Stepper Driver Configurations for SKR PRO V1.1 Board

by
@GadgetAngel

Based on Work by  @rflulling

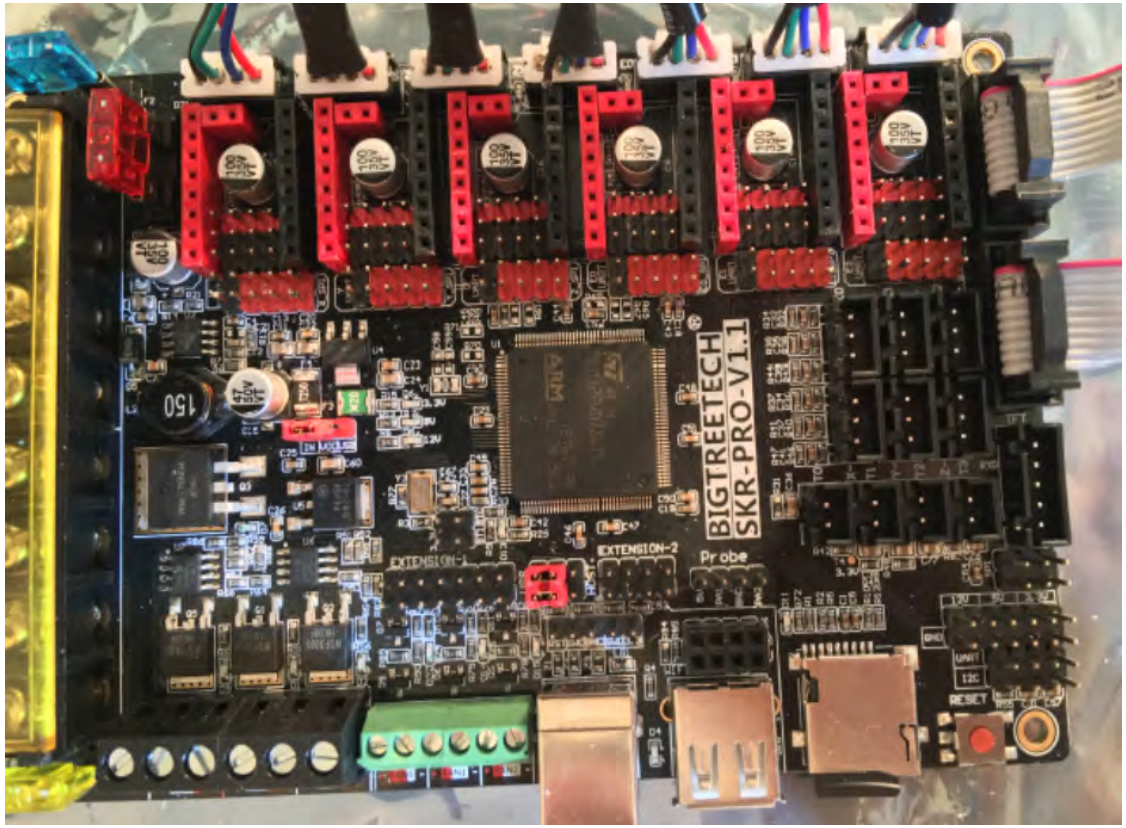

Table of Contents

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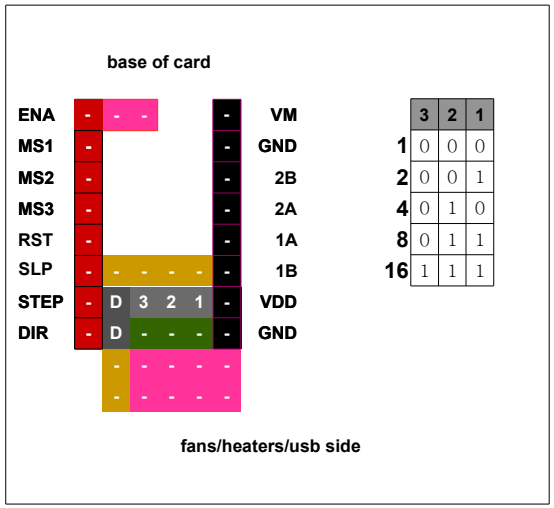
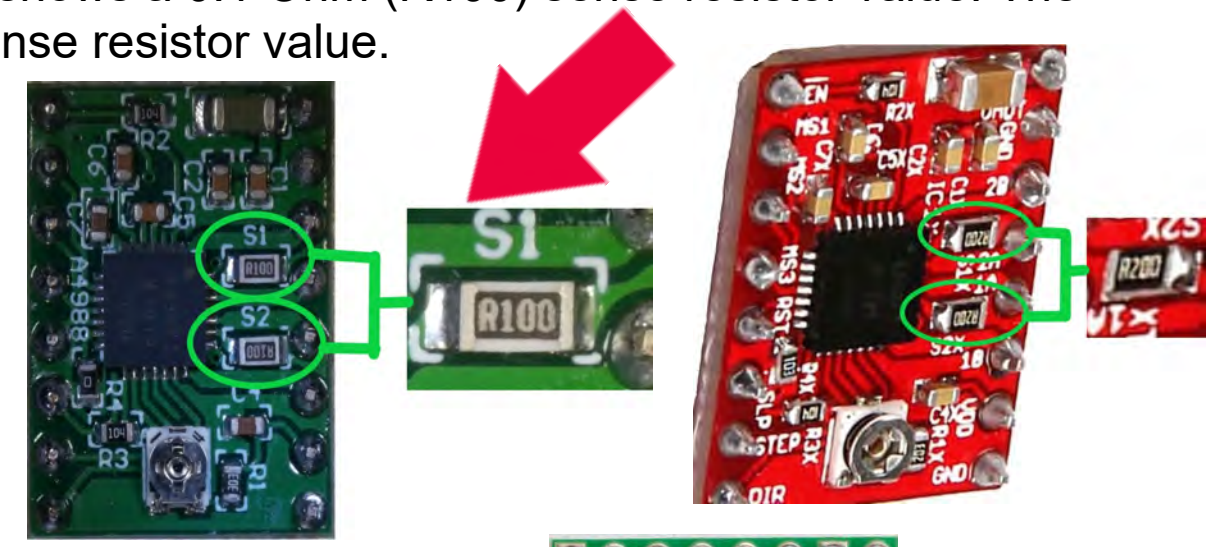
A4988

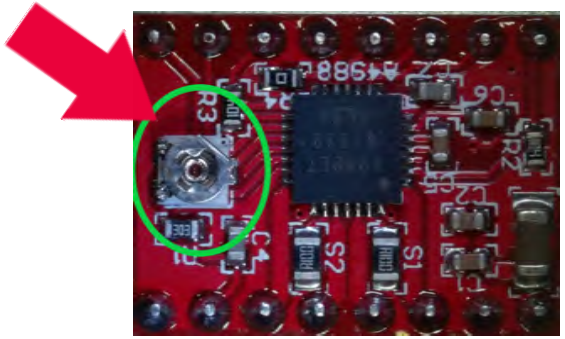


Driver Chip	MS3	MS2	MS1	Subdivision	Excitation Mode
A4988 Maximum 16 subdivision 35V 2A	L	L	L	Full Step	2 Phase
	L	L	H	1/2	1-2 Phase
	L	H	L	1/4	W1-2 Phase
	L	H	H	1/8	2W1-2 Phase
	H	H	H	1/16	4W1-2 Phase
Driving current calculation formula Rs=0.1Ω	Imax = Vref / (8 * Rs)			$V_{REF} = 8 \cdot I_{MAX} \cdot R_S$	
	Note: Use 90% of the calculated Vref when tuning the stepper driver board				

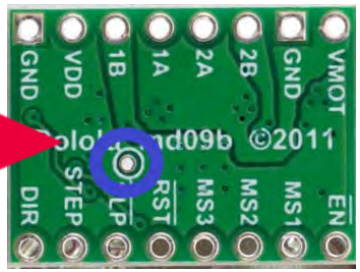
Note: Not all driver boards for the A4988 use the same current sense resistor (Rs), check your driver board for the value of the Rs resistor by examining the board, as shown in the GREEN box below. The GREEN PCB shows a 0.1 Ohm (R100) sense resistor value. The RED PCB shows a 0.2 Ohm (R200) sense resistor value.



NOTE: **Use the potentiometer (POT) on the top of the board (or use the board's "Vref Test point") to adjust your Vref .** See the appendix for instructions on how to set the Vref on a driver board.

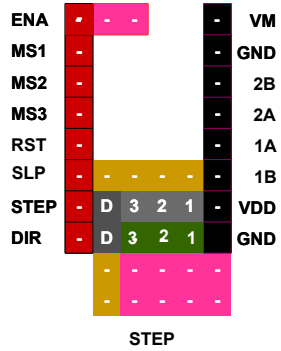


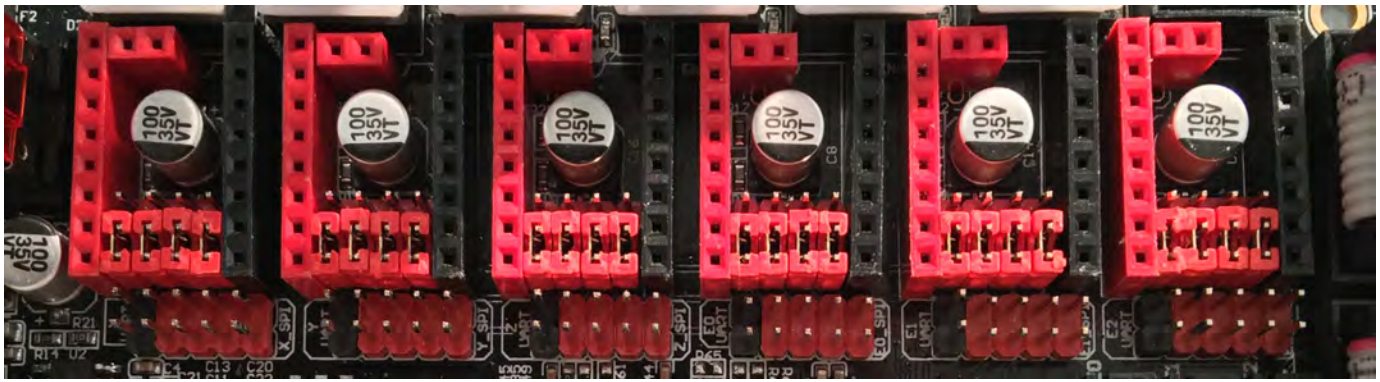
Note: "Vref Test point" location is on the bottom of the driver board, as shown in BLUE



A4988

Note: The "D" jumper MUST be SET!





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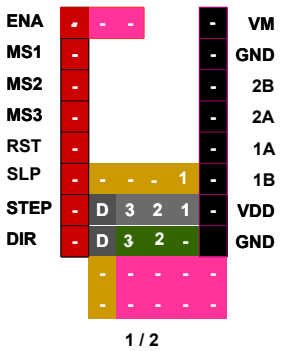

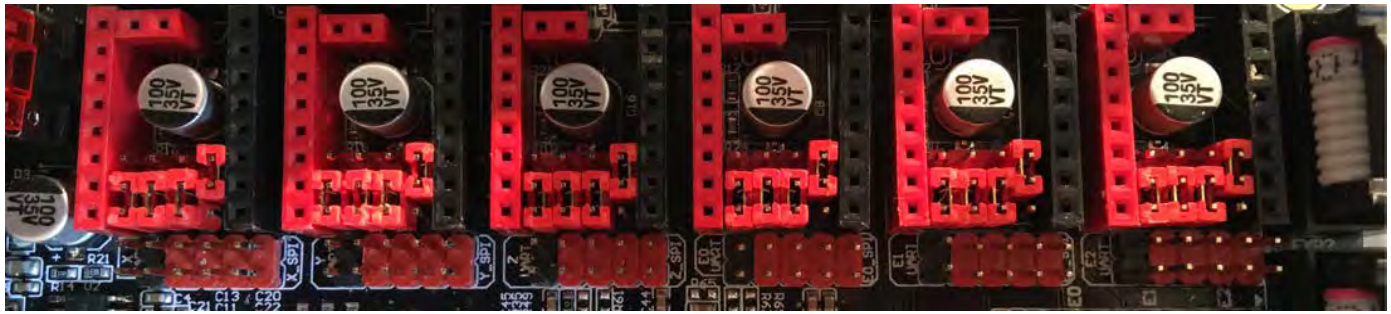

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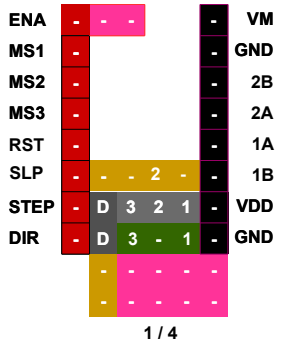

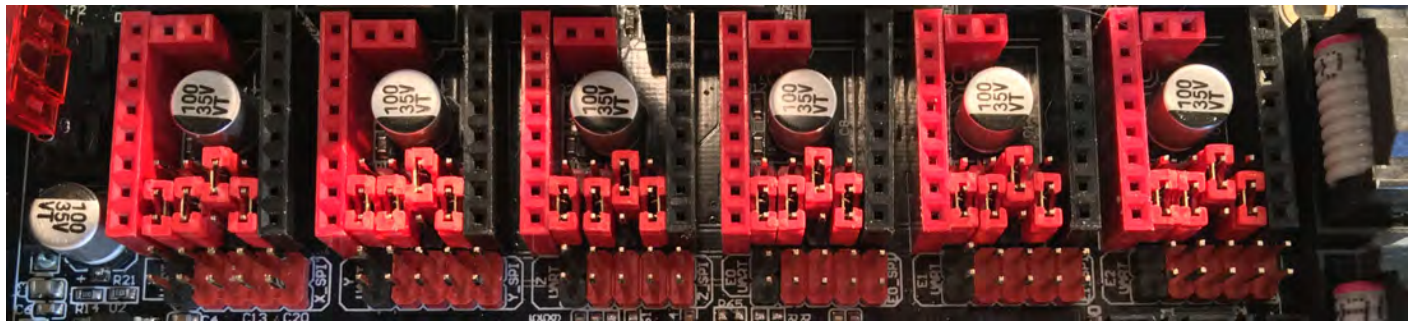

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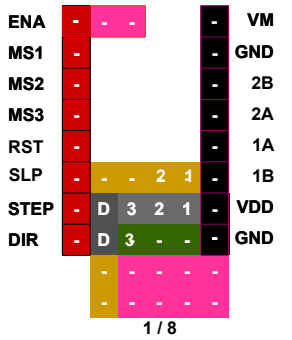

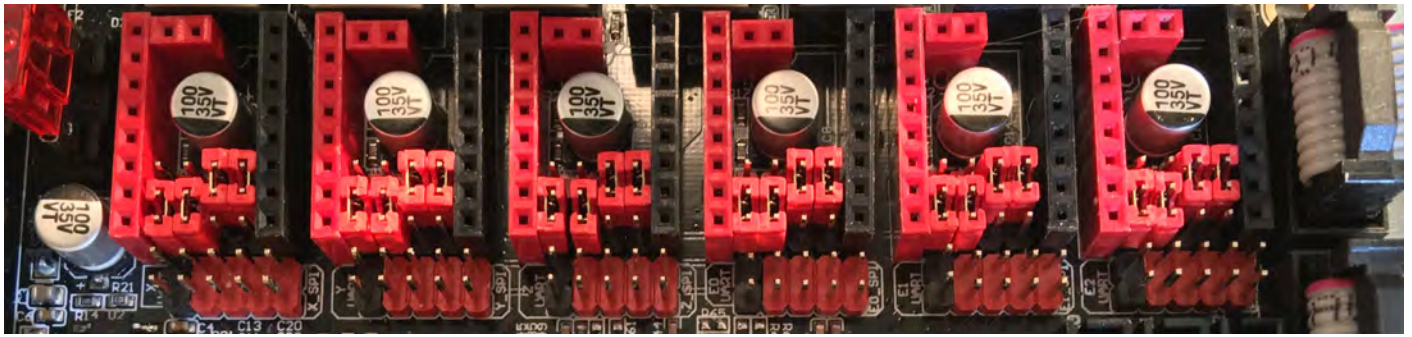

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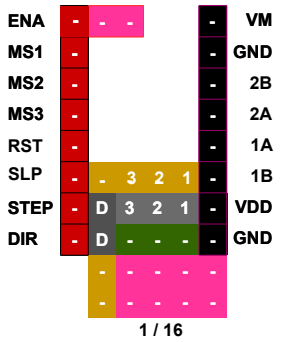
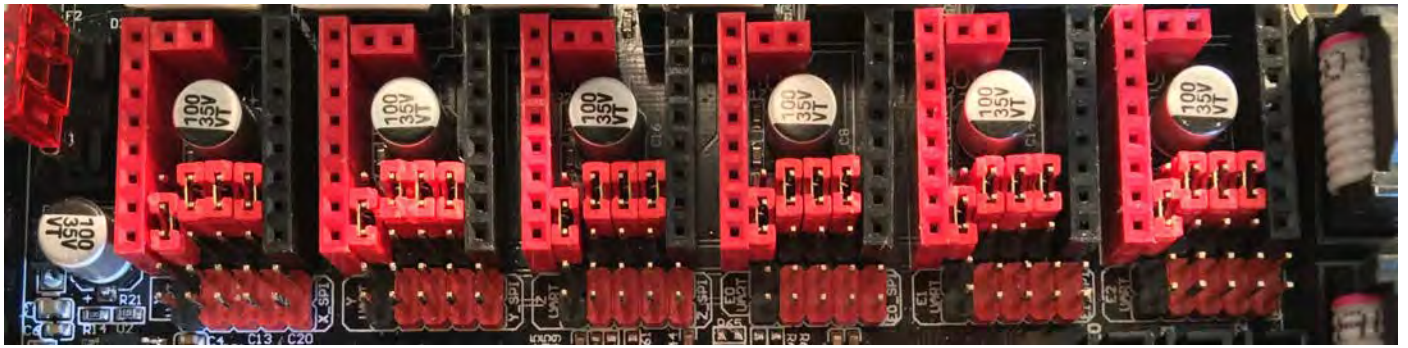
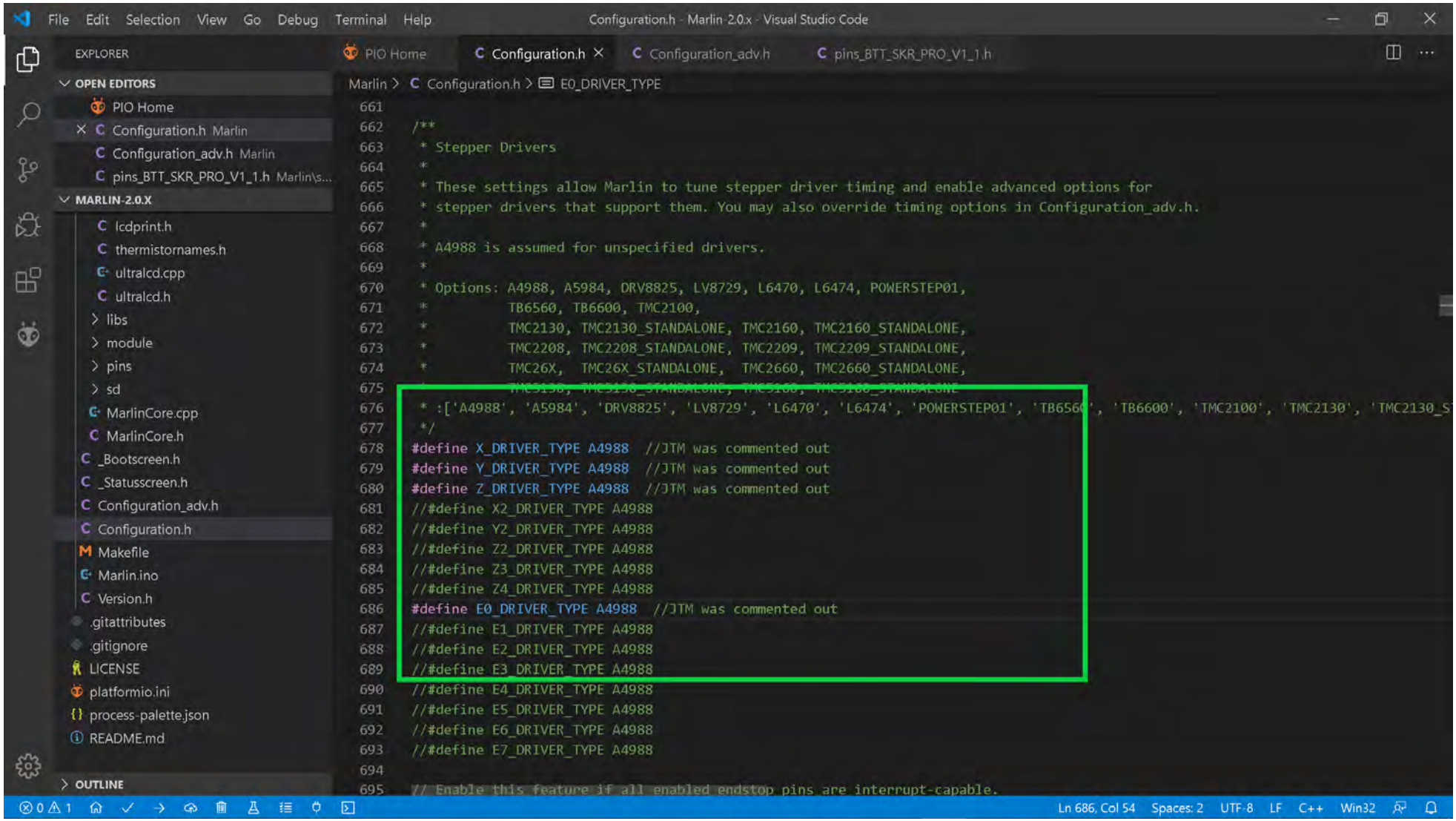




The (latest release of) Marlin Setup for A4988 Drivers

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

- Change the stepper motor drivers so that Marlin knows you are using 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 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 ("//").



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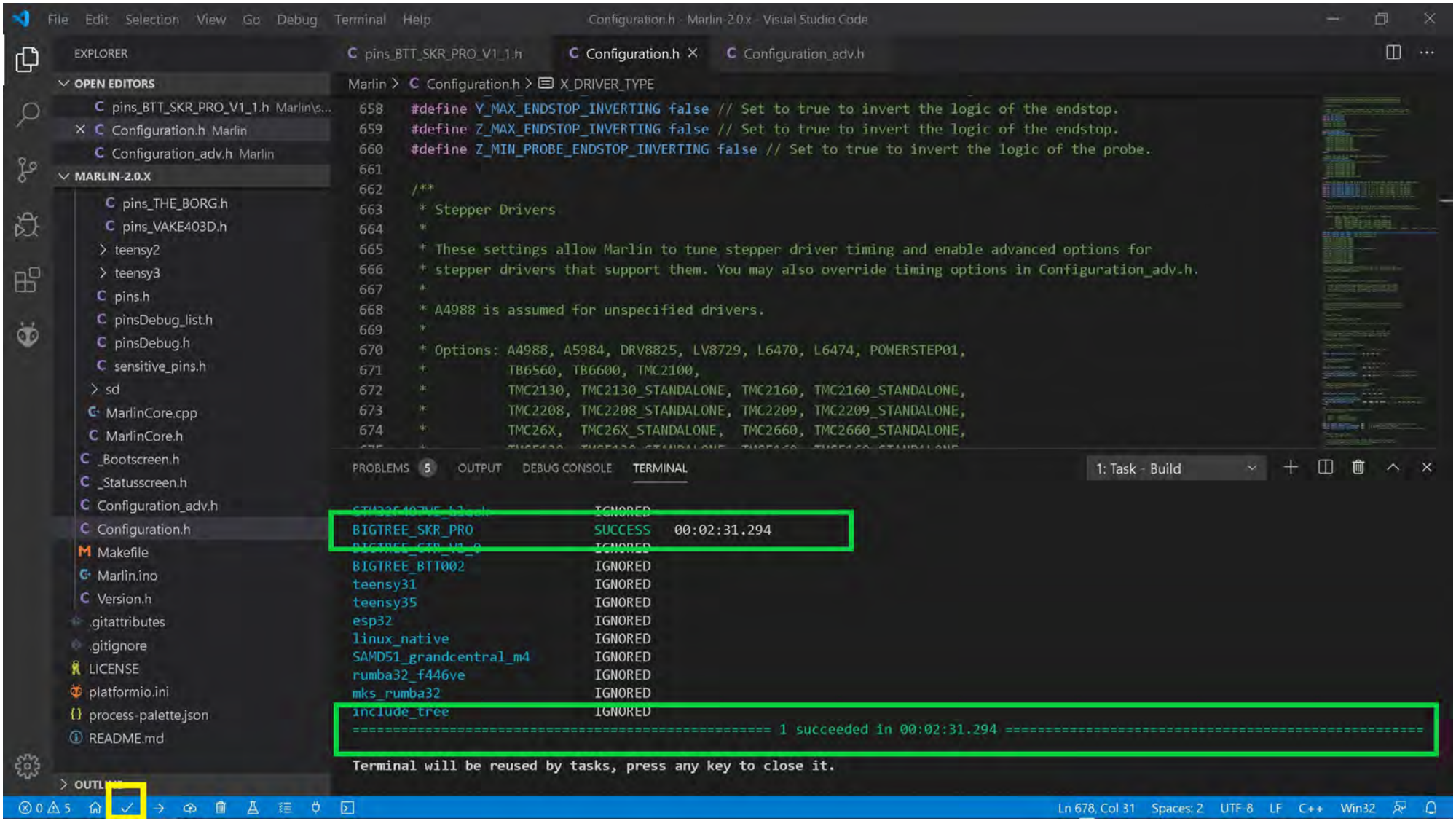
The (latest release of) Marlin Setup for A4988 Drivers

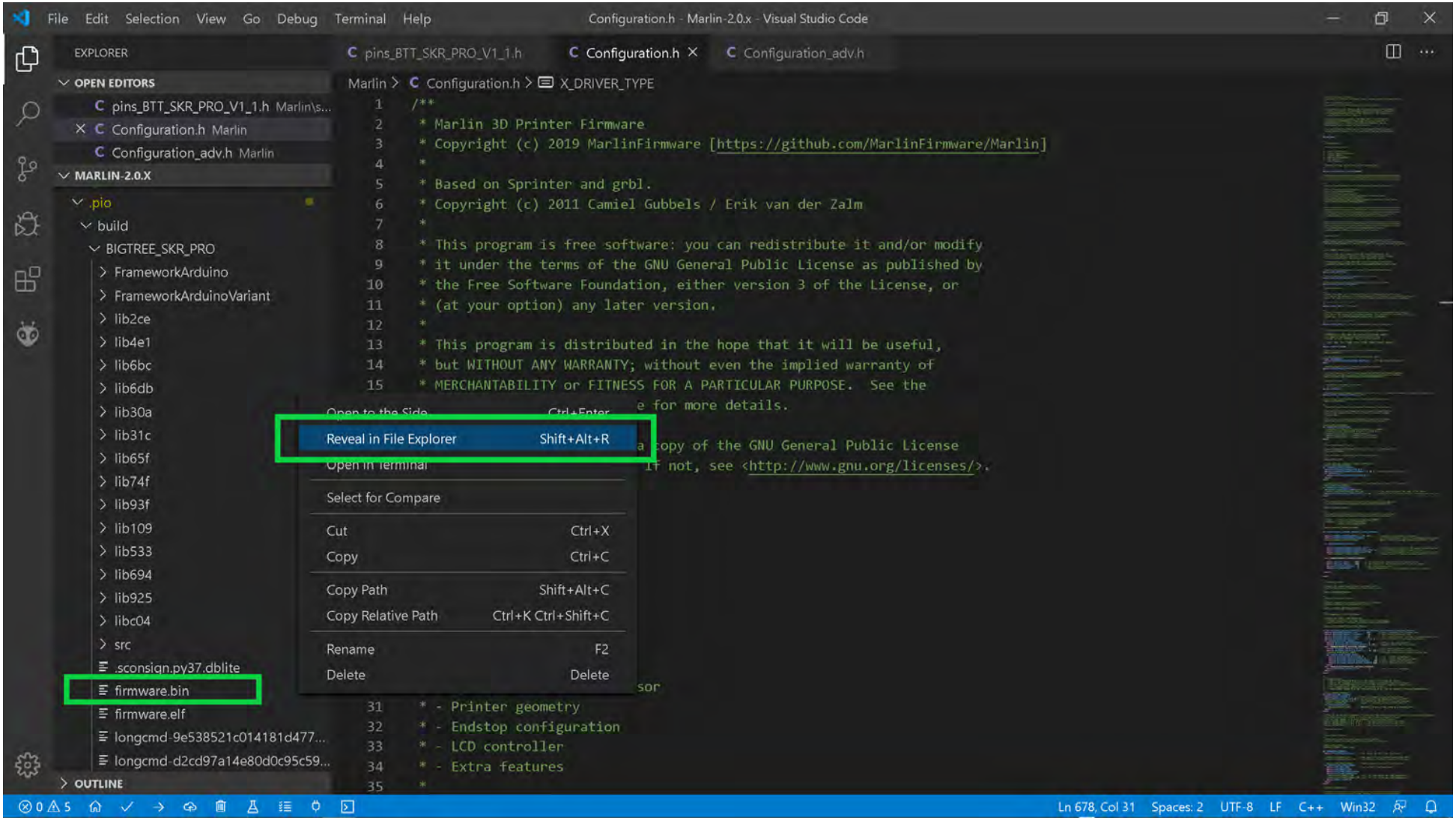
- The end of Marlin setup for A4988 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled sucessfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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 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 Window's machine open a file explorer window.



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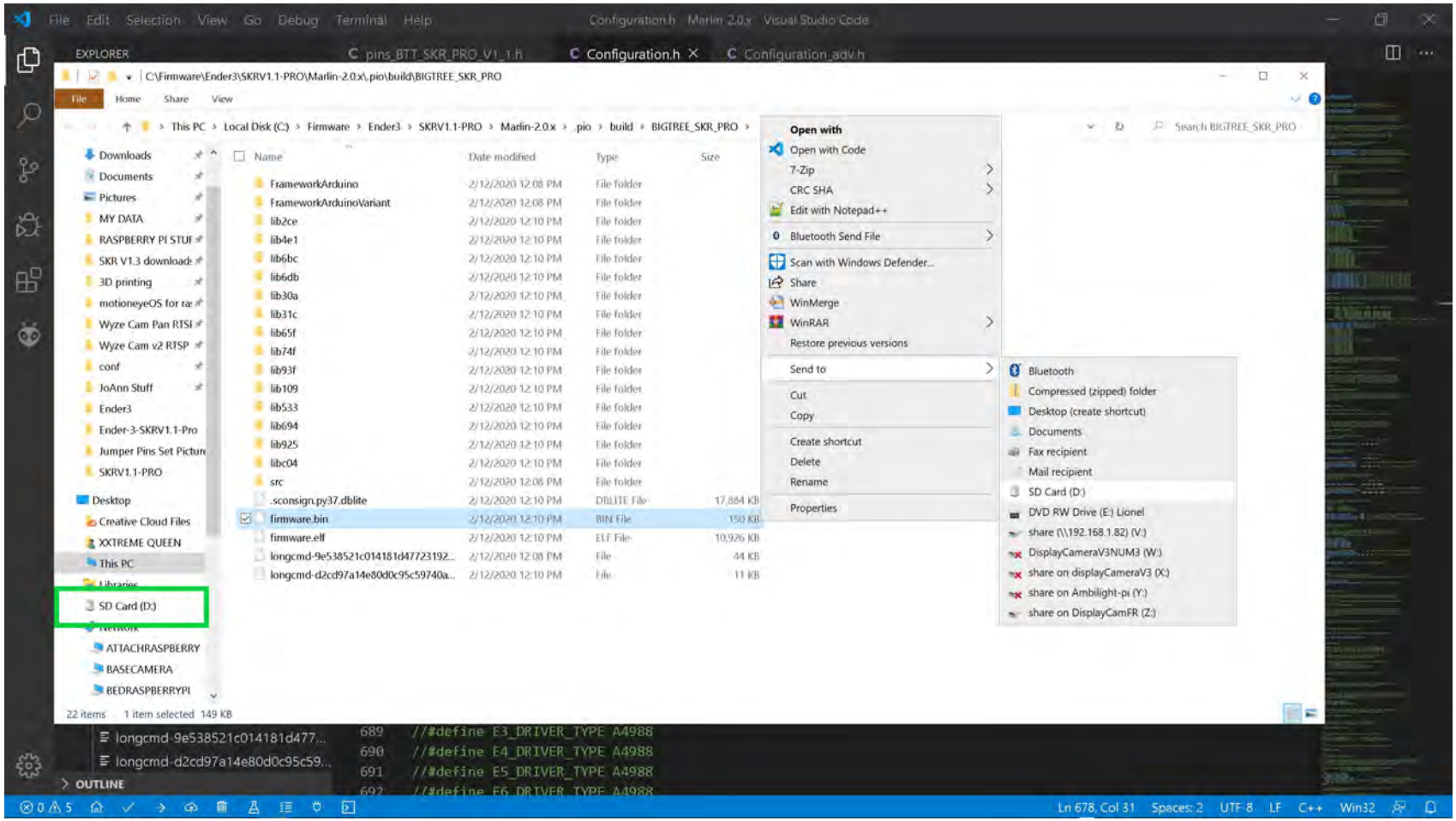
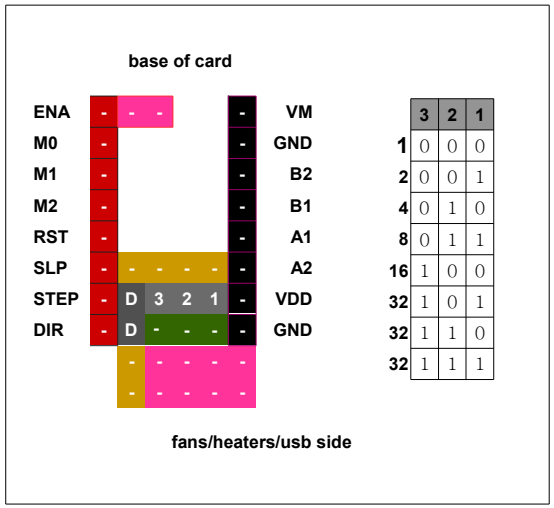
The (latest release of) Marlin Setup for A4988 Drivers

- Ensure your micro-SD card, that 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 and renamed to "firmware.bin" on the micro-SD card.

DRV8825



	3	2	1
1	0	0	0
2	0	0	1
4	0	1	0
8	0	1	1
16	1	0	0
32	1	0	1
32	1	1	0
32	1	1	1

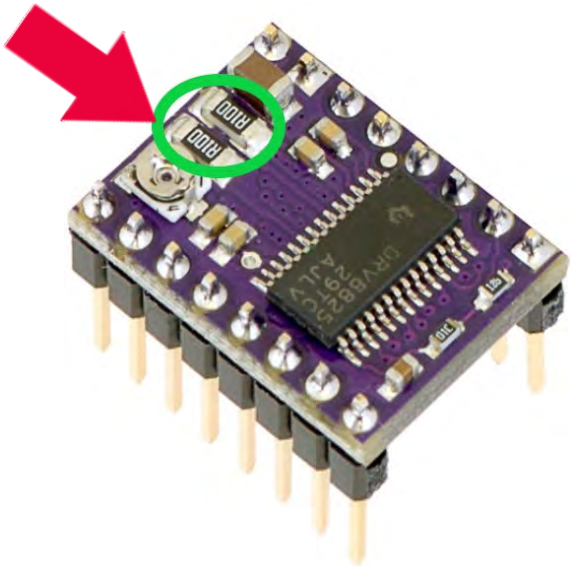
Driver Chip	MODE2	MODE1	MODE0	Subdivision	Excitation Mode
DRV8825 Maximum 32 subdivision 8.2V-45V 2.5A at 24V T=25℃	L	L	L	Full Step	2 Phase
	L	L	H	1/2	1-2 Phase
	L	H	L	1/4	W1-2 Phase
	L	H	H	1/8	
	H	L	L	1/16	
	H	L	H	1/32	Three Different Ways to Set 1/32 Steps with DRV8825 Stepper Driver
	H	H	L	1/32	
	H	H	H	1/32	
Driving current calculation formula Rs=0.1Ω	$I_{MAX} = \frac{V_{REF}}{5 \bullet R_S}$			$V_{REF} = \frac{I_{MAX}}{5 \bullet R_S}$	

Note: Use 90% of the calculated Vref when tuning the stepper driver board

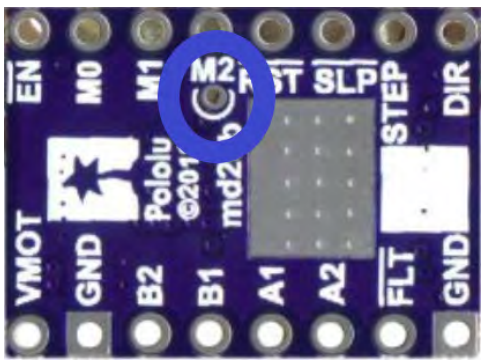
NOTE: **Use the potentiometer (POT) on the top of the board (or use the board's "Vref Test point") to adjust your Vref.**

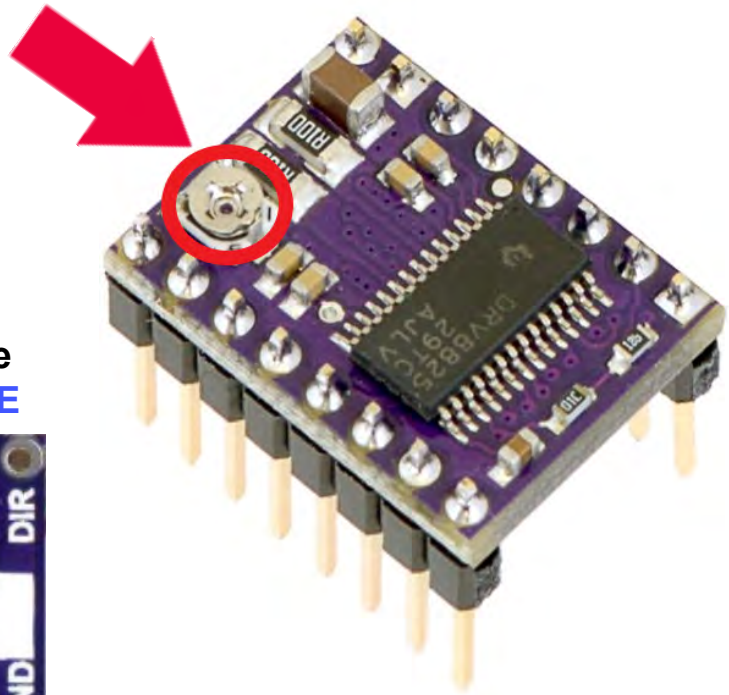
See the appendix for instructions on how to set the Vref on a driver board.

Note: Check your current sense resistor (Rs) values on the driver board, shown in GREEN below.



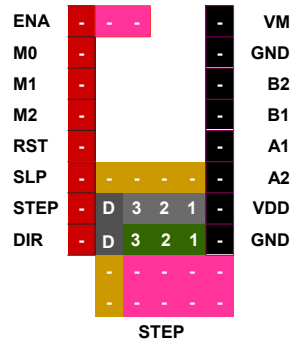
Note: "Vref Test point" location is on the bottom of the driver board, as shown in BLUE

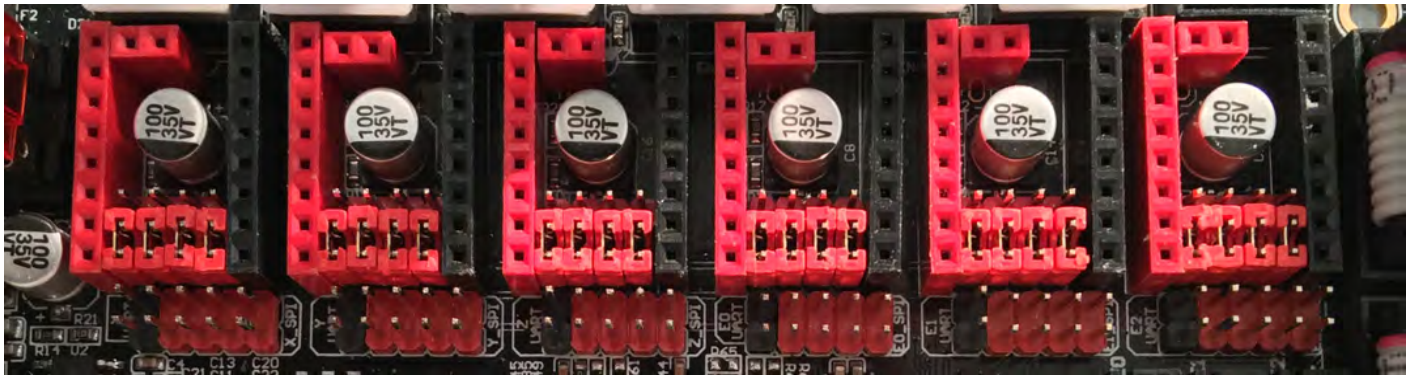




DRV8825

Note: The "D" jumper MUST be SET!





