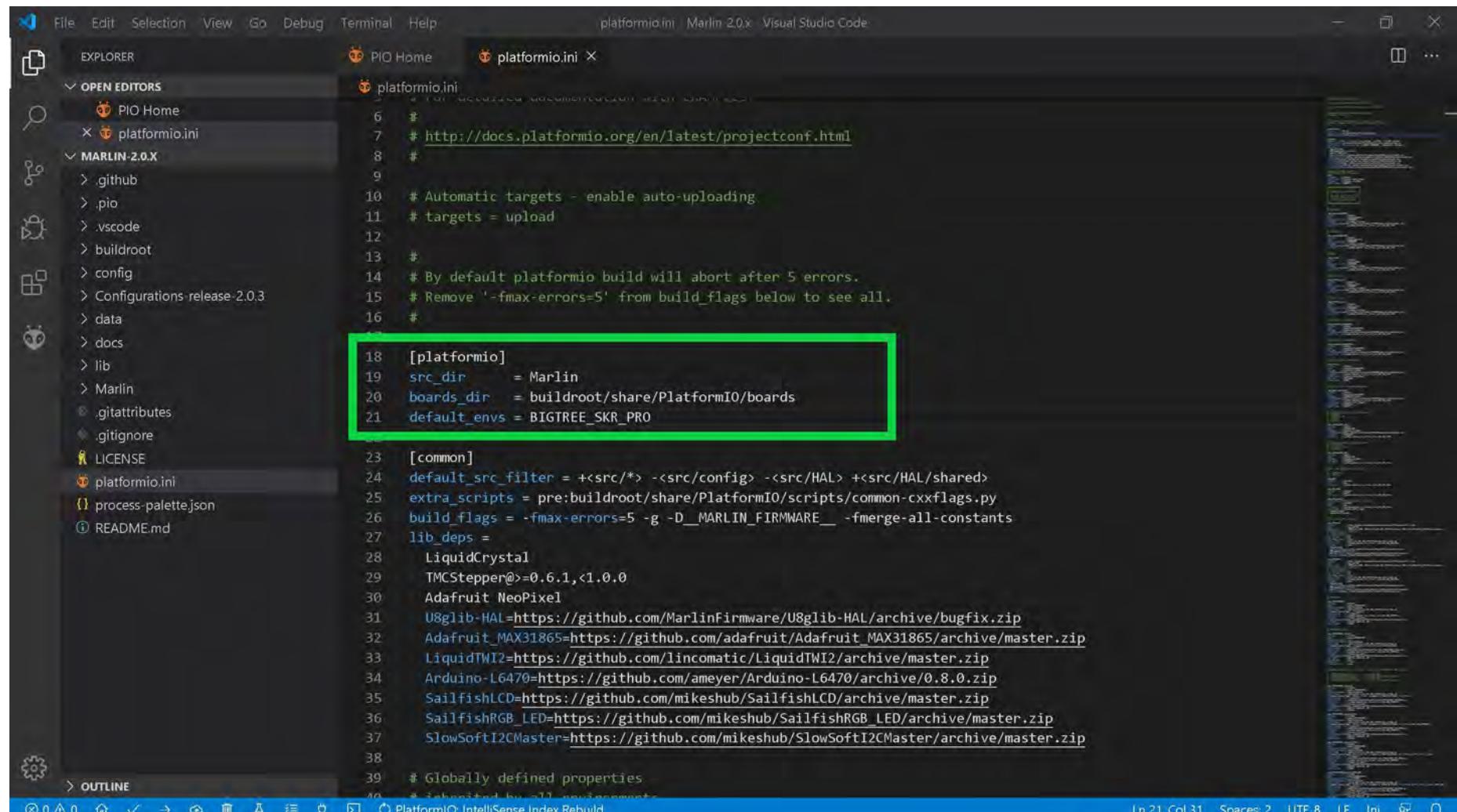
```
platformio.ini - Marlin-bugfix-2.0.x - Visual Studio Code

File Edit Selection View Go Debug Terminal Help
EXPLORER PIO Home platformio.ini
OPEN EDITORS
  PIO Home
  platformio.ini
MARLIN-BUGFIX-2.0.X
  .github
  .pio
  .vscode
  buildroot
  config
  data
  docs
  lib
  Marlin
  .editorconfig
  .gitattributes
  .gitignore
  LICENSE
  platformio.ini
  process-palette.json
  README.md
[platformio]
src_dir      = Marlin
boards_dir   = buildroot/share/PlatformIO/boards
default_envs = megaatmega2560
[common]
default_src_filter = +<src/*> -<src/config> -<src/HAL> +<src/HAL/shared>
extra_scripts = pre:buildroot/share/PlatformIO/scripts/common-cxxflags.py
build_flags = -fmax-errors=5 -g -D__MARLIN_FIRMWARE__ -fmerge-all-constants
lib_deps =
  LiquidCrystal
  TMCStepper@=0.6.1,<1.0.0
  Adafruit_NeoPixel
  U8glib-HAL=https://github.com/MarlinFirmware/U8glib-HAL/archive/bugfix.zip
  Adafruit_MAX31865=https://github.com/adafruit/Adafruit_MAX31865/archive/master.zip
  LiquidTWI2=https://github.com/lincomatic/LiquidTWI2/archive/master.zip
  Arduino-L6470=https://github.com/amever/Arduino-L6470/archive/0.8.0.zip
Ln 1, Col 1  Spaces: 2  UTF-8  LF  Ini  R  L  O  B
```

- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- Edit the "default_envs = megaatmega2560" line and make "default_envs = BIGTREE_SKR_PRO", as shown below in **GREEN**



```

File Edit Selection View Go Debug Terminal Help
platformio.ini Merlin 2.0.x Visual Studio Code

EXPLORER PIO Home platformio.ini
OPEN EDITORS
  PIO Home
  platformio.ini
MARLIN-2.0.X
  .github
  .pio
  .vscode
  buildroot
  config
  Configurations-release-2.0.3
  data
  docs
  lib
  Marlin
  .gitattributes
  .gitignore
  LICENSE
  platformio.ini
  process-palette.json
  README.md

[platformio]
src_dir      = Marlin
boards_dir   = buildroot/share/PlatformIO/boards
default_envs = BIGTREE_SKR_PRO

[common]
default_src_filter = +<src/*> -<src/config> -<src/HAL> +<src/HAL/shared>
extra_scripts = pre:buildroot/share/PlatformIO/scripts/common-cxxflags.py
build_flags = -fmax-errors=5 -g -D_MARLIN_FIRMWARE_ -fmerge-all-constants
lib_deps =
  LiquidCrystal
  TMCStepper@>=0.6.1,<1.0.0
  Adafruit NeoPixel
  U8glib-HAL=https://github.com/MarlinFirmware/U8glib-HAL/archive/bugfix.zip
  Adafruit_MAX31865=https://github.com/adafruit/Adafruit_MAX31865/archive/master.zip
  LiquidTWI2=https://github.com/lincomatic/LiquidTWI2/archive/master.zip
  Arduino-L6470=https://github.com/ameyer/Arduino-L6470/archive/0.8.0.zip
  SailfishLCD=https://github.com/mikeshub/SailfishLCD/archive/master.zip
  SailfishRGB_LED=https://github.com/mikeshub/SailfishRGB_LED/archive/master.zip
  SlowSoftI2CMaster=https://github.com/mikeshub/SlowSoftI2CMaster/archive/master.zip

# Globally defined properties

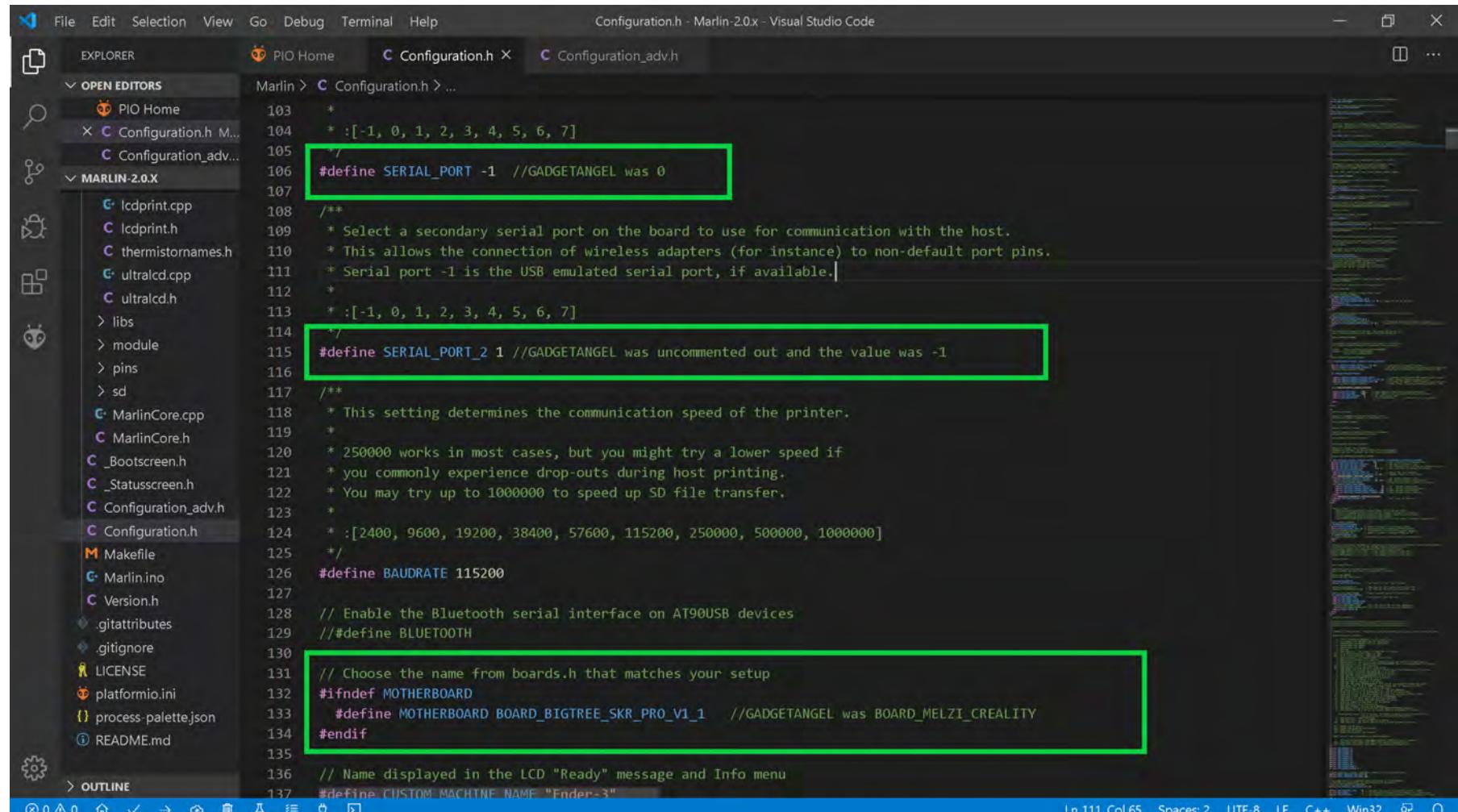
```