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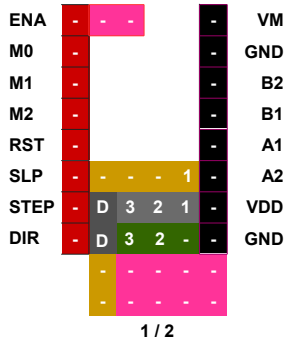
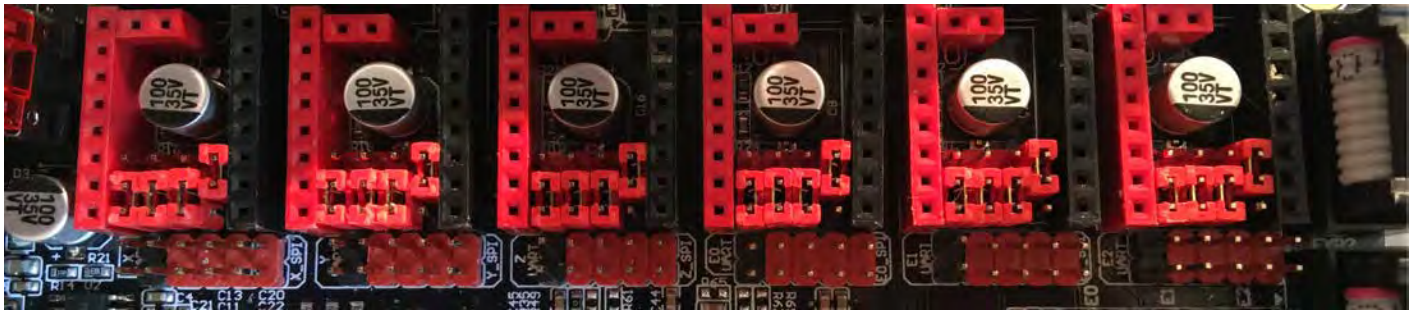
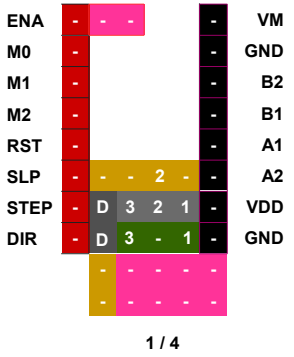




DRV8825



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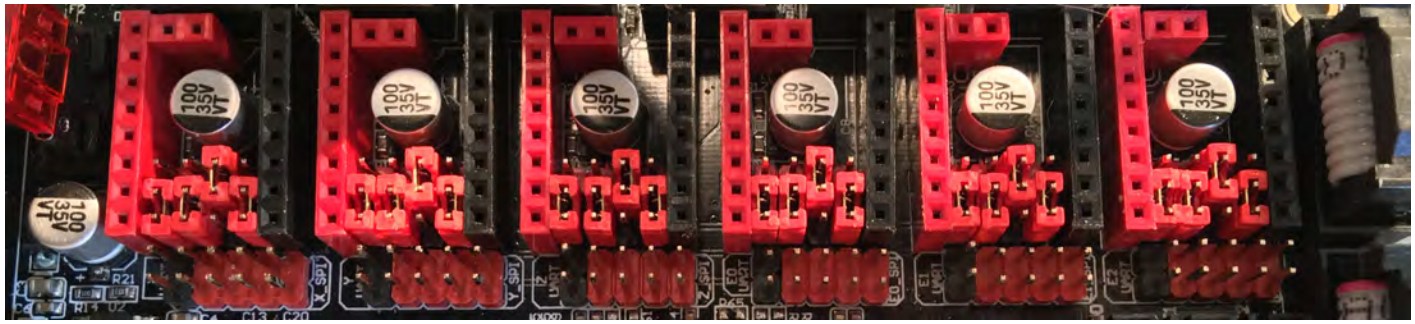

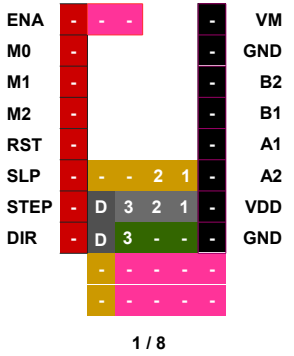

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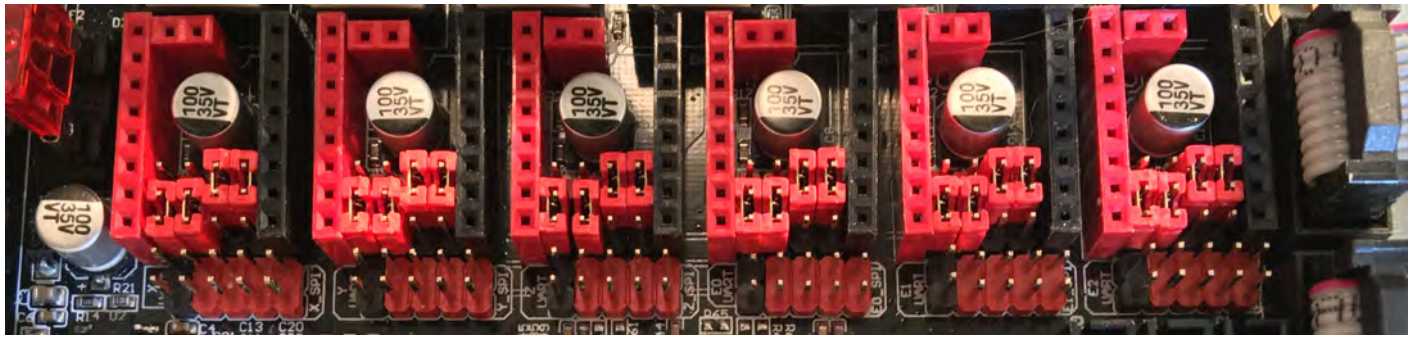

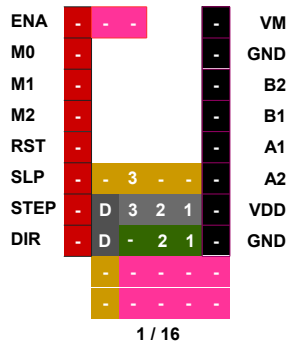

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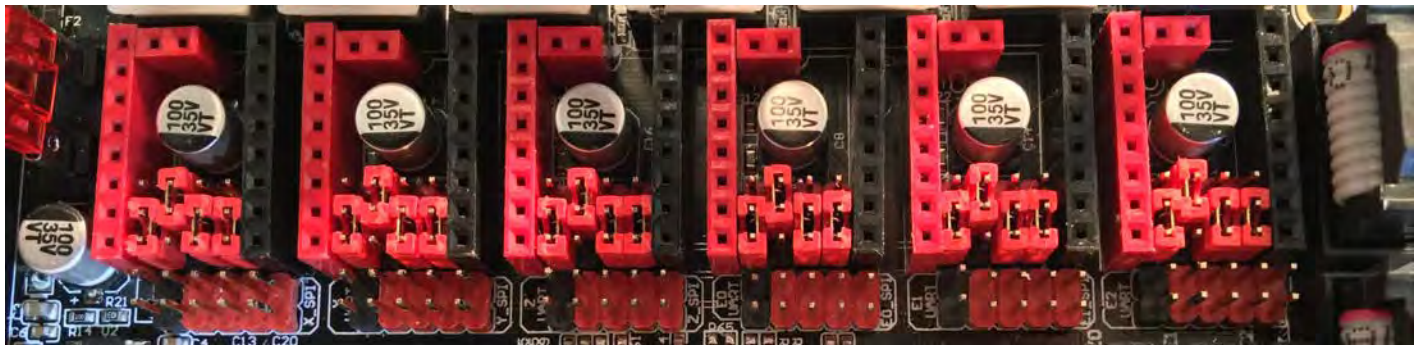
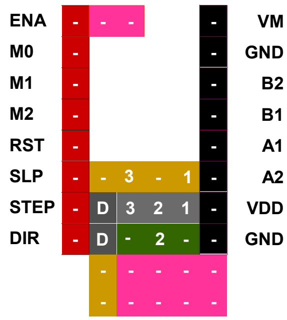


DRV8825

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



1 / 32

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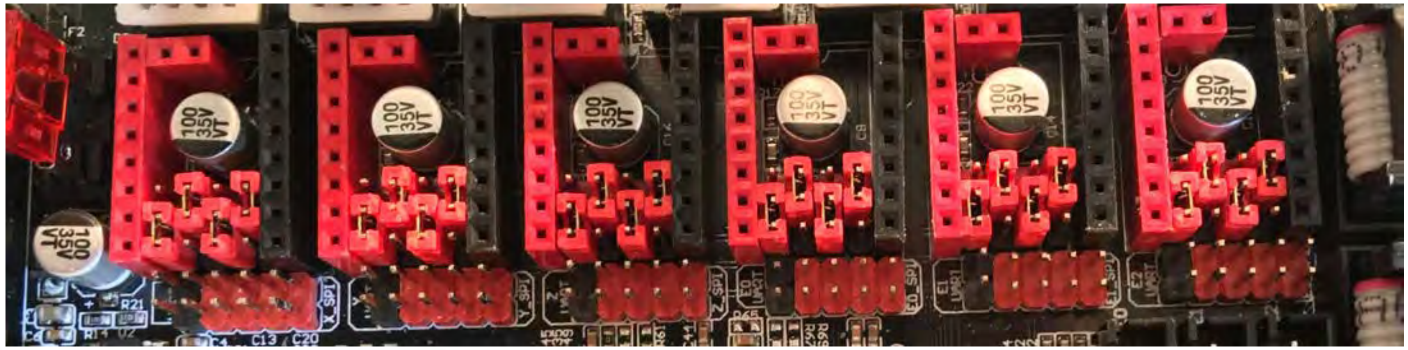

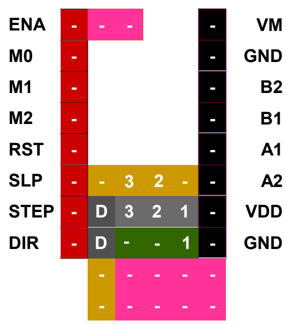

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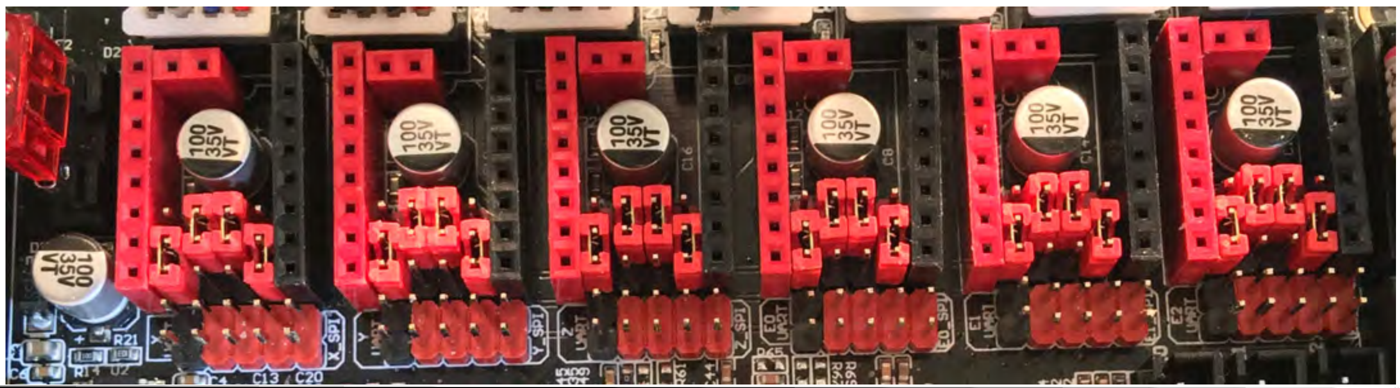

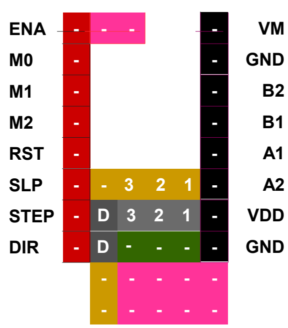

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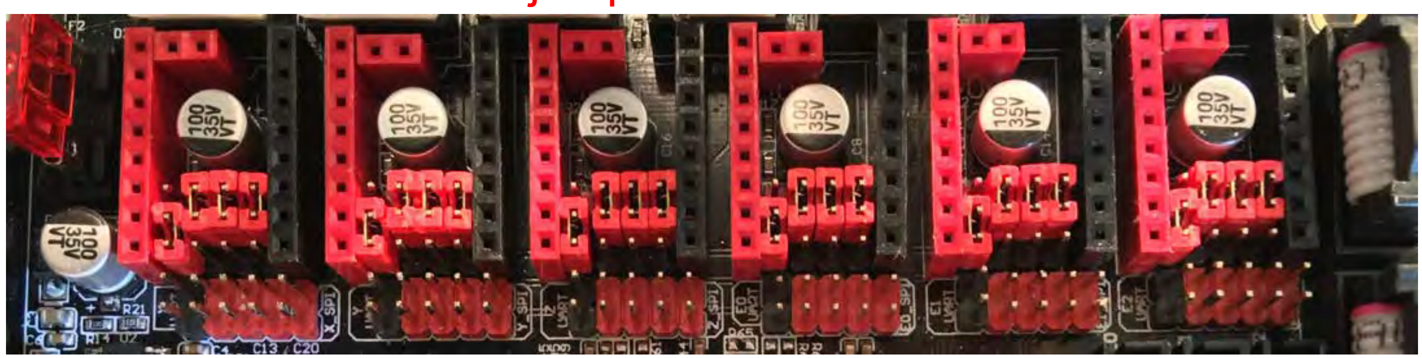
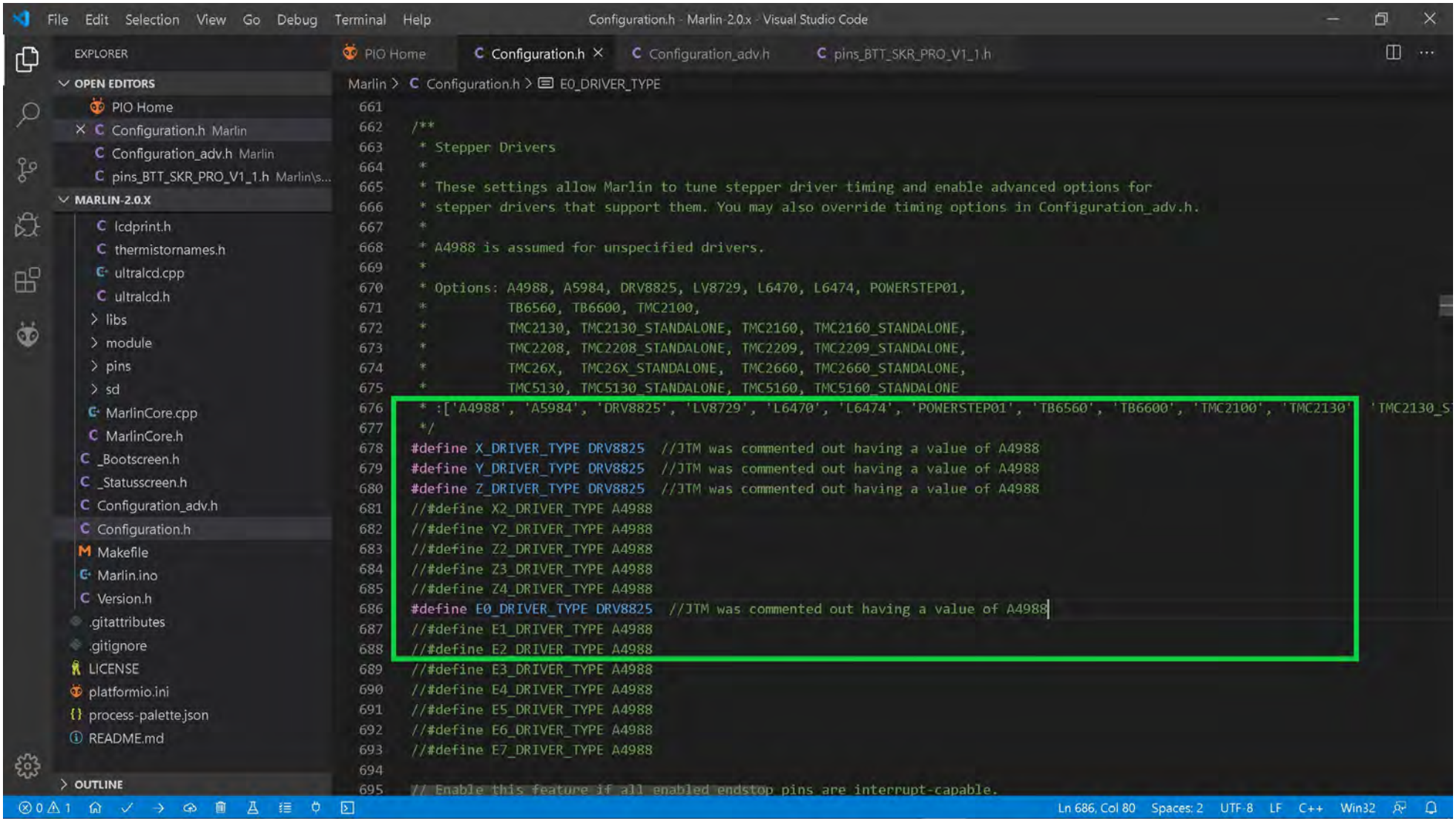


NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

The (latest release of) Marlin Setup for DRV8825 Drivers

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

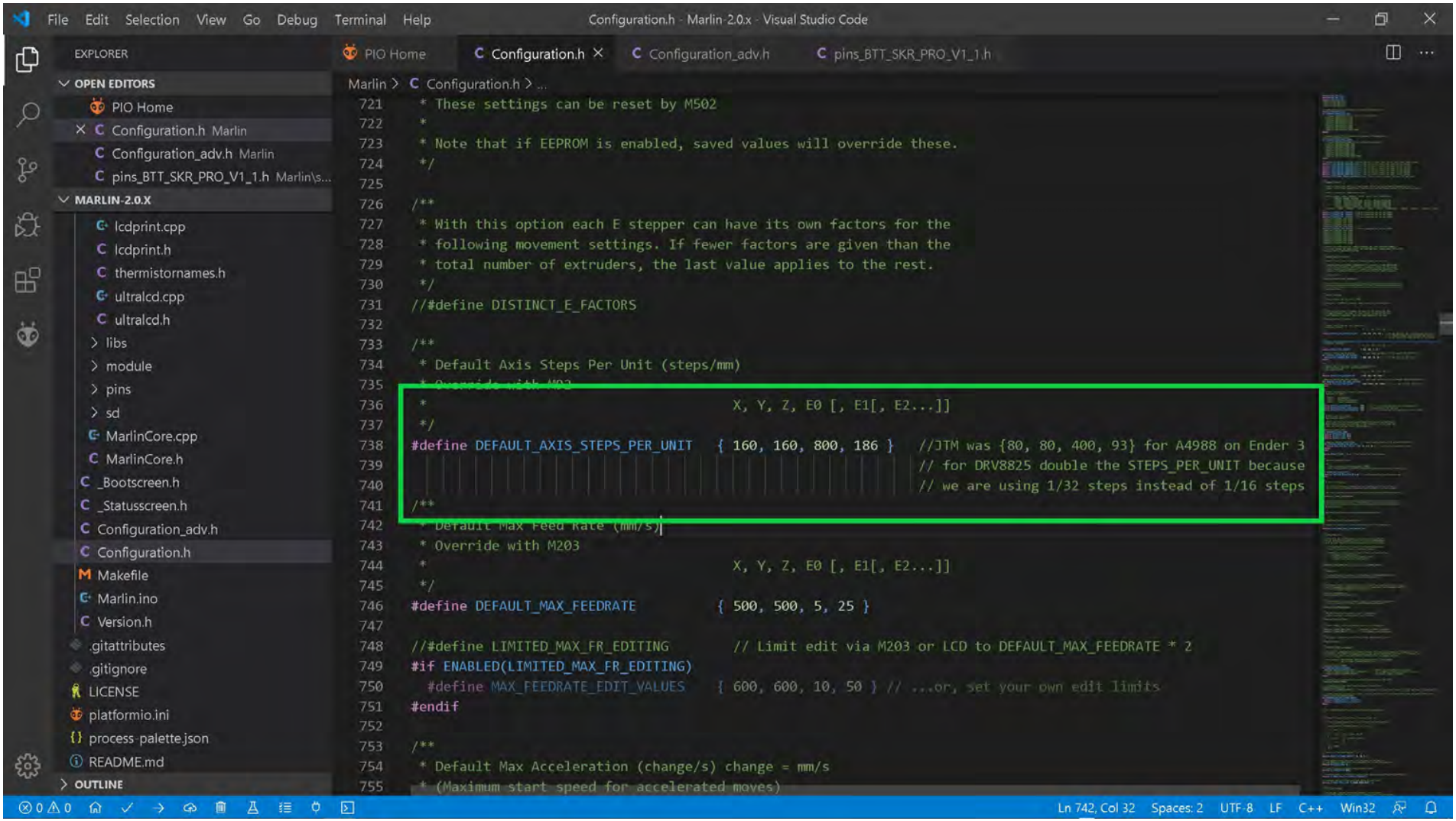
- Change the stepper motor drivers so that Marlin knows you are using DRV8825 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use DRV8825 drivers. When two "//" appear at the beginning of a line that means that line is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



- 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.



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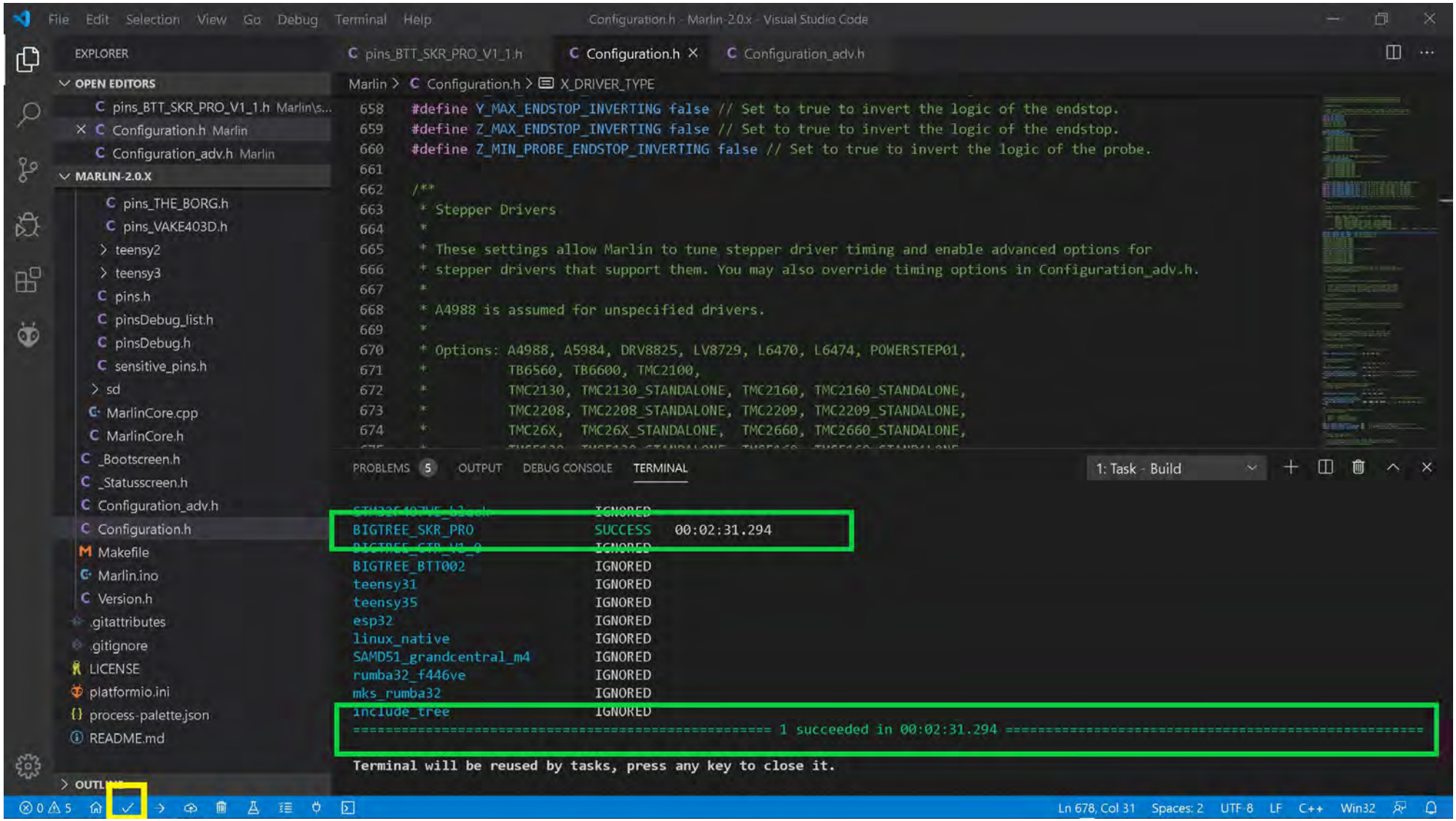
The (latest release of) Marlin Setup for DRV8825 Drivers

- 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.



- 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.

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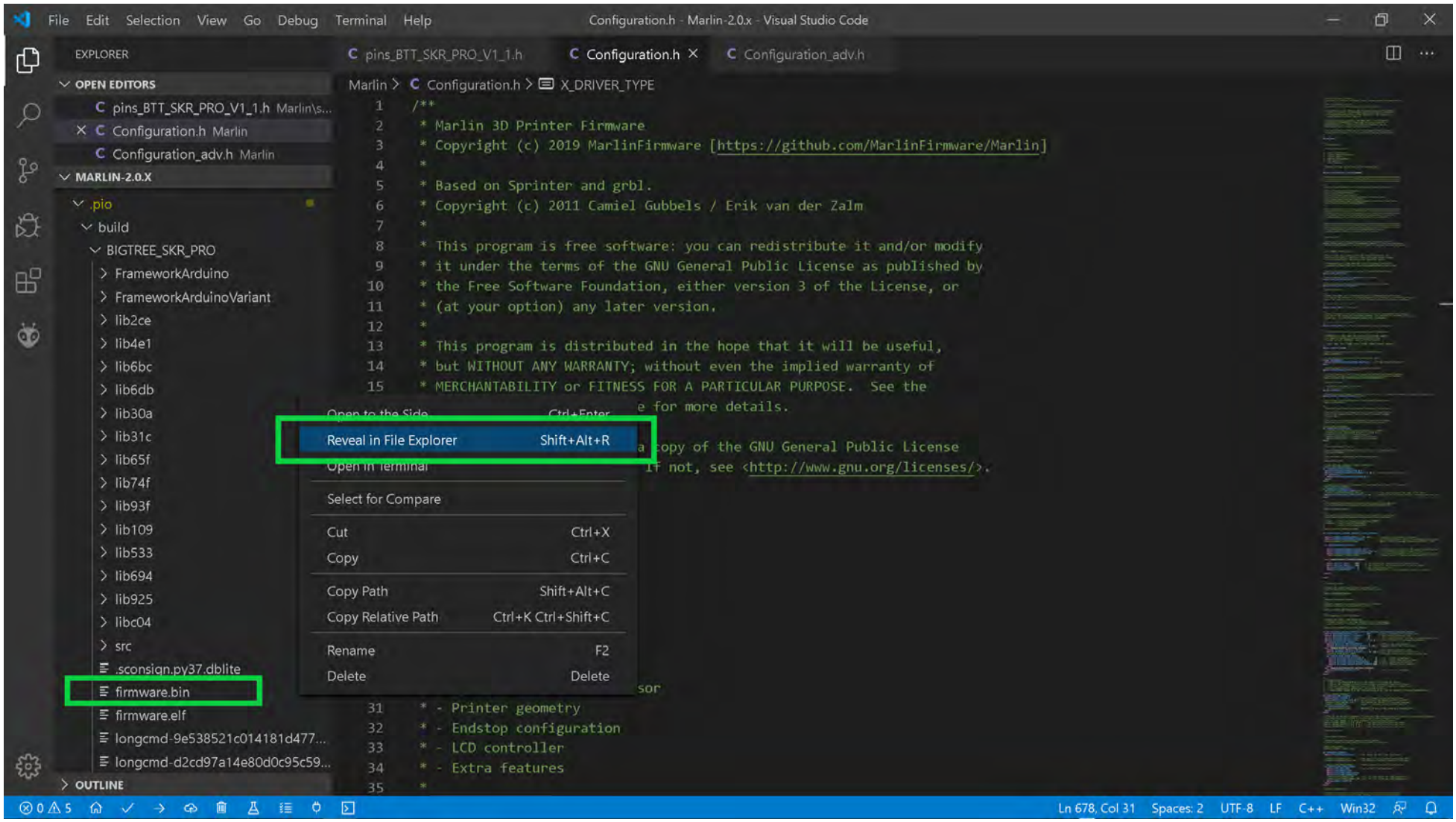

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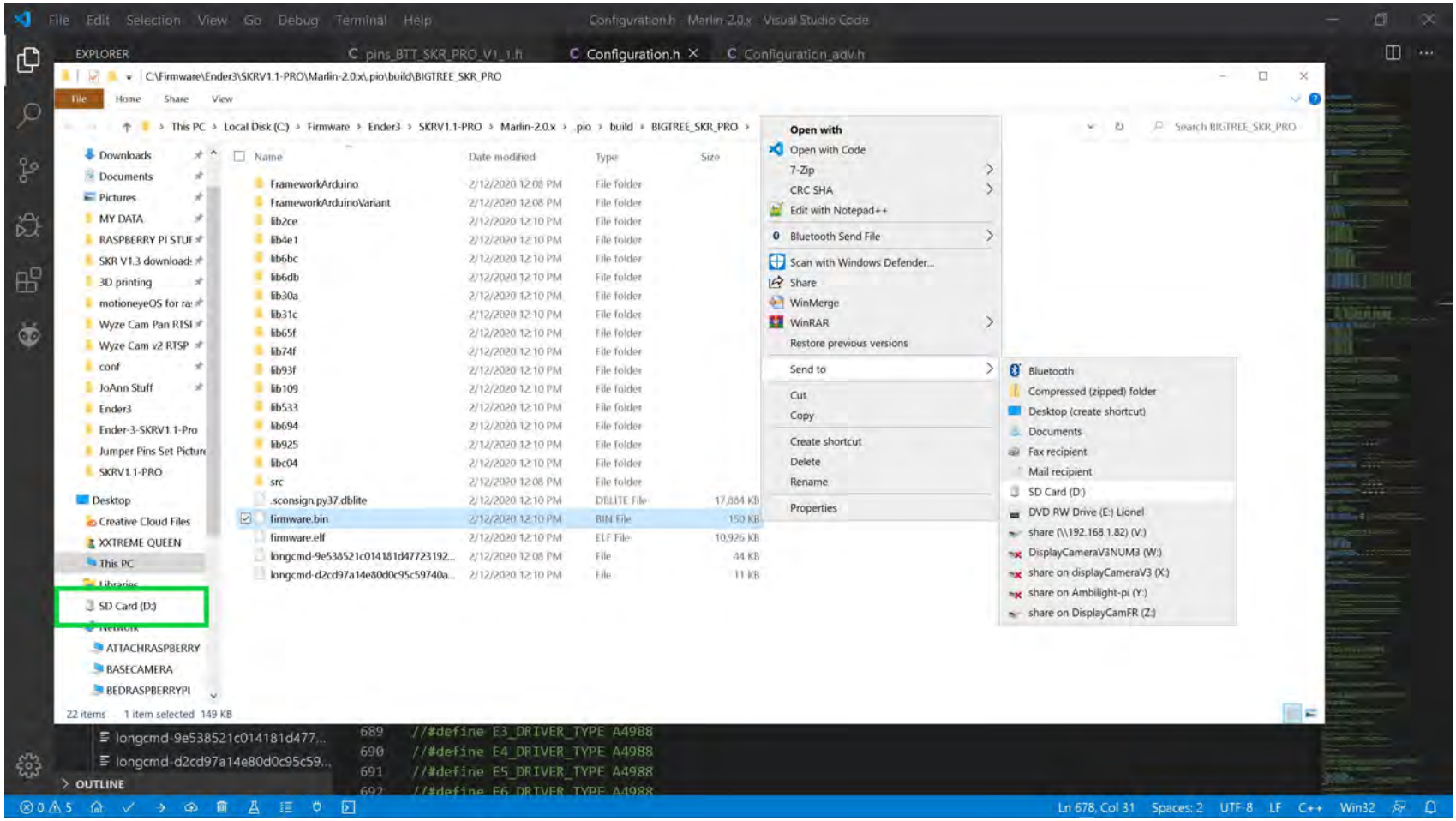
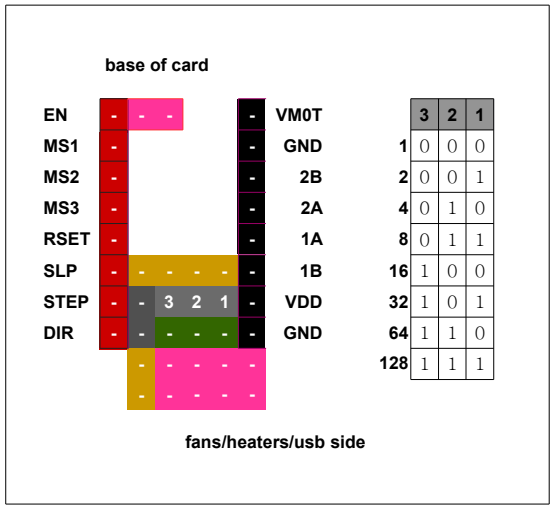
- Ensure your micro-SD card, that came with your SKR PRO V1.1 board, is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD 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 and renamed to "firmware.bin" on the micro-SD card.

BIQU LV8729



	3	2	1
1	0	0	0
2	0	0	1
4	0	1	0
8	0	1	1
16	1	0	0
32	1	0	1
64	1	1	0
128	1	1	1

Driver Chip	MD3	MD2	MD1	Subdivision	Excitation Mode
LV8729 Maximum 128 subdivision 36V 1.5A	L	L	L	Full Step	2 Phase
	L	L	H	1/2	1-2 Phase
	L	H	L	1/4	W1-2 Phase
	L	H	H	1/8	2W1-2 Phase
	H	L	L	1/16	4W1-2 Phase
	H	L	H	1/32	8W1-2 Phase
	H	H	L	1/64	16W1-2 Phase
	H	H	H	1/128	32W1-2 Phase

Driving current calculation formula		
Rs=0.1Ω	$I_{MAX} = V_{REF} \bullet 2$	$V_{REF} = (I_{MAX}) / 2$
Rs=0.22Ω	$I_{MAX} = \frac{V_{REF}}{1.1}$	$V_{REF} = I_{MAX} * 1.1$

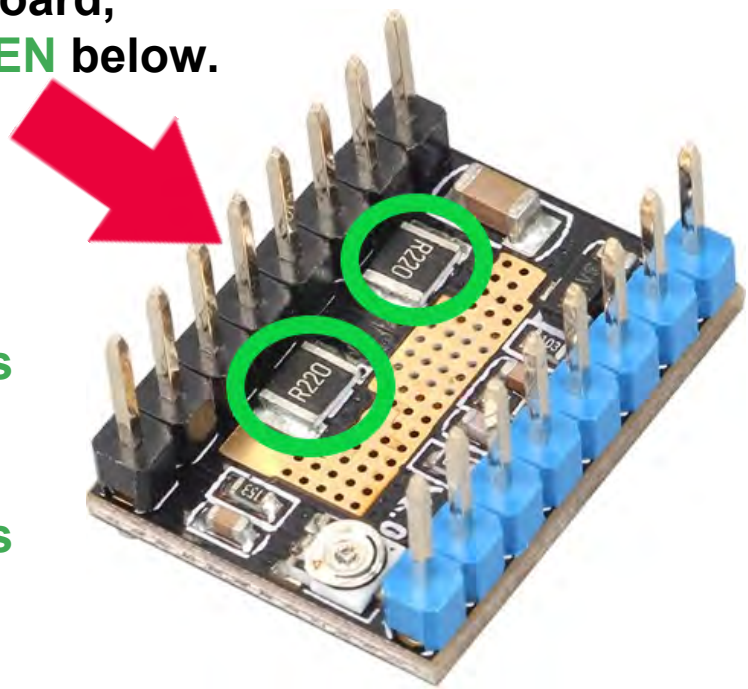
Note: Use 90% of the calculated Vref when tuning the stepper driver board

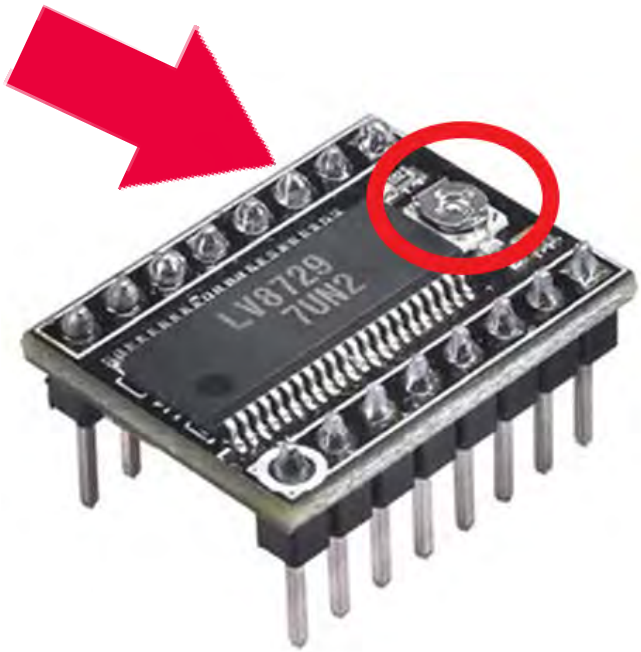
Note: Check your current sense resistor (Rs) values on the driver board, shown in GREEN below.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref. See the appendix for instructions on how to set the Vref on a driver . board.

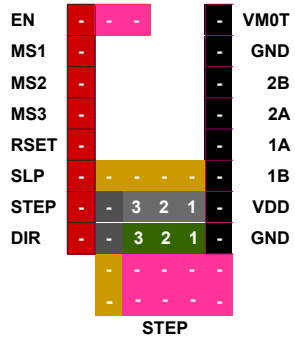
Rs = R220 is 0.22 Ohms

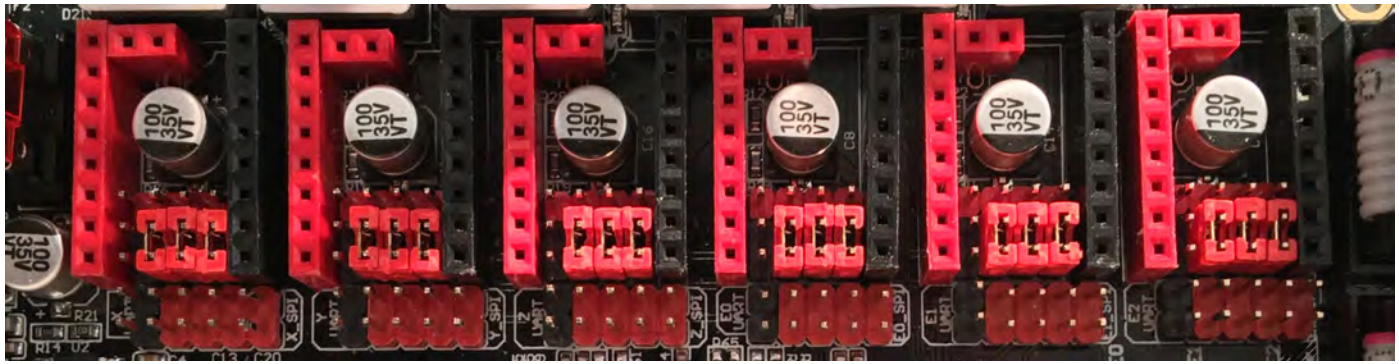
Rs = R100 is 0.1 Ohms

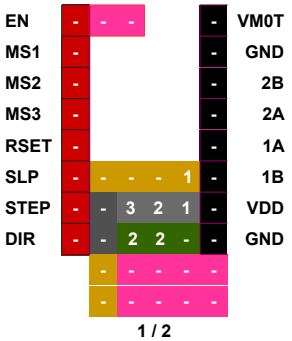


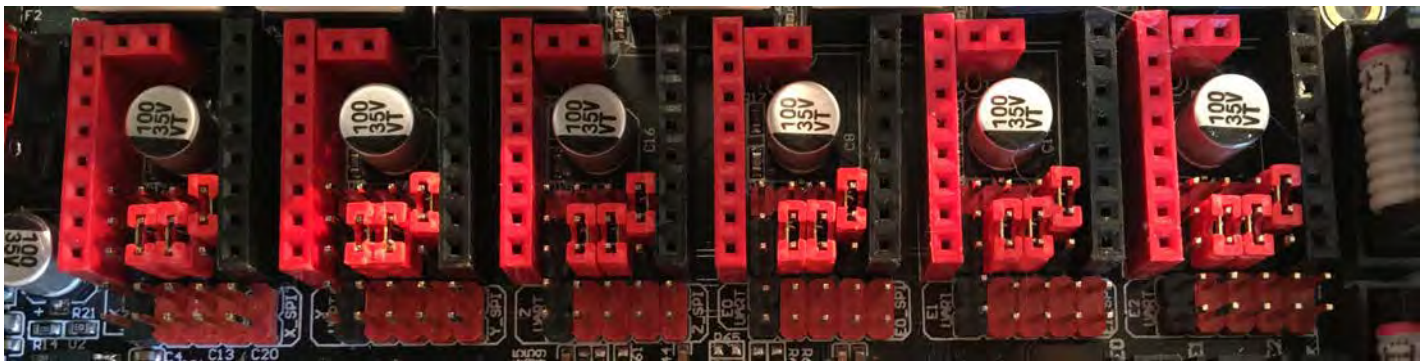


BIQU LV8729

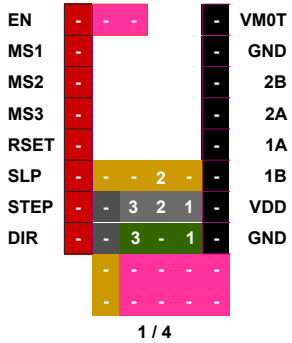

EN
MS1
MS2
MS3
RSET
SLP
STEP
DIR
VM0T
GND
2B
2A
1A
1B
VDD
GND
3 2 1
3 2 1
STEP



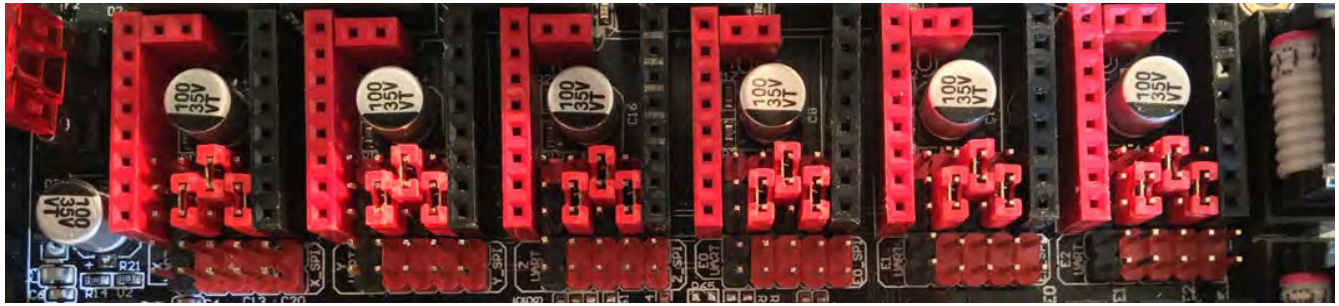

EN
MS1
MS2
MS3
RSET
SLP
STEP
DIR
VM0T
GND
2B
2A
1A
1B
VDD
GND
1
3 2 1
2 2
1 / 2

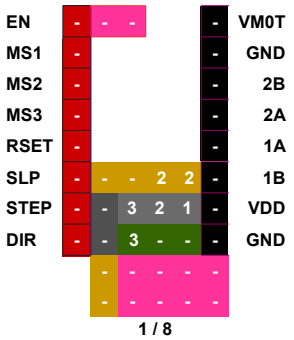


BIQU LV8729

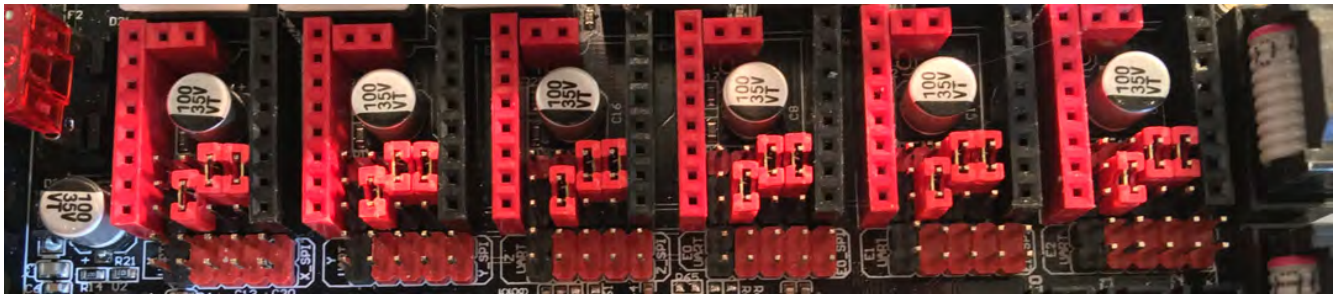


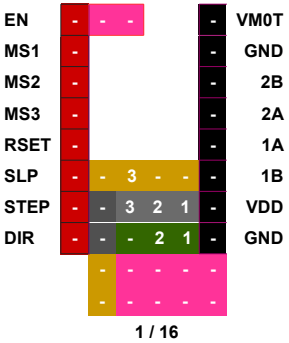
1 / 4



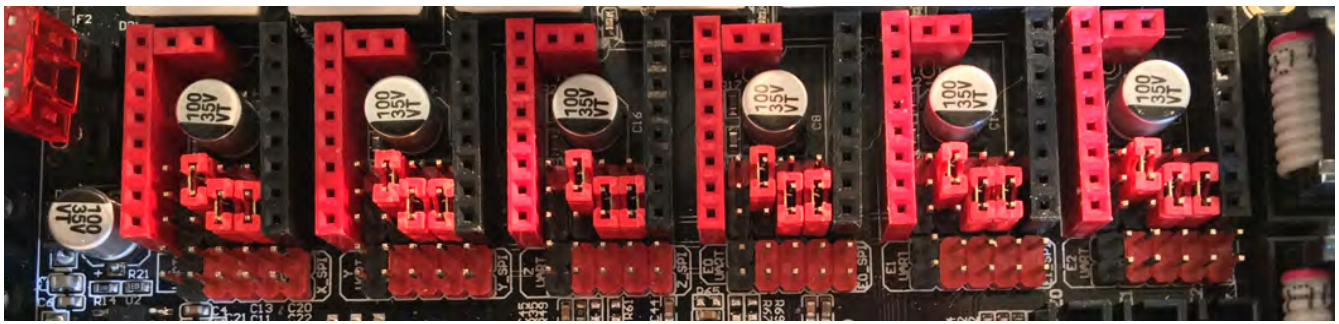


1 / 8

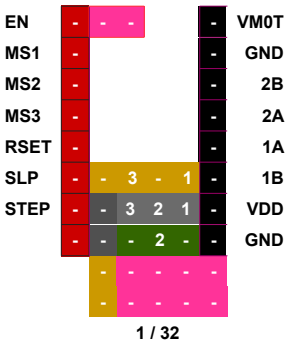


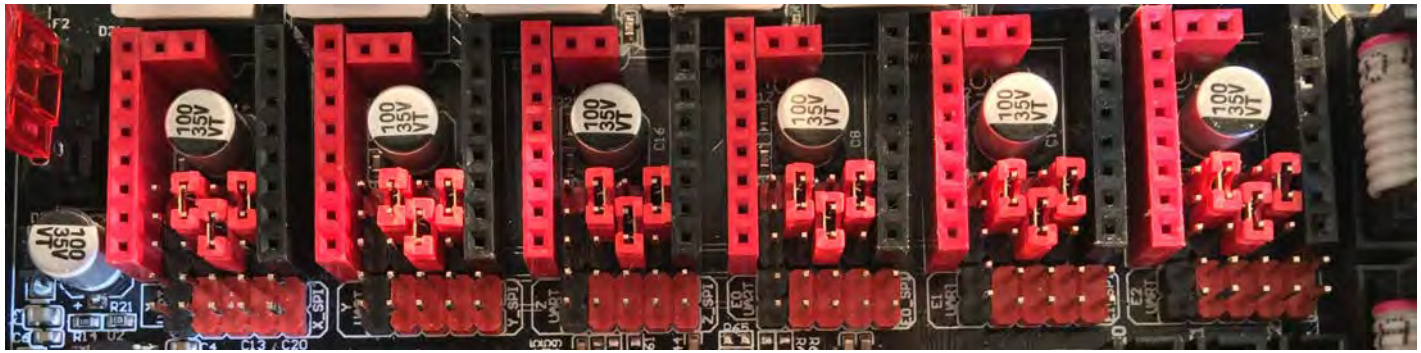


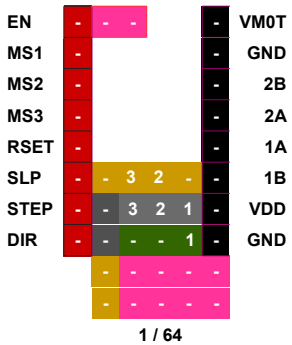
1 / 16

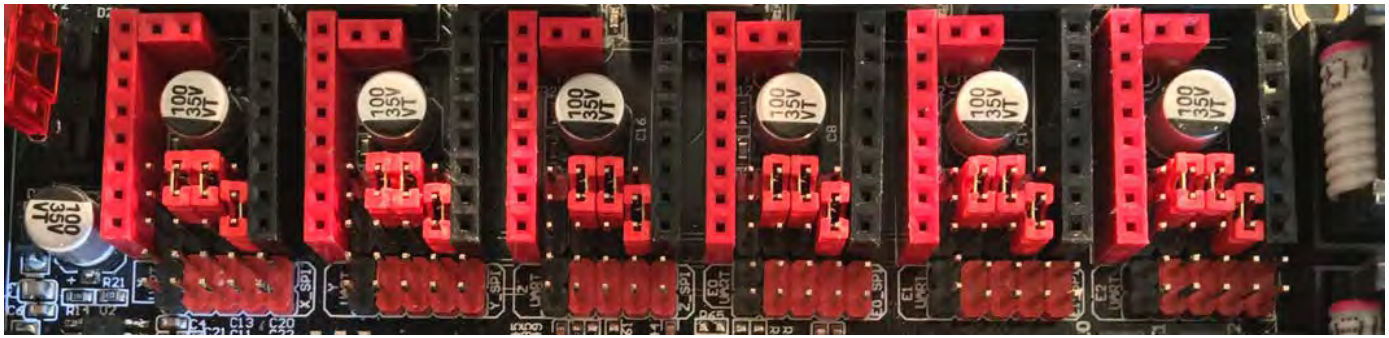


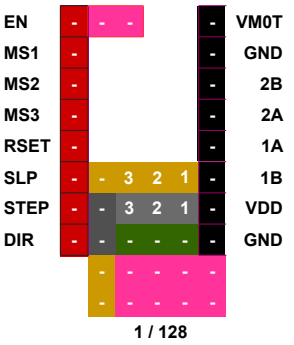
BIQU LV8729

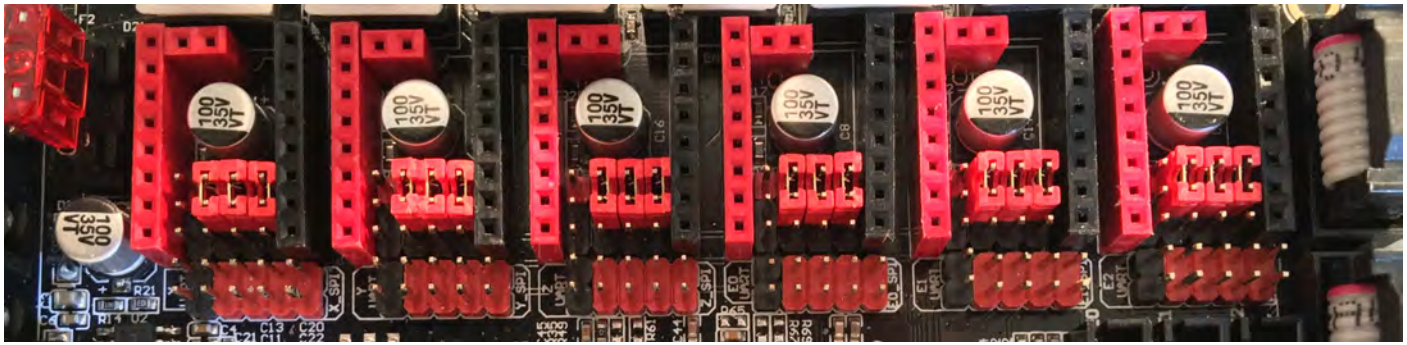

EN
MS1
MS2
MS3
RSET
SLP
STEP
VM0T
GND
2B
2A
1A
1B
VDD
GND
1 / 32




EN
MS1
MS2
MS3
RSET
SLP
STEP
DIR
VM0T
GND
2B
2A
1A
1B
VDD
GND
1 / 64



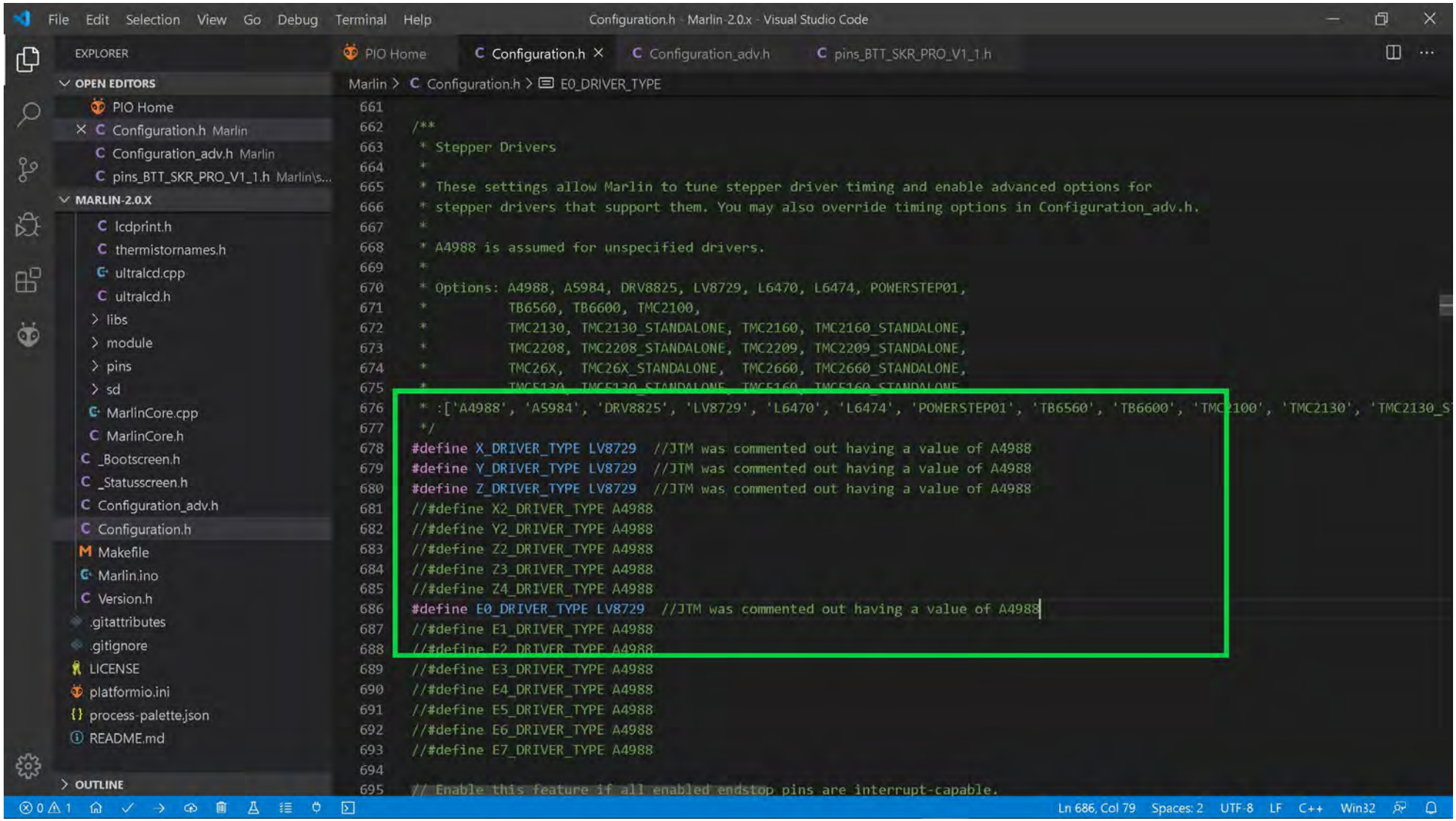

EN
MS1
MS2
MS3
RSET
SLP
STEP
DIR
VM0T
GND
2B
2A
1A
1B
VDD
GND
1 / 128



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

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

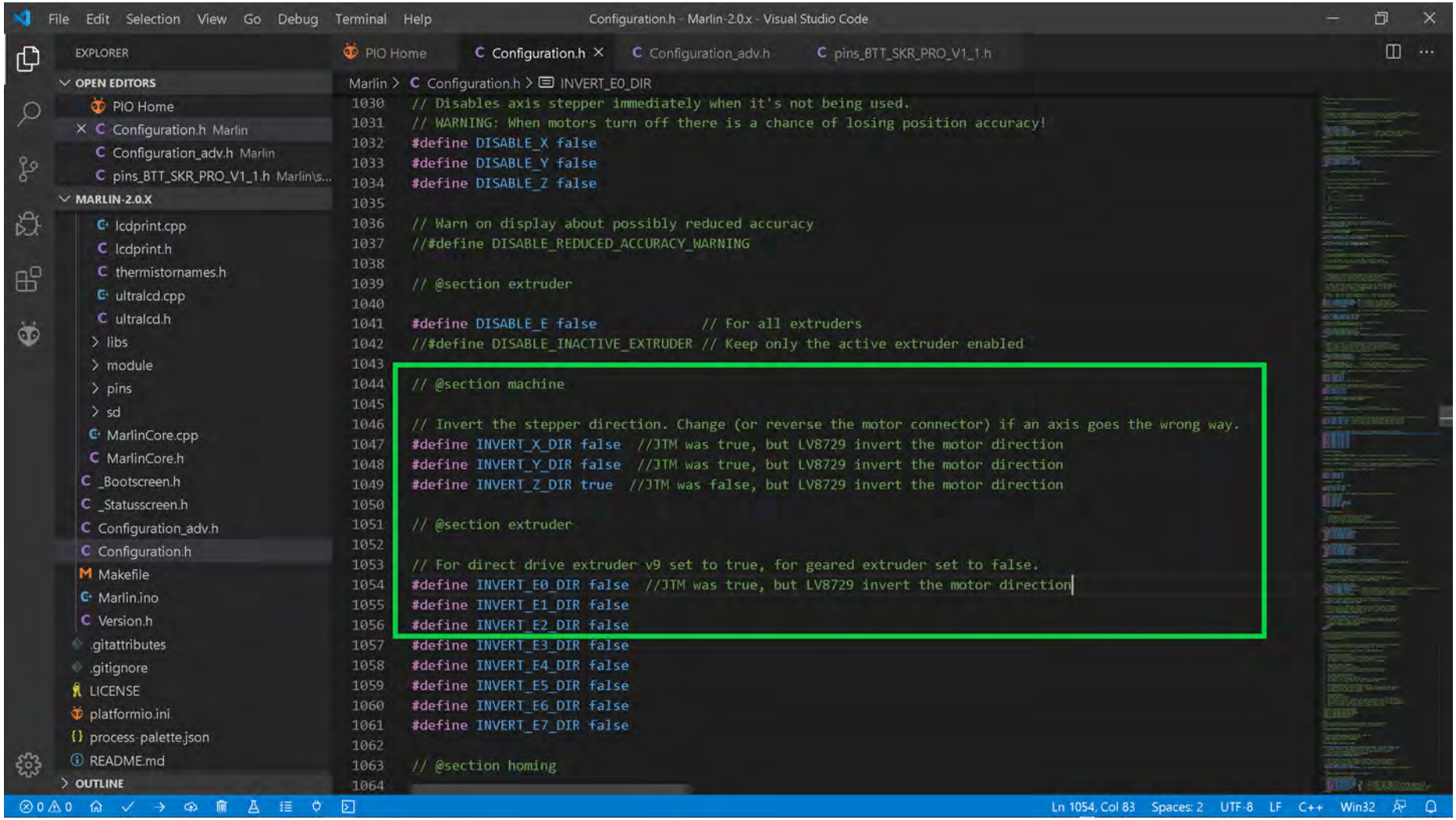
- Change the stepper motor drivers so that Marlin knows you are using BIQU LV8729 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use BIQU LV8729 drivers. When two "//" appear at the beginning of a line that means that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



- Go to the next page.

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

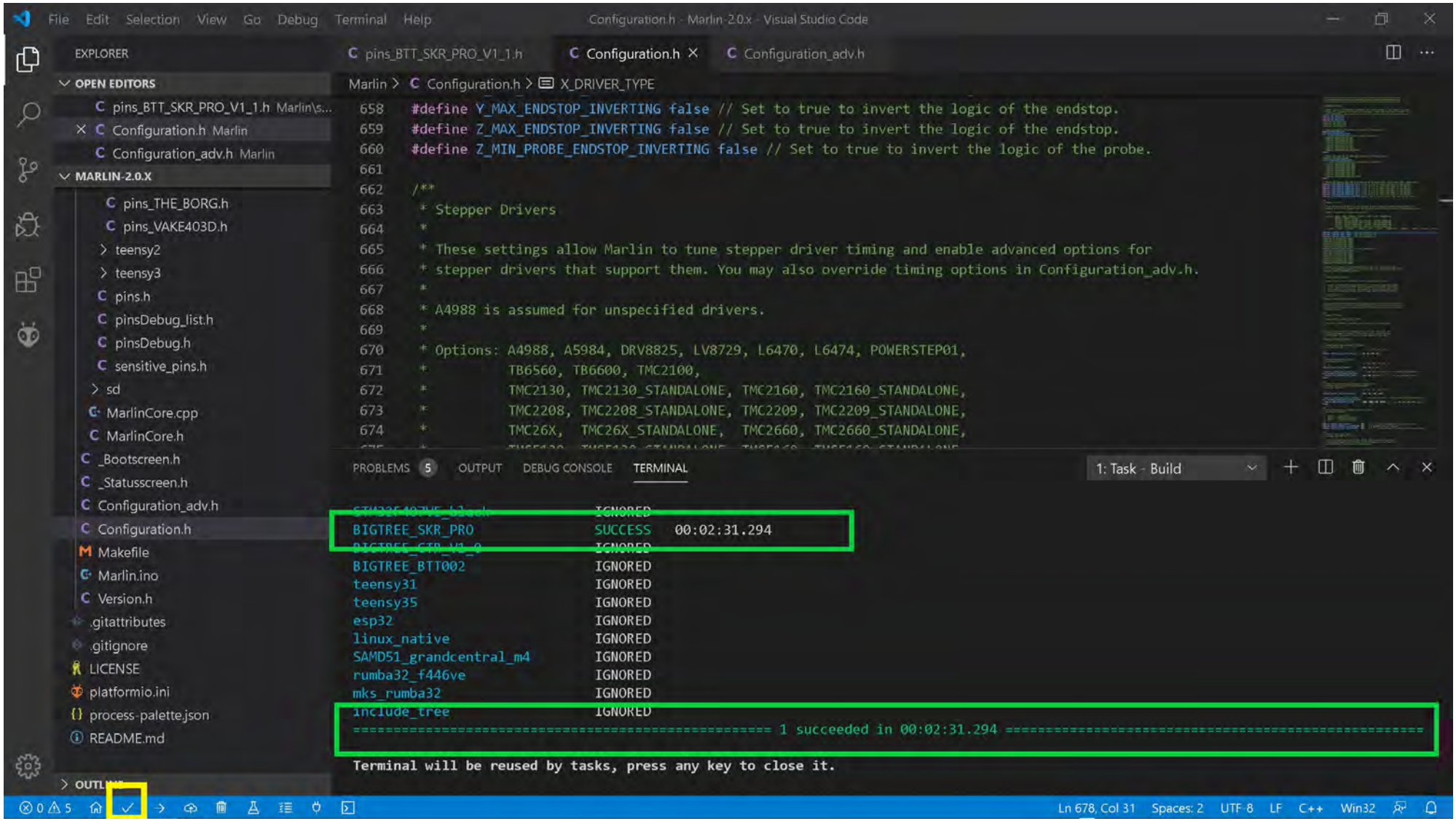
- Since the A4988 driver is what my Ender 3 used, but, now I want to use LV8729 drivers, I must invert the stepper motor direction because the LV8729 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the LV8729 driver 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



- Go to the next page.

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

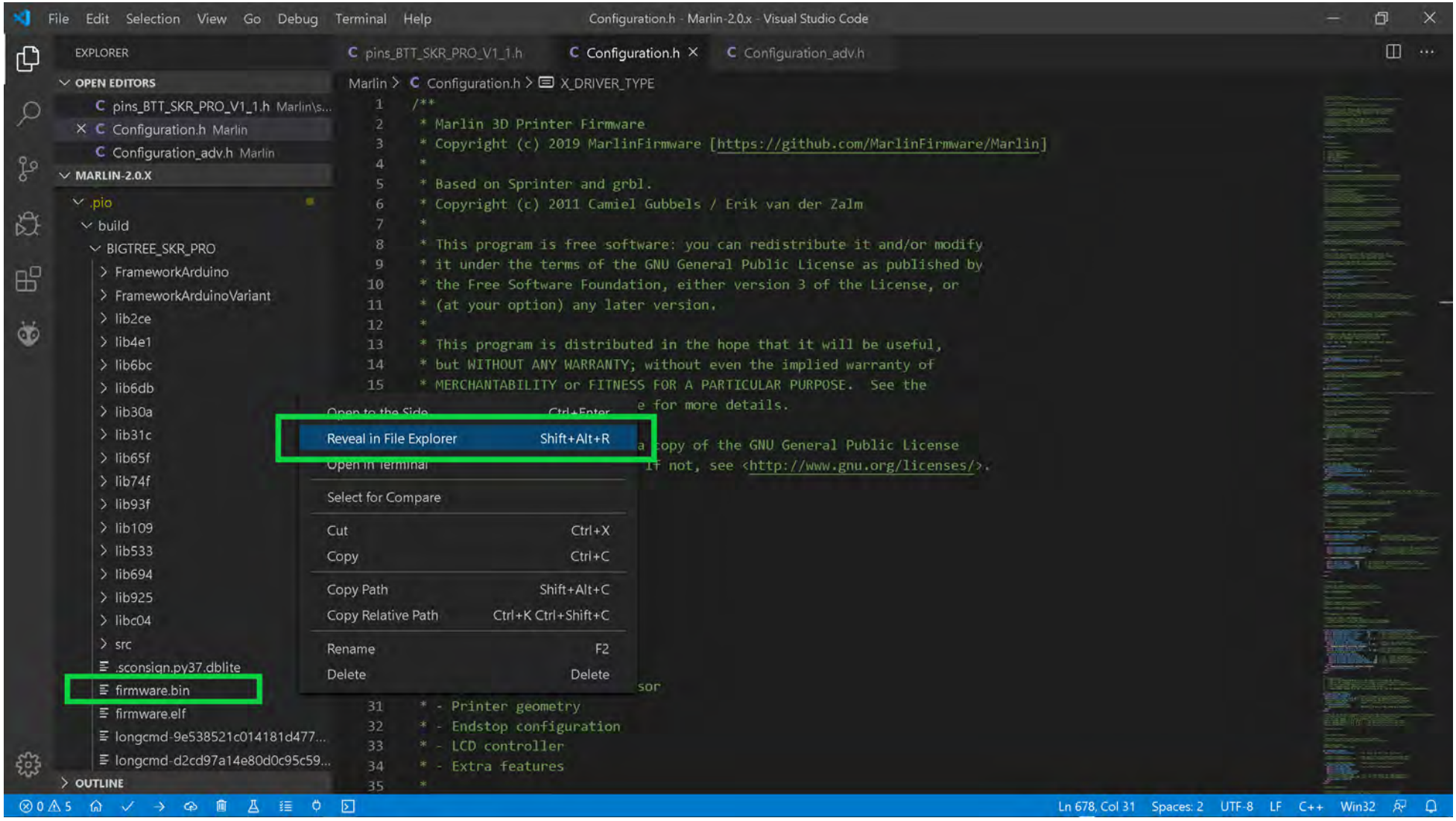
- The end of Marlin setup for BIQU LV8729 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

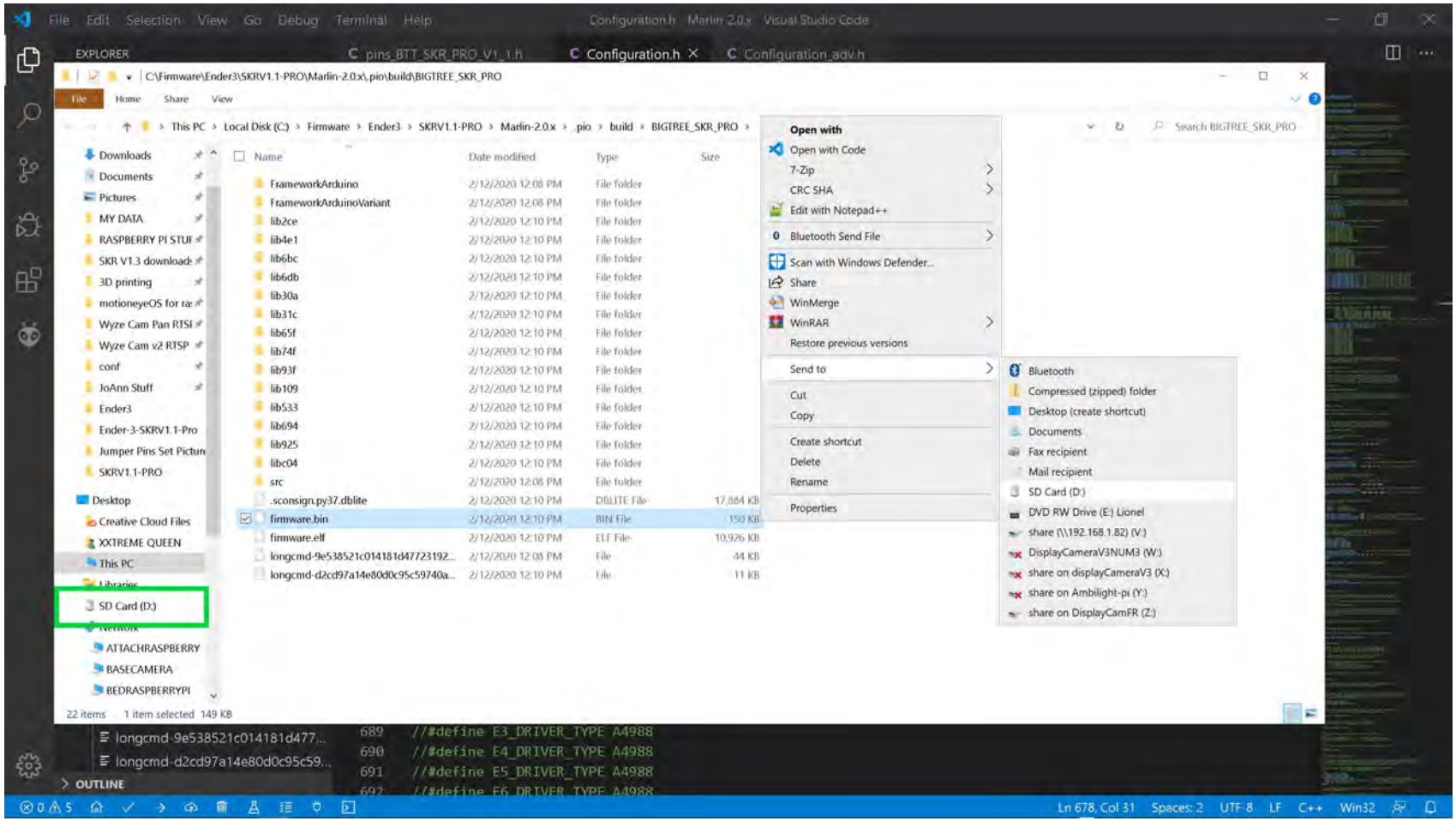
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



- Go to the next page.

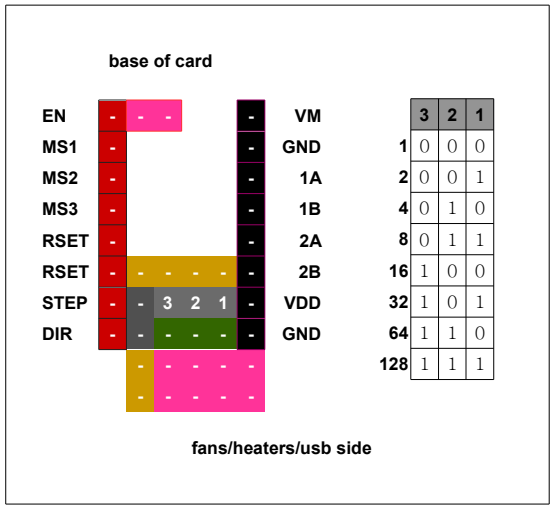
The (latest release of) Marlin Setup for BIQU LV8729 Drivers

- Ensure your micro-SD card that 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 and renamed to "firmware.bin" on the micro-SD card.

FYSETC LV8729



3	2	1	
0	0	0	1
0	0	1	2
0	1	0	4
0	1	1	8
1	0	0	16
1	0	1	32
1	1	0	64
1	1	1	128

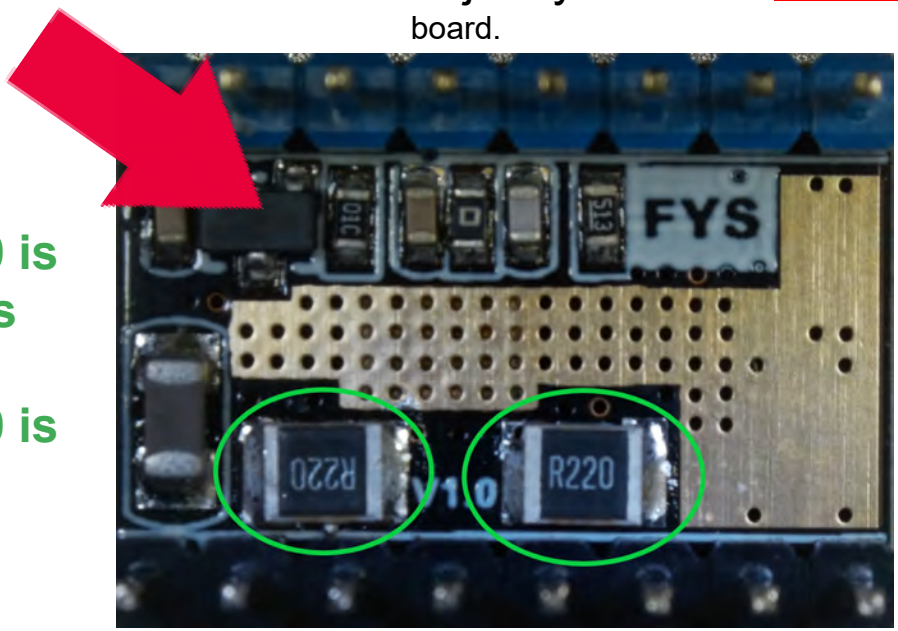
Driver Chip	MD3	MD2	MD1	Subdivision	Excitation Mode
LV8729 Maximum 128 subdivision 36V 1.5A	L	L	L	Full Step	2 Phase
	L	L	H	1/2	1-2 Phase
	L	H	L	1/4	W1-2 Phase
	L	H	H	1/8	2W1-2 Phase
	H	L	L	1/16	4W1-2 Phase
	H	L	H	1/32	8W1-2 Phase
	H	H	L	1/64	16W1-2 Phase
	H	H	H	1/128	32W1-2 Phase

Driving current calculation formula		
Rs=0.1Ω	$I_{MAX} = V_{REF} \bullet 2$	$V_{REF} = (I_{MAX}) / 2$
Rs=0.22Ω	$I_{MAX} = \frac{V_{REF}}{1.1}$	$V_{REF} = I_{MAX} * 1.1$

Note: Use 90% of the calculated Vref when tuning the stepper driver board

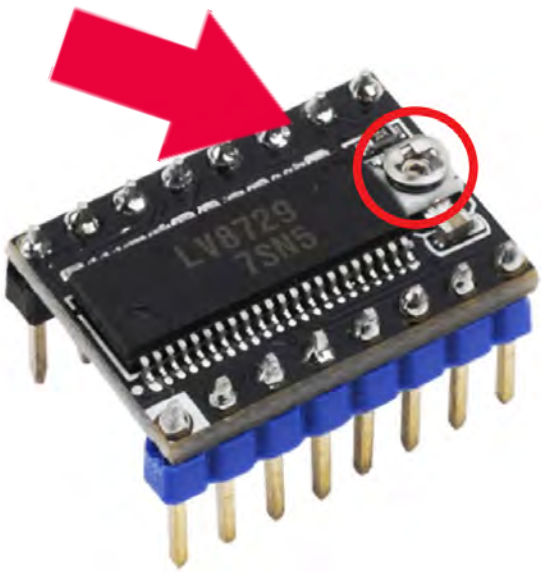
Note: Check your current sense resistor (Rs) values on the driver board, shown in GREEN below.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref. See the appendix for instructions on how to set the Vref on a driver board.

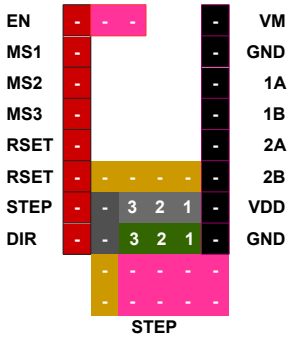


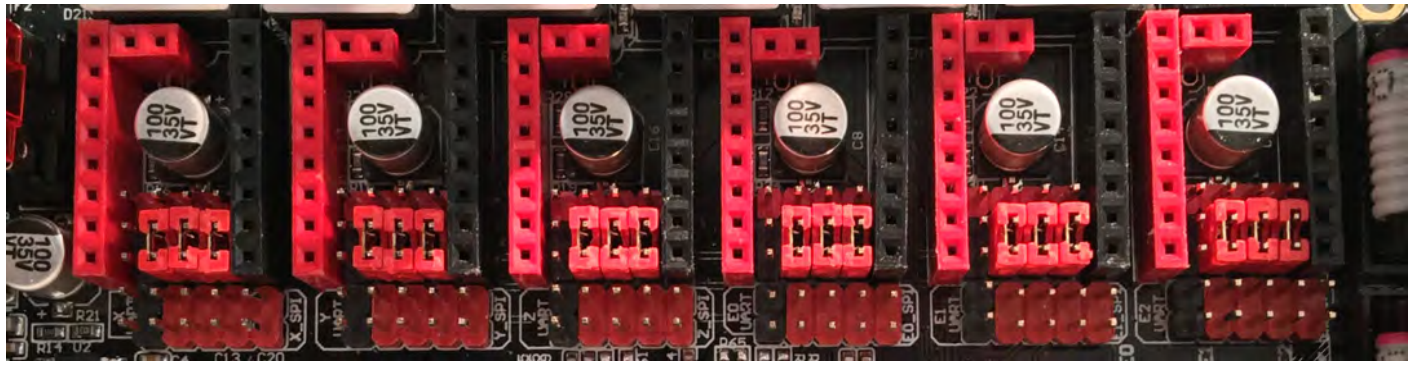
Rs = R220 is 0.22 Ohms

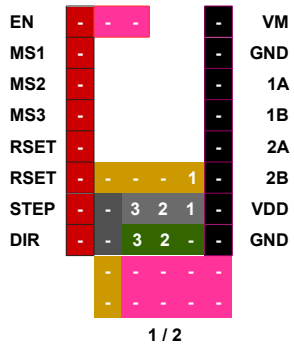
Rs = R100 is 0.1 Ohms

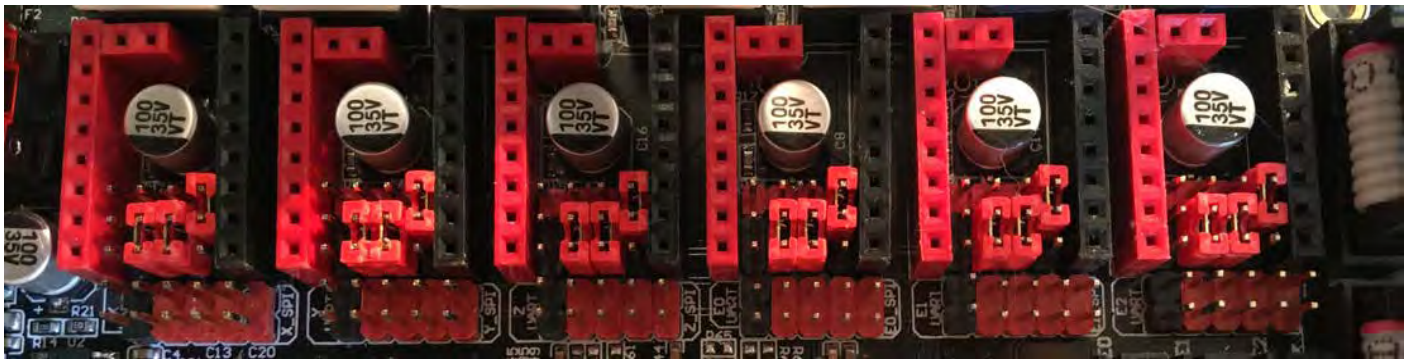


FYSETC LV8729

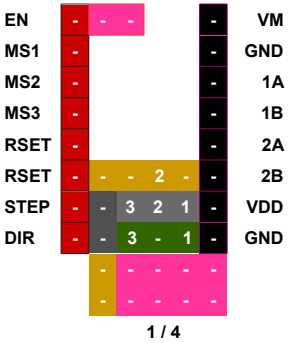


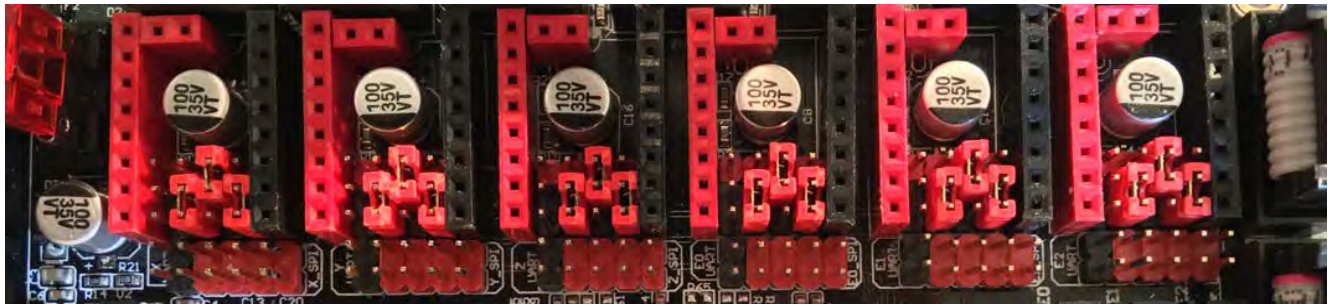


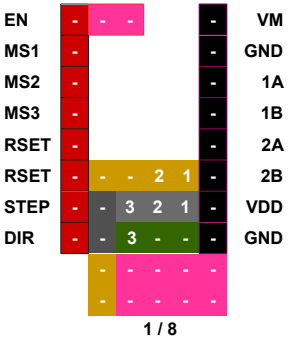


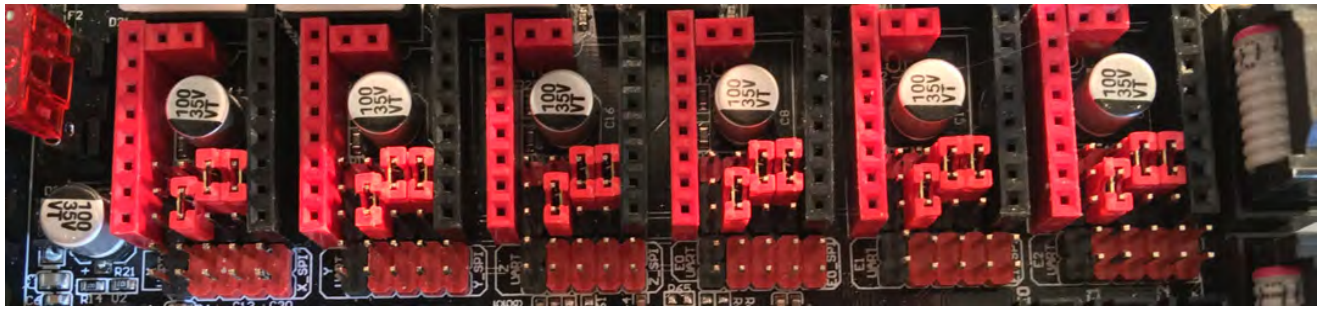


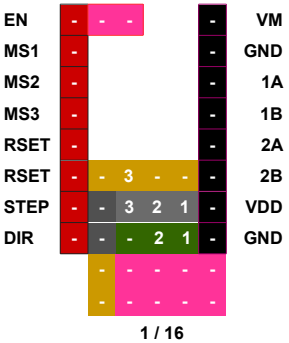
FYSETC LV8729

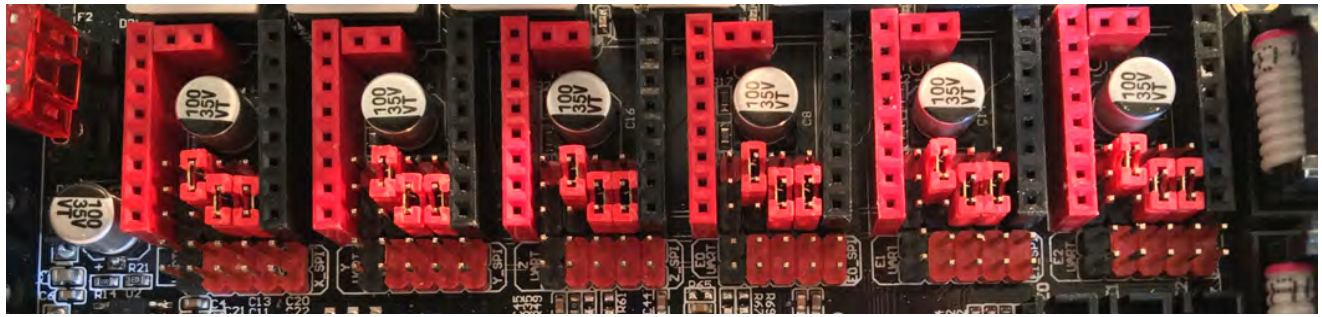




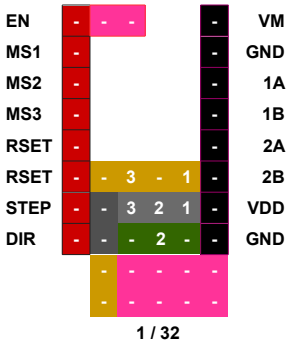


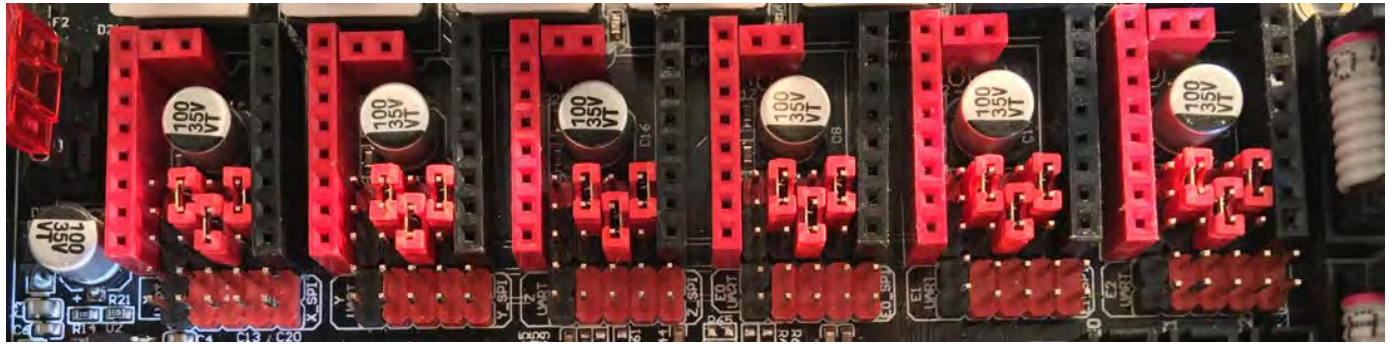


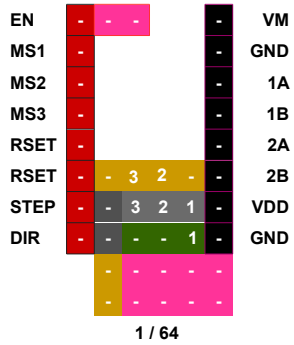


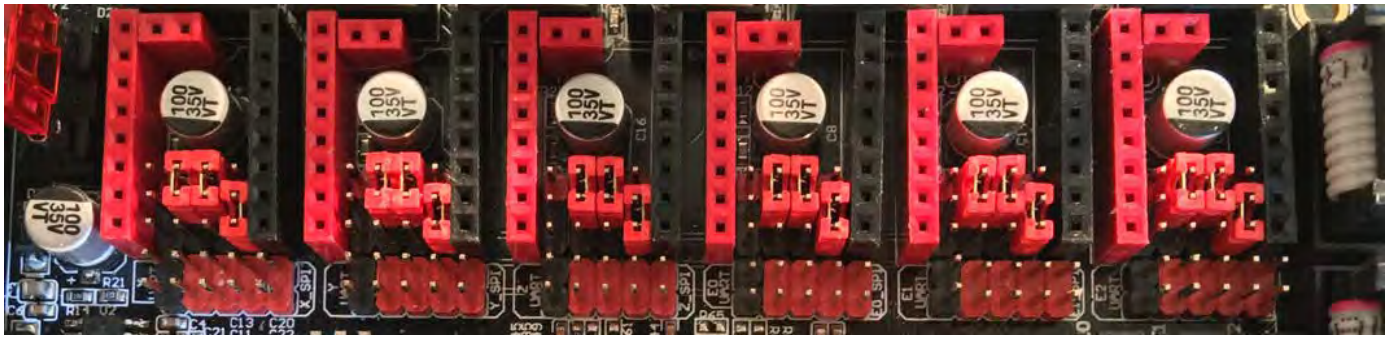


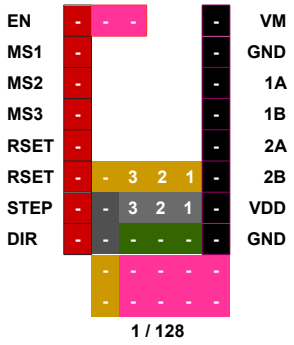
FYSETC LV8729

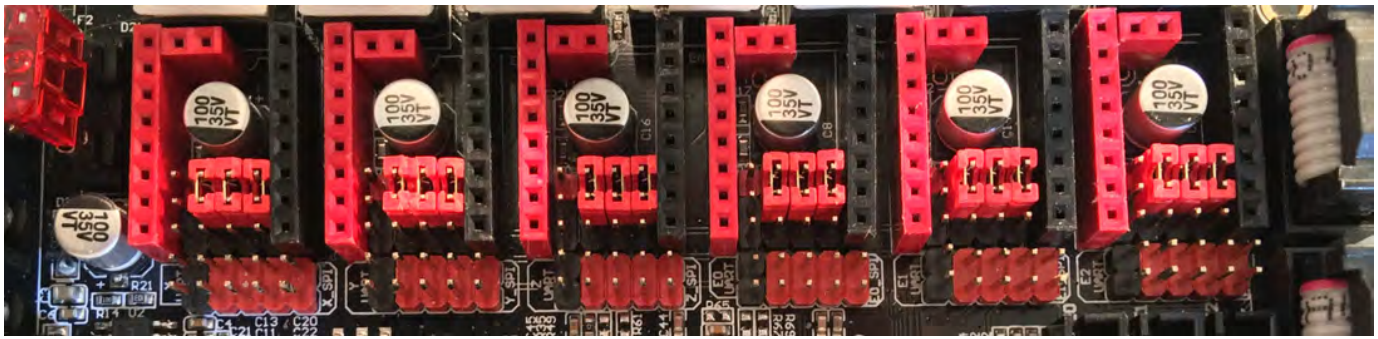








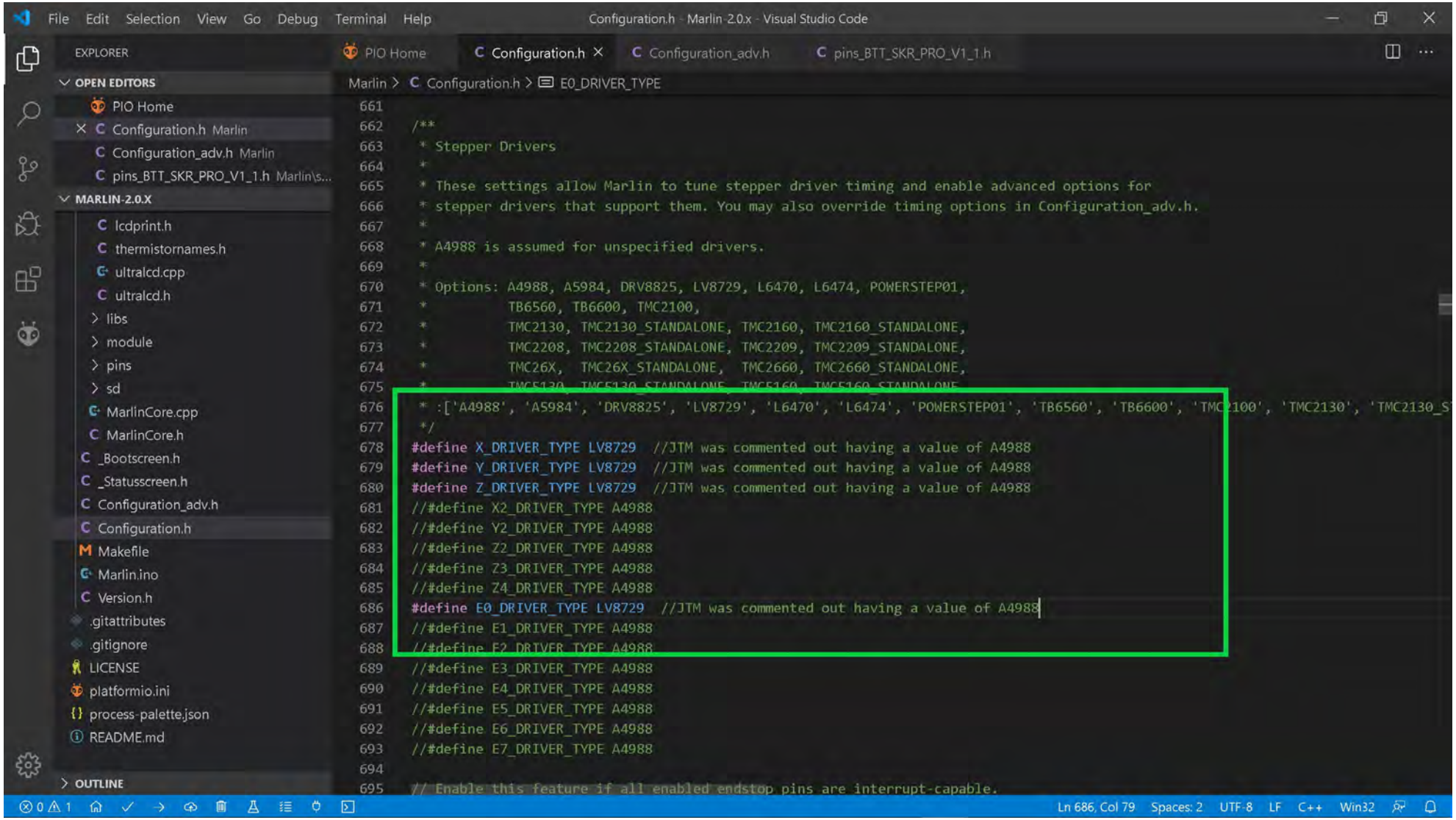




The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

NOTE: Go to Appendix C 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 ("//").



- Go to the next page.