Ln 21, Col 31 Spaces: 2 UTF 8 LF Inl

- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- Go to the Configuration.h file and change the following three items, as seen in the **3 GREEN** boxes below.



```

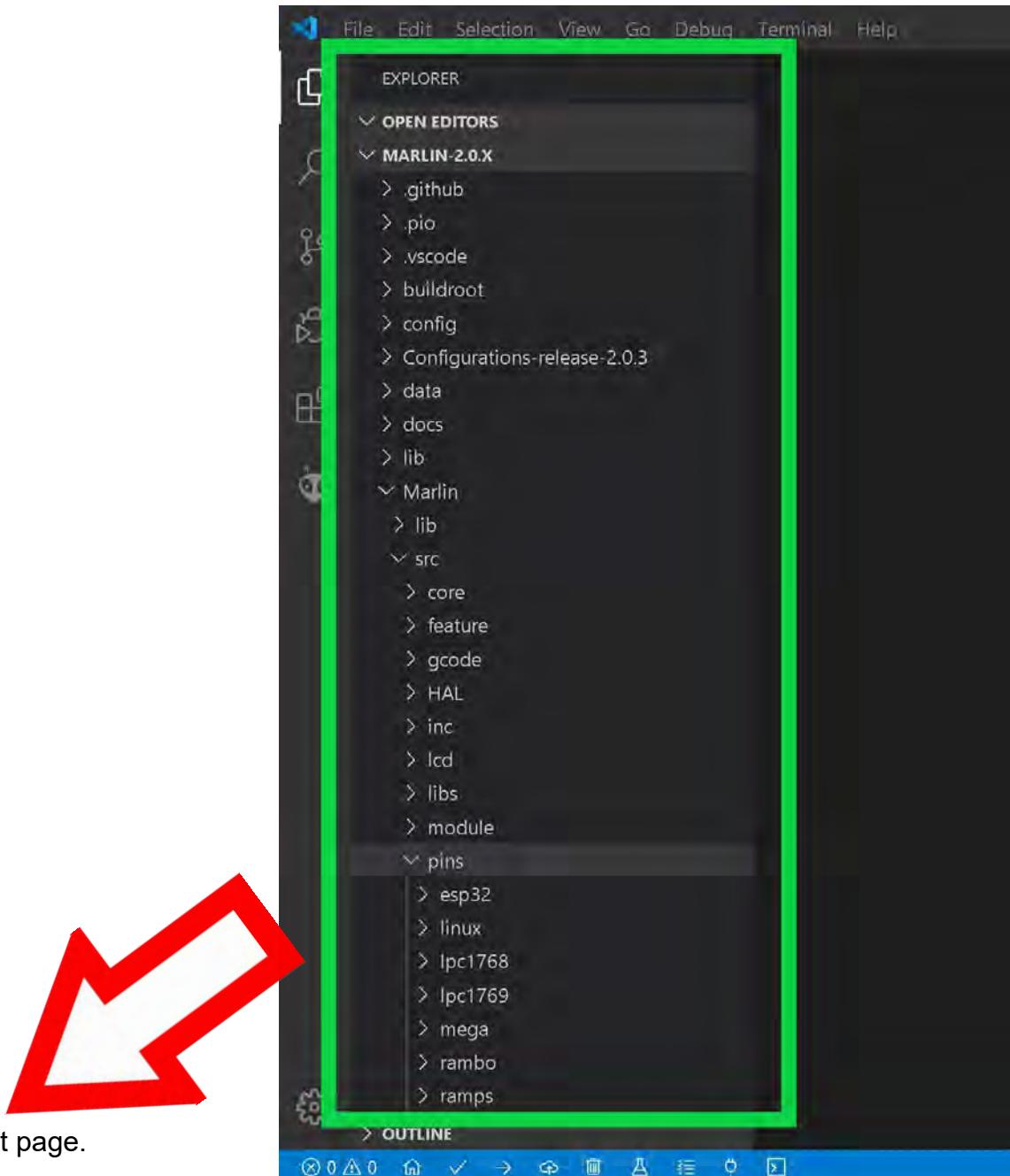
103  *
104  * :[-1, 0, 1, 2, 3, 4, 5, 6, 7]
105  */
106 #define SERIAL_PORT -1 //GADGETANGEL was 0
107
108 /**
109  * Select a secondary serial port on the board to use for communication with the host.
110  * This allows the connection of wireless adapters (for instance) to non-default port pins.
111  * Serial port -1 is the USB emulated serial port, if available.
112  *
113  * :[-1, 0, 1, 2, 3, 4, 5, 6, 7]
114 */
115 #define SERIAL_PORT_2 1 //GADGETANGEL was uncommented out and the value was -1
116
117 /**
118  * This setting determines the communication speed of the printer.
119  *
120  * 250000 works in most cases, but you might try a lower speed if
121  * you commonly experience drop-outs during host printing.
122  * You may try up to 1000000 to speed up SD file transfer.
123  *
124  * :[2400, 9600, 19200, 38400, 57600, 115200, 250000, 500000, 1000000]
125 */
126 #define BAUDRATE 115200
127
128 // Enable the Bluetooth serial interface on AT90USB devices
129 //#define BLUETOOTH
130
131 // Choose the name from boards.h that matches your setup
132 #ifndef MOTHERBOARD
133 #define MOTHERBOARD BOARD_BIGTREE_SKR_PRO_V1_1 //GADGETANGEL was BOARD_MELZI_CREALITY
134 #endif
135
136 // Name displayed in the LCD "Ready" message and Info menu
137 #define CUSTOM_MACHINE_NAME "Ender-3"

```

- You can set "BAUDRATE" to "115200" or "250000 ". Either setting will work but I have found that "115200" option works with any LCD that you choose to use.
- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- Time to learn where the SKR PRO V1.1 board's pins file is located: look at the left side and find the Marlin-2.0.X/Marlin/src/pins/stm32 subdirectory, as seen in the pictures below. Open the file, pins_BTT_SKR_PRO_V1_1.h, by double clicking on it.



- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

File Edit Selection View Go Debug Terminal Help pins_BTT_SKR_PRO_V1_1.h Marlin-2.0.x - Visual Studio Code

EXPLORER pins_BTT_SKR_PRO_V1_1.h ×

OPEN EDITORS Marlin > src > pins > stm32 > pins_BTT_SKR_PRO_V1_1.h ...

MARLIN-2.0.X

pins_BTT_SKR_PRO_V1_1.h Marlin's...