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

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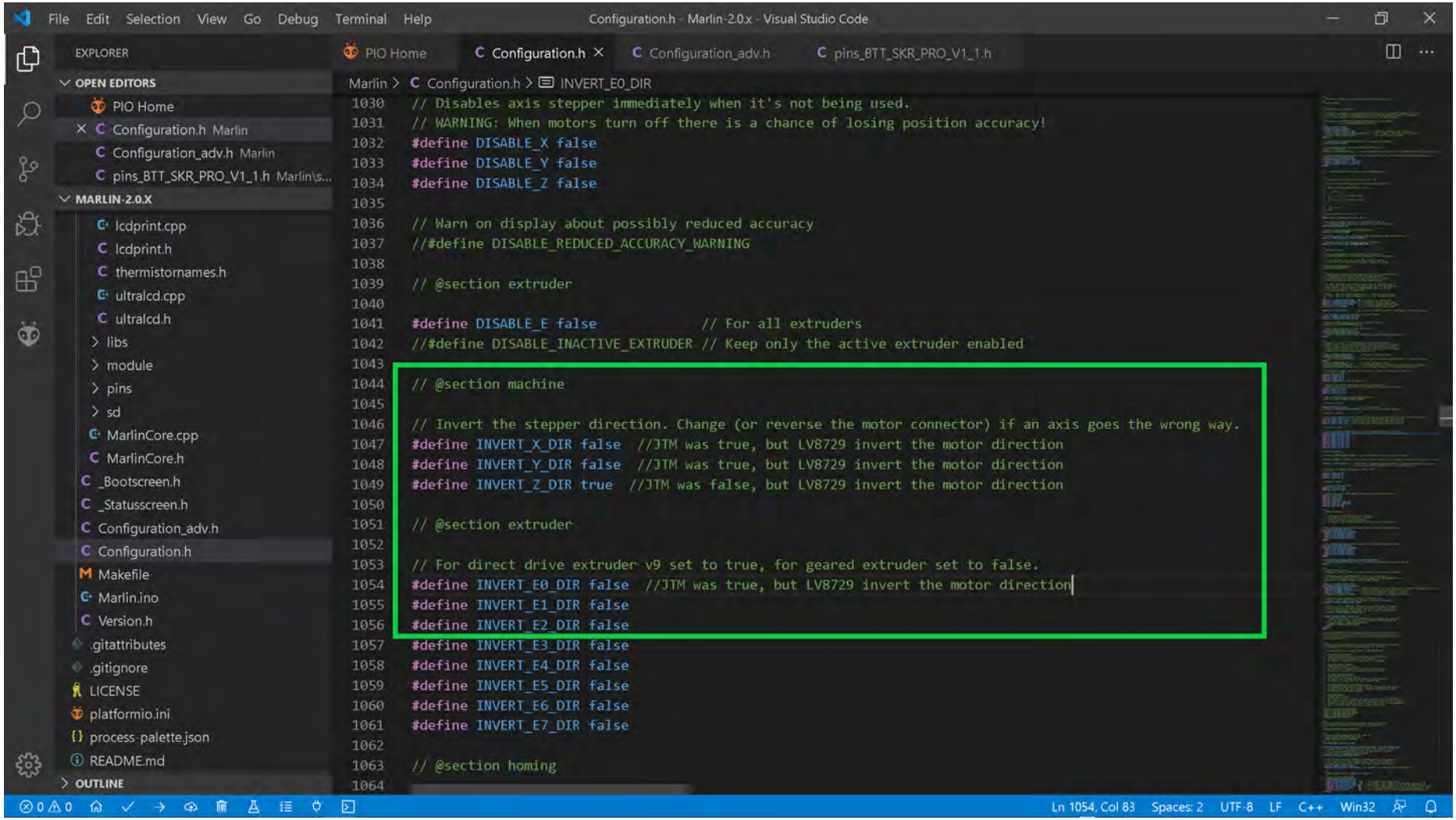

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The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

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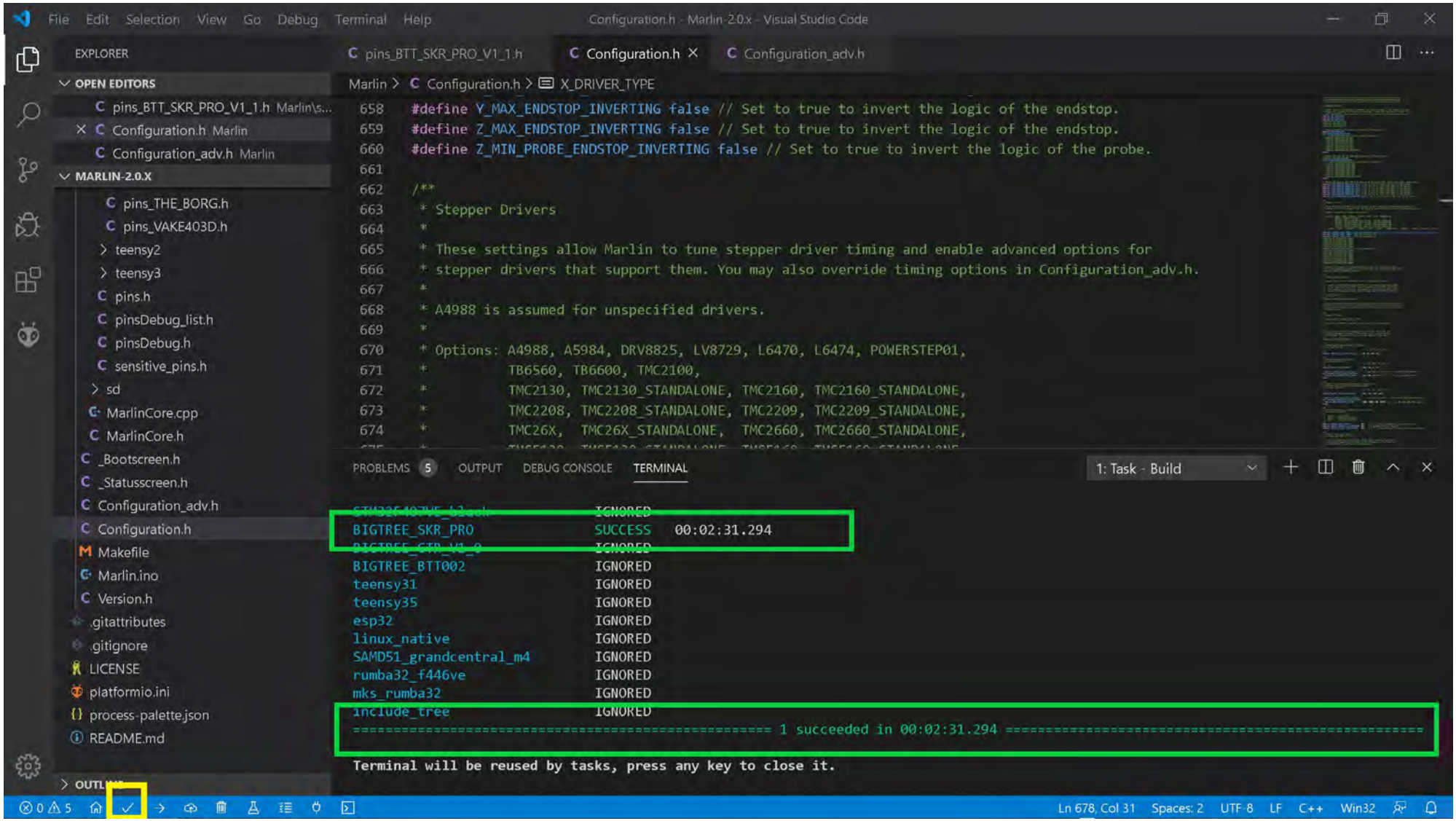

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The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

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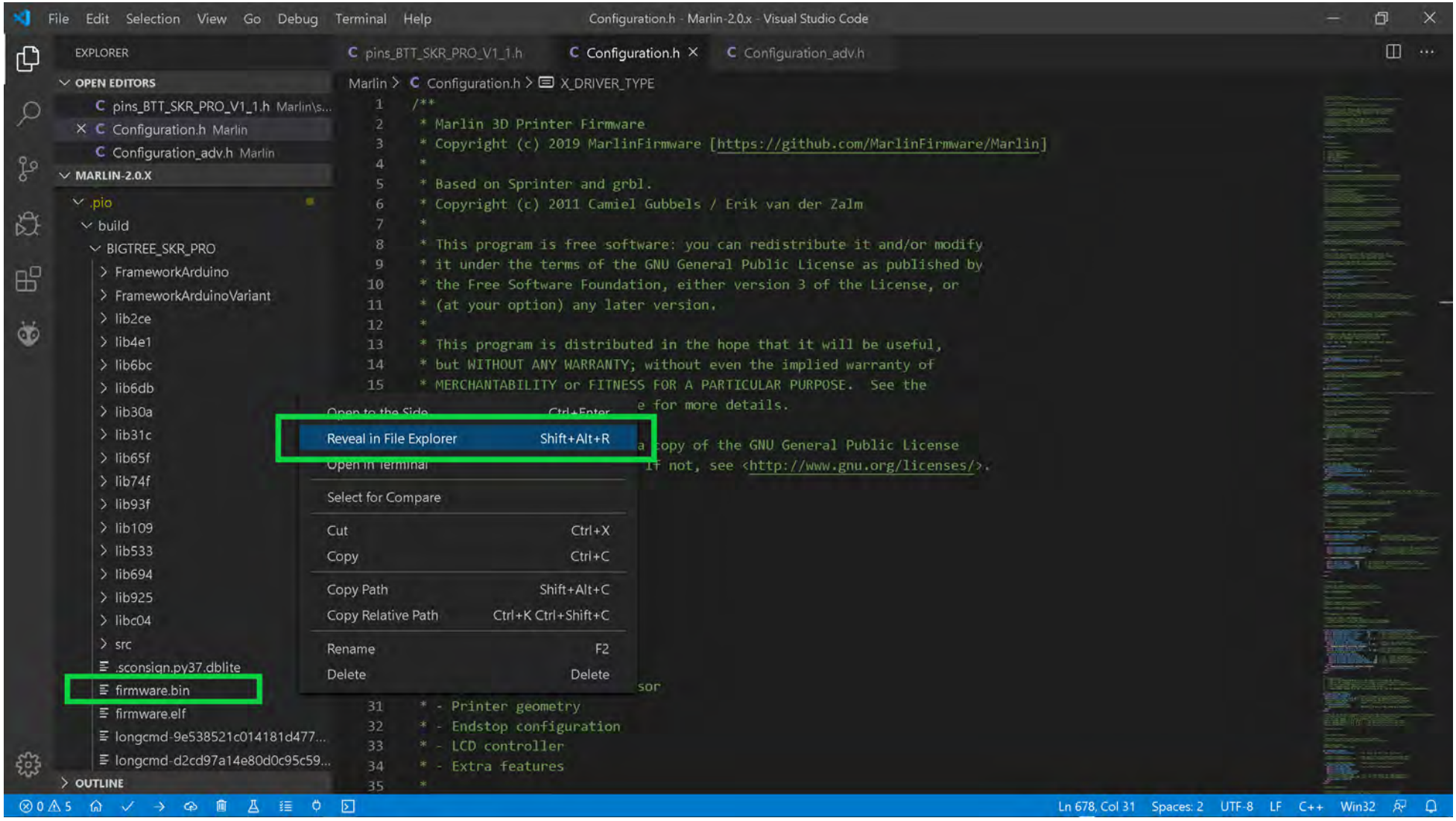

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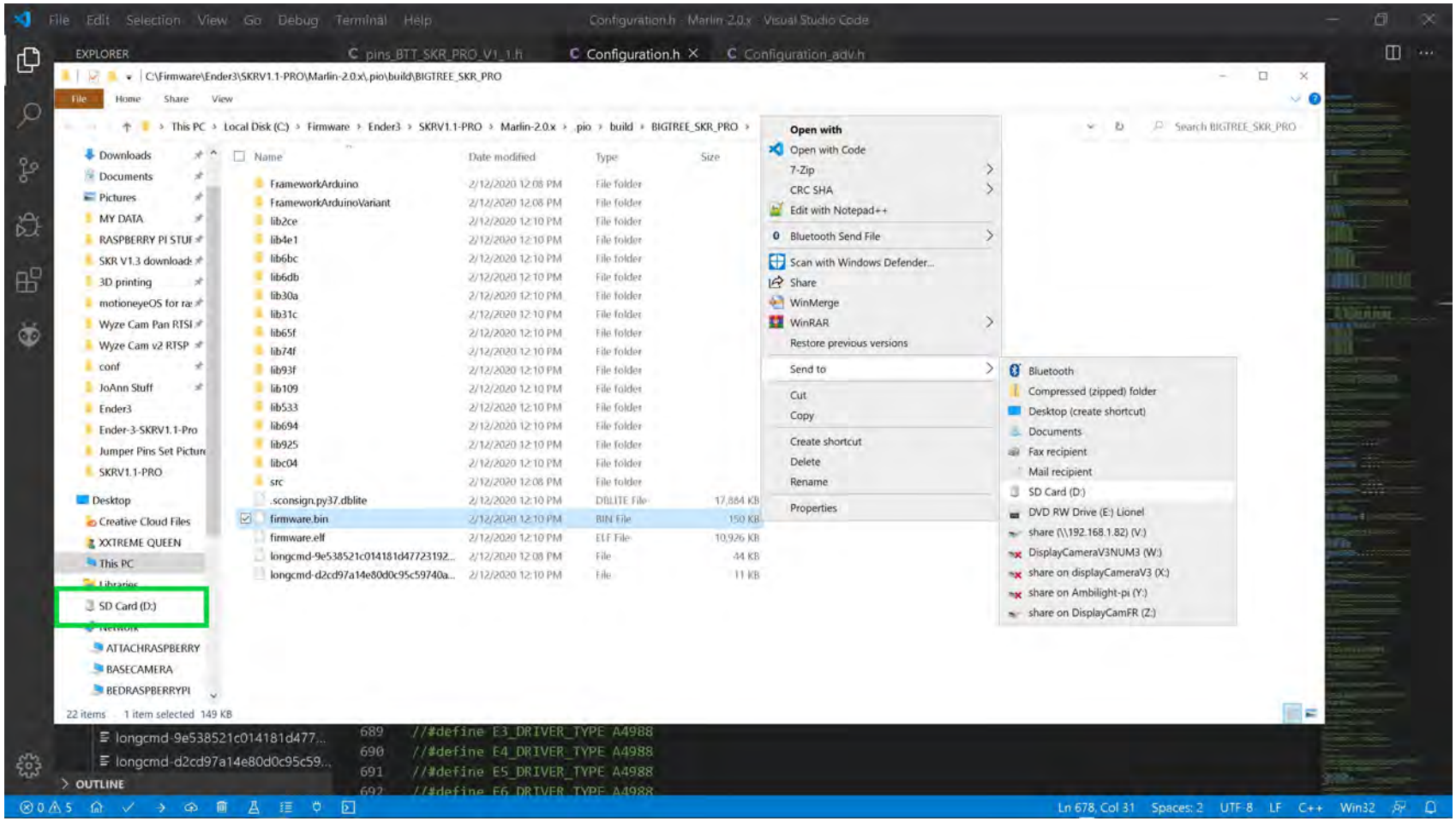
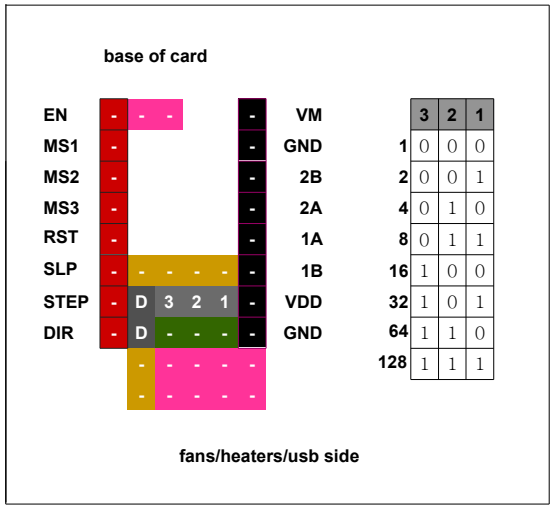
The (latest release of) Marlin Setup for FYSETC LV8729 Drivers

- Ensure your micro-SD card that 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 and renamed to "firmware.bin" on the micro-SD card.

Lerdge LV8729



3	2	1
1	0	0	0
2	0	0	1
4	0	1	0
8	0	1	1
16	1	0	0
32	1	0	1
64	1	1	0
128	1	1	1

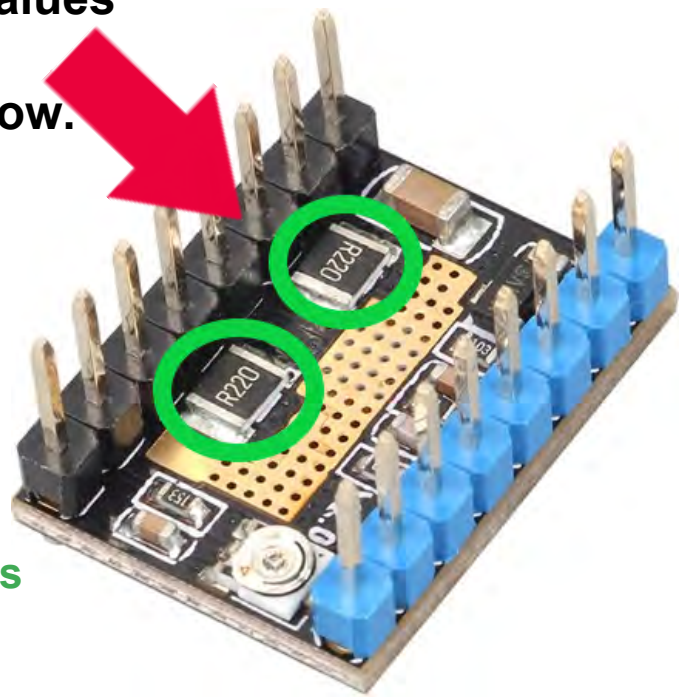
Driver Chip	MD3	MD2	MD1	Subdivision	Excitation Mode
LV8729 Maximum 128 subdivision 36V 1.5A	L	L	L	Full Step	2 Phase
	L	L	H	1/2	1-2 Phase
	L	H	L	1/4	W1-2 Phase
	L	H	H	1/8	2W1-2 Phase
	H	L	L	1/16	4W1-2 Phase
	H	L	H	1/32	8W1-2 Phase
	H	H	L	1/64	16W1-2 Phase
	H	H	H	1/128	32W1-2 Phase

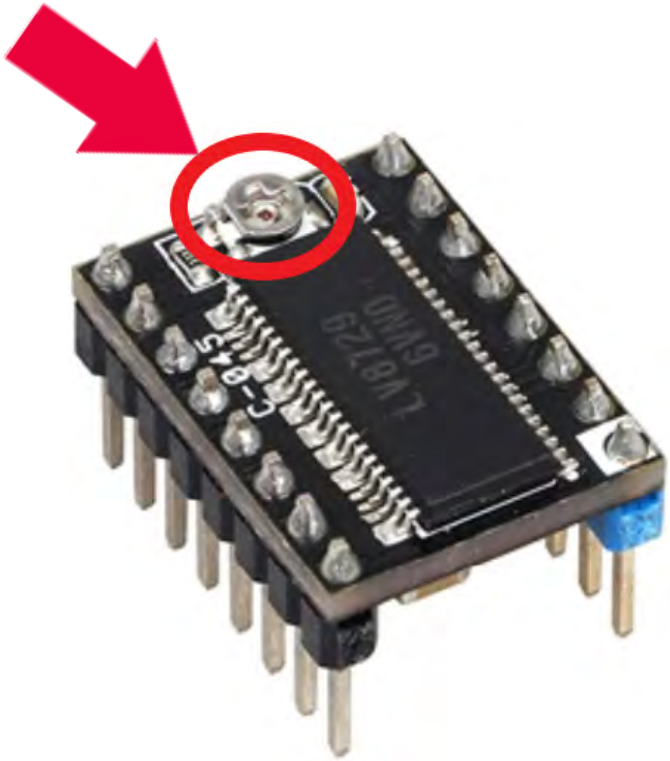
Driven current calculation formula		
Rs=0.1Ω	$I_{MAX} = V_{REF} \bullet 2$	$V_{REF} = (I_{MAX}) / 2$
Rs=0.22Ω	$I_{MAX} = \frac{V_{REF}}{1.1}$	$V_{REF} = I_{MAX} * 1.1$

Note: Use 90% of the calculated Vref when tuning the stepper driver board

Note: Check your current sense resistor (Rs) values on the driver board, shown in GREEN below.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref. See the appendix for instructions on how to set the Vref on a driver board.



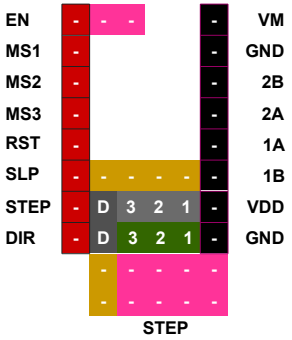


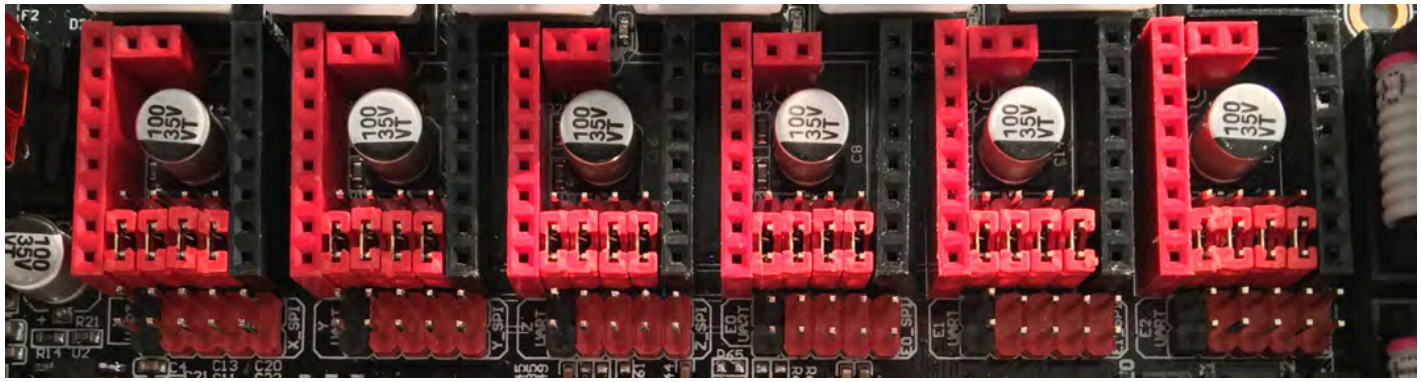
Rs = R220 is 0.22 Ohms

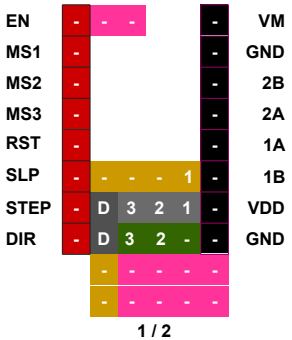
Rs = R100 is 0.1 Ohms

Lerdge LV8729

Note: The "D" jumper MUST be SET!







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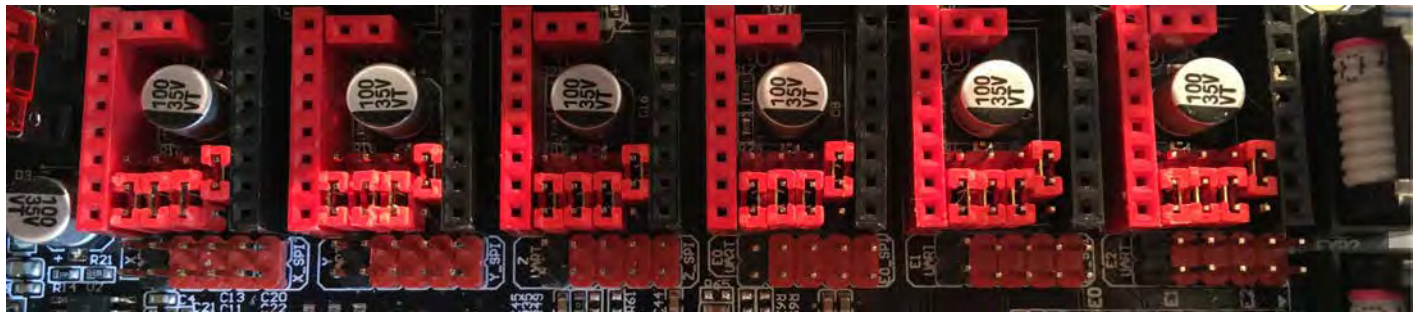
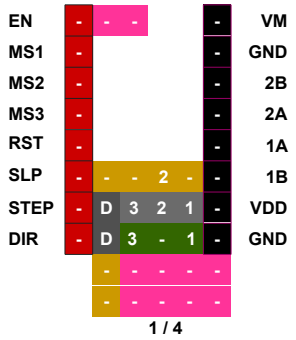


Lerdge LV8729



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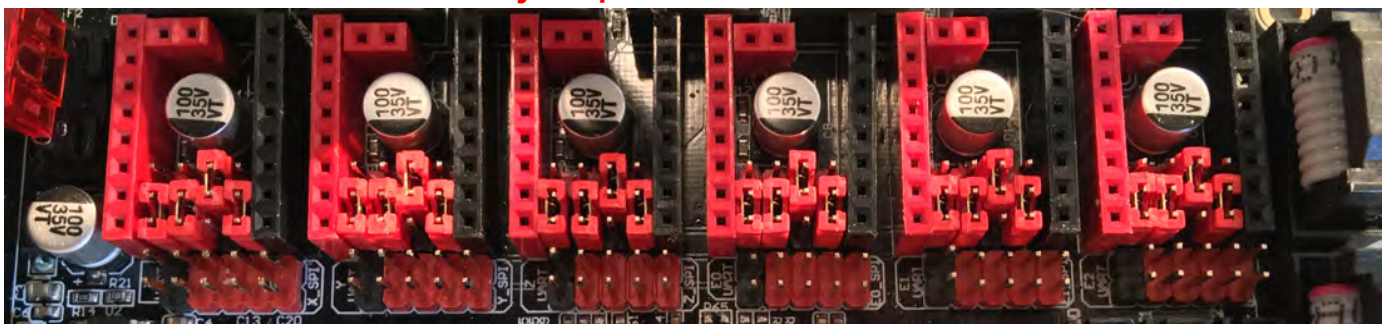

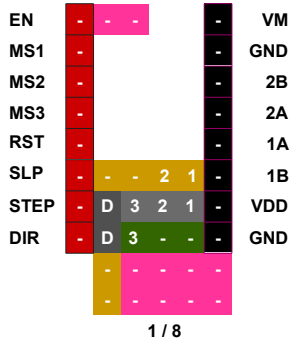

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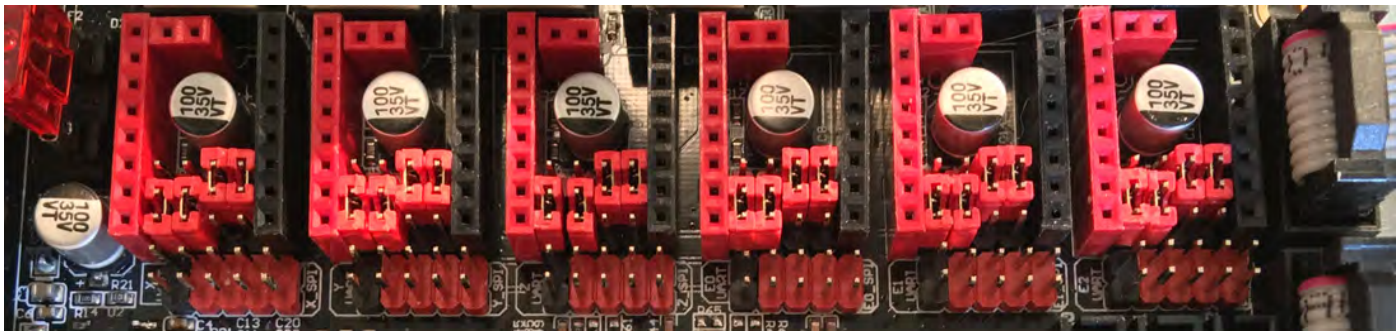

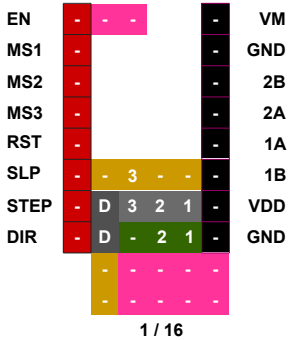

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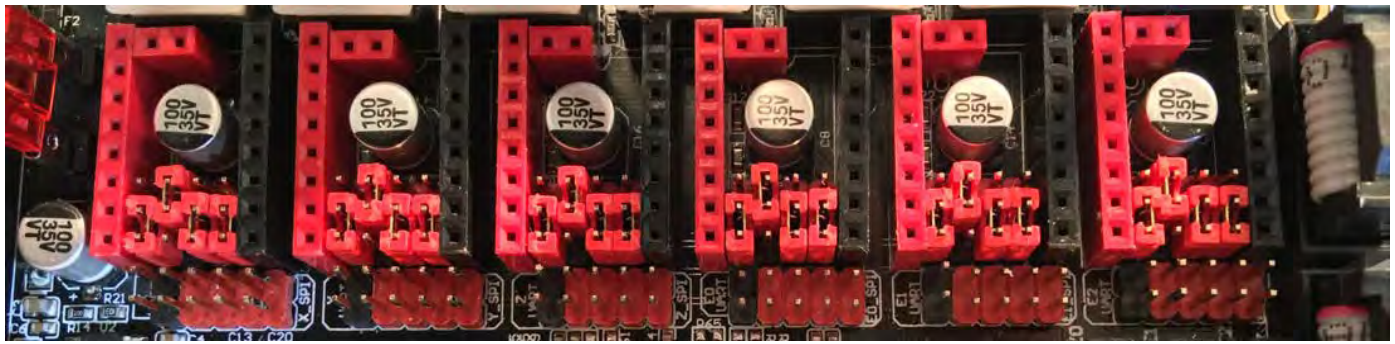

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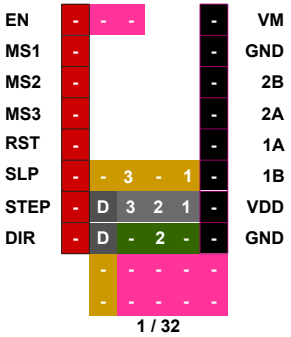

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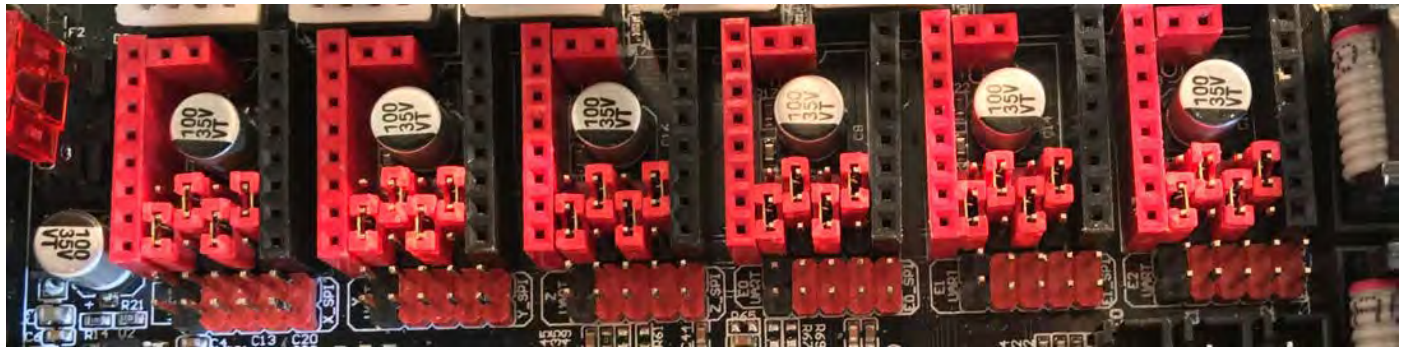

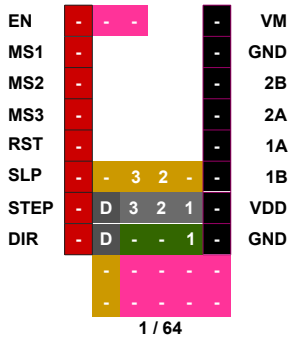

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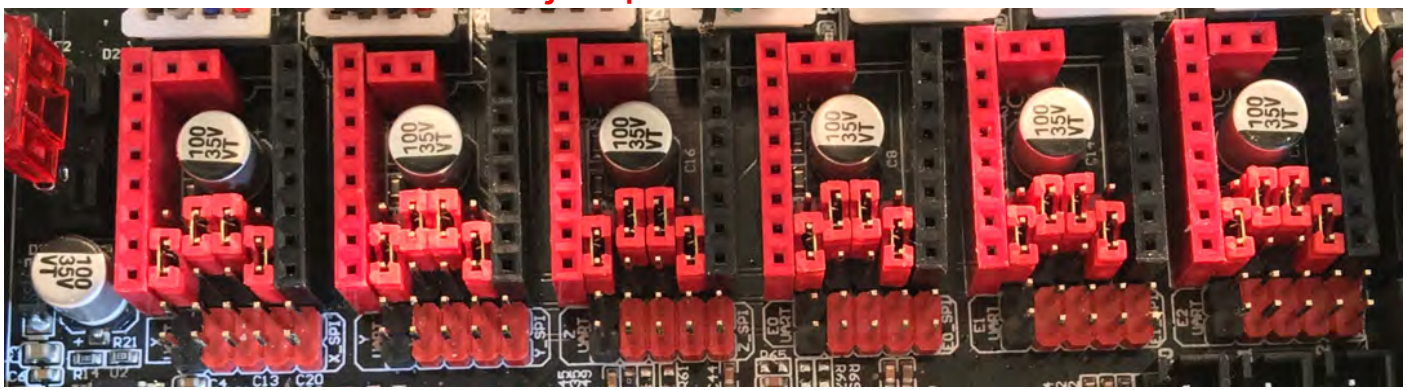

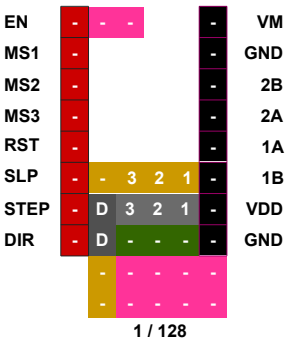

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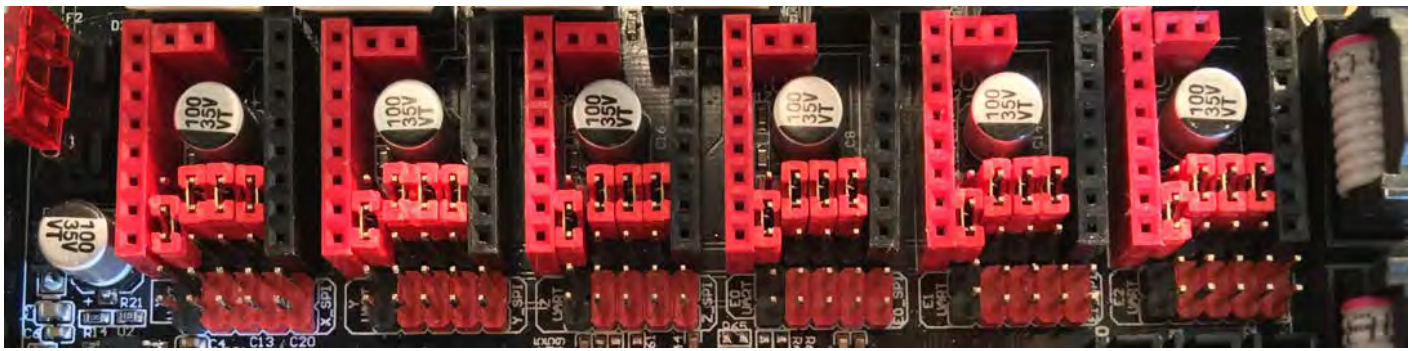

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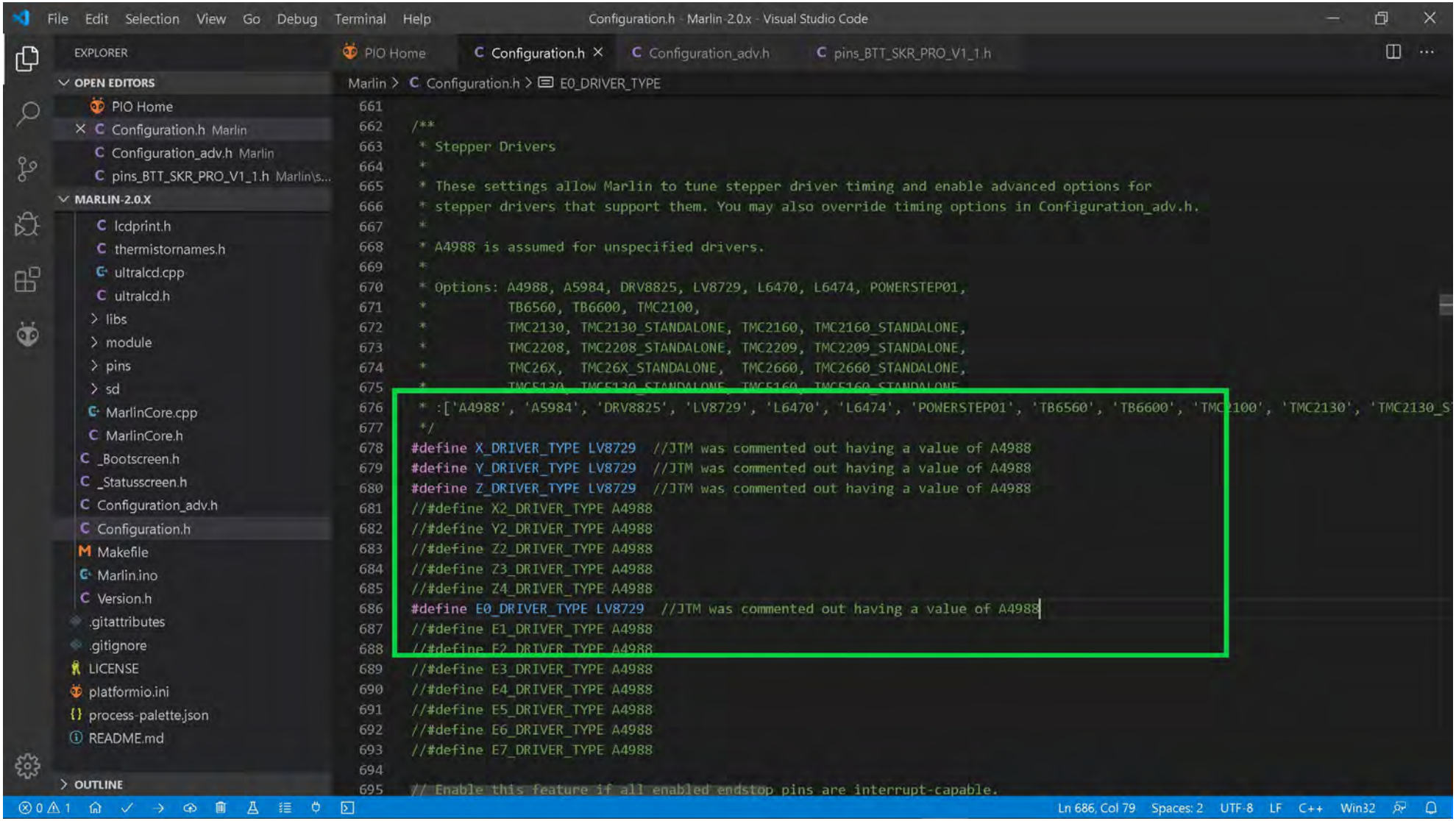

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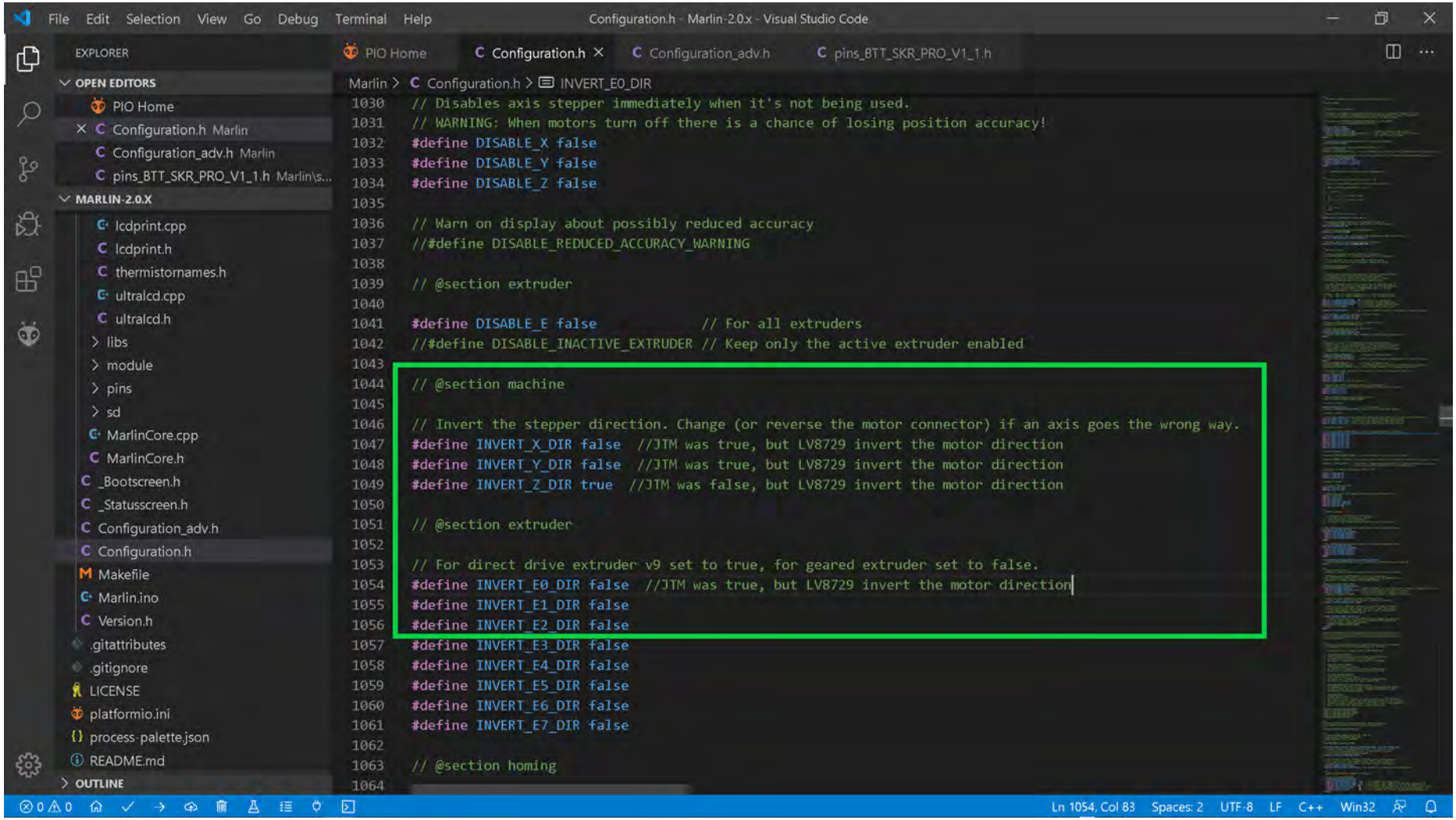

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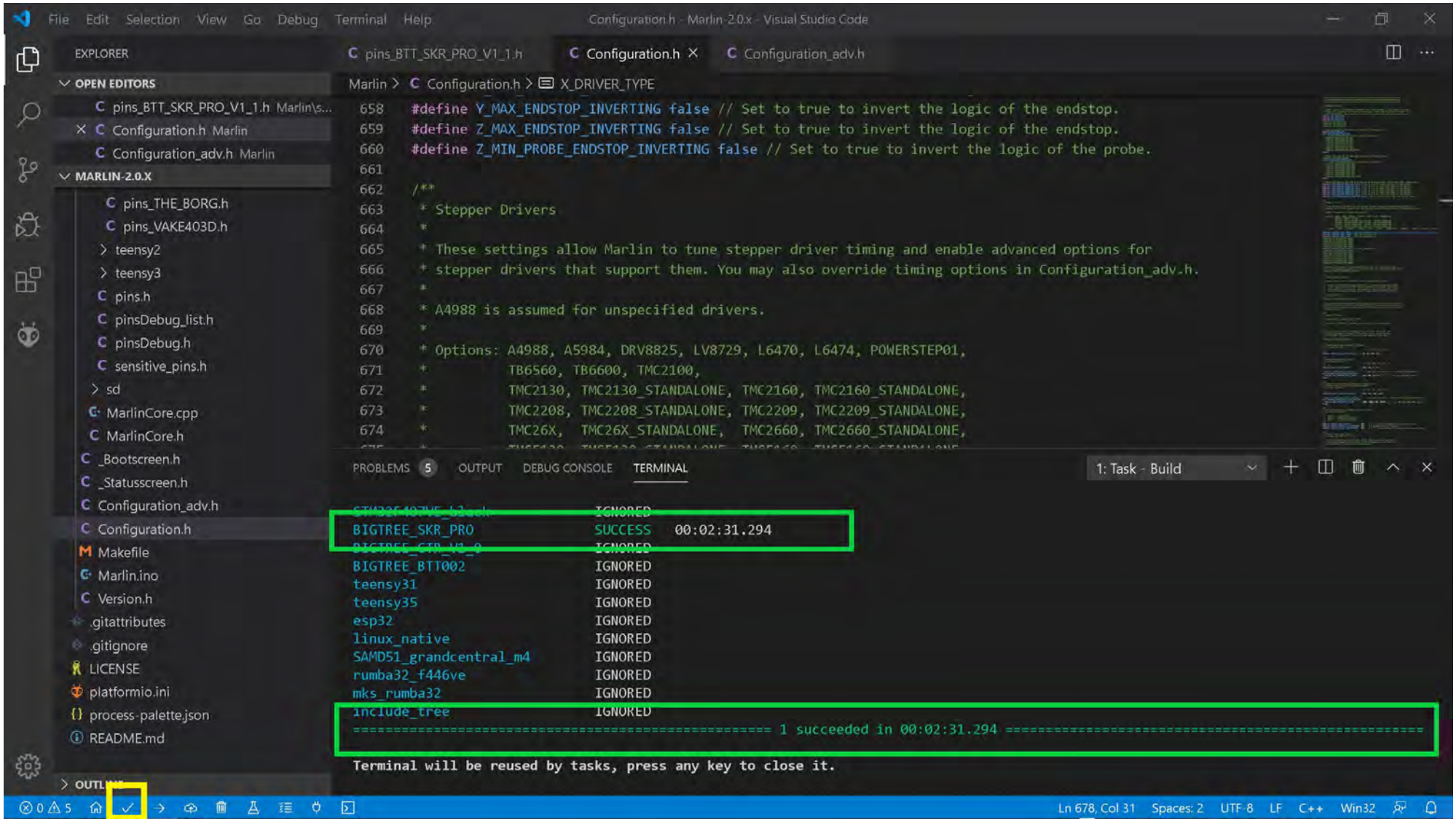

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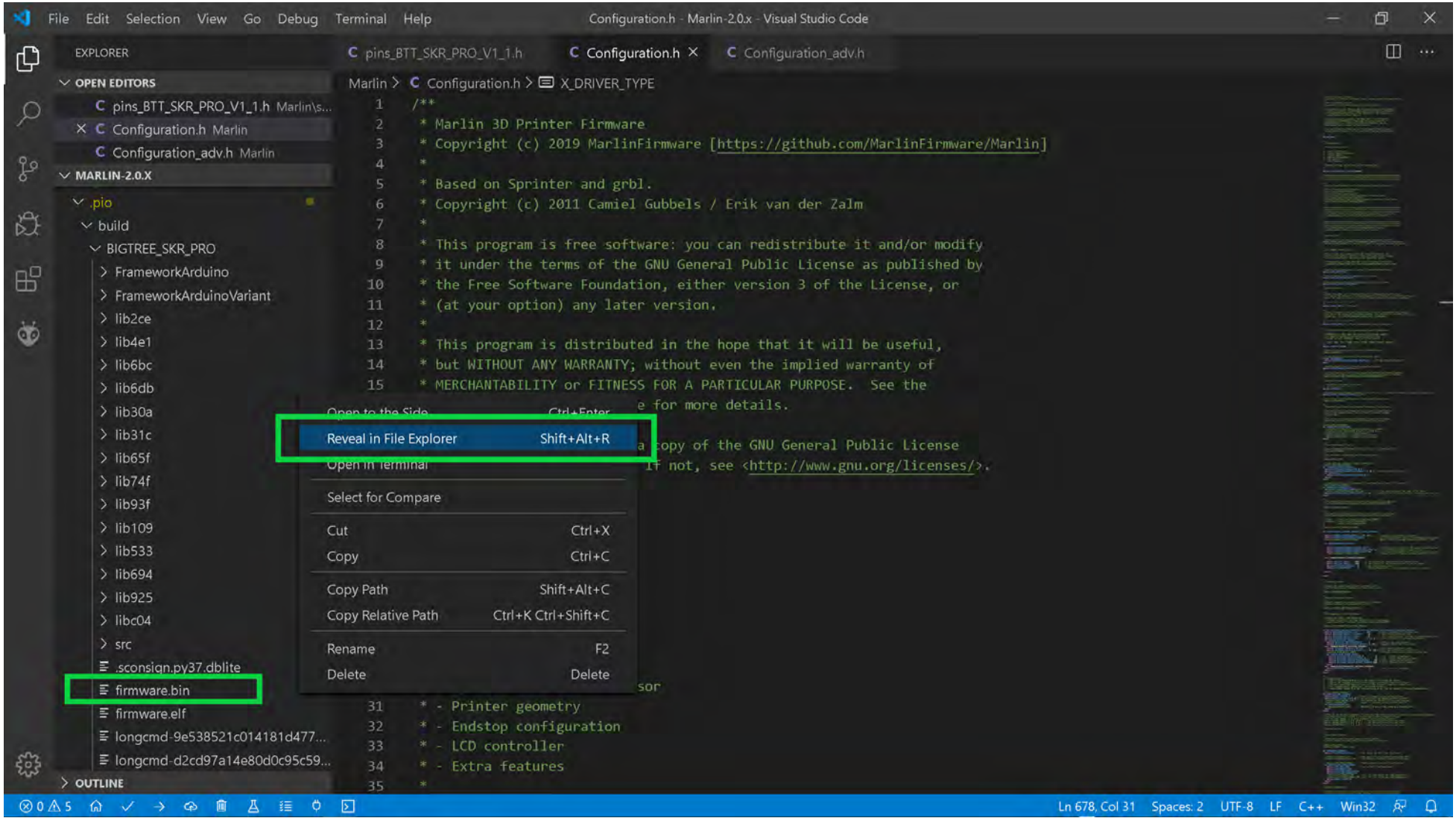

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The (latest release of) Marlin Setup for Lerdge LV8729 Drivers