Module pins

> esp32

> linux

> lpc1768

> lpc1769

> mega

> rambo

> ramps

> sam

> sanguino

> stm32

C:\Firmware\Ender3\SKR V1.1-PRO\Marlin\src\pins\stm32\pins_BTT_SKR_PRO_V1_1.h

pins_BEAST.h

pins_BLACK_STM32F407VE.h

pins_BTT_BTT002_V1_0.h

pins_BTT_GTR_V1_0.h

pins_BTT_SKR_E3_DIP.h

pins_BTT_SKR_MINI_E3_V1_0.h

pins_BTT_SKR_MINI_E3_V1_2.h

pins_BTT_SKR_MINI_E3.h

pins_BTT_SKR_MINI_V1_1.h

pins_BTT_SKR_PRO_V1_1.h

pins_CHITU3D.h

pins_FLYF407ZG.h

pins_FYSETC_AIO_ll.h

pins_FYSETC_CHEETAH_V12.h

pins_FYSETC_CHEETAH.h

161 //

162 // Temperature Sensors

163 //

164 //

165 #define TEMP_0_PIN PF4 // T1 <-> E0

166 #define TEMP_1_PIN PF5 // T2 <-> E1

167 #define TEMP_2_PIN PF6 // T3 <-> E2

168 #define TEMP_BED_PIN PF3 // T0 <-> Bed

169 //

170 //

171 // Heaters / Fans

172 //

173 #define HEATER_0_PIN PB1 // Heater0

174 #define HEATER_1_PIN PD14 // Heater1

175 #define HEATER_2_PIN PB0 // Heater1

176 #define HEATER_BED_PIN PD12 // Hotbed

177 #define FAN_PIN PC8 // Fan0

178 #define FAN1_PIN PE5 // Fan1

179 #define FAN2_PIN PE6 // Fan2

180 //

181 //

182 // Misc. Functions

183 //

184 #define SDSS PB12

185 *

186 **

187 *

188 * NC | + + | GND 5V | + + | GND

189 * RESET | + + | PF12(SD_DETECT) (LCD_D7) PG7 | + + | PG6 (LCD_D6)

190 * (MOSI)PB15 | + + | PF11(BTN_EN2) (LCD_D5) PG3 | + + | PG2 (LCD_D4)

191 * (SD_SS)PB12 | + + | PG10(BTN_EN1) (LCD_RS) PD10 | + + | PD11 (LCD_EN)

192 * (SCK)PB13 | + + | PB14(MISO) (BTN_ENC) PA8 | + + | PG4 (BEEPER)