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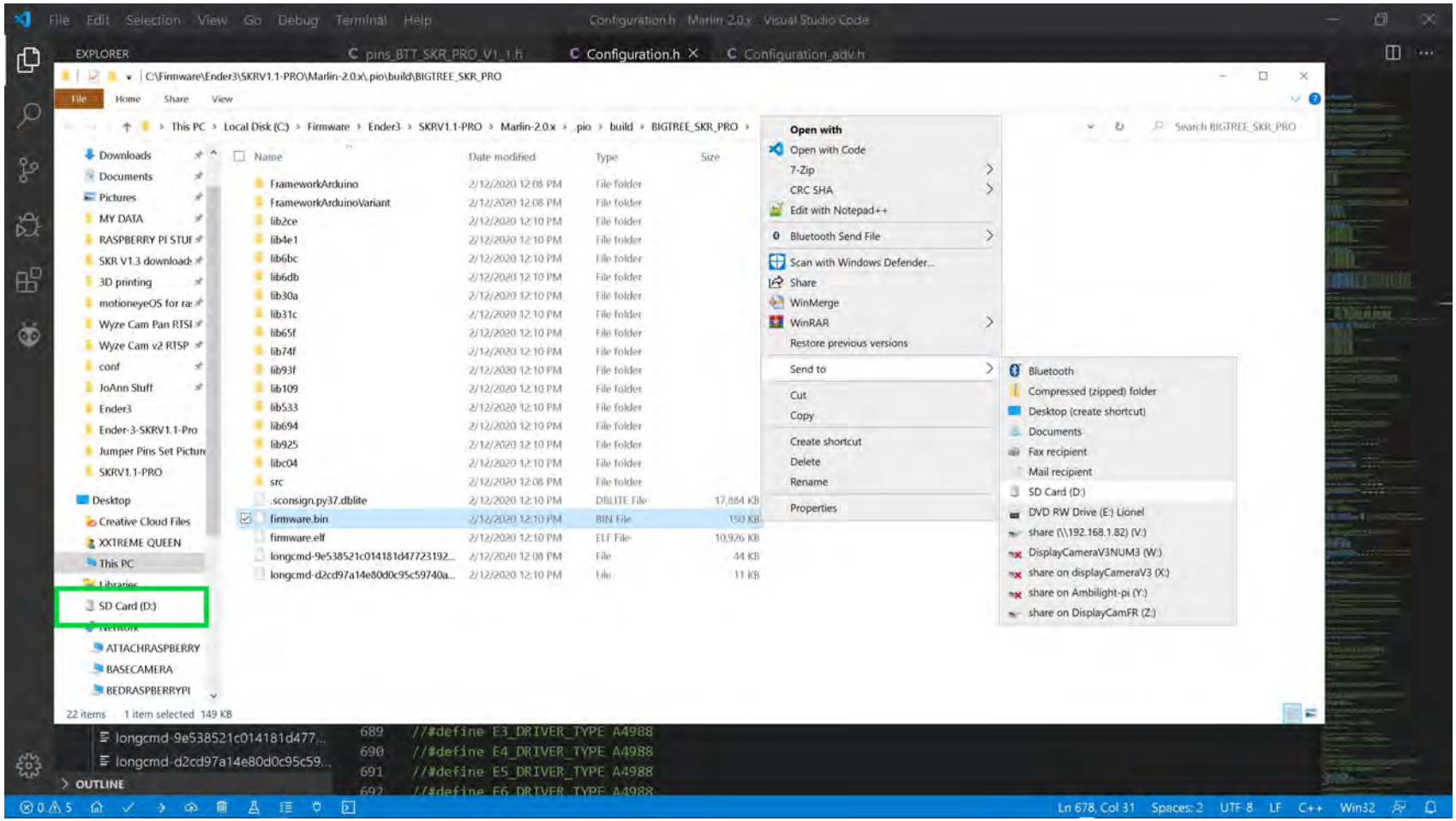
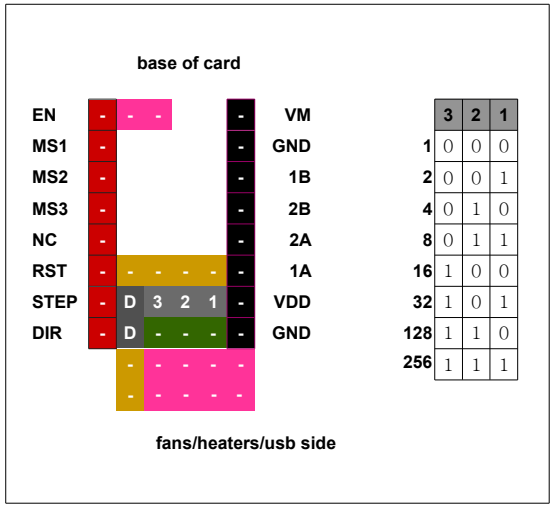


- Right click on the SD card reader, as seen in the GREEN box above, and select "Eject" from the context menu. Take the micro-SD card out of the adapter and place it into the micro-SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR"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

FYSETC ST820



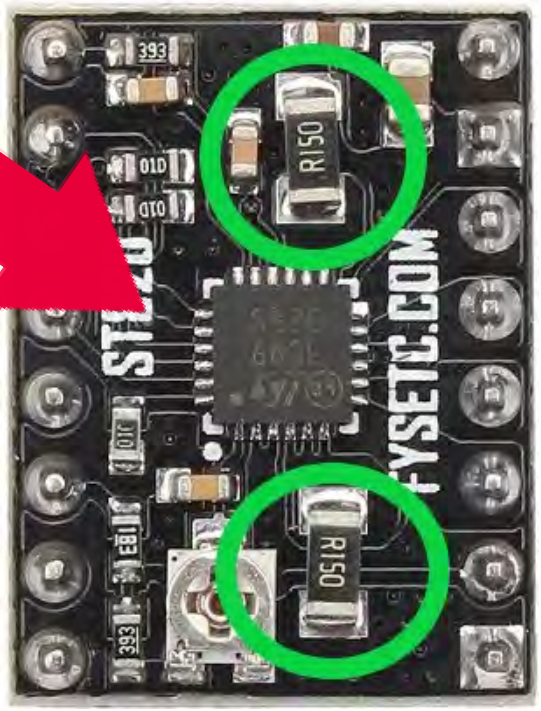
3	2	1
1	0	0	0
2	0	0	1
4	0	1	0
8	0	1	1
16	1	0	0
32	1	0	1
128	1	1	0
256	1	1	1

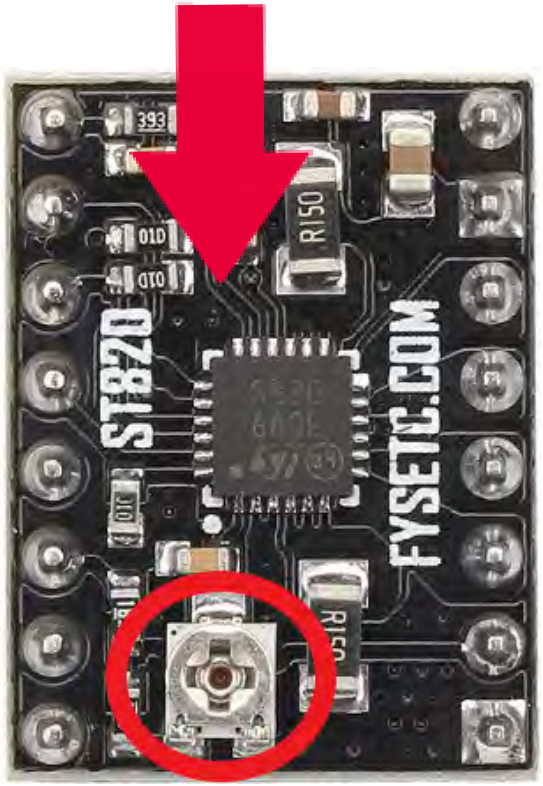
Driver Chip	MS3	MS2	MS1	Subdivision
ST820 Maximum 256 subdivision 45V 1.5A	L	L	L	Full Step
	L	L	H	1/2
	L	H	L	1/4
	L	H	H	1/8
	H	L	L	1/16
	H	L	H	1/32
	H	H	L	1/128
	H	H	H	1/256
Driving current calculation formula Rs=0.15Ω	$I_{MAX} = \frac{V_{REF} - V_{DD}}{5 * R_S}$			$V_{REF} = 5 * I_{MAX} * \frac{R_S}{V_{DD}}$

Note: Use 90% of the calculated Vref when tuning the stepper driver board

Note: Check your current sense resistor (Rs) values on the driver board, shown in GREEN below.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref. See the appendix for instructions on how to set the Vref on a driver board.



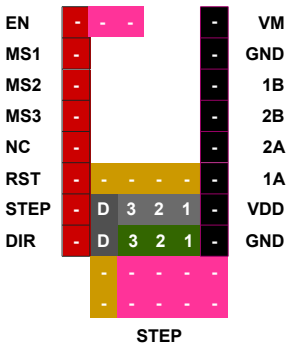


Rs = R150 is 0.15 Ohms

Rs = R200 is 0.2 Ohms

FYSETC ST820

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.



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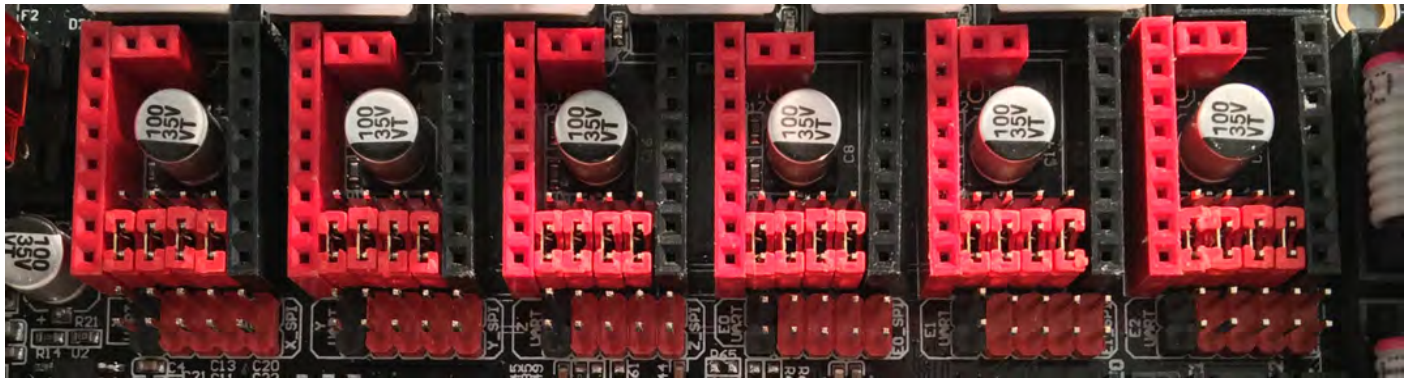

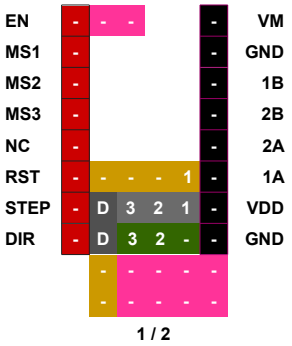

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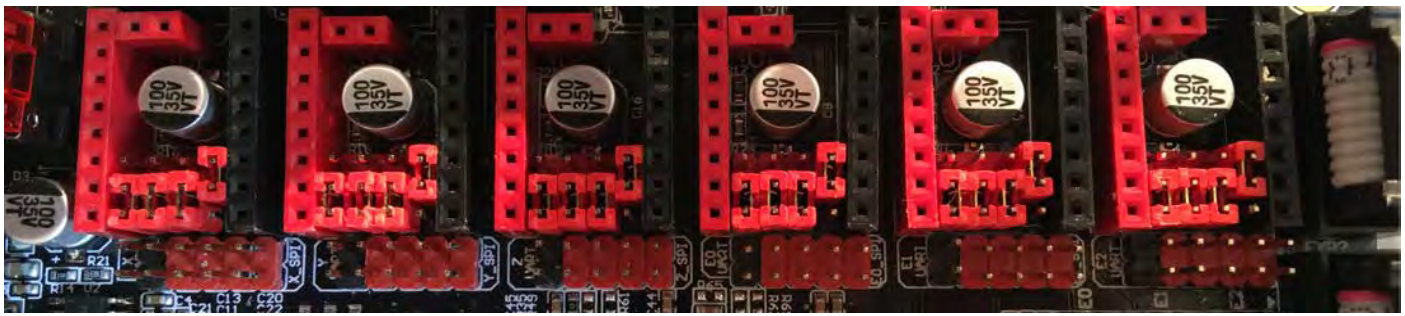

FYSETC ST820

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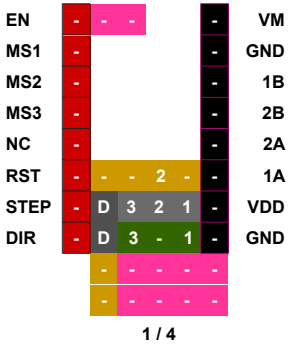

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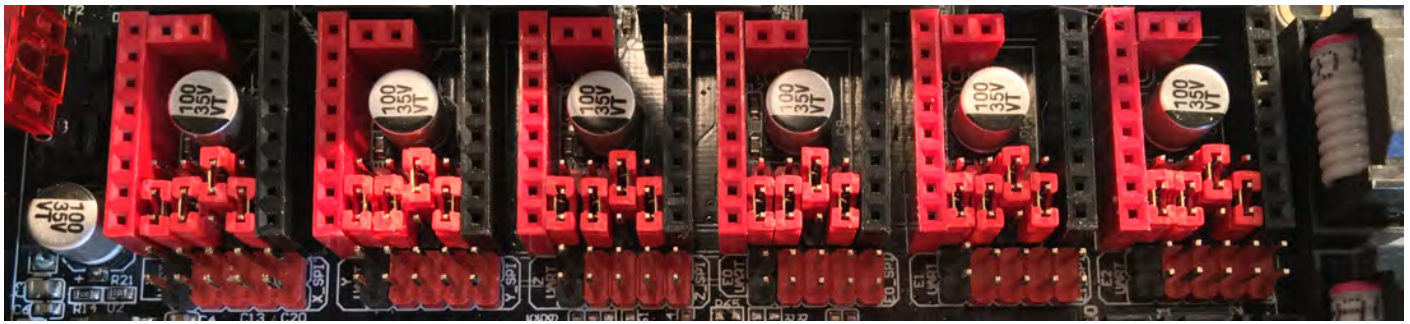

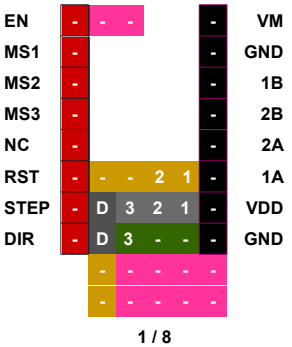

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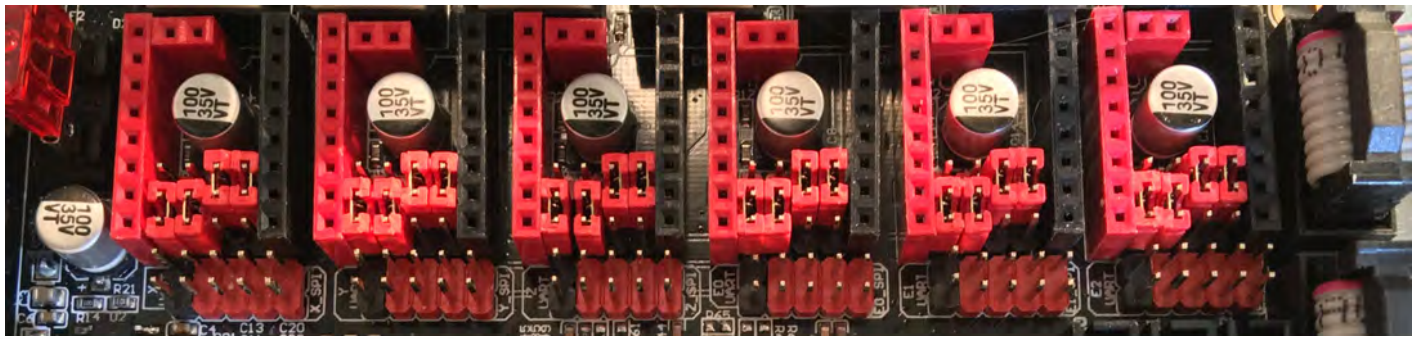

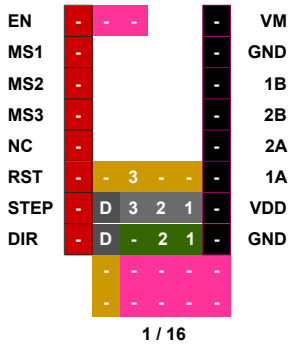

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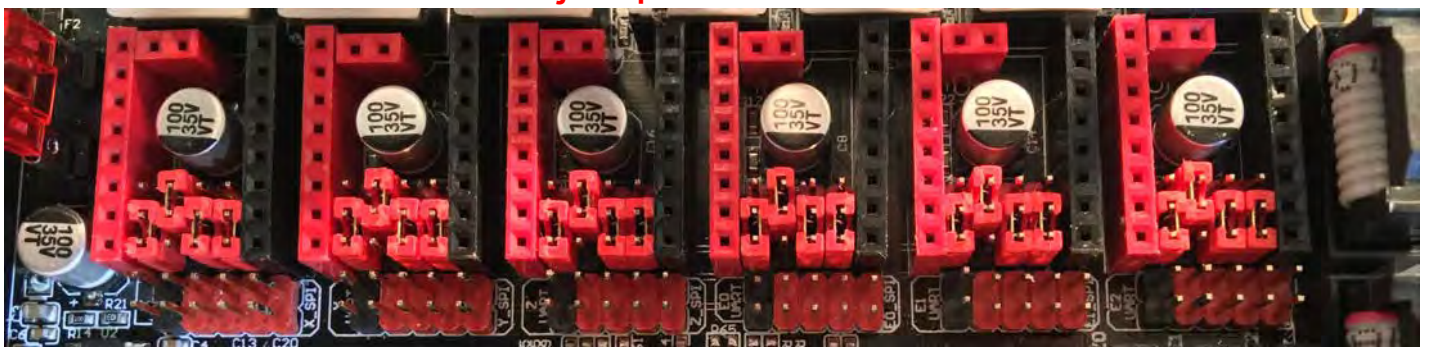
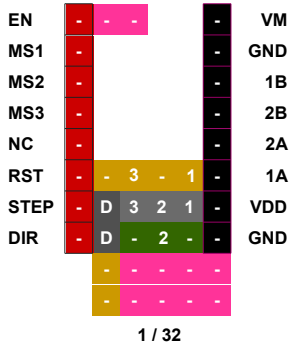
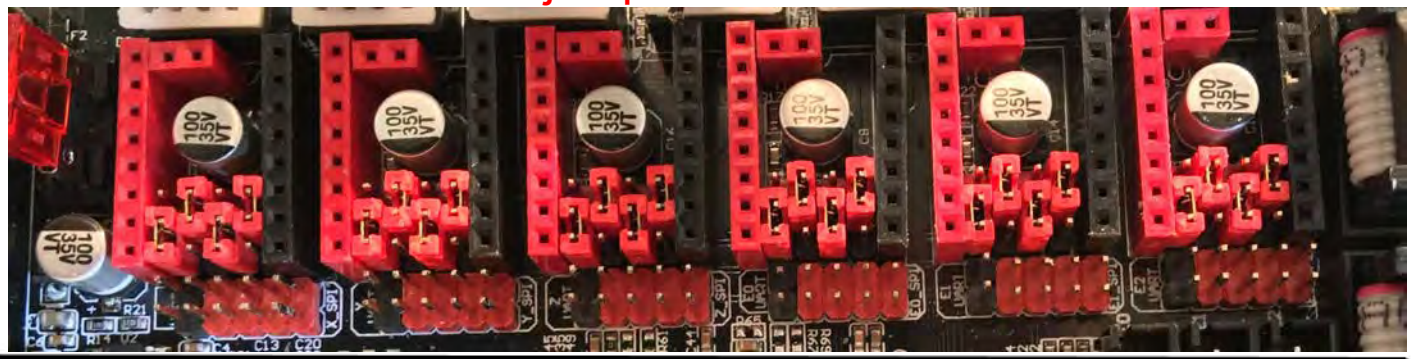


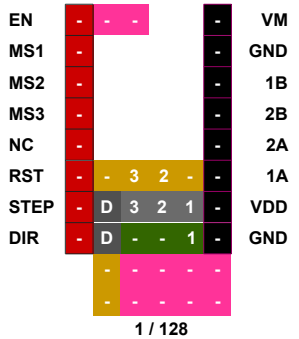
FYSETC ST820

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.

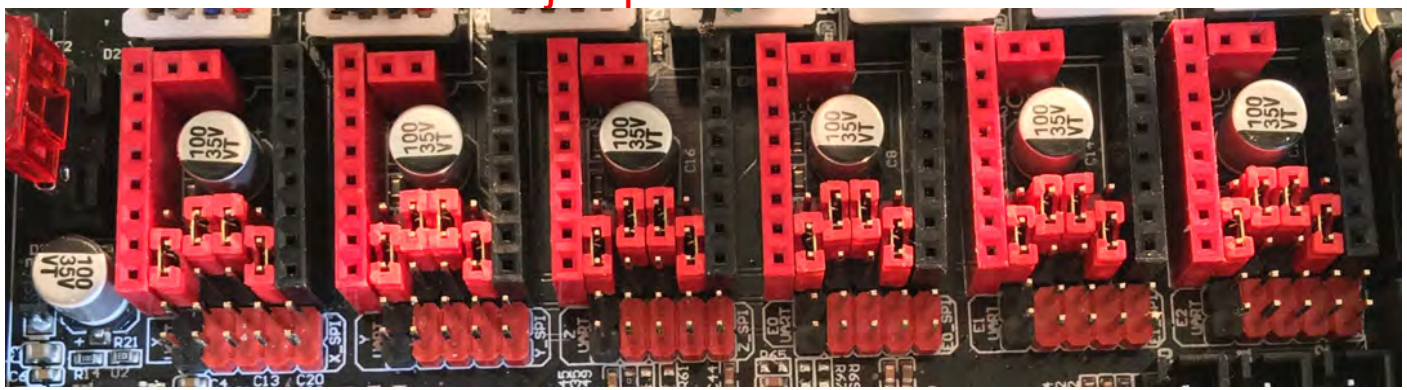


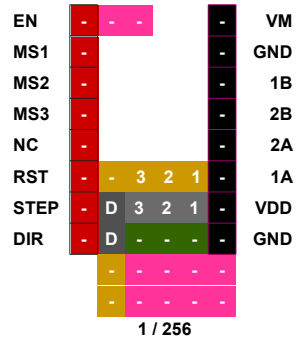
Note: The "D" jumper MUST be SET!





Note: The "D" jumper MUST be SET!





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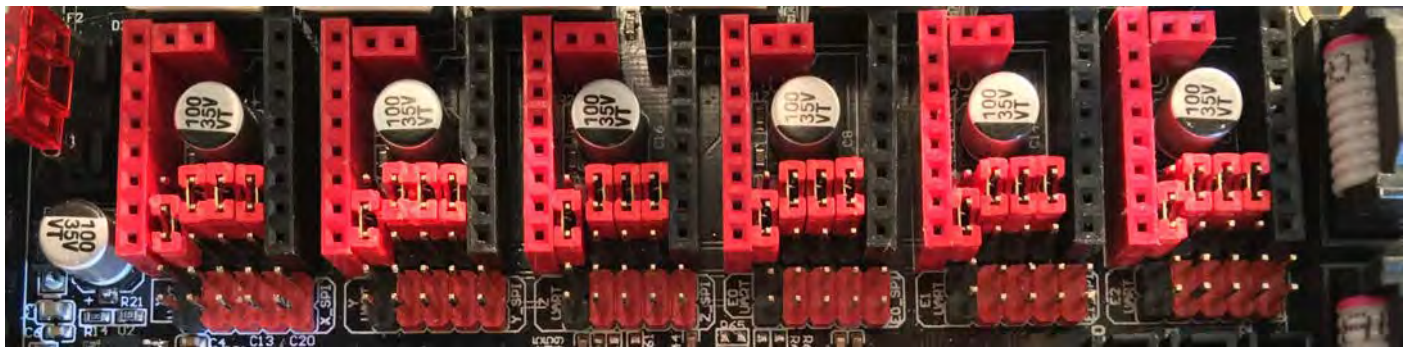
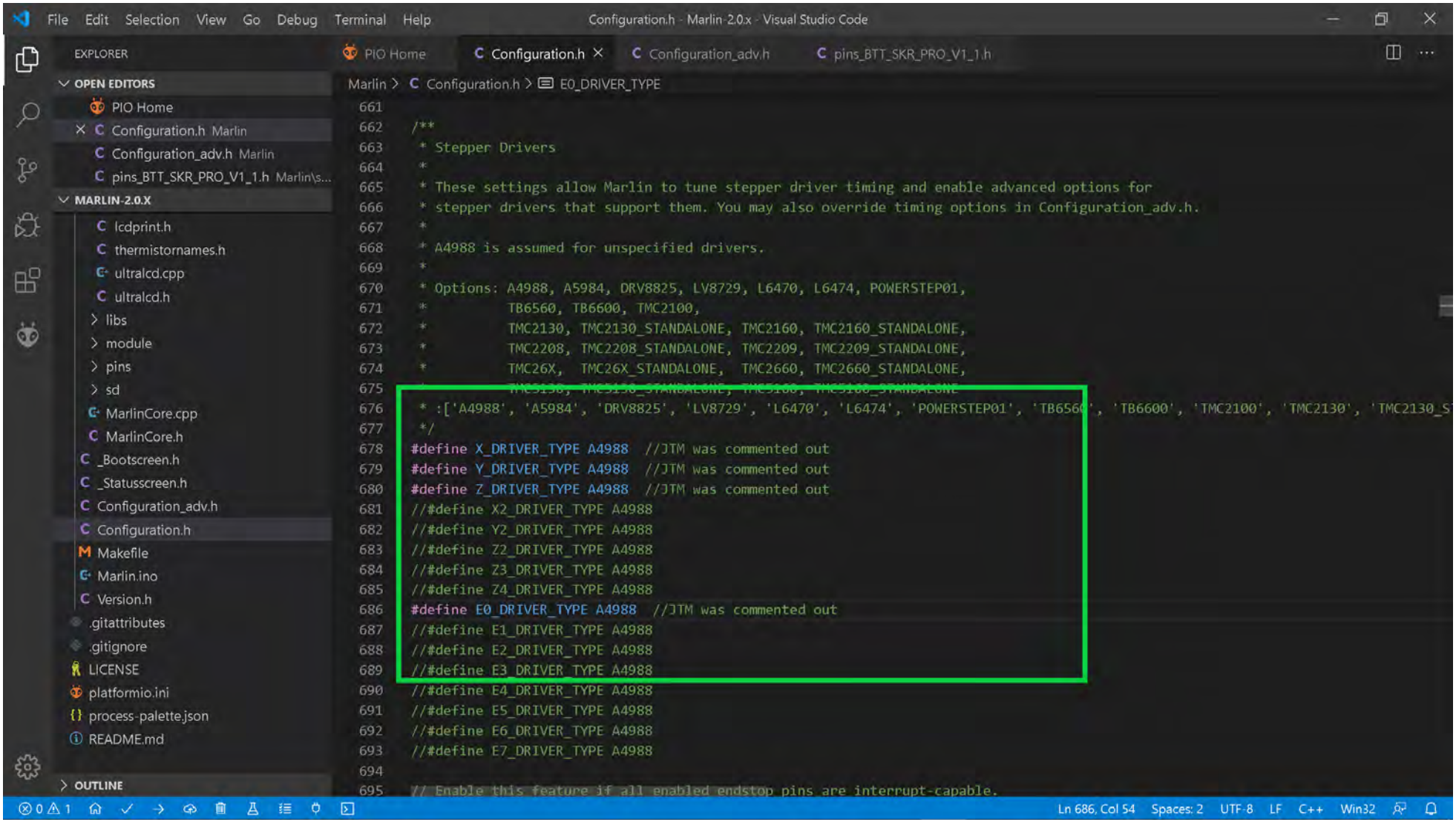


The (latest release of) Marlin Setup for FYSETC ST820 Drivers

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

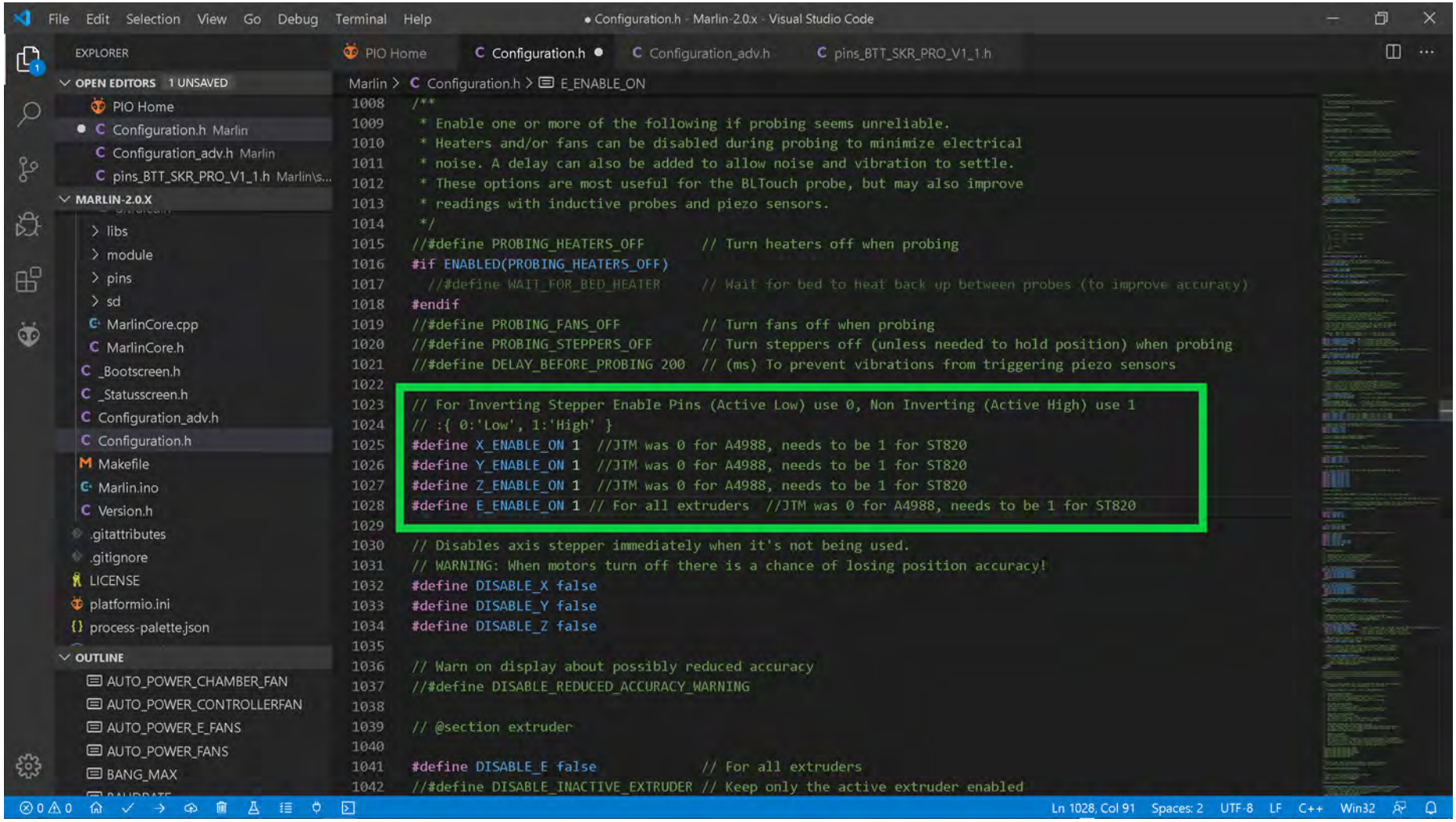
- Change the stepper motor drivers so that Marlin knows you are using FYSETC ST820 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use FYSETC ST820 drivers. When two "//" appear at the beginning of a line that means that 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.



- 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.



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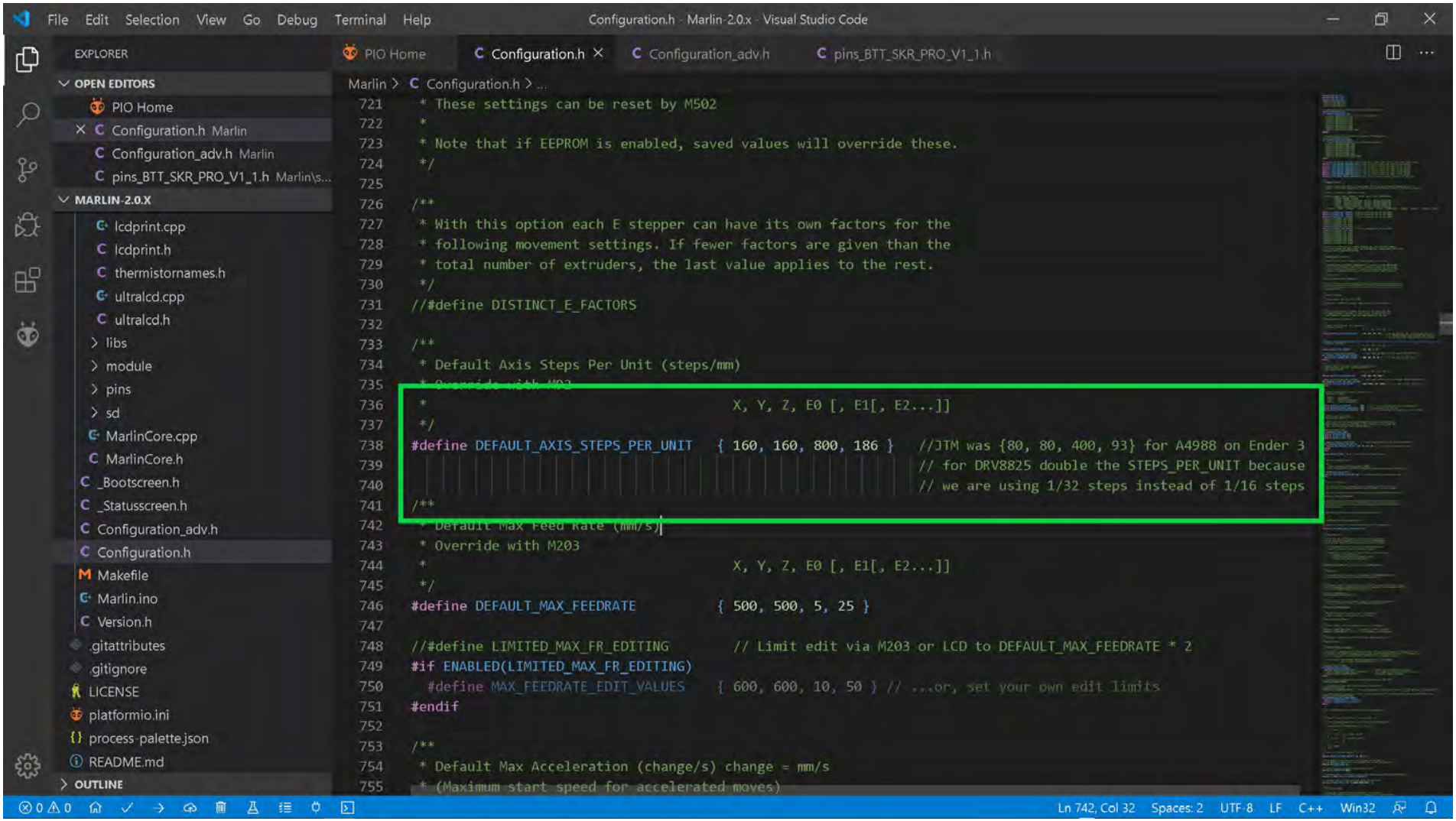
The (latest release of) Marlin Setup for FYSETC ST820 Drivers

- 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.



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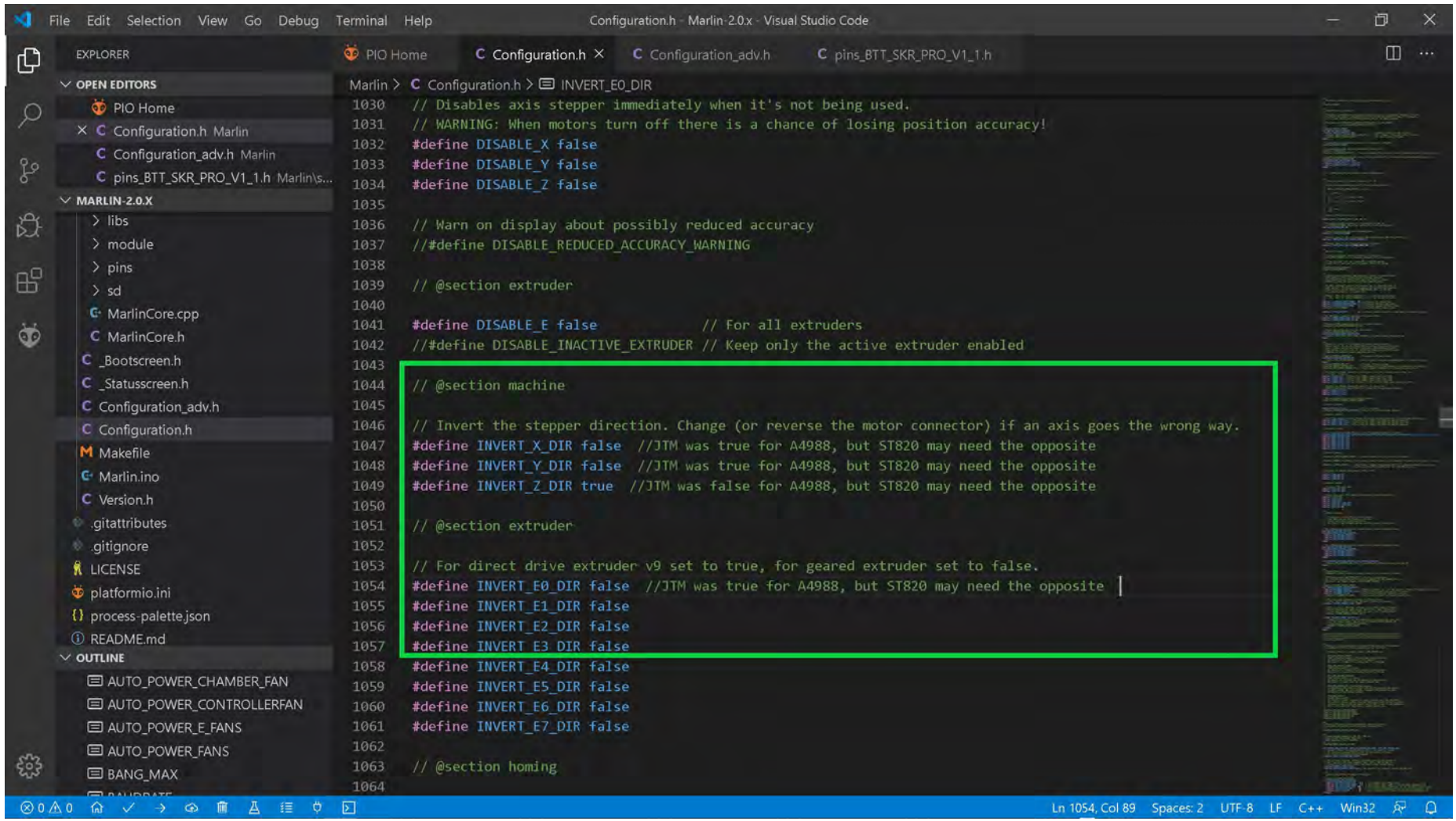
The (latest release of) Marlin Setup for FYSETC ST820 Drivers

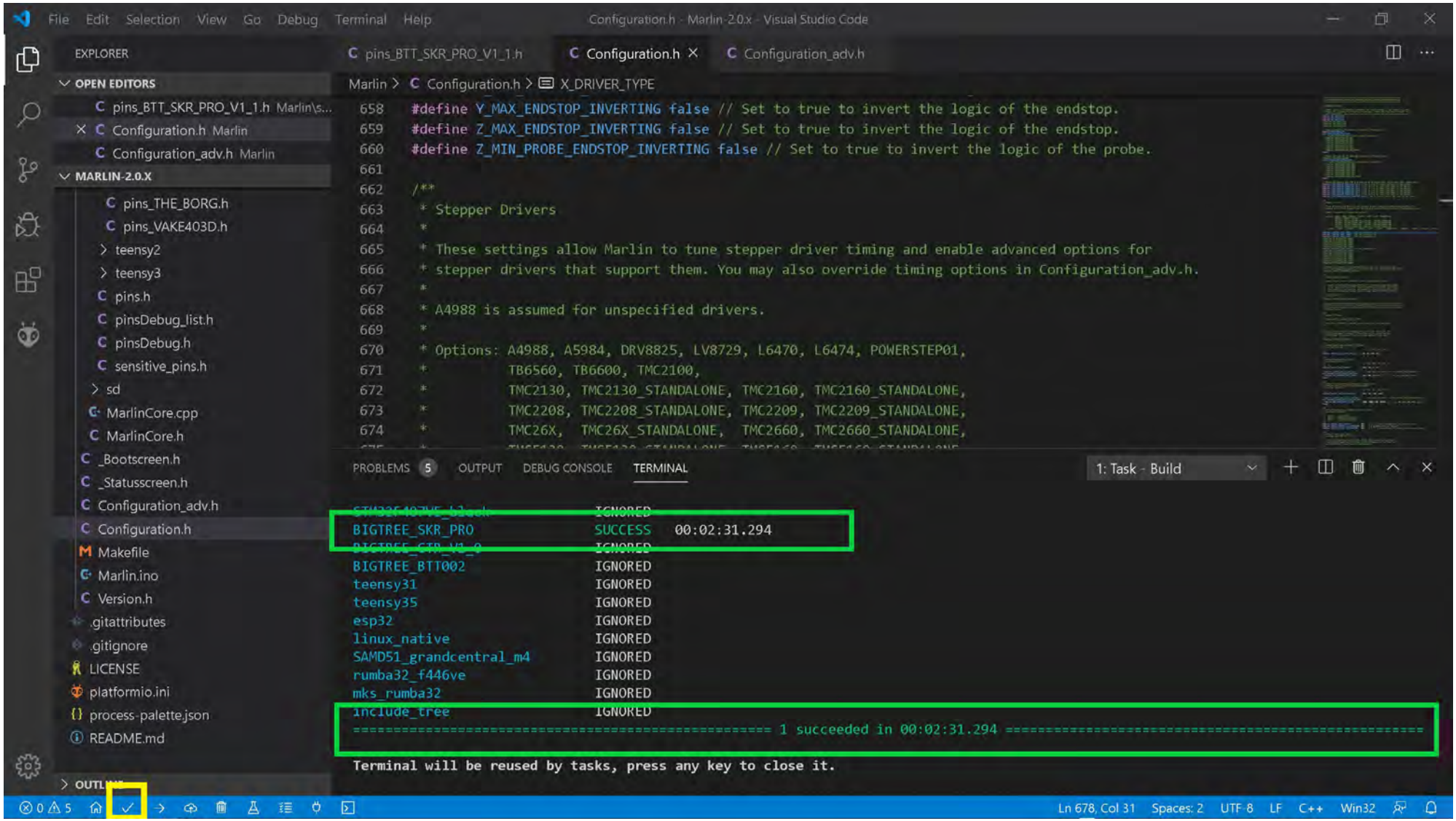
- Optional Step: I found conflicting information on the ST820 driver. Some sources say you will need to change the motor direction others say you may not. So I provide the below information in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring 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



- Go to the next page.

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

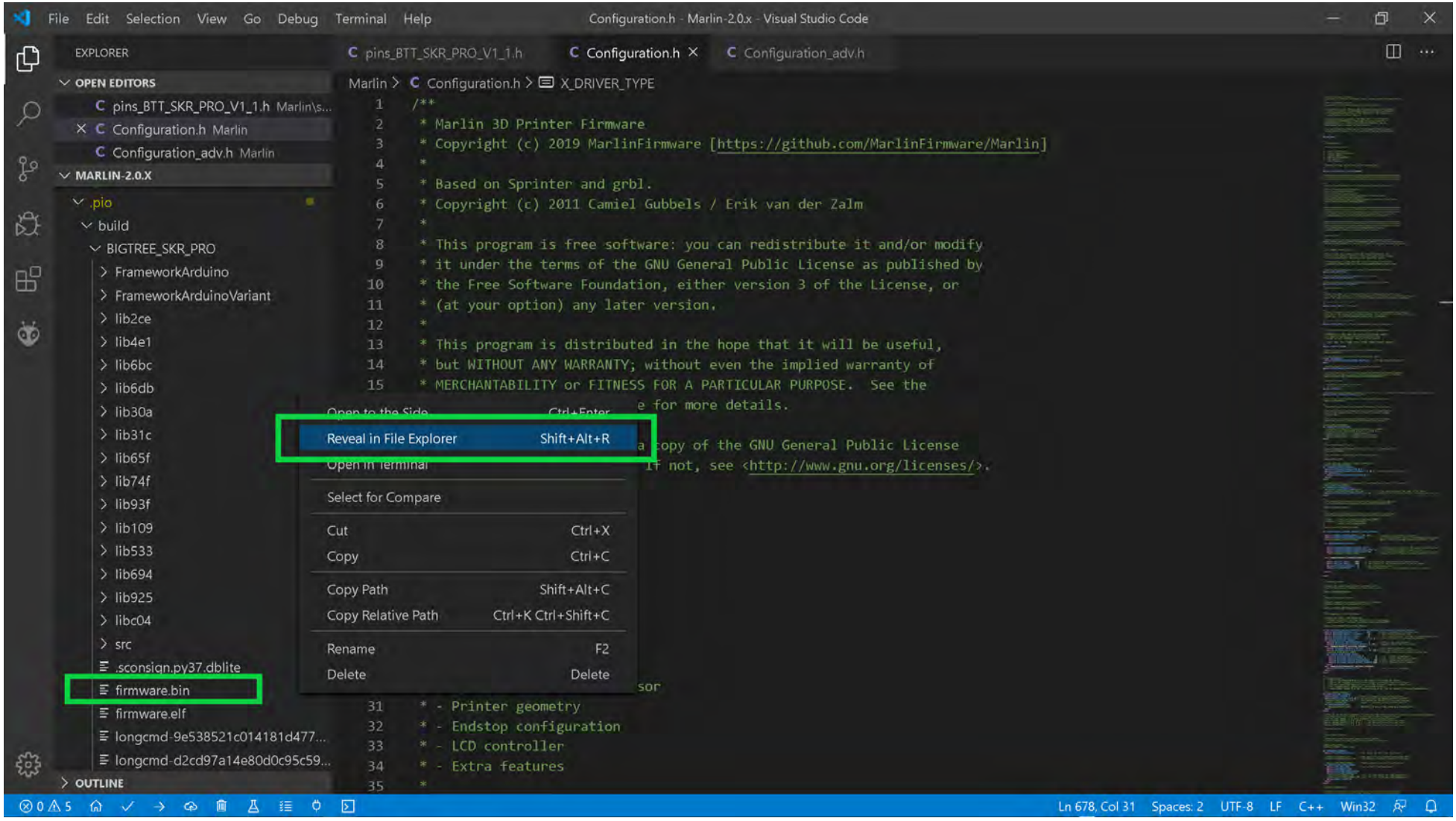
- The end of Marlin setup for FYSETC ST820 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

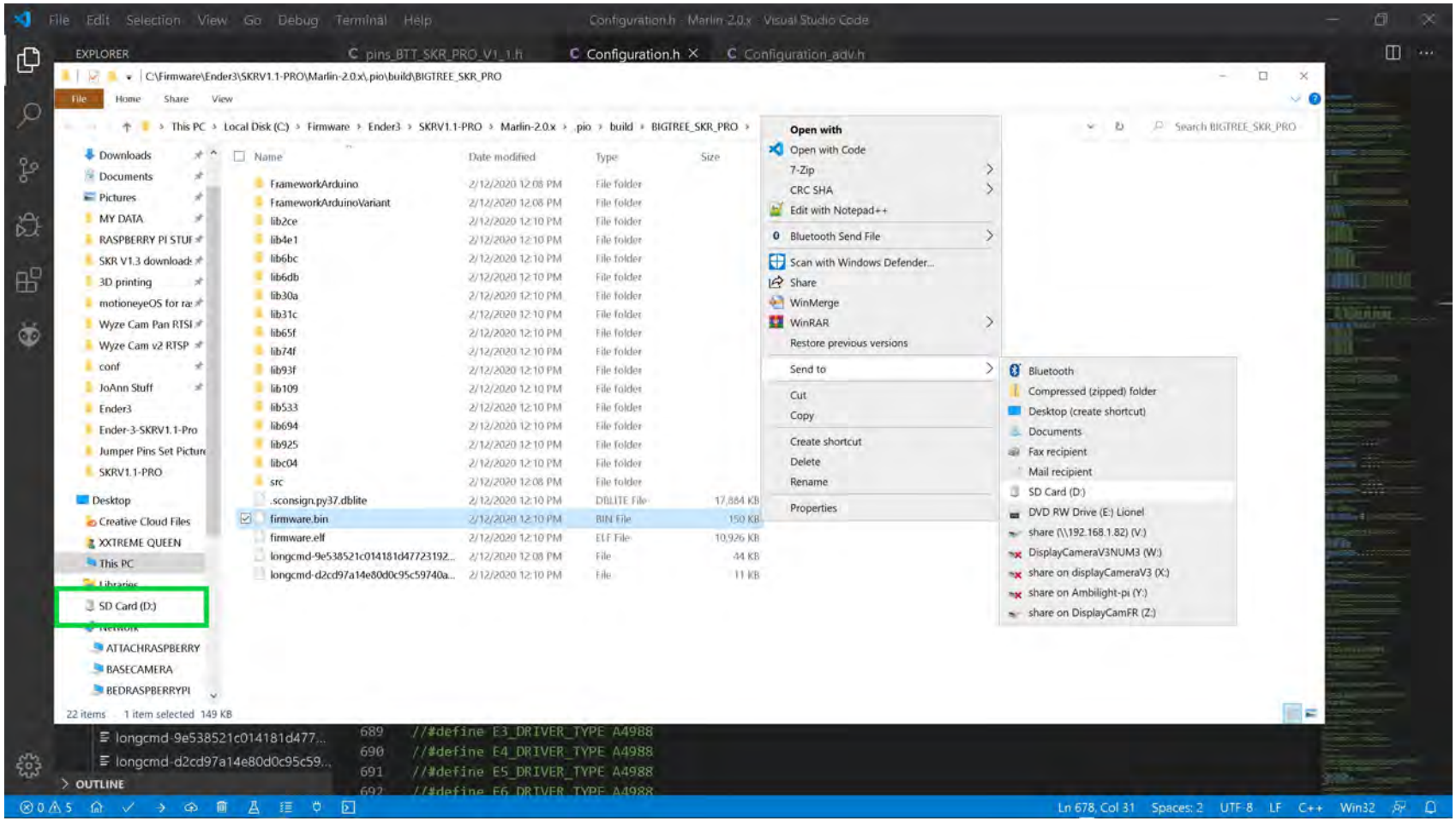
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



- Go to the next page.