193 *

194 * EXP2 EXP1

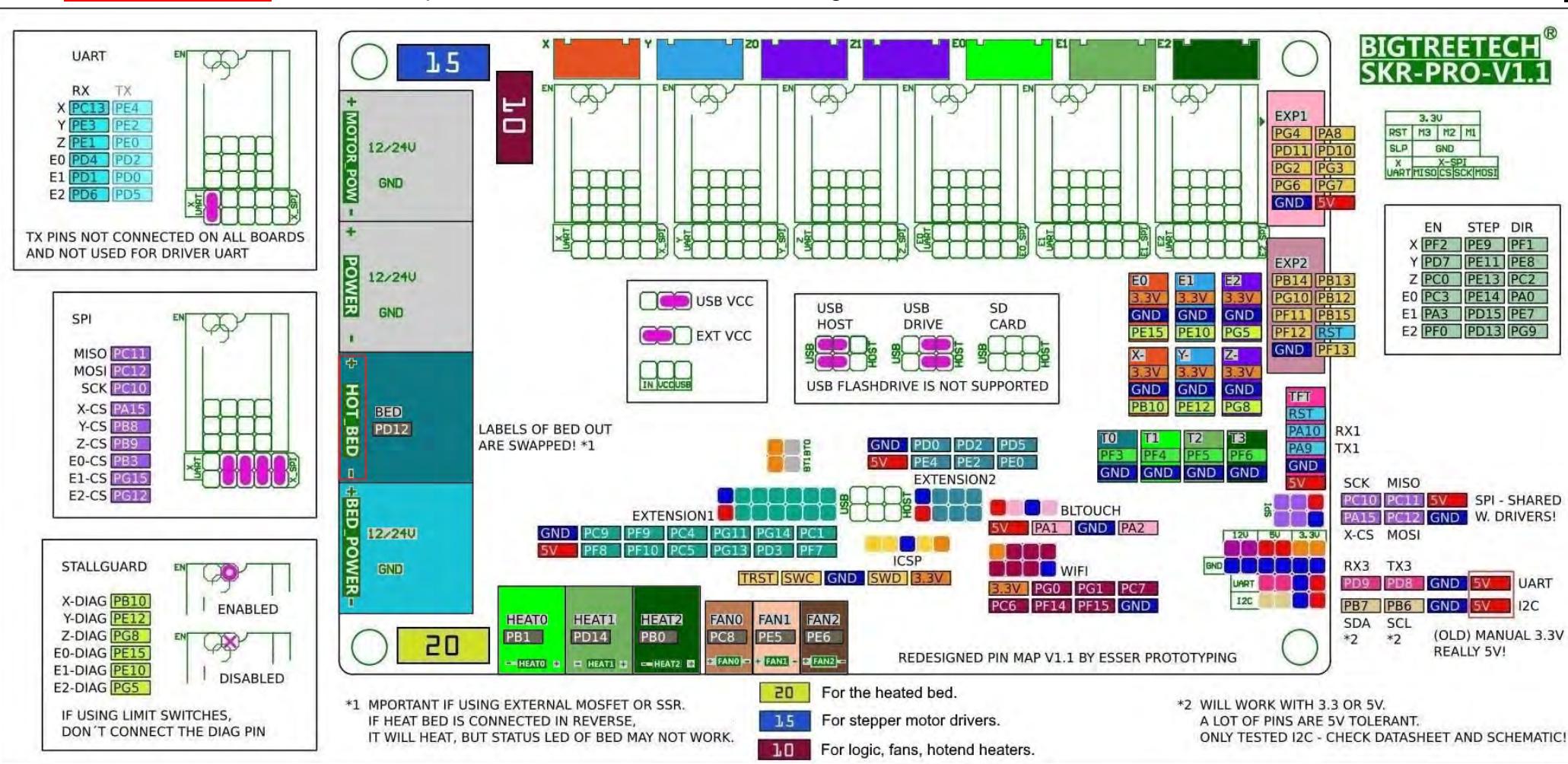
```
> sanguino  
 175 #define HEATER_2_PIN  
 176 #define HEATER_BED_PIN  
C | C:\Firmware\Ender3\SKRV1.1-PRO\Marlin-2.0.x\Marlin\src\pins\stm32.h  
C pins_BEAST.h  
 178 #define FAN_PIN  
 179 #define FAN1_PIN
```

- Go to the next page.

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- We want to set the fan on the hot end to automatically turn on when the hot end starts to get hot. In the pins_BTT_SKR_PRO_V1_1.h file you will find all the pins that are defined for the board. They should all conform to the SKR PRO V1.1 Pin diagram shown below.
- [See the next page](#) for a function picture of the SKR PRO V1.1 wire diagram.

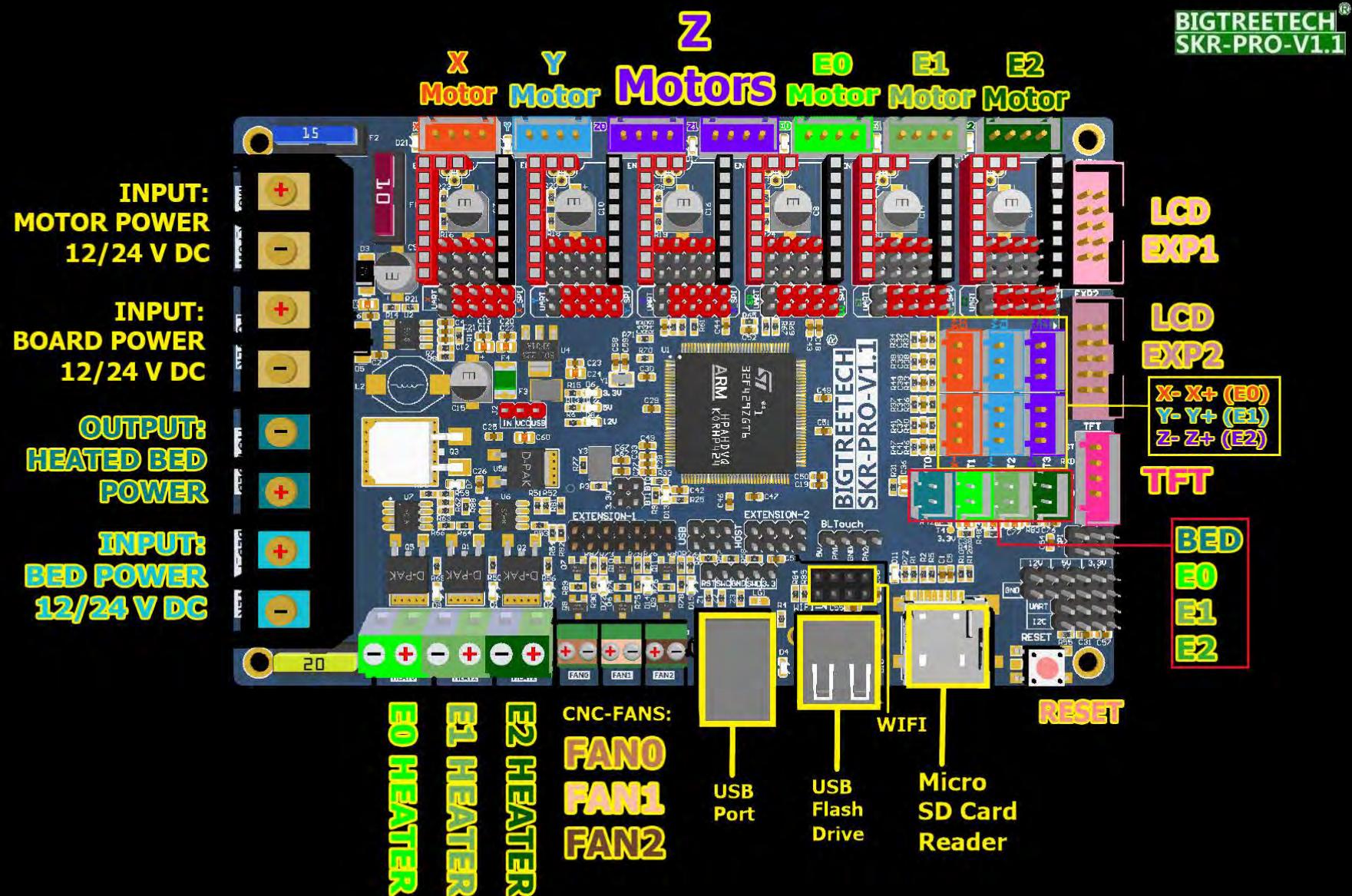
3



- We want to copy and paste the Marlin name or the actual pin number of where you hooked up the fan for your hot end and use that to set "E0_AUTO_FAN_PIN" in the Configuration_adv.h file. I am connecting FAN1 port to my electronics case fan. I am connecting FAN0 port to my part or print cooling fan and connecting FAN2 port to my dual 5015 hot end cooling fans. But we are only interested in how to set the hot end cooling fan up. So, in this example I will use FAN2 port for my hot end cooling fan. In pins_BTT_SKR_PRO_V1_1.h file we see FAN2 port is defined as PE6. So you can choose to copy "PE6" or "FAN2_PIN".