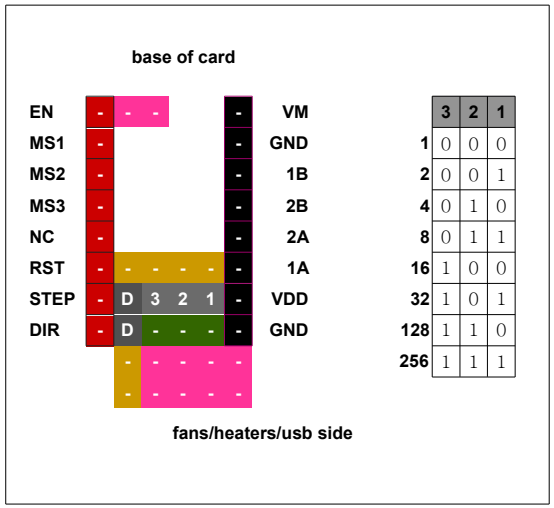
The (latest release of) Marlin Setup for FYSETC ST820 Drivers

- Ensure your micro-SD card, that came with your SKR PRO V1.1 board, is in a micro-to-SD-card adapter and plugged into yourWindow'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 and renamed to "firmware.bin" on the micro-SD card.

BIQU ST820

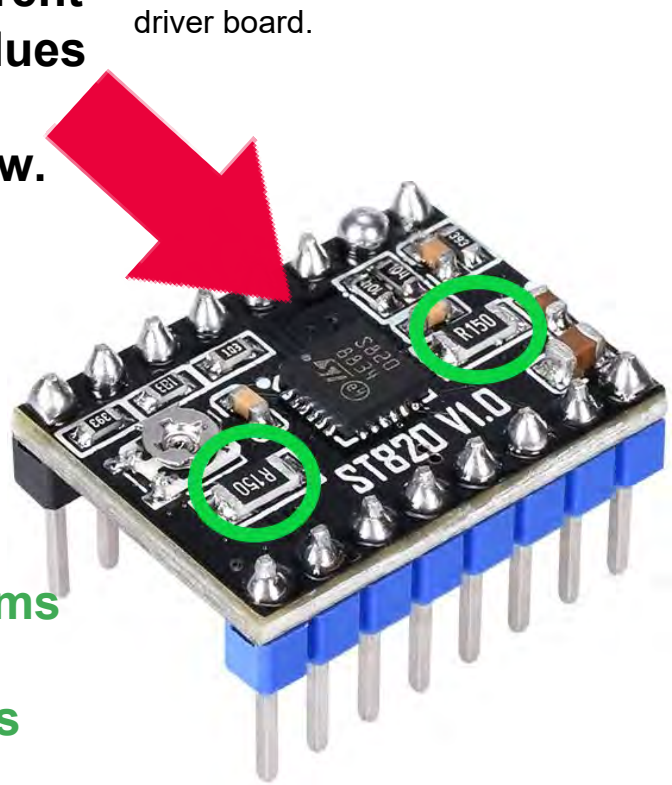


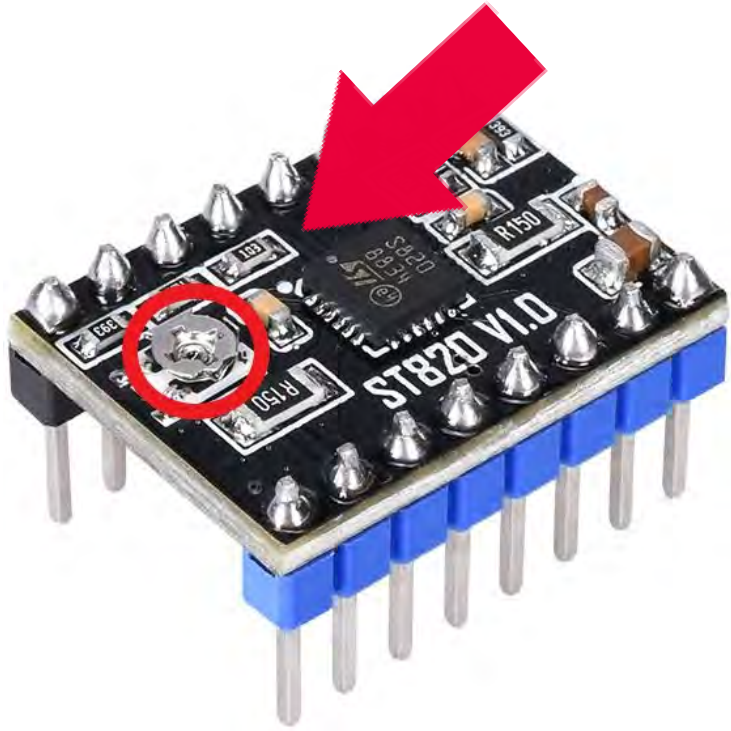
Driver Chip	MS3	MS2	MS1	Subdivision
ST820 Maximum 256 subdivision 45V 1.5A	L	L	L	Full Step
	L	L	H	1/2
	L	H	L	1/4
	L	H	H	1/8
	H	L	L	1/16
	H	L	H	1/32
	H	H	L	1/128
	H	H	H	1/256
Driving current calculation formula Rs=0.15Ω	$I_{MAX} = \frac{V_{REF} - V_{DD}}{5 * R_S}$		$V_{REF} = 5 * I_{MAX} * \frac{R_S}{V_{DD}}$	

Note: Use 90% of the calculated Vref when tuning the stepper driver board

Note: Check your current sense resistor (Rs) values on the driver board, shown in GREEN below.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref. See the appendix for instructions on how to set the Vref on a driver board.



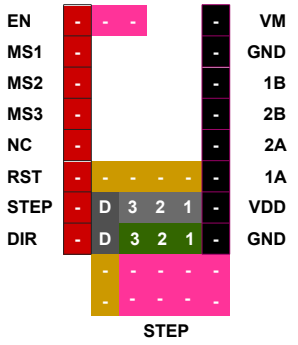


Rs = R150 is 0.15 Ohms

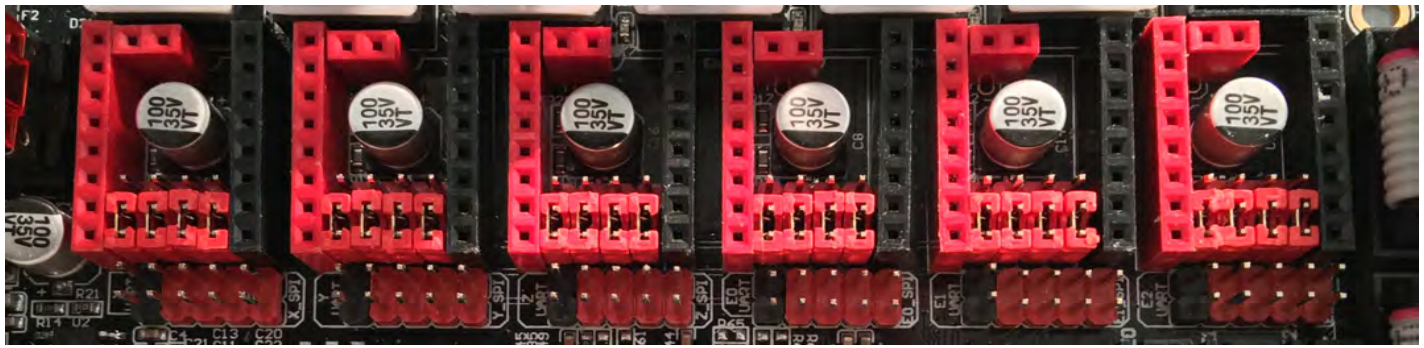
Rs = R200 is 0.2Ohms

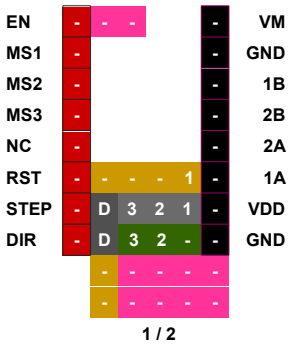
BIQU ST820

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!





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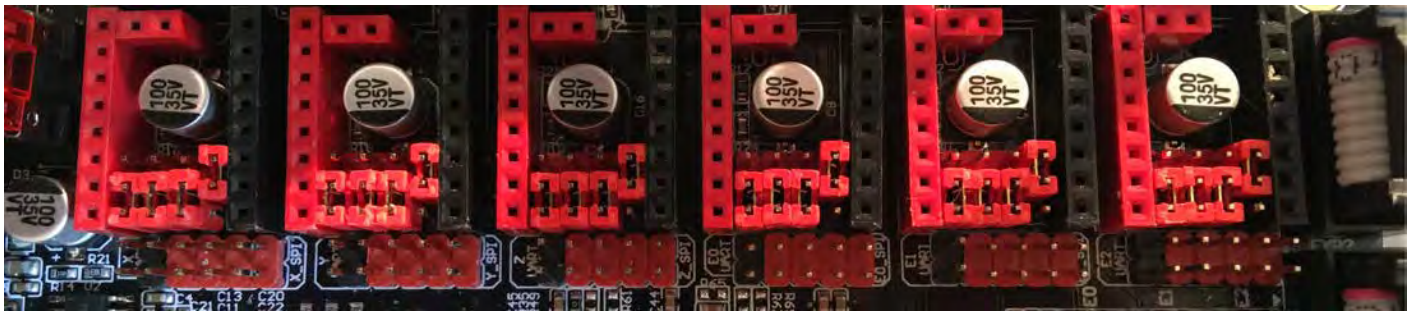
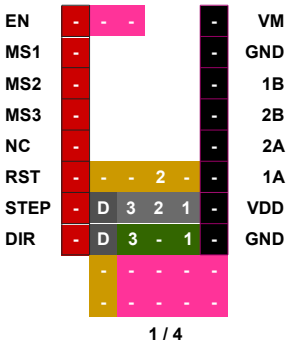


BIQU ST820

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.



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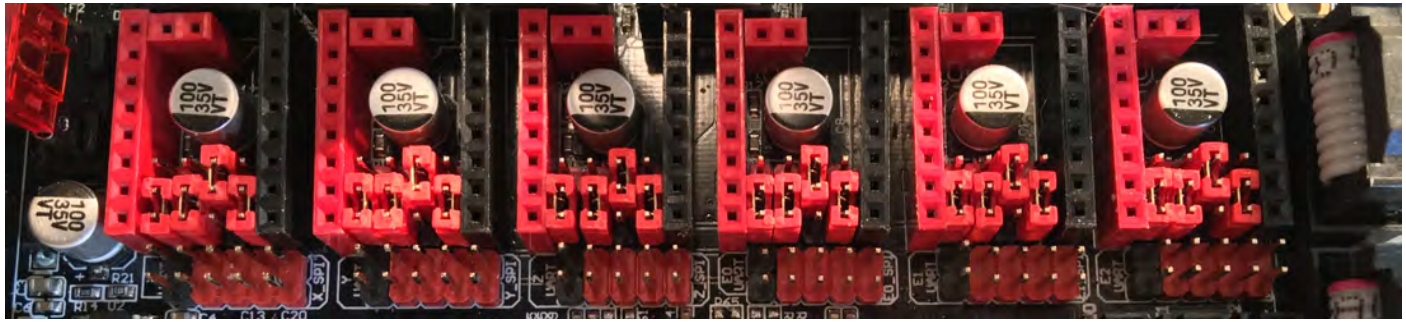

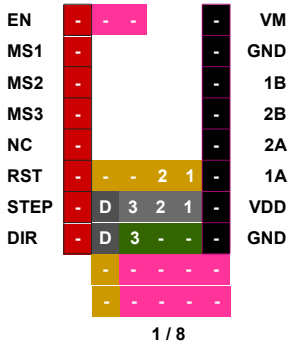

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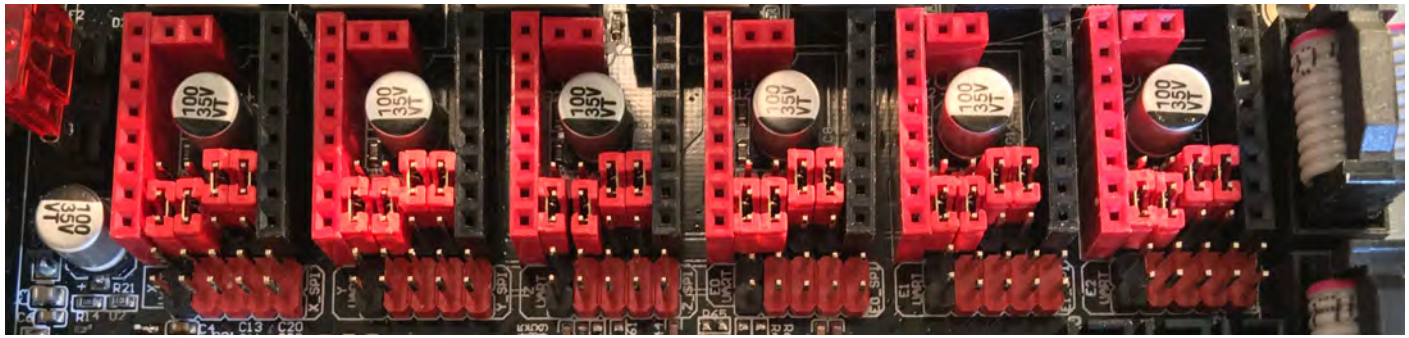

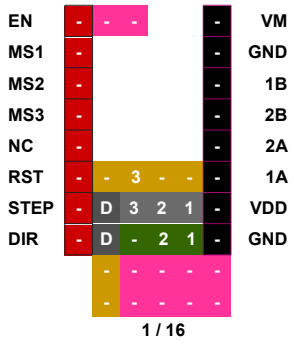

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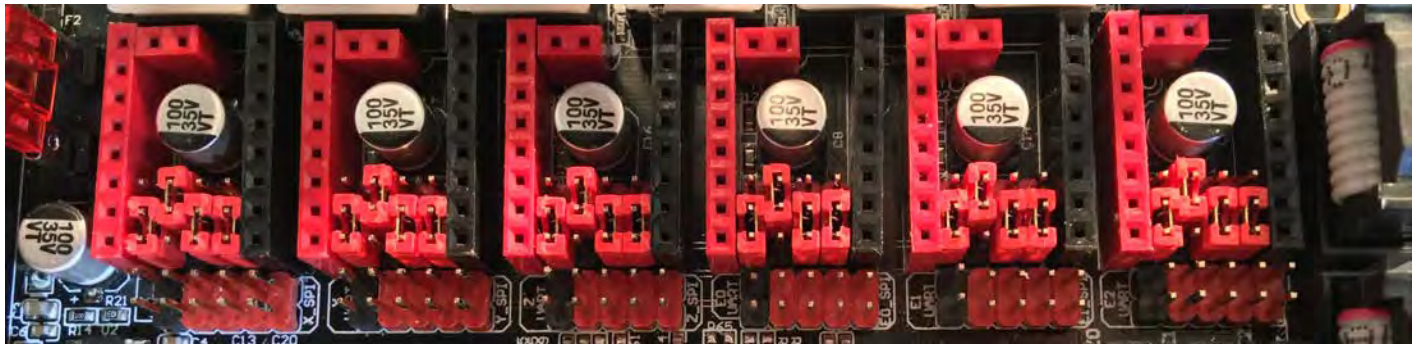
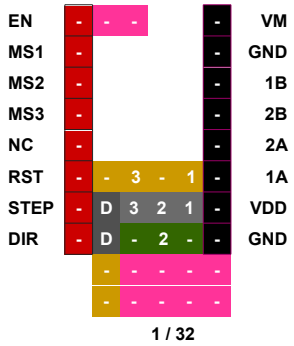


BIQU ST820

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.



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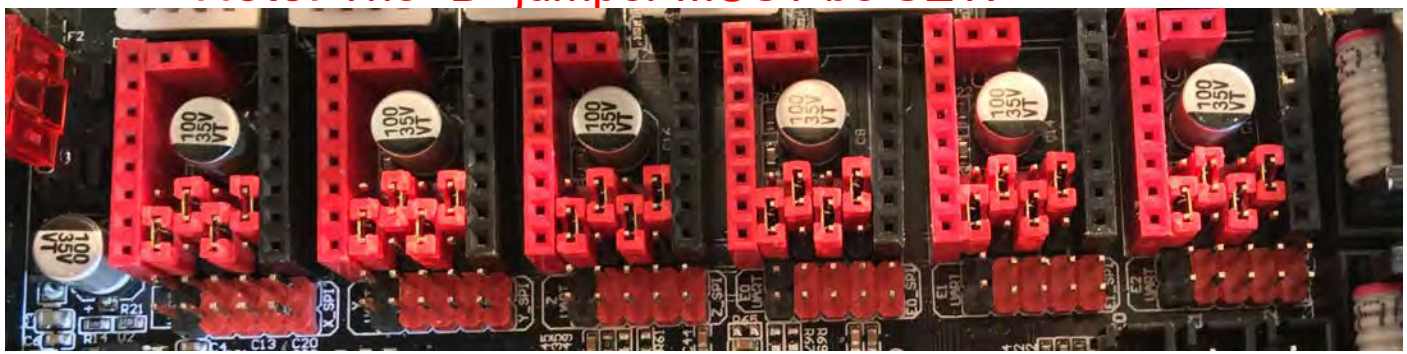

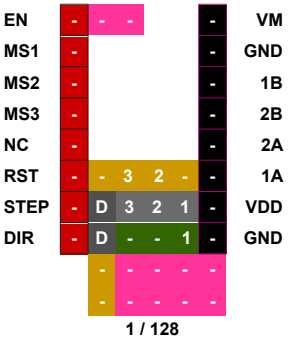

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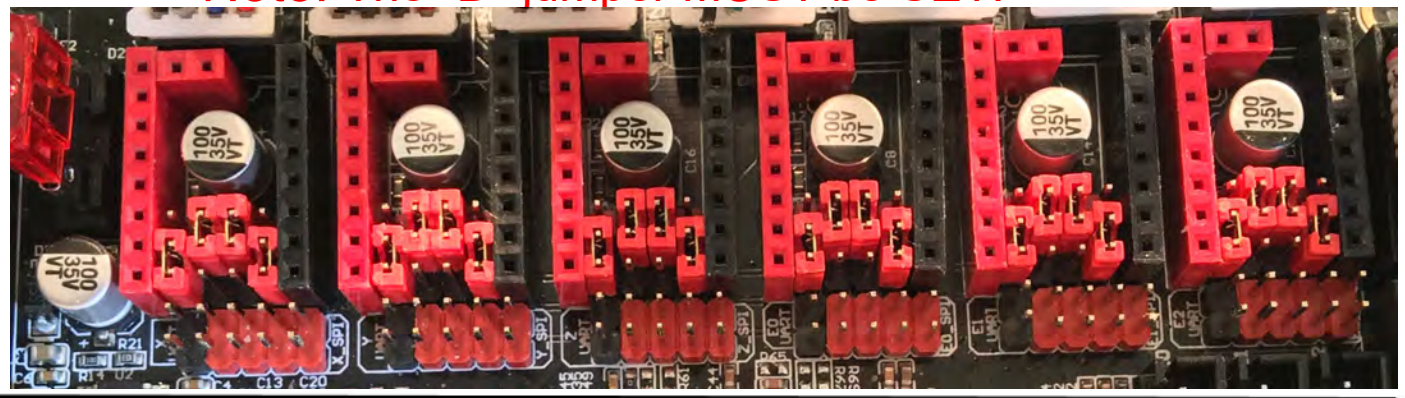

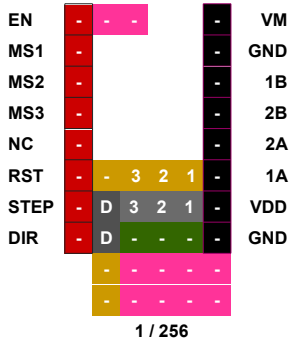

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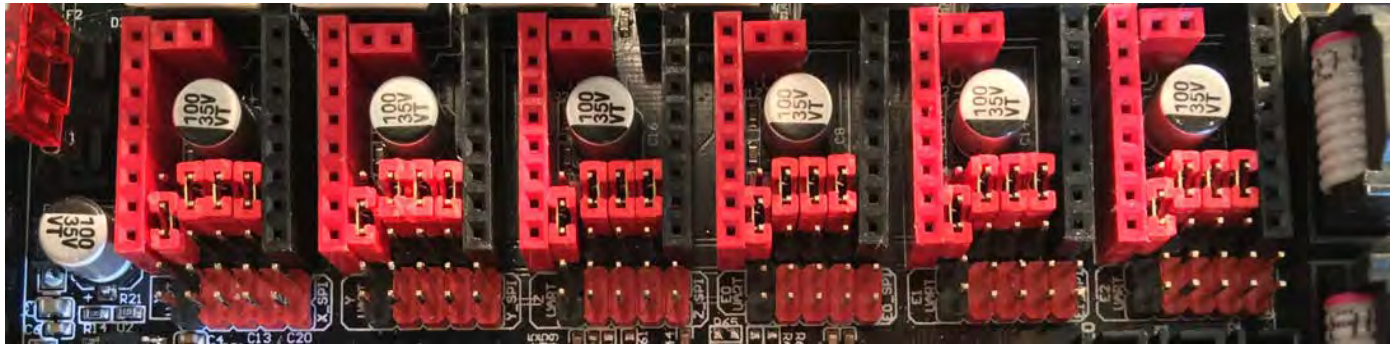
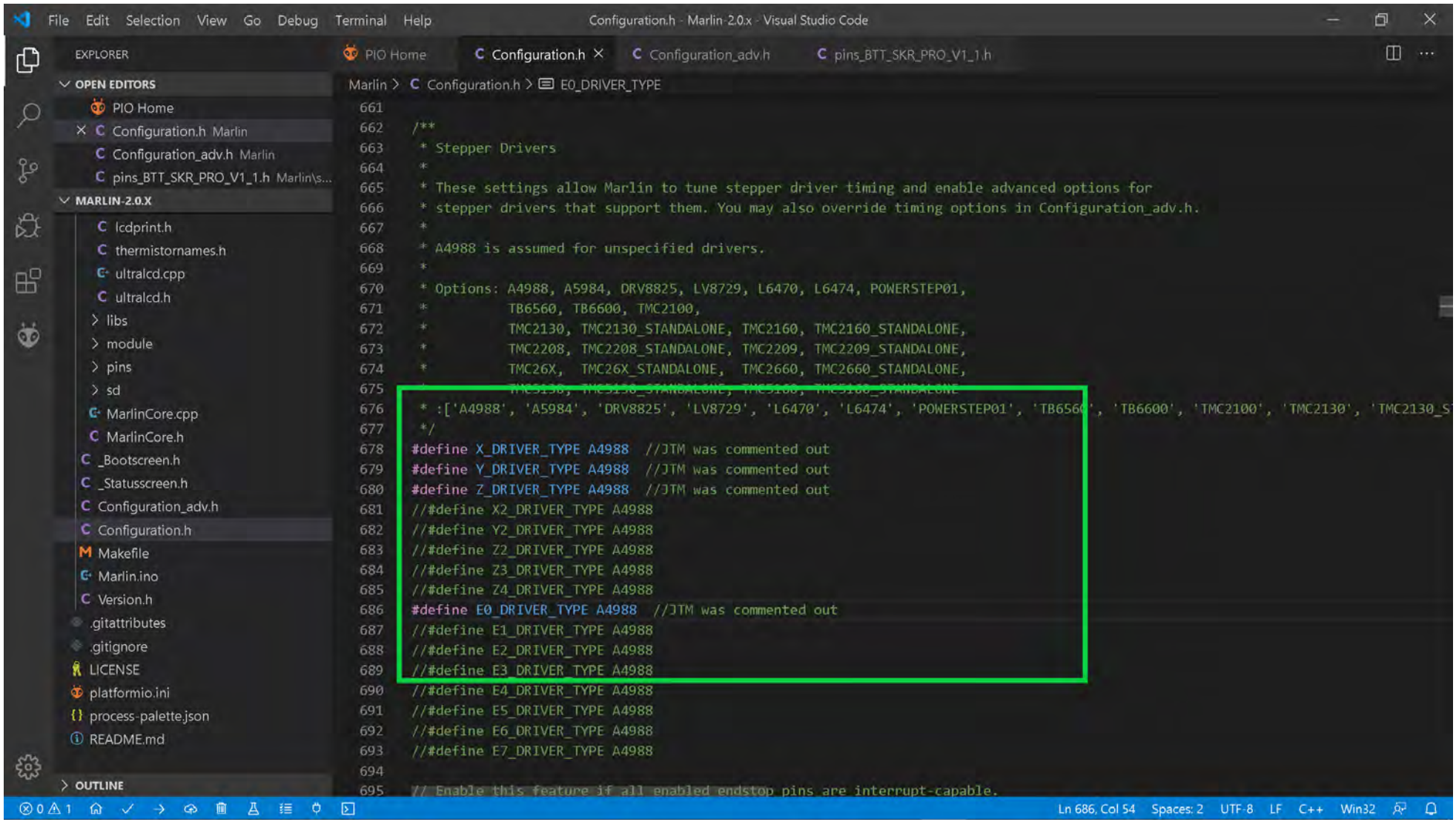


The (latest release of) Marlin Setup for BIQU ST820 Drivers

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

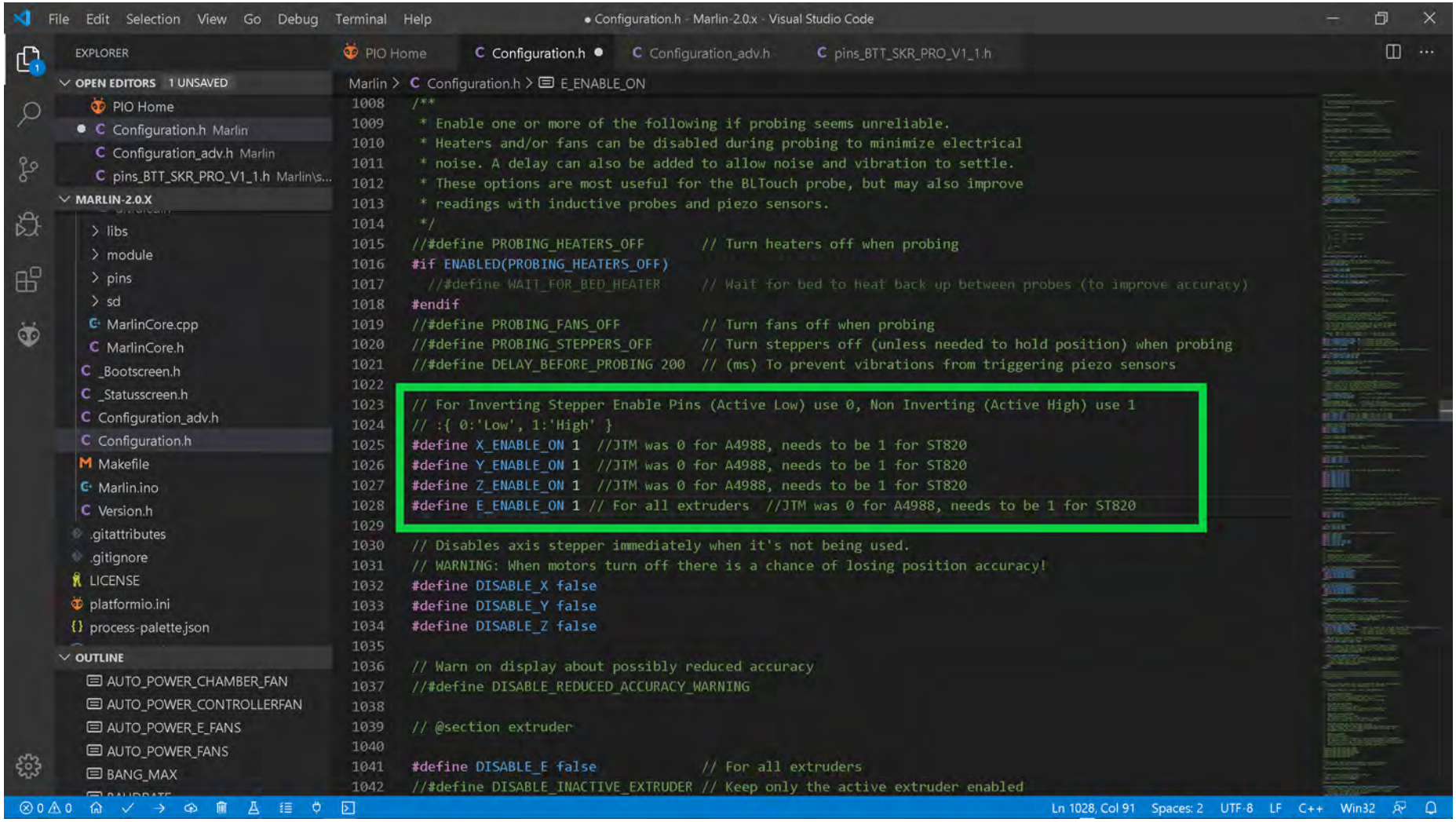
- Change the stepper motor drivers so that Marlin knows you are using BIQU ST820 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use BIQU ST820 drivers. When two "//" appear at the beginning of a line that means that line 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.



- 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.



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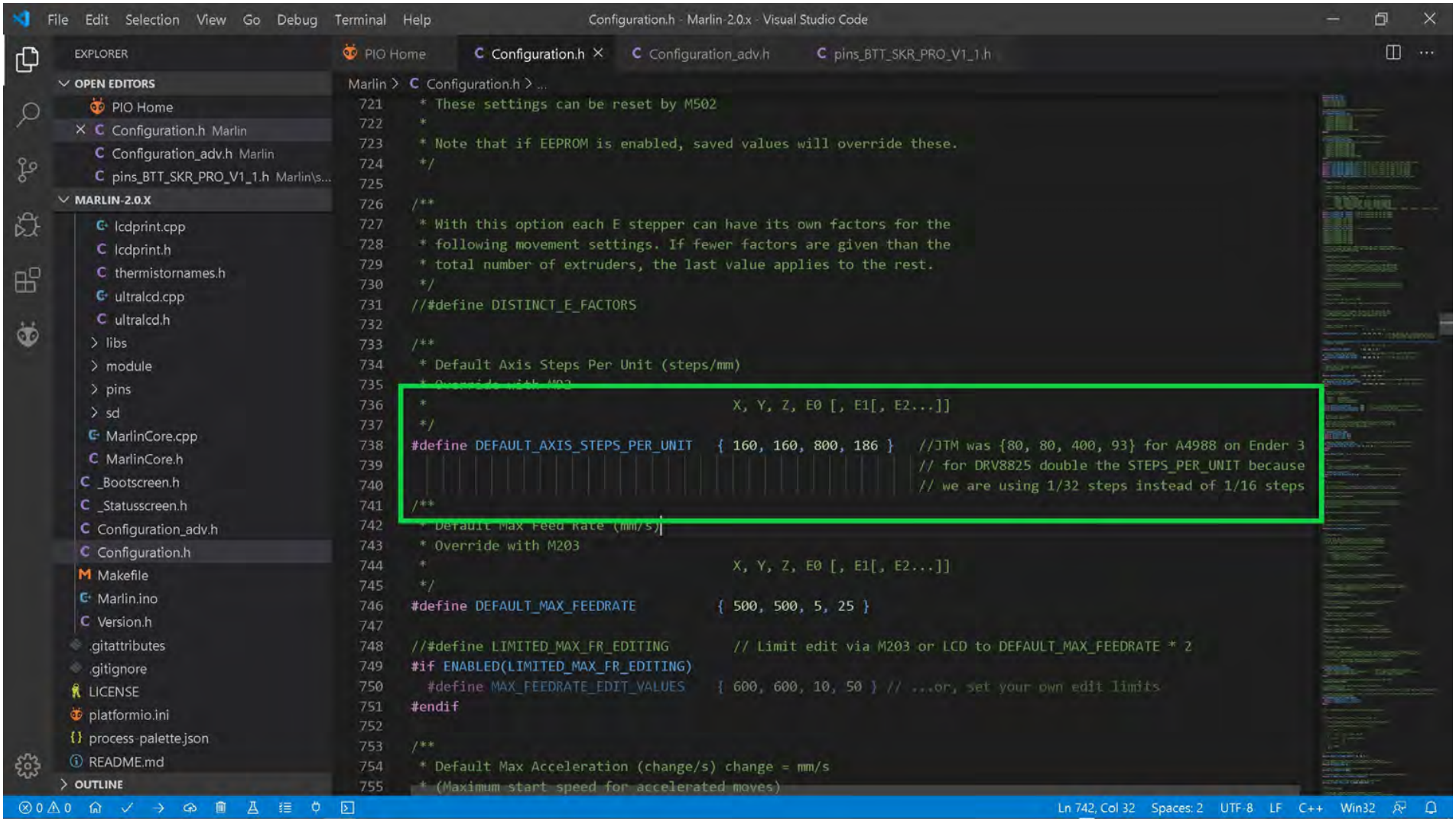
The (latest release of) Marlin Setup for BIQU ST820 Drivers

- 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.



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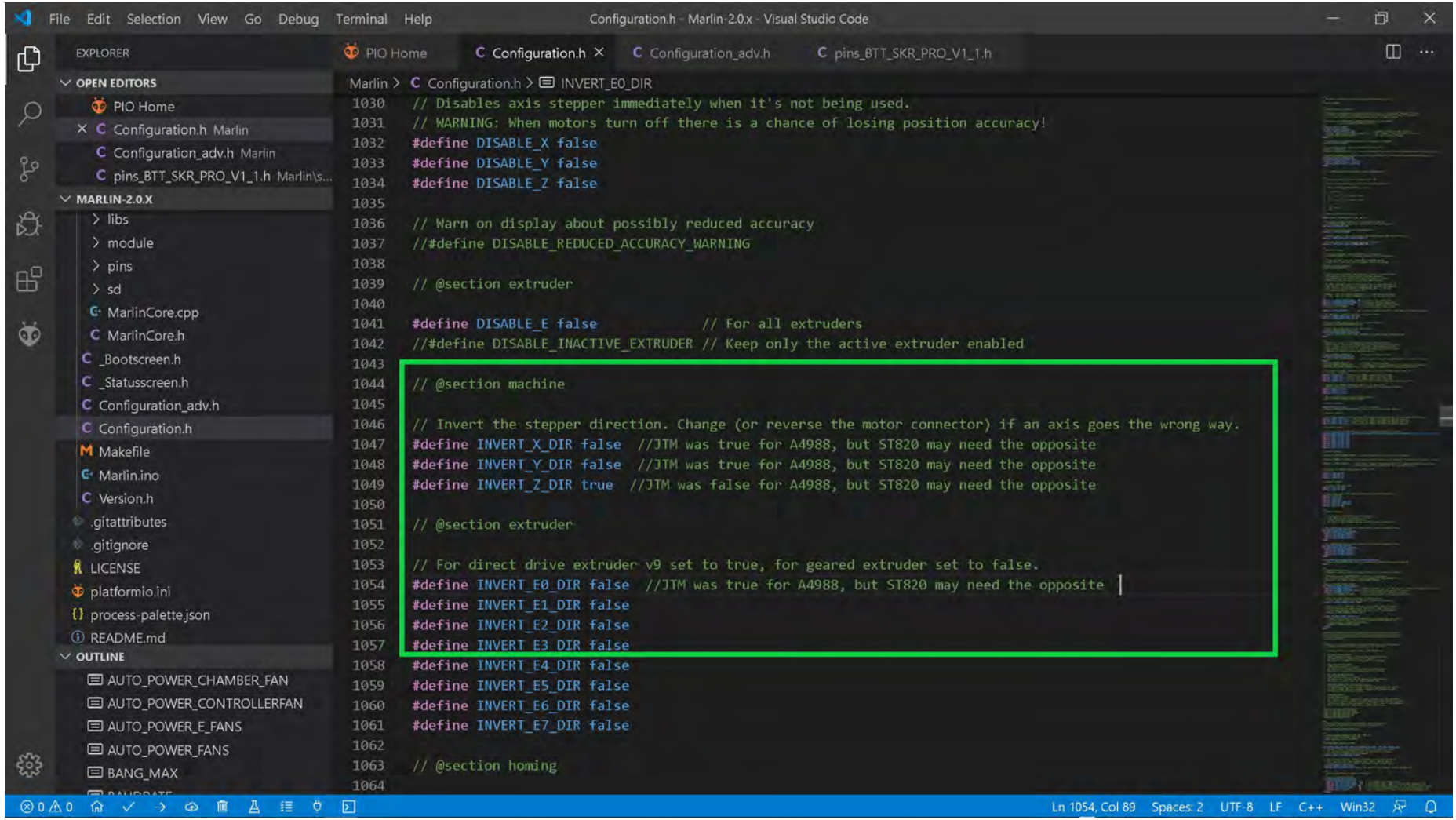
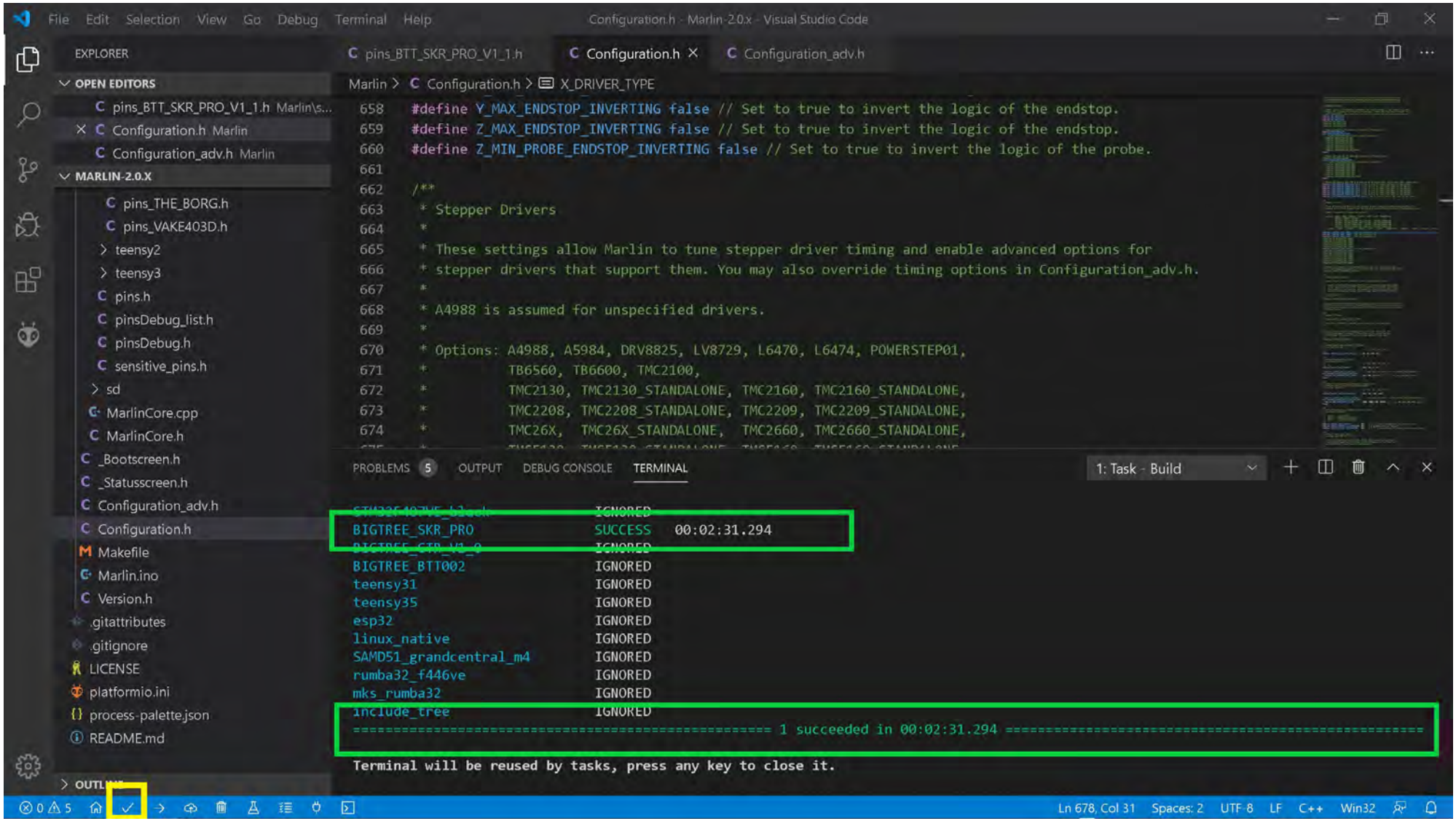
- Optional Step: I found conflicting information on the ST820 driver. Some sources say you will need to change the motor direction others say you may not. So I provide, the below information, in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring 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



- 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.



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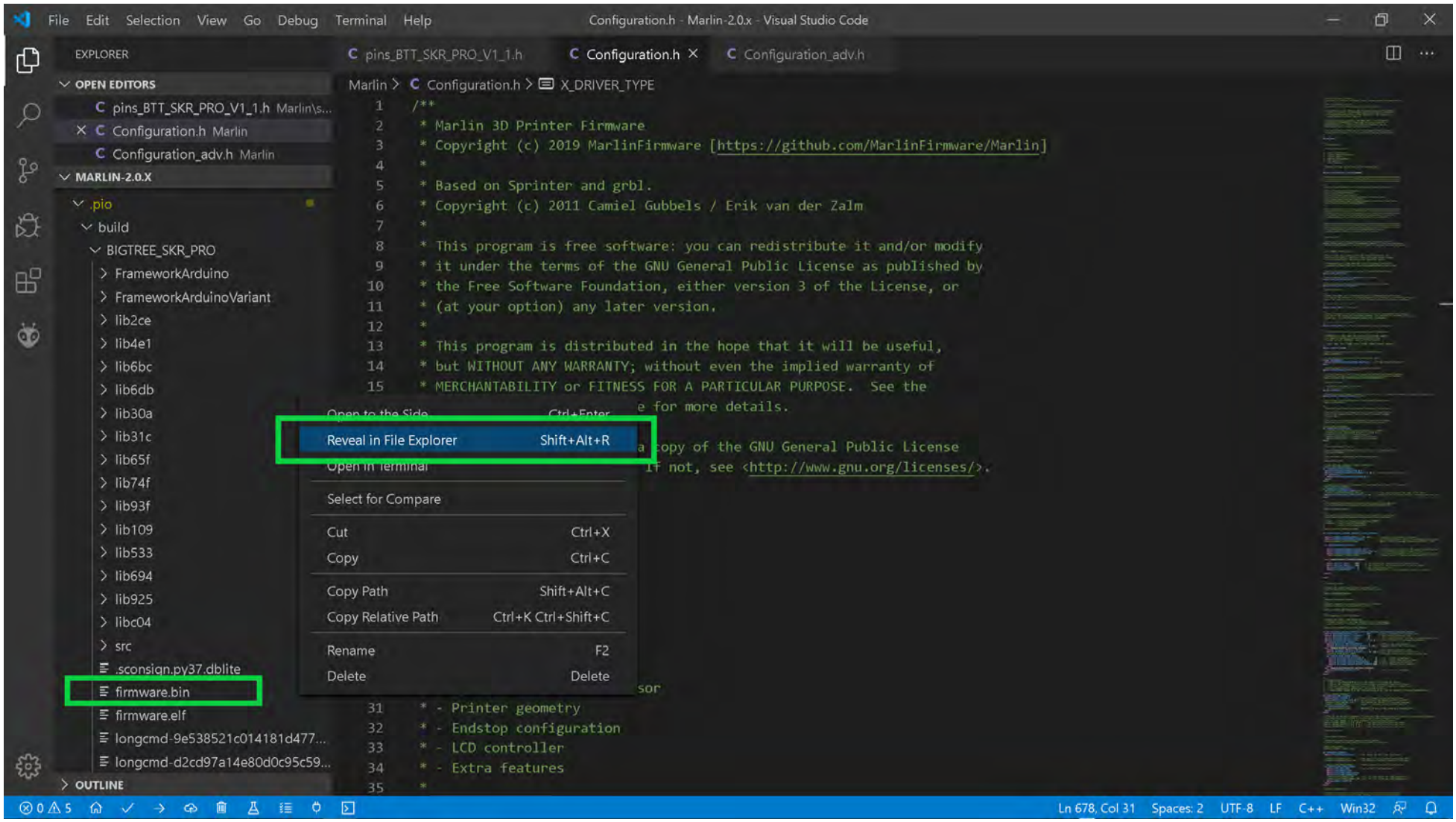
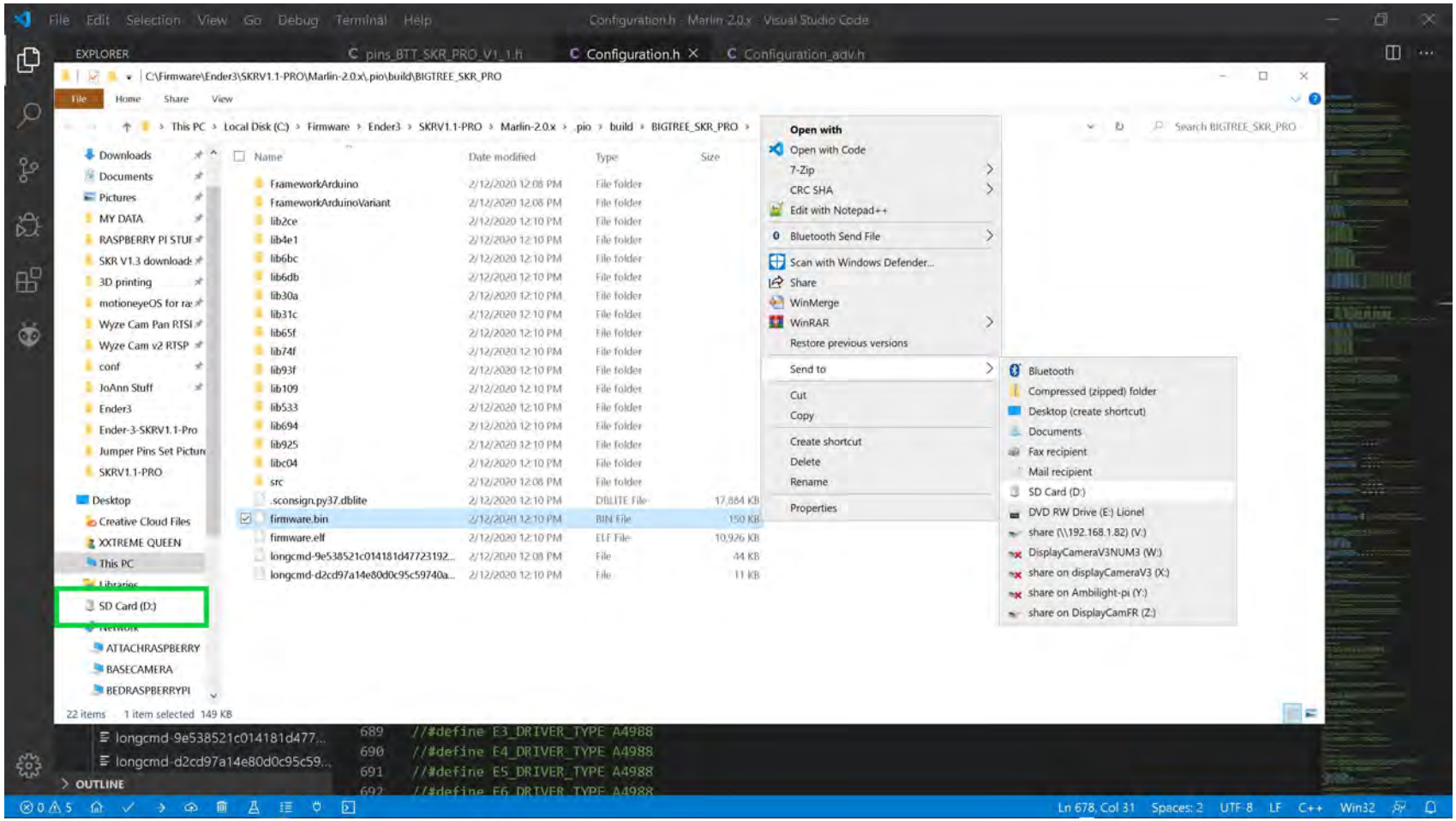


- Go to the next page.