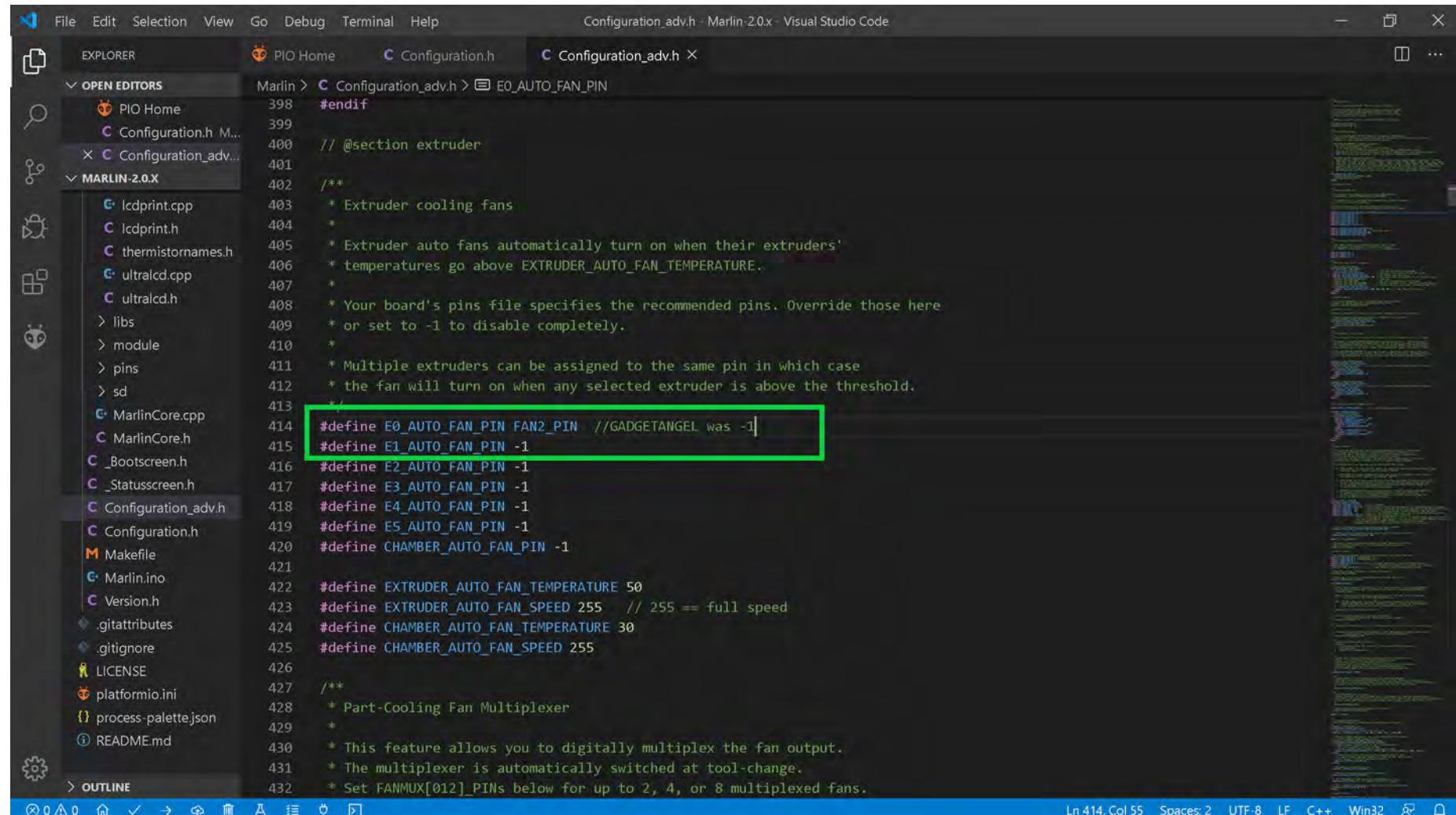
3 Pin Diagram is done by Thomas White

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers



The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- To set the hot end fan, I will use FAN2_PIN and set "E0_AUTO_FAN_PIN" in the Configuration_adv.h file to FAN2_PIN, as seen in the picture below



```

File Edit Selection View Go Debug Terminal Help Configuration_adv.h - Marlin-2.0.x - Visual Studio Code
EXPLORER PIO Home Configuration.h Configuration_adv.h
Marlin > Configuration_adv.h > E0_AUTO_FAN_PIN
398 #endif
399
400 // @section extruder
401
402 /**
403 * Extruder cooling fans
404 *
405 * Extruder auto fans automatically turn on when their extruders'
406 * temperatures go above EXTRUDER_AUTO_FAN_TEMPERATURE.
407 *
408 * Your board's pins file specifies the recommended pins. Override those here
409 * or set to -1 to disable completely.
410 *
411 * Multiple extruders can be assigned to the same pin in which case
412 * the fan will turn on when any selected extruder is above the threshold.
413 */
414 #define E0_AUTO_FAN_PIN FAN2_PIN //GADGETANGEL was -1
415 #define E1_AUTO_FAN_PIN -1
416 #define E2_AUTO_FAN_PIN -1
417 #define E3_AUTO_FAN_PIN -1
418 #define E4_AUTO_FAN_PIN -1
419 #define E5_AUTO_FAN_PIN -1
420 #define CHAMBER_AUTO_FAN_PIN -1
421
422 #define EXTRUDER_AUTO_FAN_TEMPERATURE 50
423 #define EXTRUDER_AUTO_FAN_SPEED 255 // 255 == full speed
424 #define CHAMBER_AUTO_FAN_TEMPERATURE 30
425 #define CHAMBER_AUTO_FAN_SPEED 255
426
427 /**
428 * Part-Cooling Fan Multiplexer
429 *
430 * This feature allows you to digitally multiplex the fan output.
431 * The multiplexer is automatically switched at tool-change.
432 * Set FANMUX[012]_PINs below for up to 2, 4, or 8 multiplexed fans.

```

- To see more Marlin setup for the latest release, [please refer to the stepper motor driver section of this document for the stepper motor driver of your choice.](#)