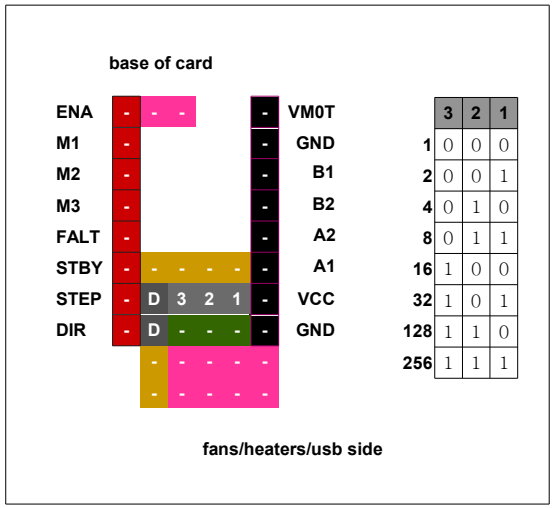
The (latest release of) Marlin Setup for BIQU ST820 Drivers

- Ensure your micro-SD card, that 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 and renamed to "firmware.bin" on the micro-SD card.

POLOLU ST820 (STSPIN820)



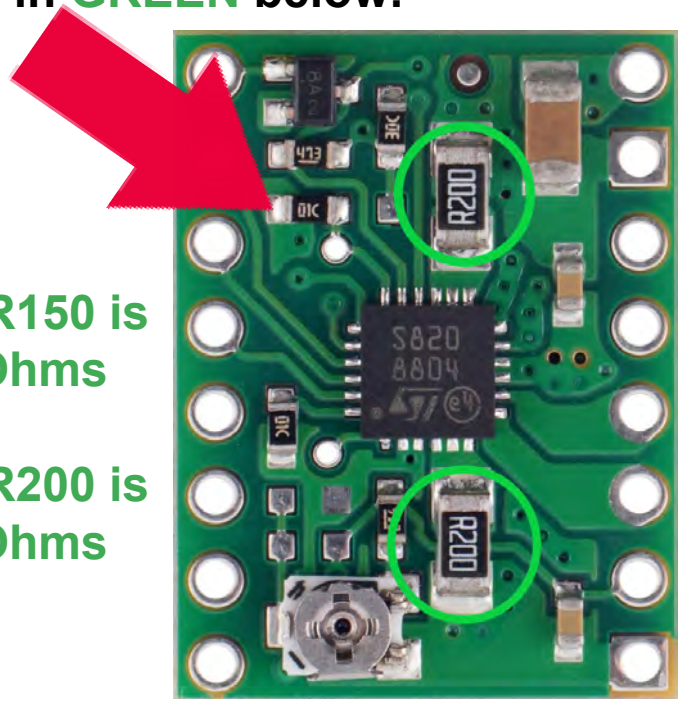
	3	2	1
1	0	0	0
2	0	0	1
4	0	1	0
8	0	1	1
16	1	0	0
32	1	0	1
128	1	1	0
256	1	1	1

Driver Chip	MS3	MS2	MS1	Subdivision
Pololu ST820 Maximum 256 subdivision 45V 0.9 A	L	L	L	Full Step
	L	L	H	1/2
	L	H	L	1/4
	L	H	H	1/8
	H	L	L	1/16
	H	L	H	1/32
	H	H	L	1/128
	H	H	H	1/256
Driving current calculation formula Rs=0.2Ω	$I_{MAX} = V_{REF} * 5$		$V_{ref} = I_{MAX} / 5$	

Note: Use 90% of the calculated Vref when tuning the stepper driver board

Note: Check your current sense resistor (Rs) values on the driver board, shown in GREEN below.

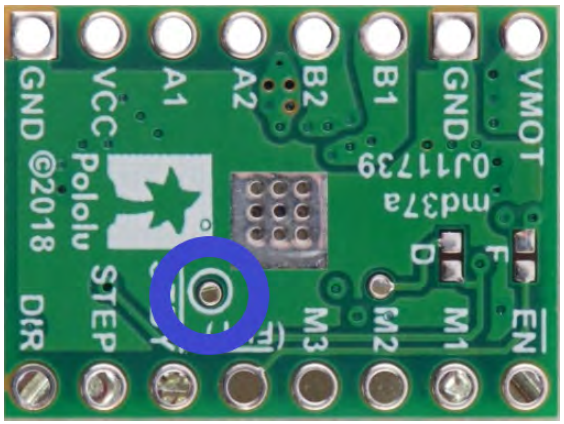
NOTE: Use the potentiometer (POT) on the top of the board (or use the board's "Vref Test point") to adjust your Vref. See the appendix for instructions on how to set the Vref on a driver board.

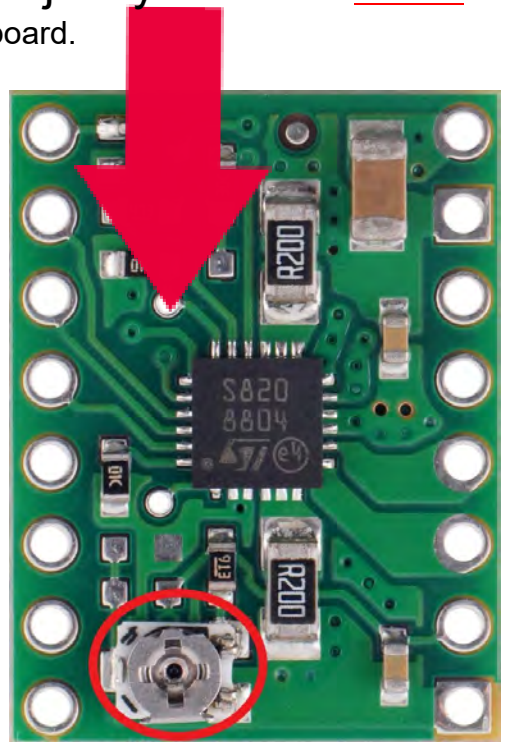


Rs = R150 is 0.15 Ohms

Rs = R200 is 0.20 Ohms

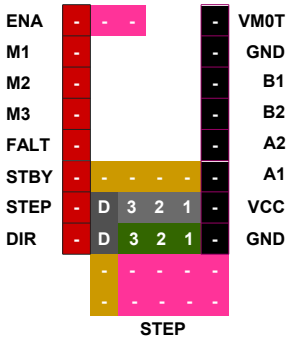
Note: "Vref Test point" location is on the bottom of the driver board, as shown in BLUE



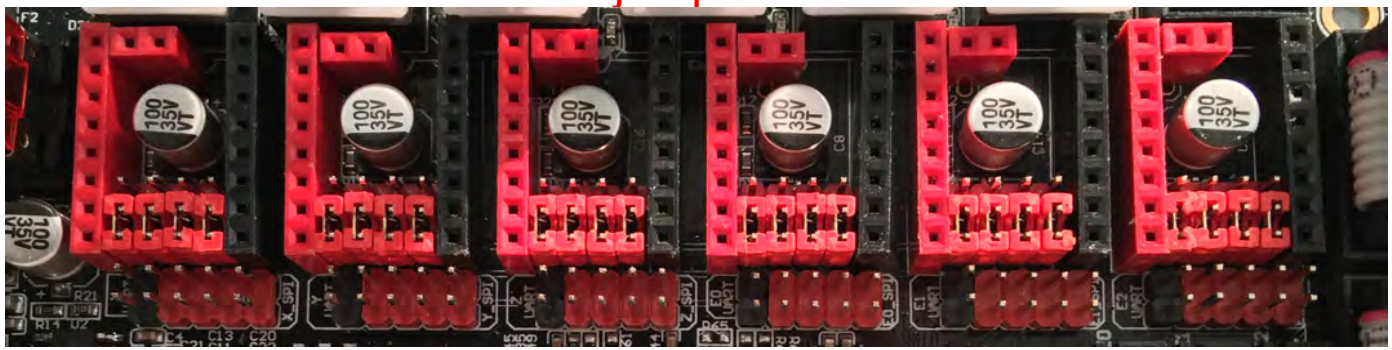


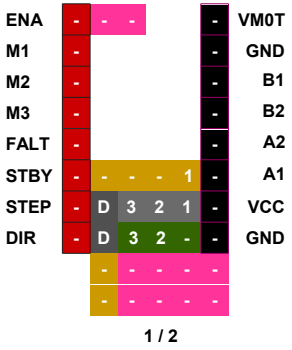
POLOLU ST820 (STSPIN820)

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.

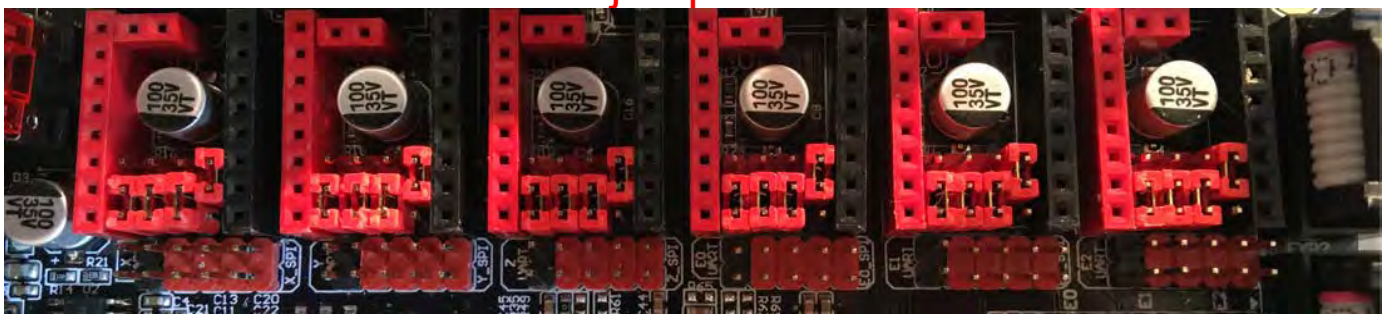


Note: The "D" jumper MUST be SET!



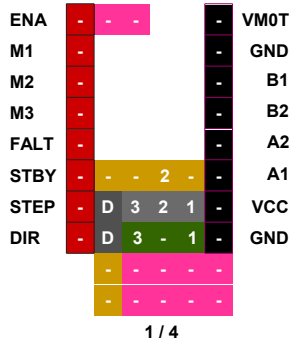


Note: The "D" jumper MUST be SET!

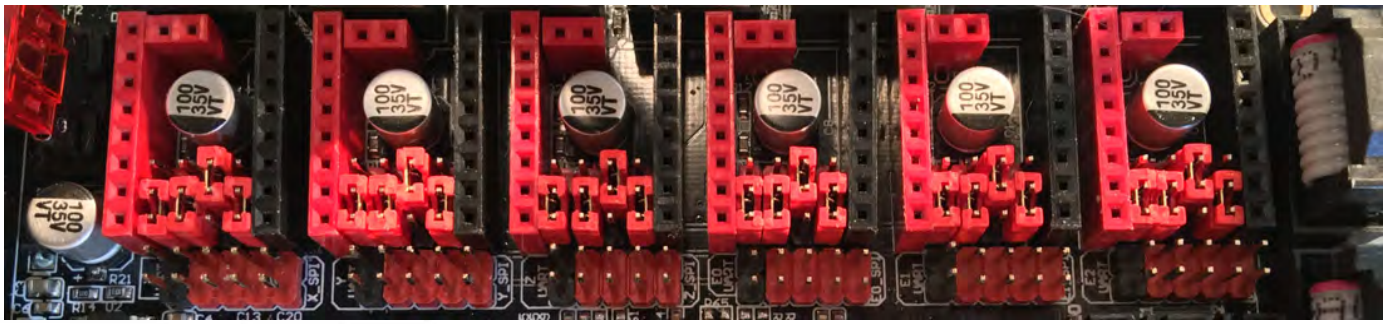


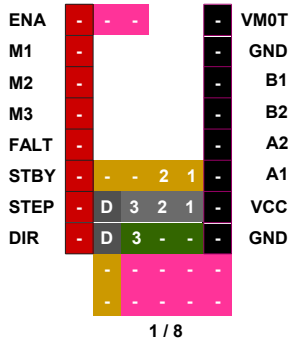
POLOLU ST820 (STSPIN820)

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.

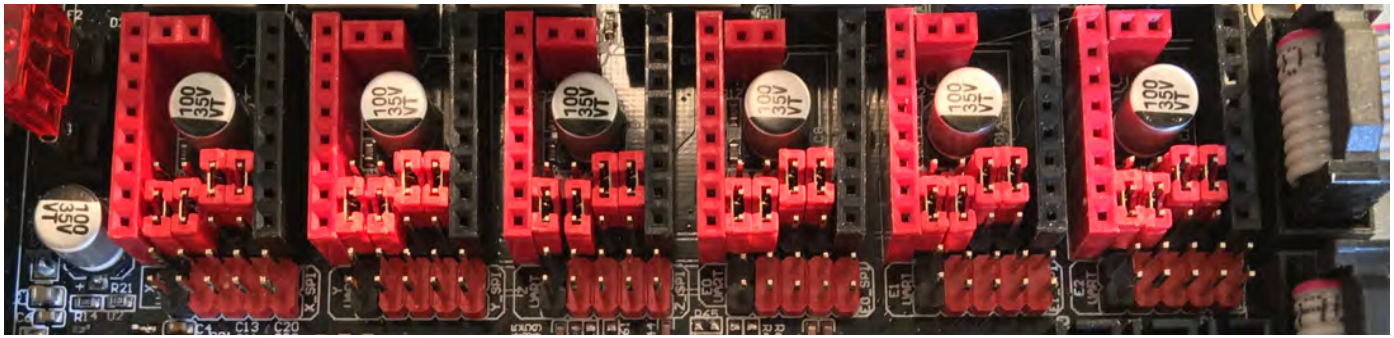


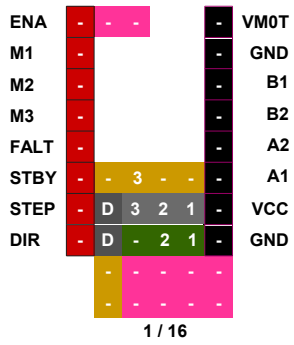
Note: The "D" jumper MUST be SET!



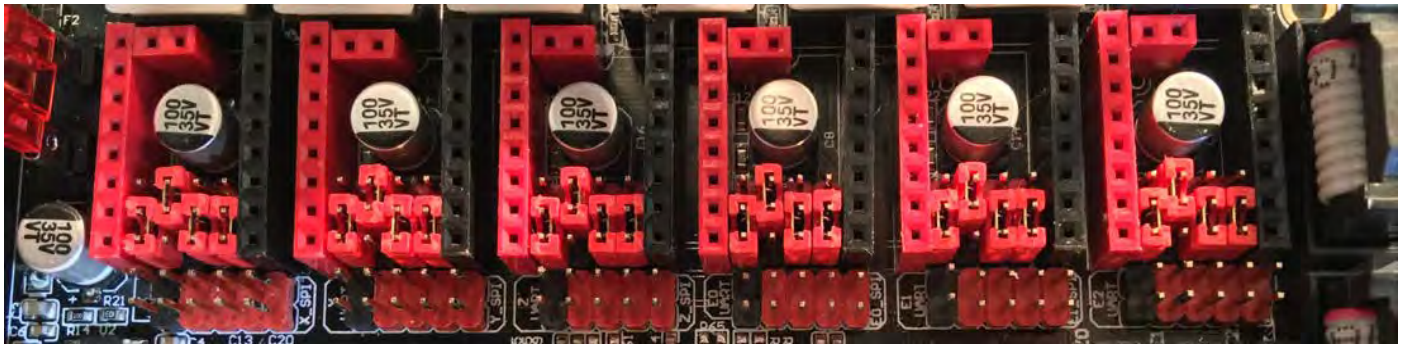


Note: The "D" jumper MUST be SET!



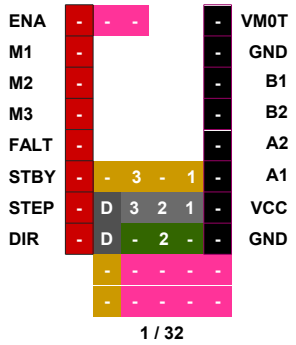


Note: The "D" jumper MUST be SET!

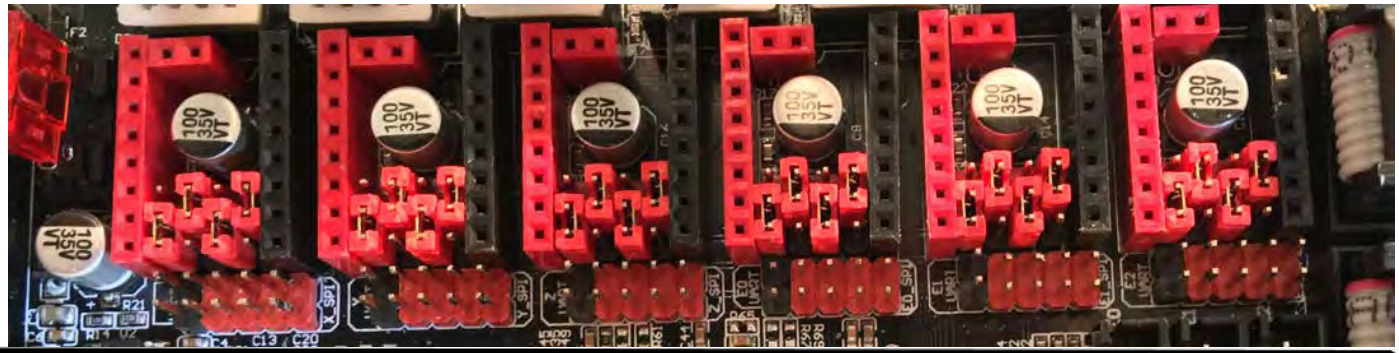


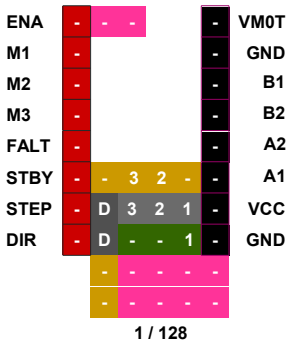
POLOLU ST820 (STSPIN820)

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.

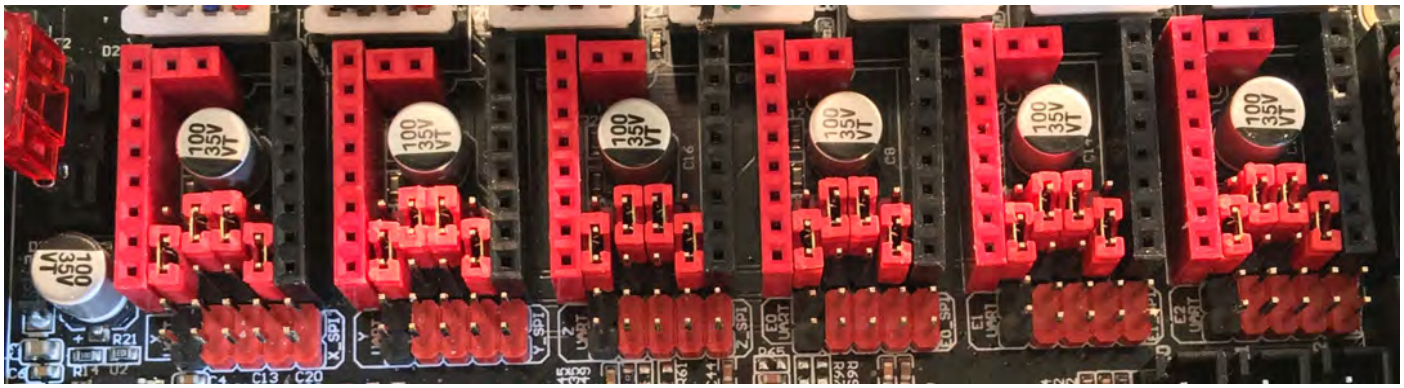


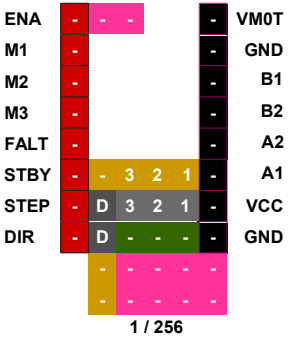
Note: The "D" jumper MUST be SET!



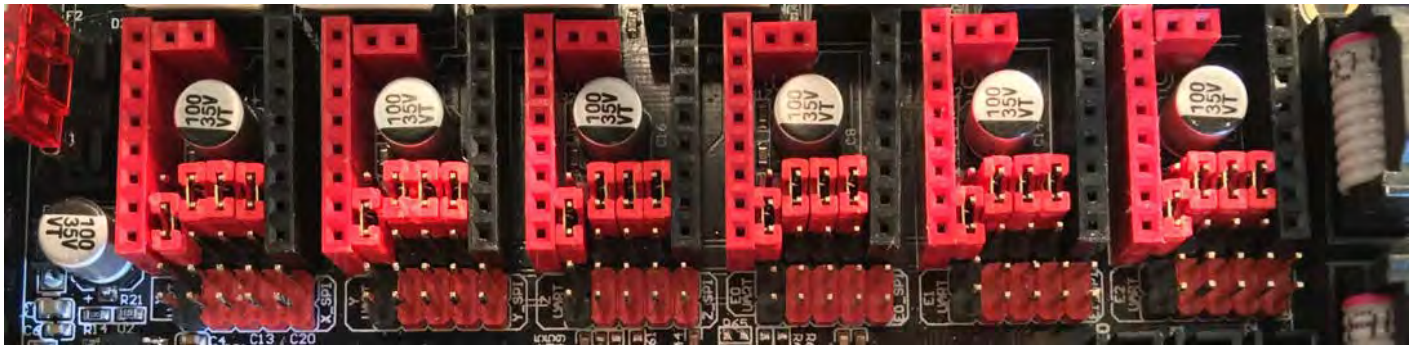


Note: The "D" jumper MUST be SET!





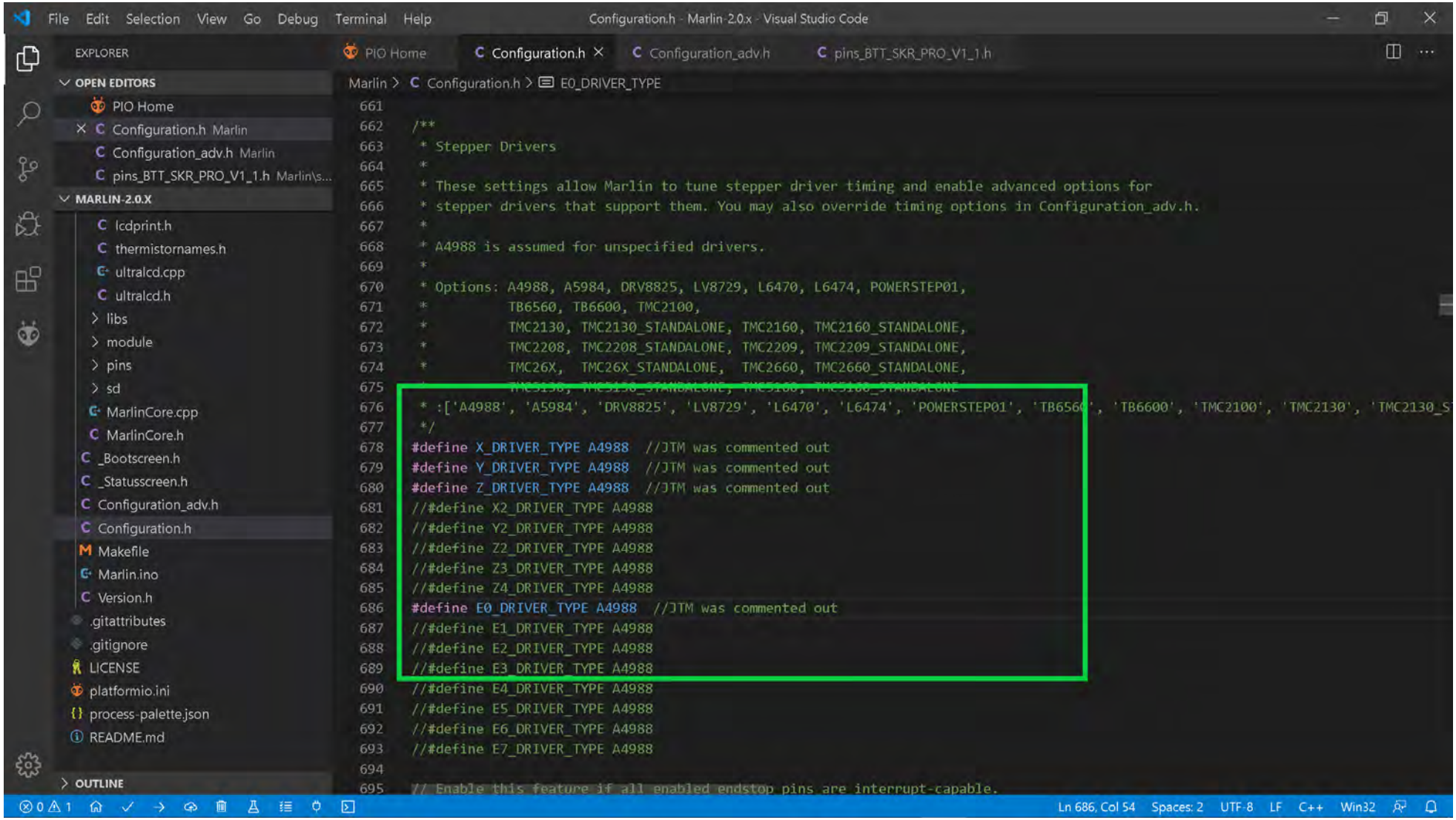
Note: The "D" jumper MUST be SET!



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

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

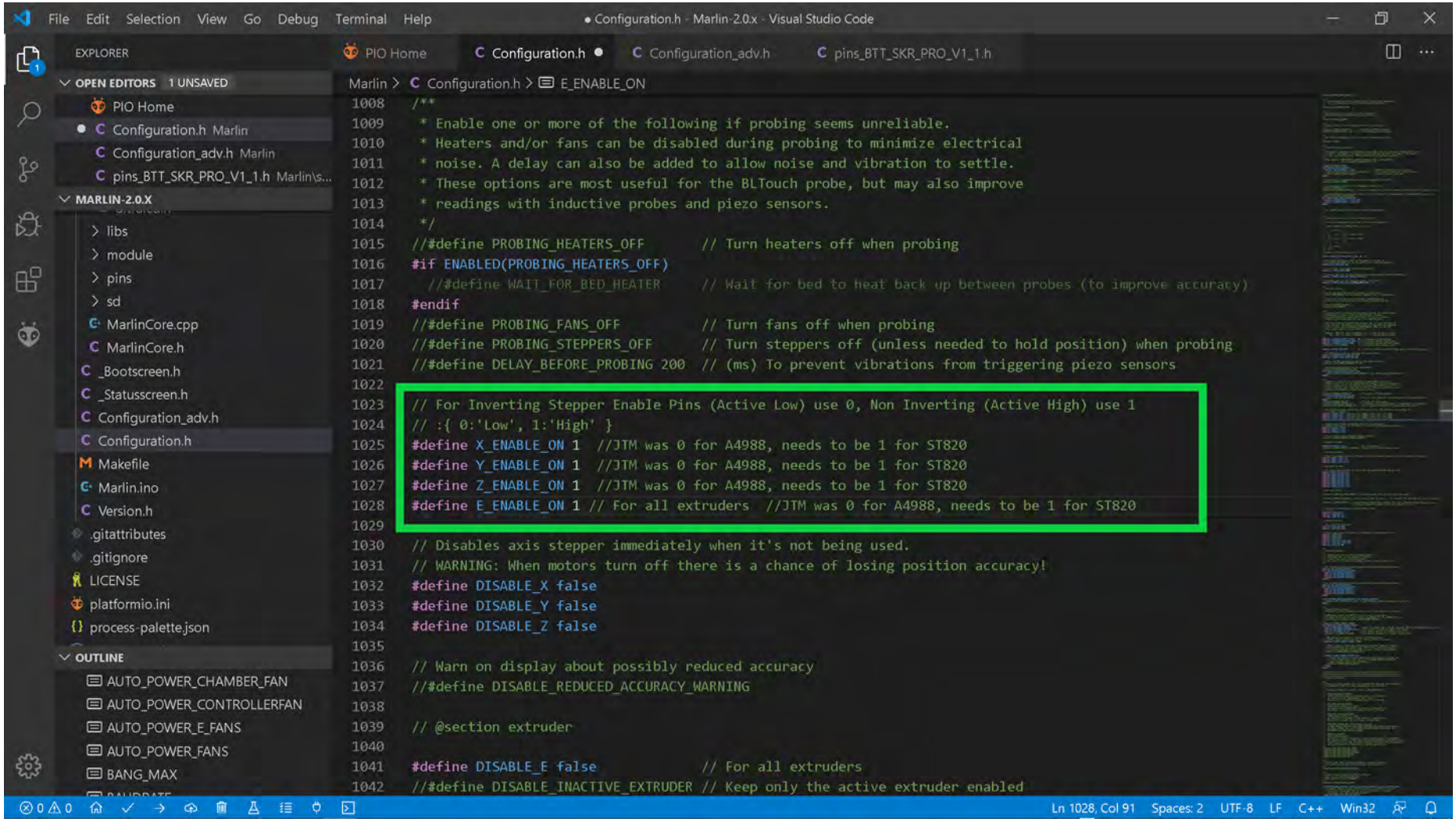
- Change the stepper motor drivers so that Marlin knows you are using POLOLU ST820 (STSPIN820) drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use POLOLU ST820 (STSPIN820) drivers. When two "//" appear at the beginning 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.



- Go to the next page.

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

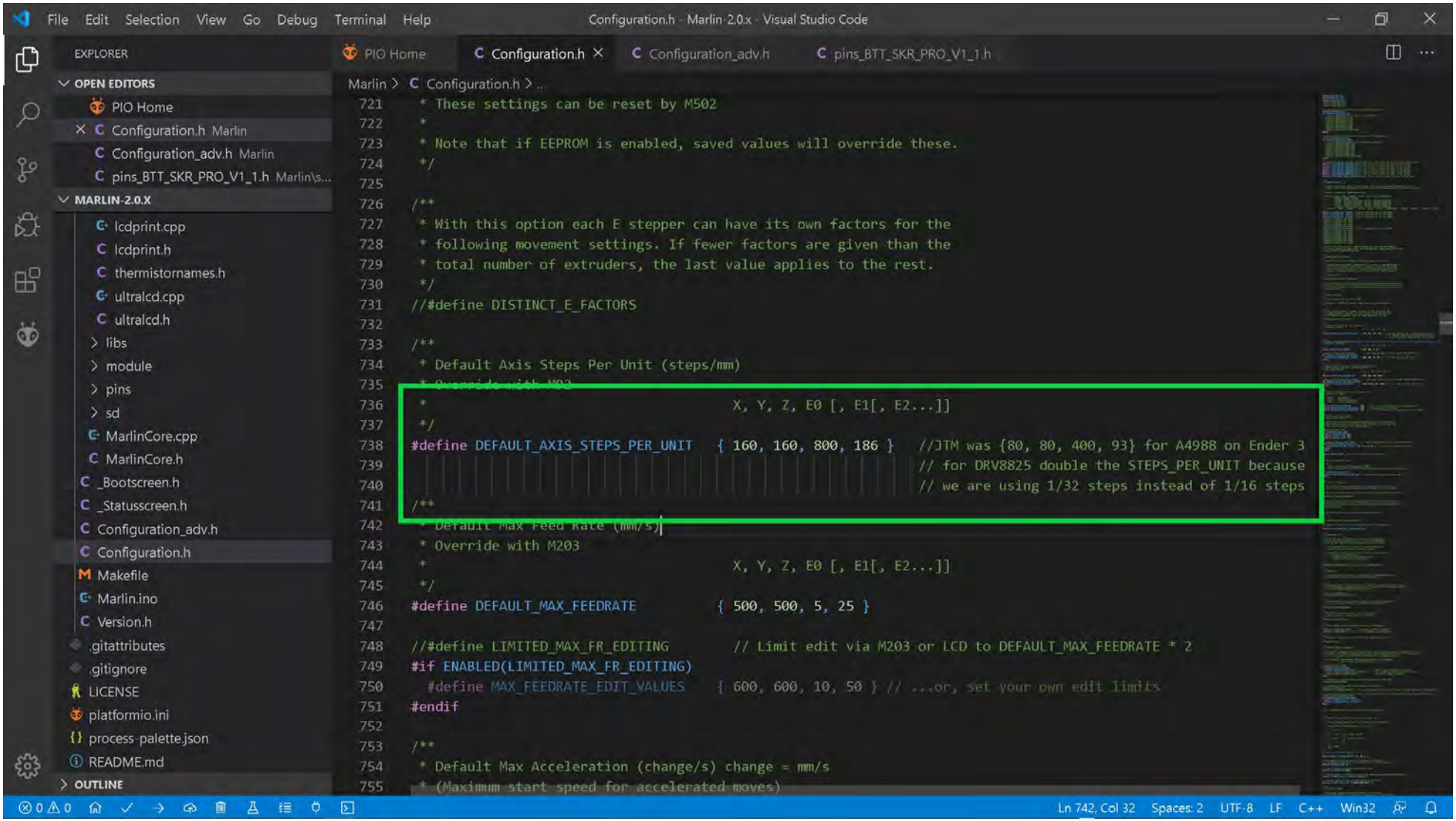
- In the Marlin firmware, the ST820 drivers needs an ACTIVE HIGH for the stepper motor driver's enable pin, so set "X_ENABLE_ON" to 1, "Y_ENABLE_ON" to 1, "Z_ENABLE_ON" to 1 and "E_ENABLE_ON" to 1, as seen in the GREEN box below.



- Go to the next page.

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

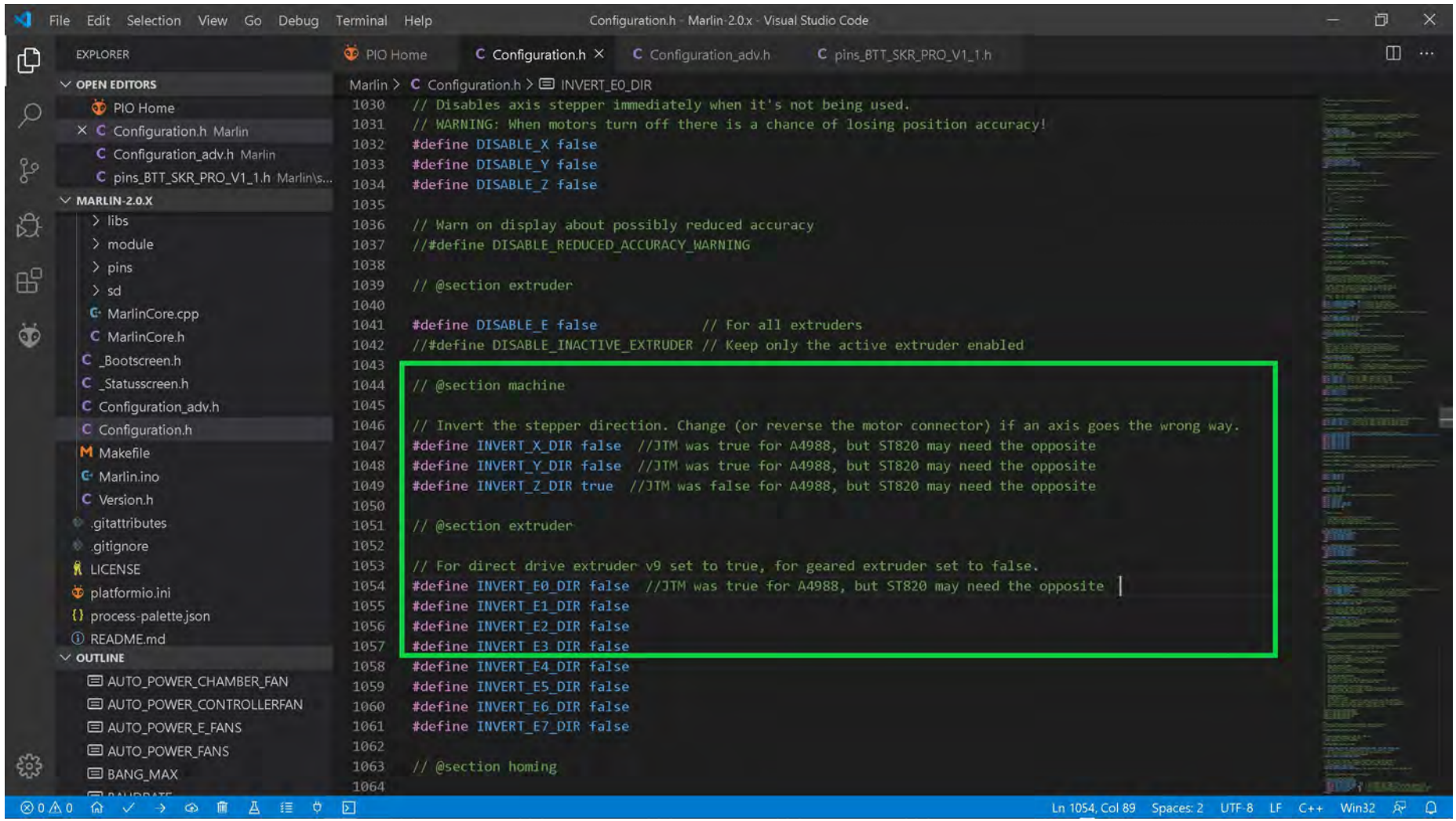
- Since we are changing from A4988 stepper motor drivers on the Ender 3 to POLOLU ST820 (STSPIN820) stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" 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.



- Go to the next page.

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

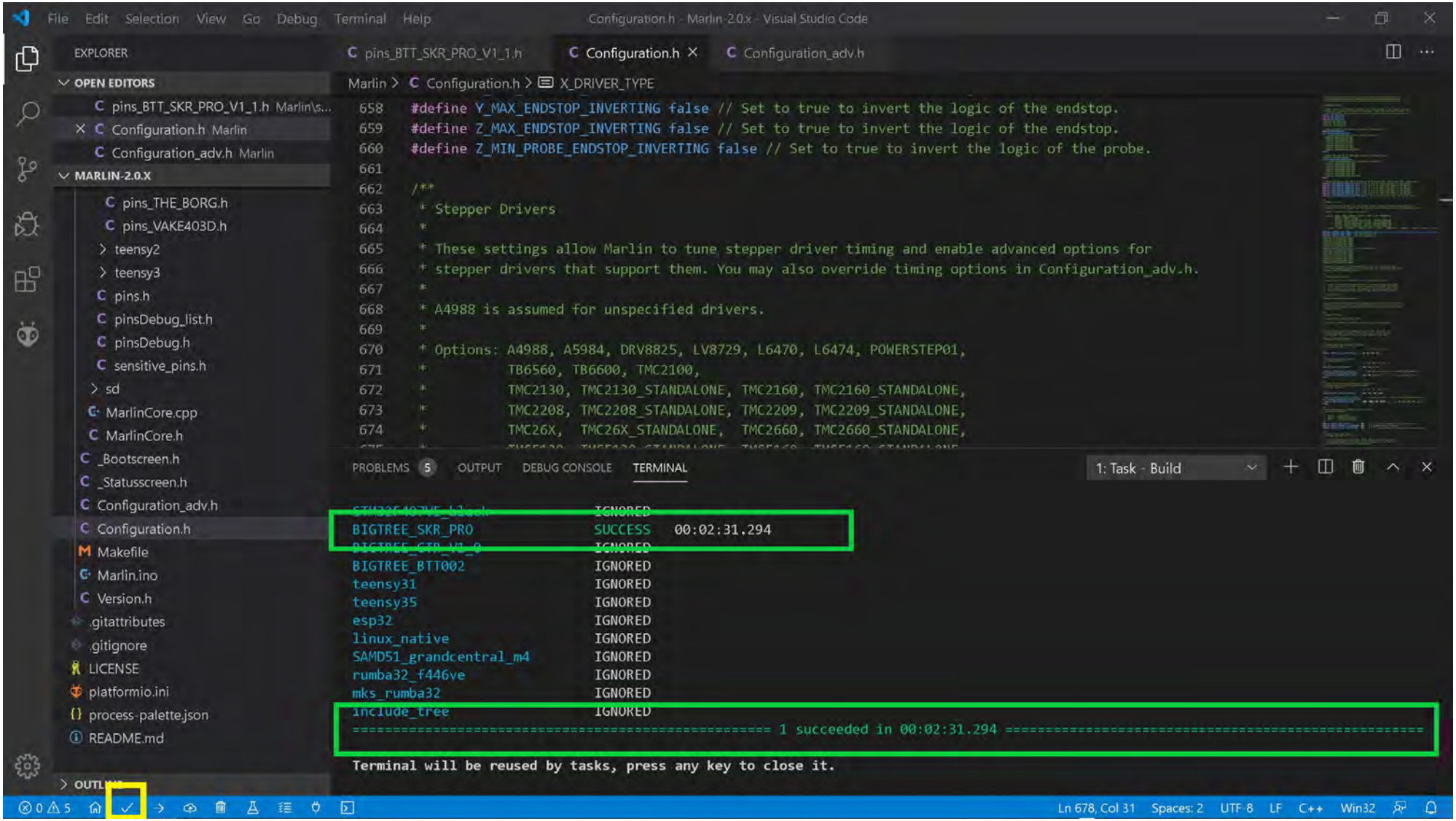
- Optional Step: I found conflicting information on the ST820 driver. Some sources say you will need to change the motor direction others say you may not. So I provide the below information in case you do need to change the stepper motor direction. If you prefer to change the motor direction with wiring 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



- Go to the next page.

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

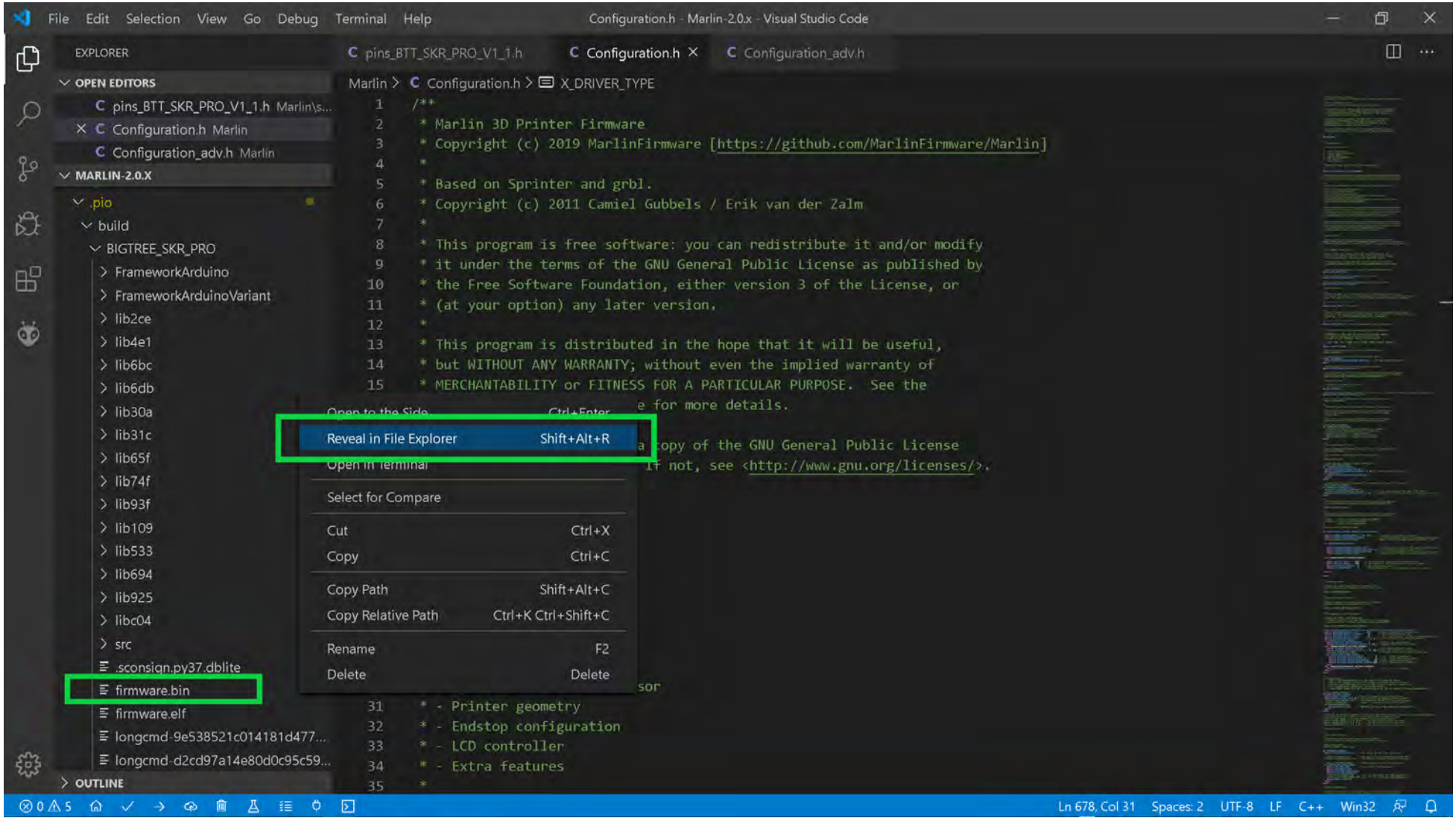
- The end of Marlin setup for POLOLU ST820 (STSPIN820) drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

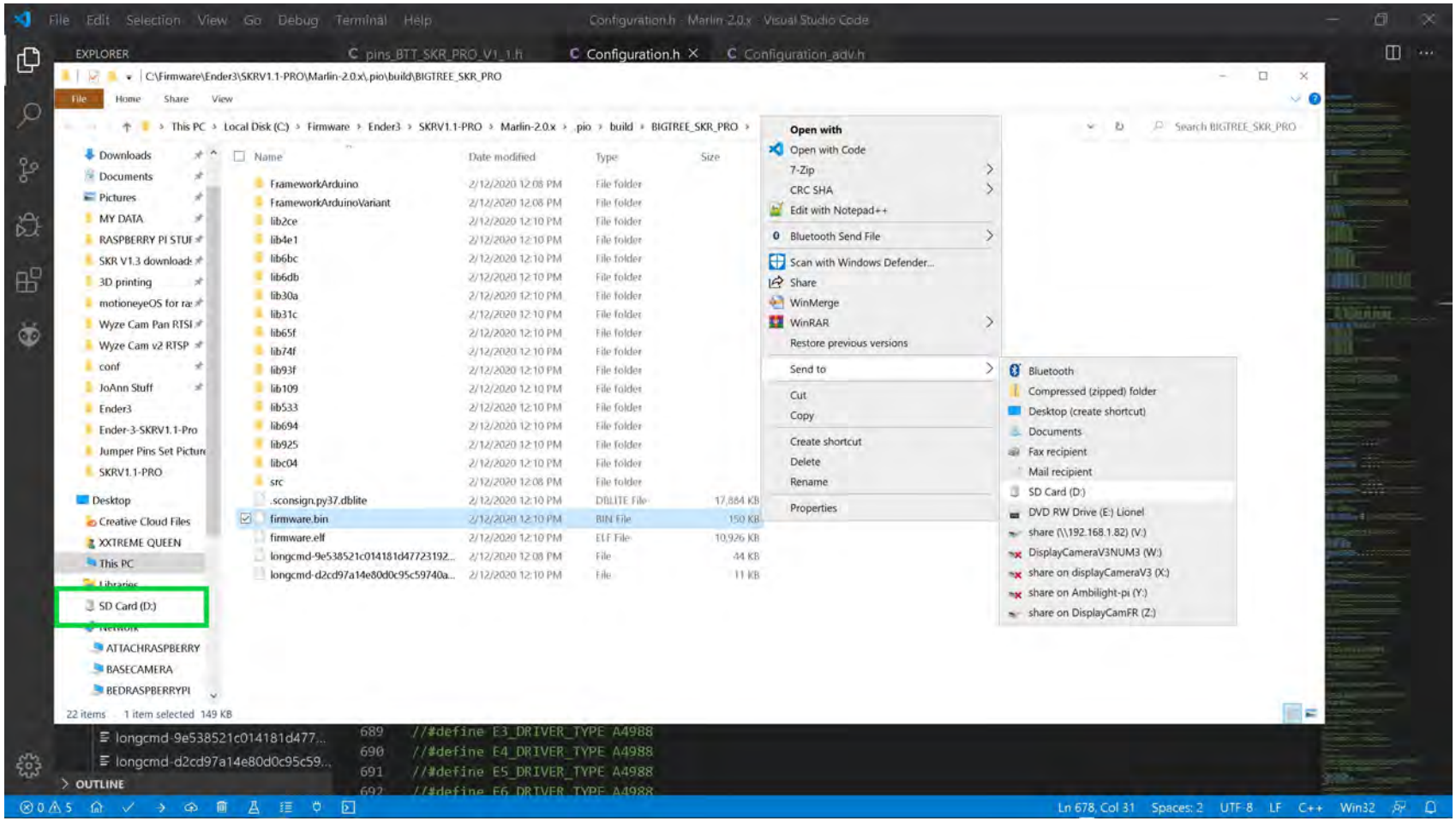
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer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



- Go to the next page.

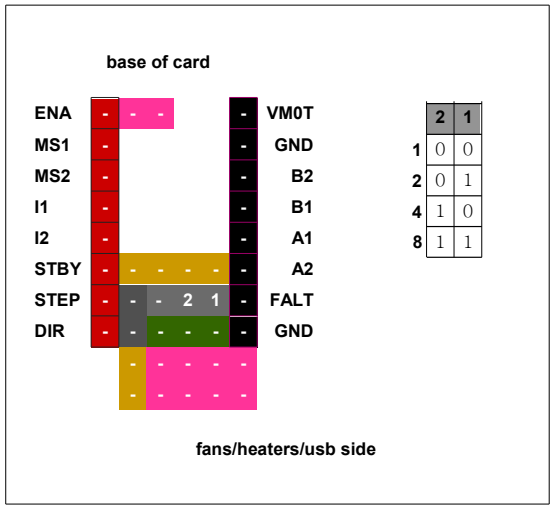
The (latest release of) Marlin Setup for POLOLU ST820 (STSPIN820) Drivers

- Ensure your micro-SD card that 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 and renamed to "firmware.bin" on the micro-SD card.

POLOLU MP6500



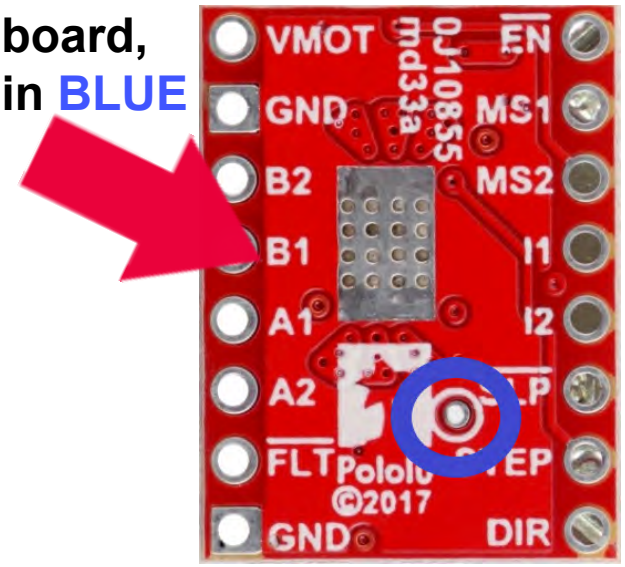
2	1
1	0	0
2	0	1
4	1	0
8	1	1

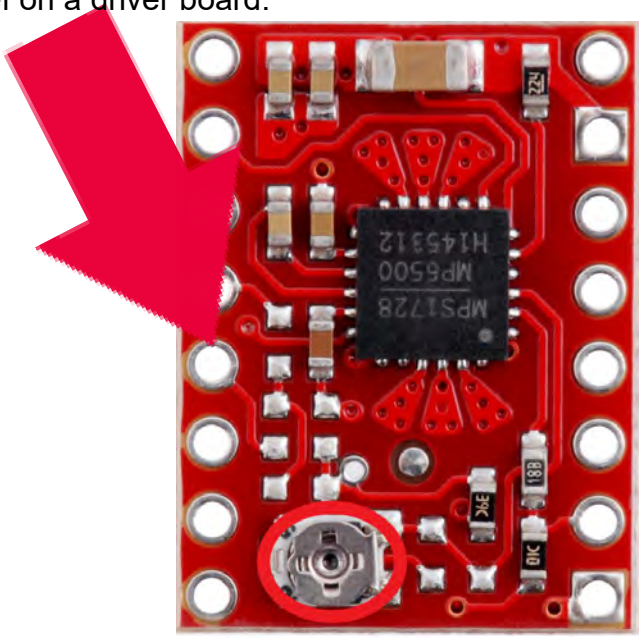
Driver Chip	MS2	MS1	Microstep Resolution
MP6500 Maximum 16 subdivision 4.5 V to 35 V 1.5 A	Low	Low	Full step
	Low	High	Half (1/2) step
	High	Low	Quarter (1/4) step
	High	High	Eighth (1/8) step
Driving current calculation formula	$I_{MAX} = V_{ref} * 3.5$		$V_{ref} = \frac{I_{MAX}}{3.5}$

Note: Use 90% of the calculated Vref when tuning the stepper driver board

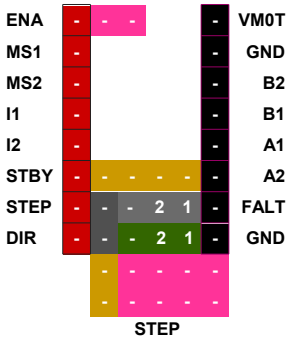
Note: "Vref Test point" location is on the bottom of the driver board, as shown in BLUE

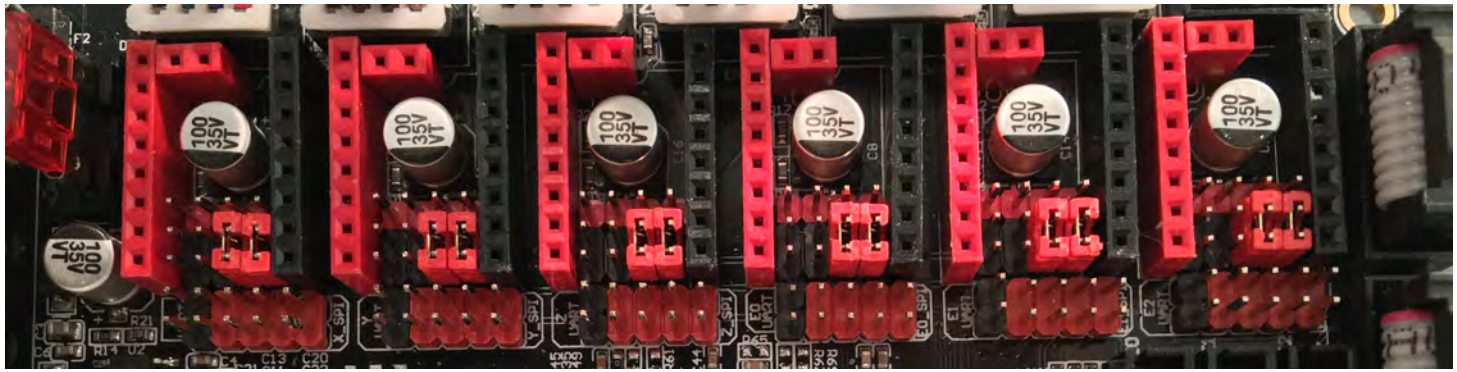
NOTE: Use the potentiometer (POT) on the top of the board (or use the board's "Vref Test point") to adjust your Vref See the appendix for instructions on how to set the Vref on a driver board.

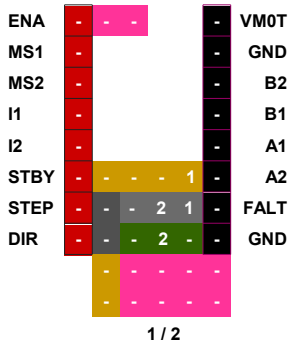


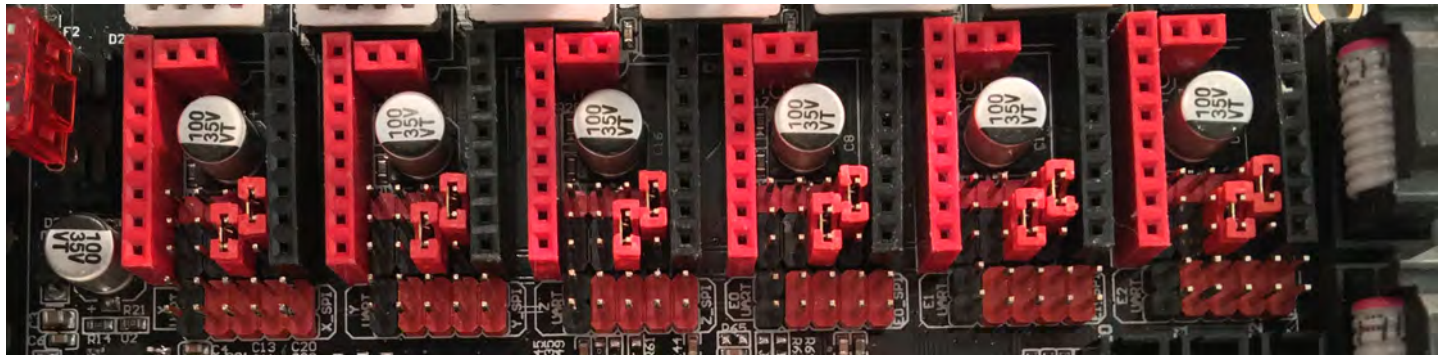


POLOLU MP6500

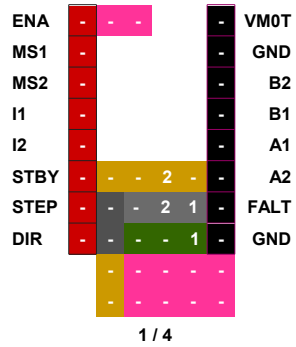


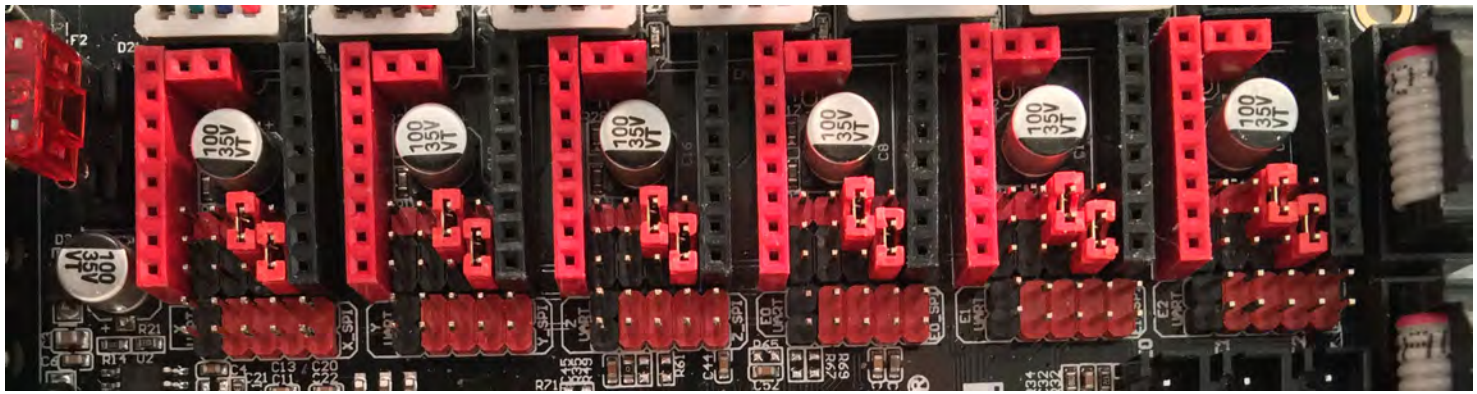


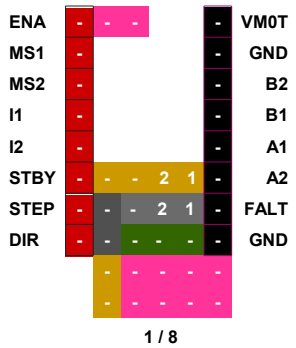


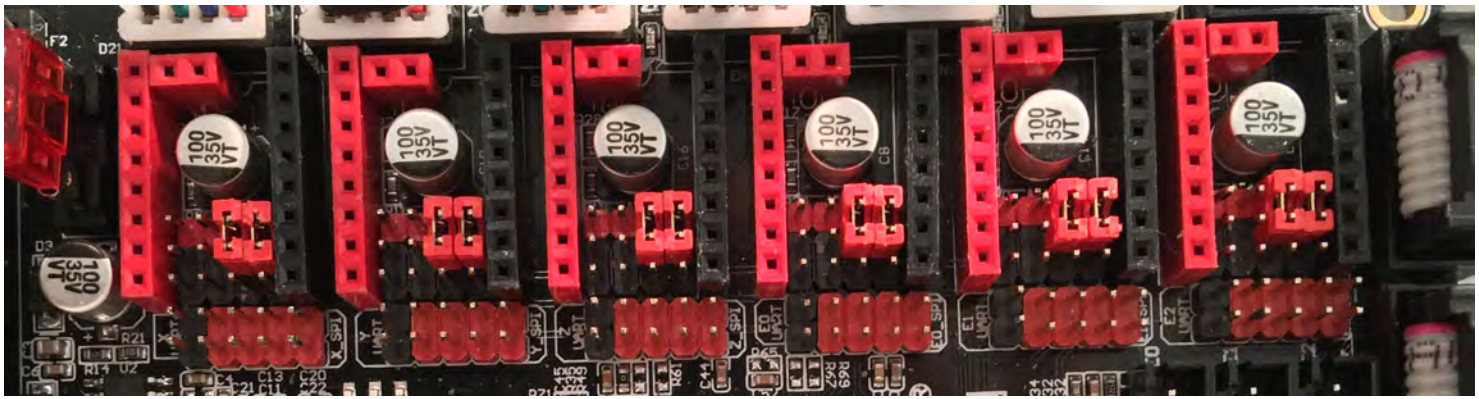


POLOLU MP6500





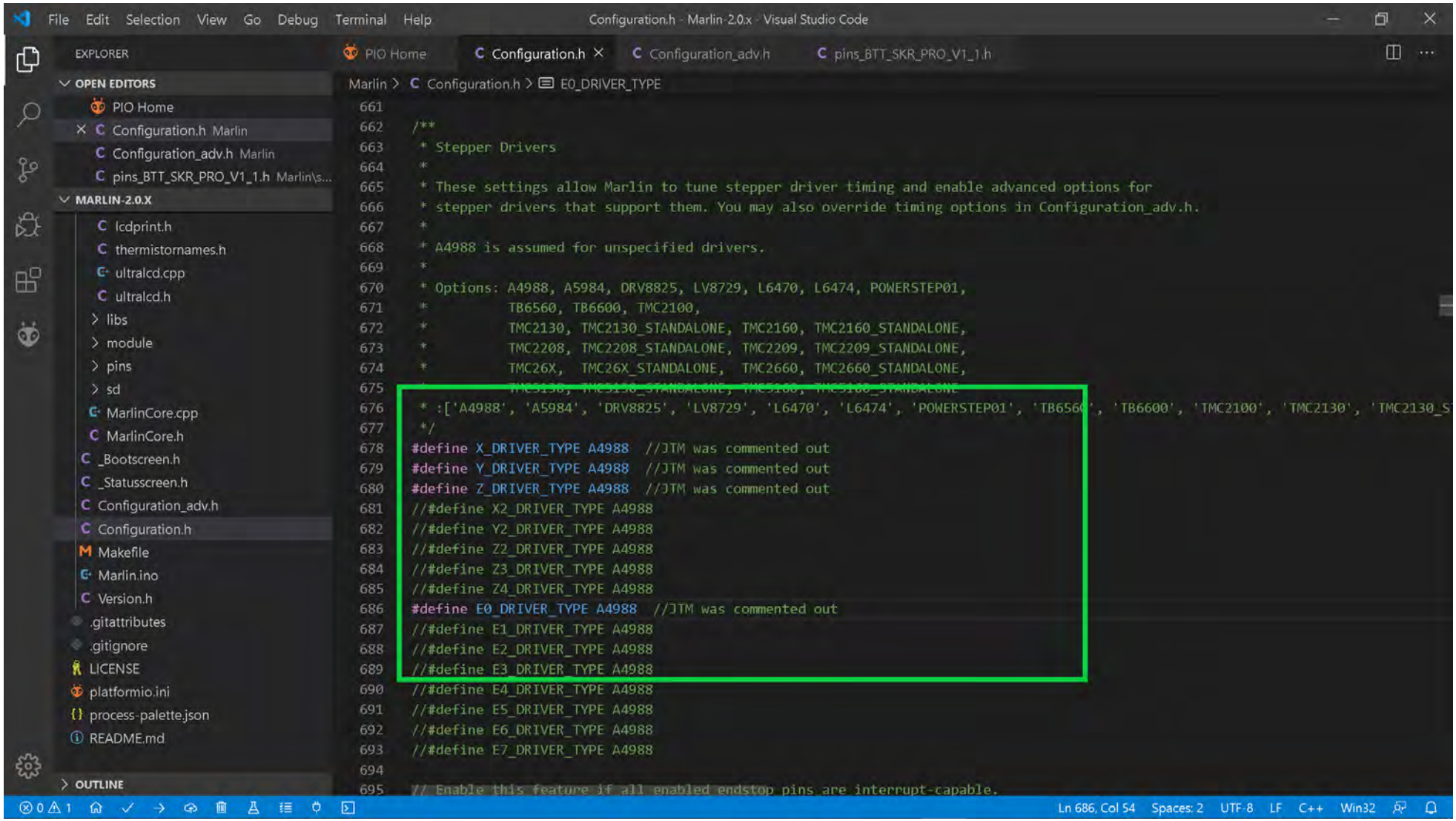




The (latest release of) Marlin Setup for POLOLU MP6500 Drivers

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

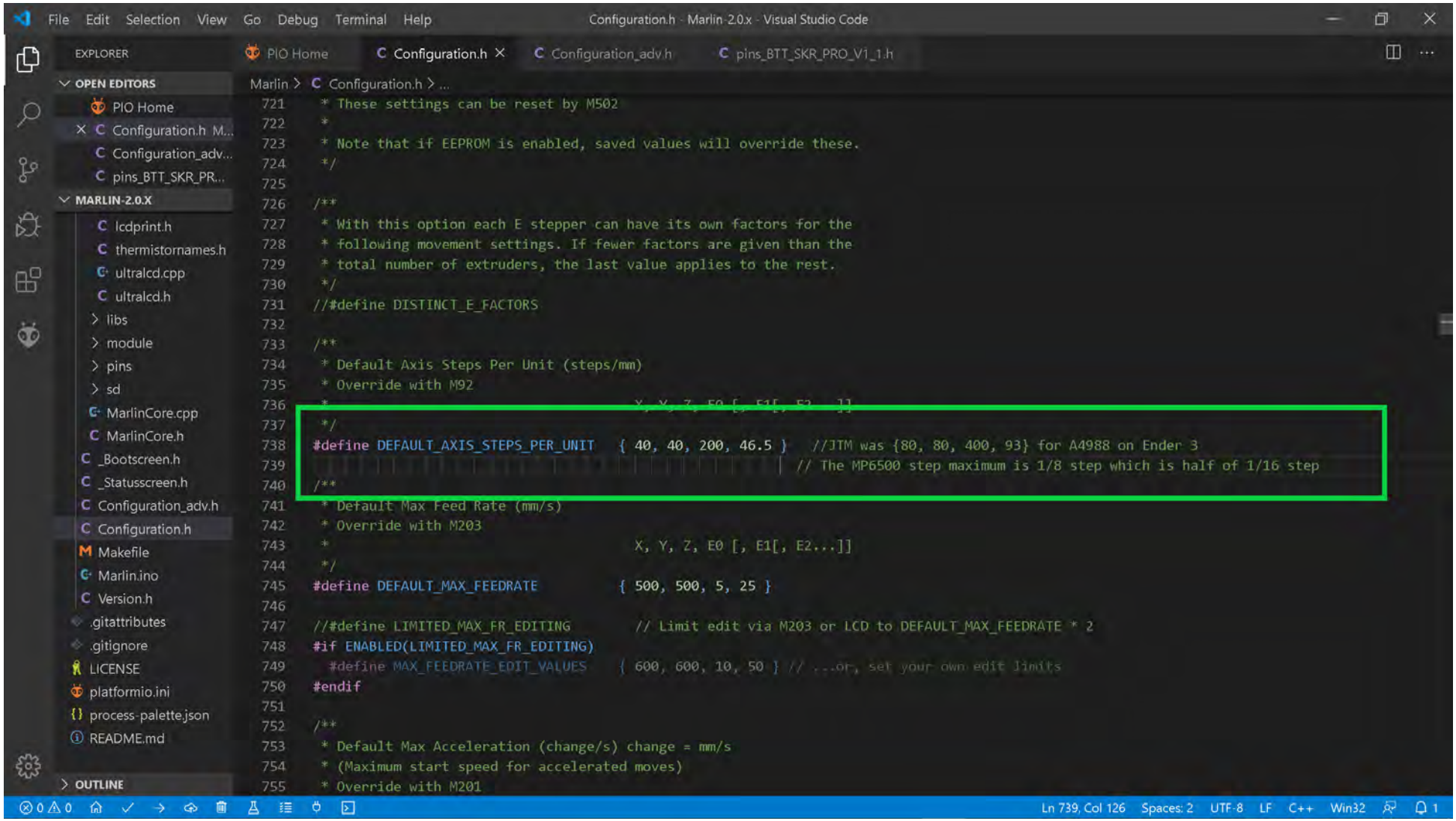
- Change the stepper motor drivers so that Marlin knows you are using POLOLU MP6500 drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use POLOLU MP6500 drivers. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").
- The ST820 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.



- Go to the next page.

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

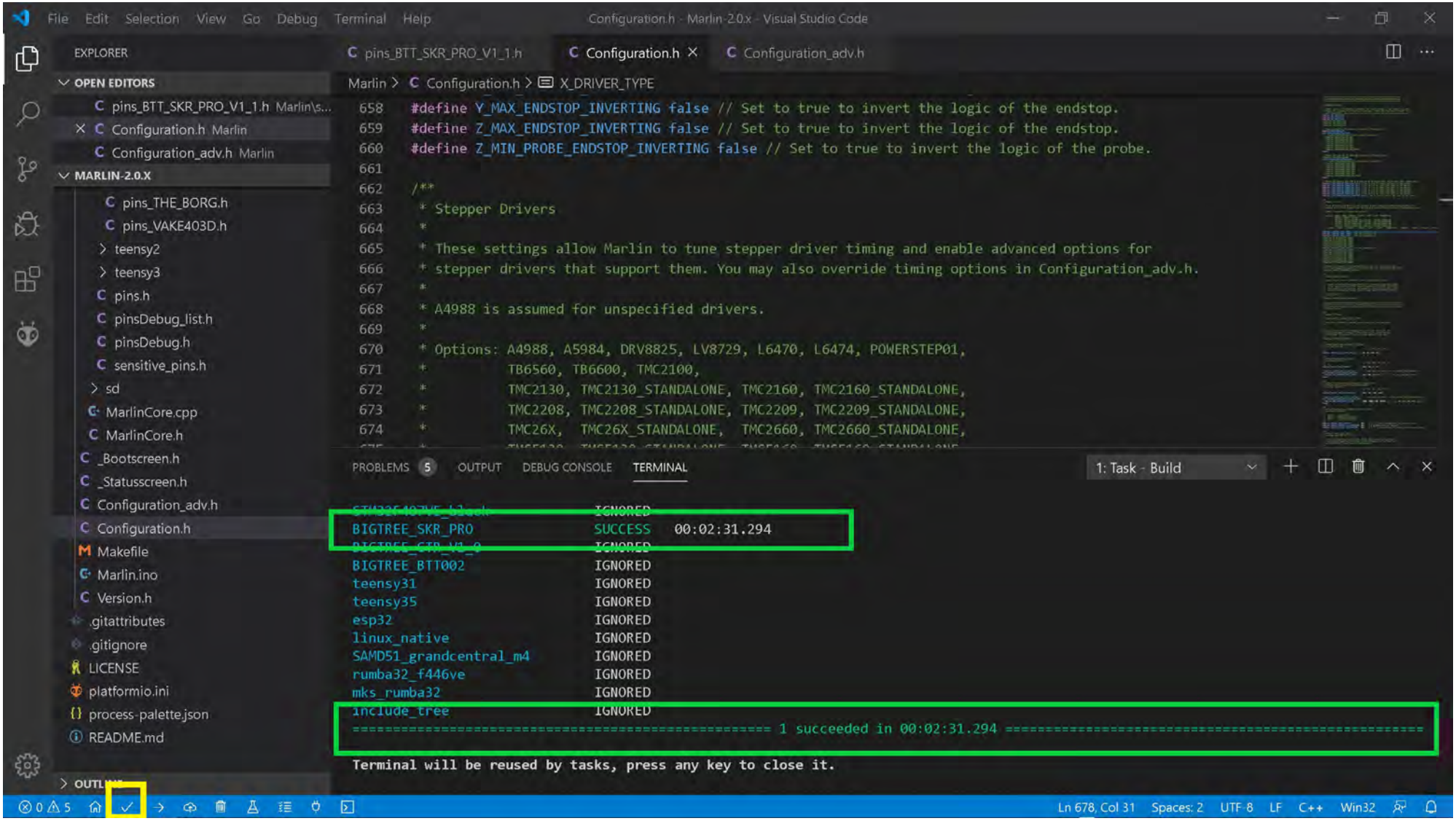
- Since we are changing from A4988 stepper motor drivers on the Ender 3 to for POLOLU MP6500 stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/8 stepping. So we are cutting our STEPS in half. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" 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.



- Go to the next page.

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

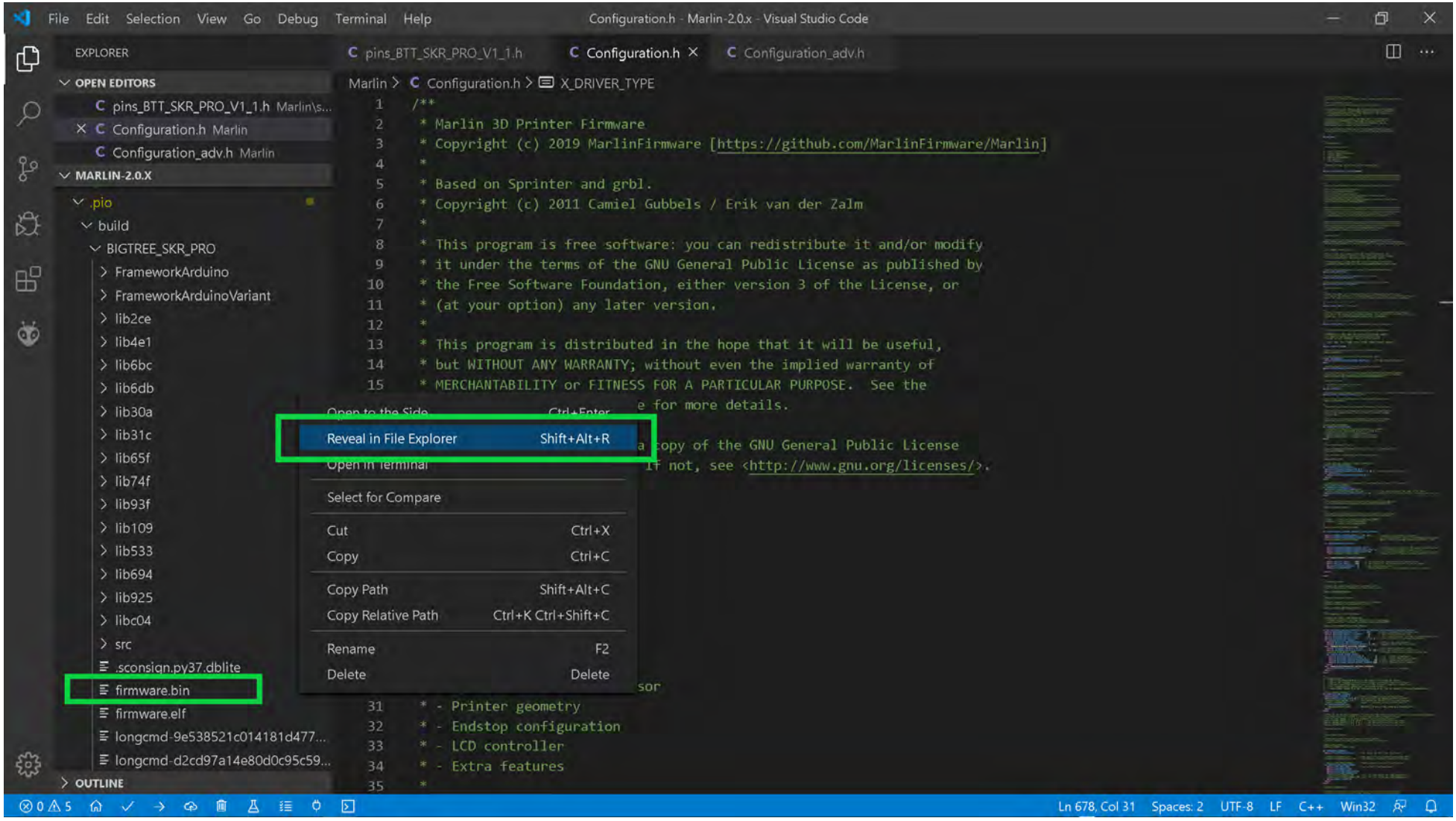
- The end of Marlin setup for POLOLU MP6500 drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

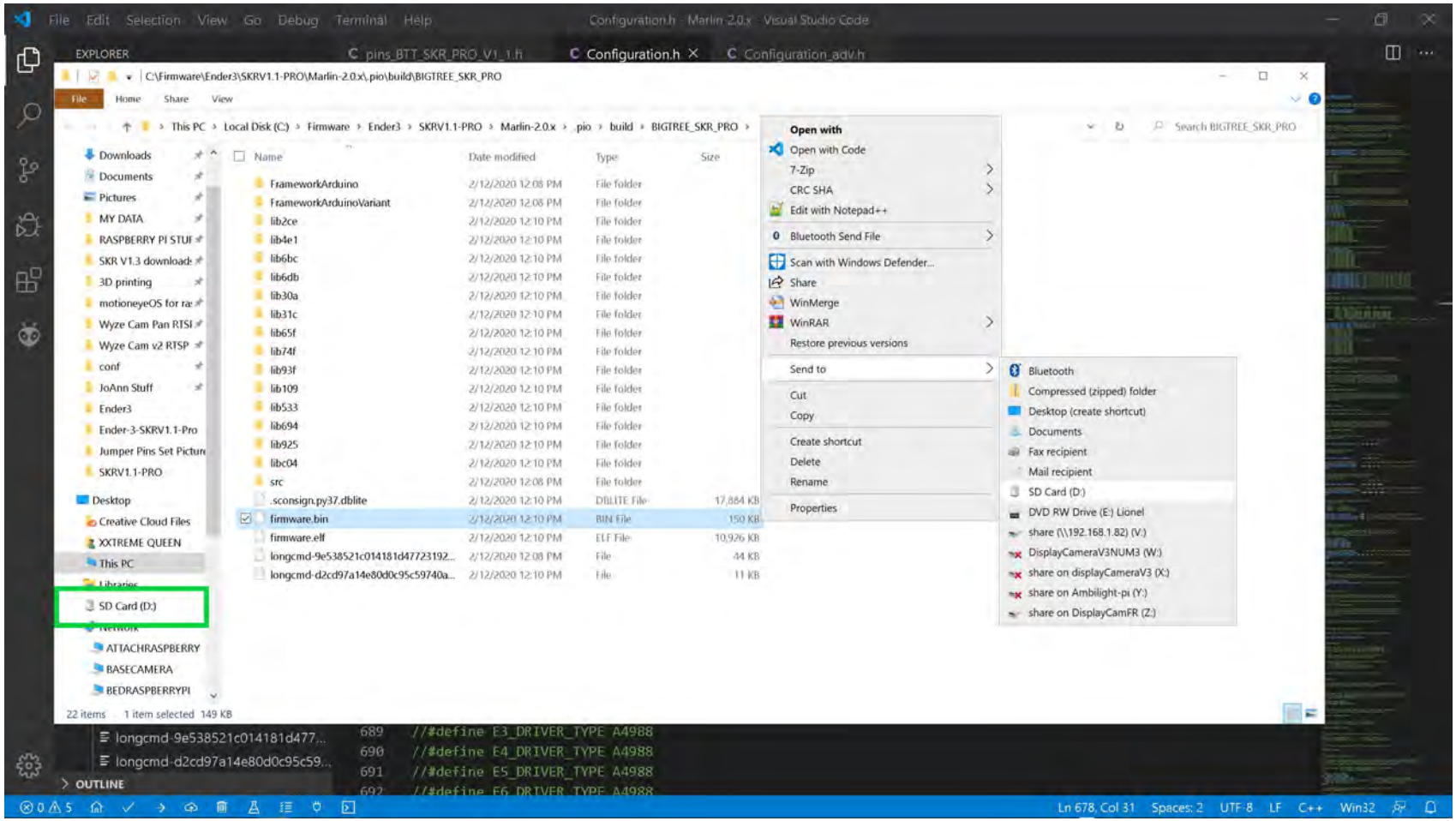
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



- Go to the next page.

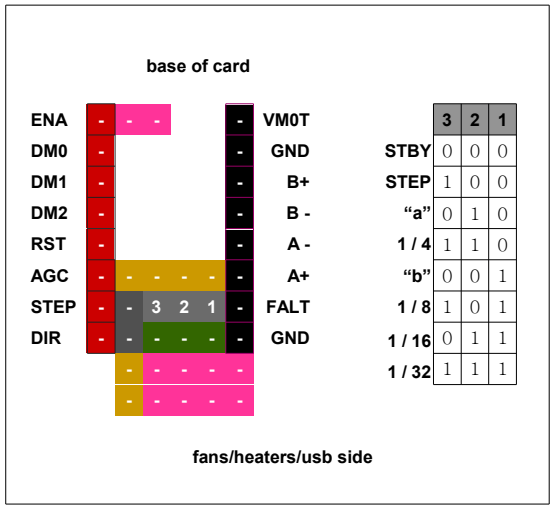
The (latest release of) Marlin Setup for POLOLU MP6500 Drivers

- Ensure your micro-SD card that 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 and renamed to "firmware.bin" on the micro-SD card.

POLOLU TB67S249FTG



STBY	3	2	1
STEP	0	0	0
"a"	1	0	0
1 / 4	0	1	0
"b"	1	1	0
1 / 8	0	0	1
1 / 16	1	0	1
1 / 32	0	1	1
	1	1	1

Driver Chip	DMODE2	DMODE1	DMODE0	Microstep Resolution
TB67S249FTG Maximum 32 subdivision 10 V to 47 V 1.6 A	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

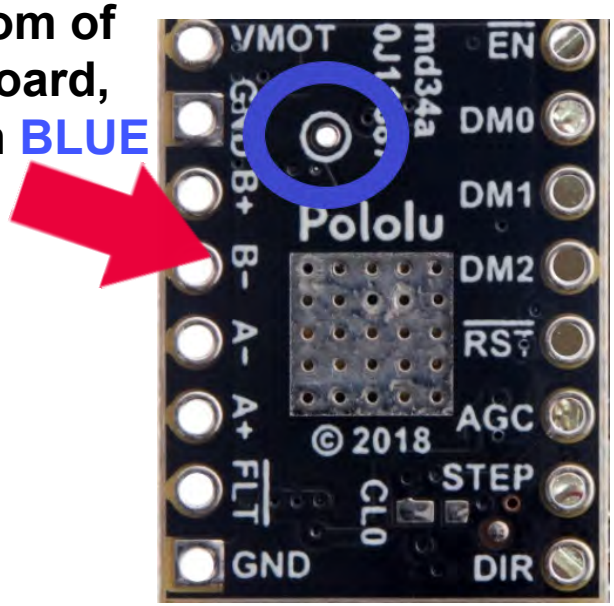
$$I_{MAX} = V_{REF} * 1.25$$

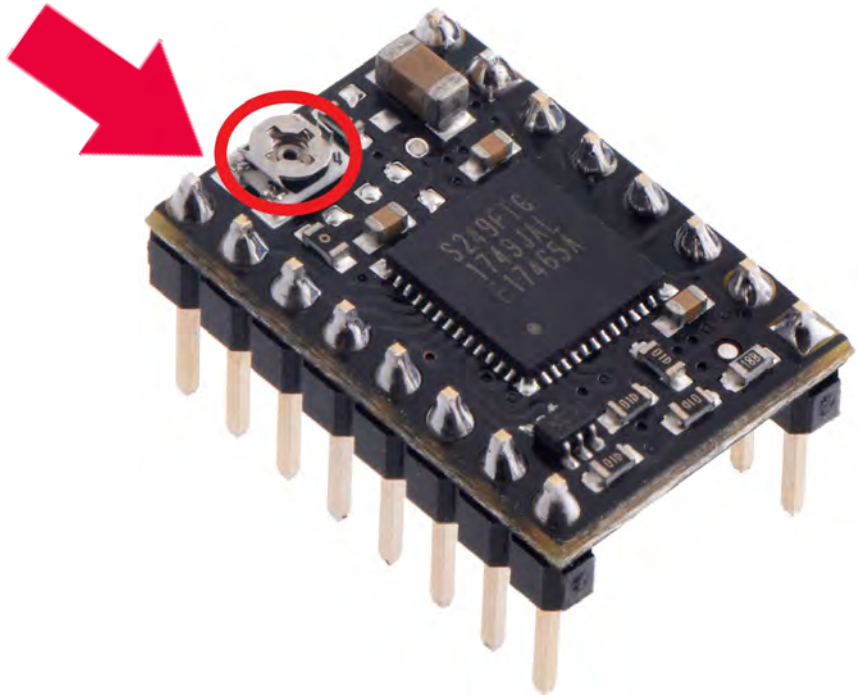
$$V_{REF} = \frac{I_{MAX}}{1.25}$$

Note: Use 90% of the calculated Vref when tuning the stepper driver board

NOTE: Use the potentiometer (POT) on the top of the board (or use the board's "Vref Test point") to adjust your Vref. See the appendix for instructions on how to set the Vref on a driver board.

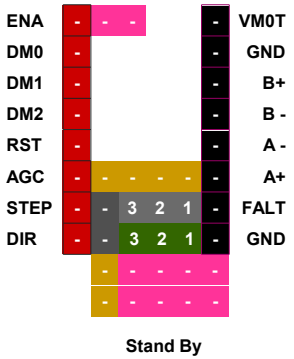
Note: "Vref Test point" location is on the Bottom of the driver board, as shown in BLUE

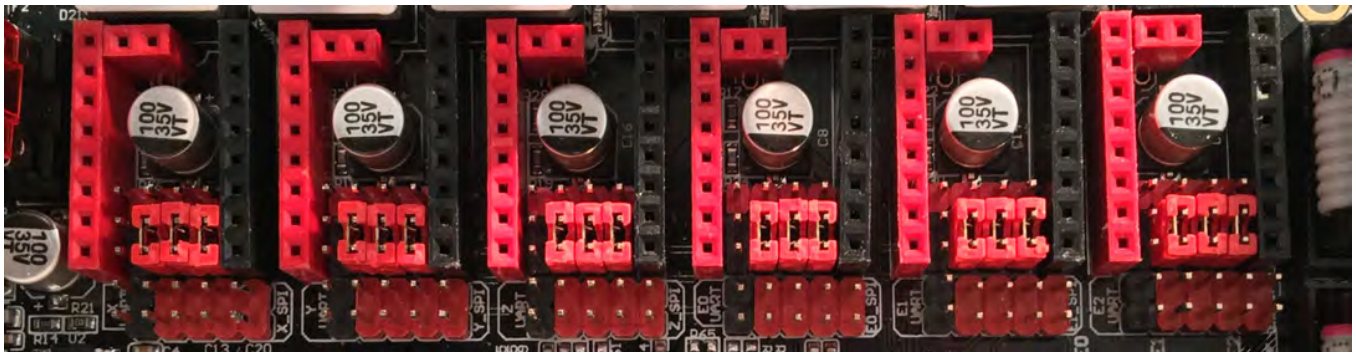


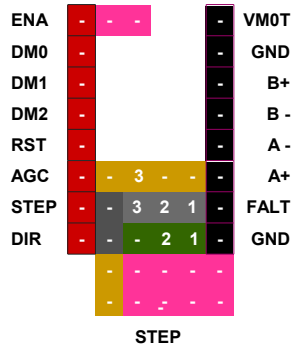


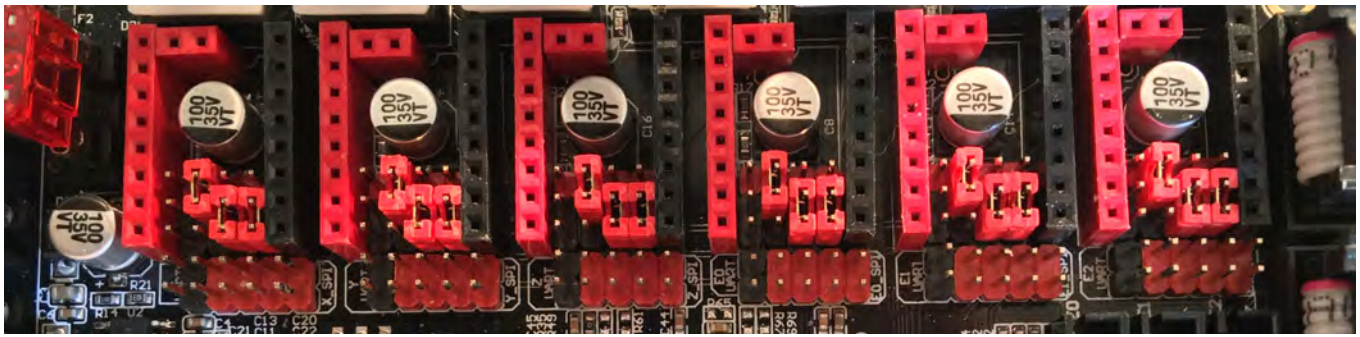
POLOLU TB67S249FTG

Note: **“a” and “b” referred to a non-circular, and circular half step. Please understand that I do not know what this means and did not see a description about this in the vendor data. If you click on the title of this page the datasheet is available.**



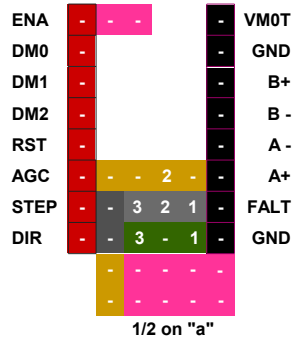


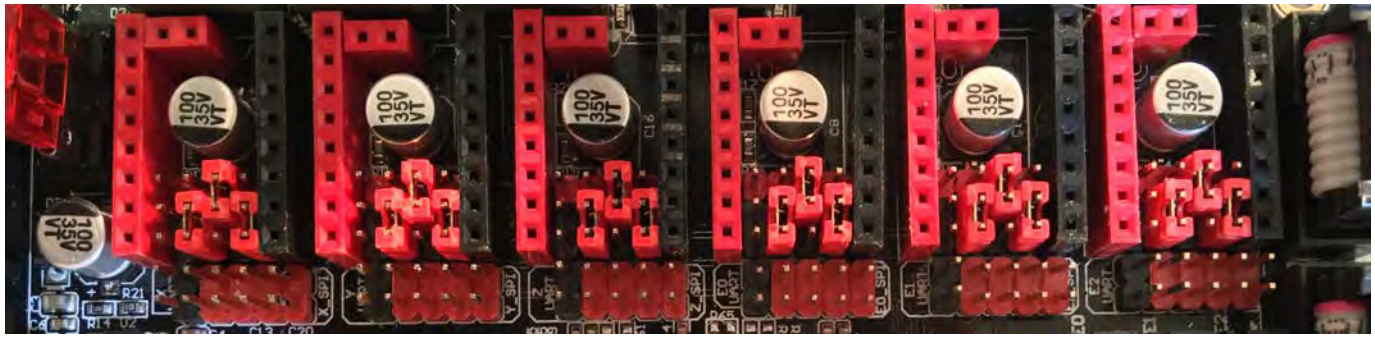


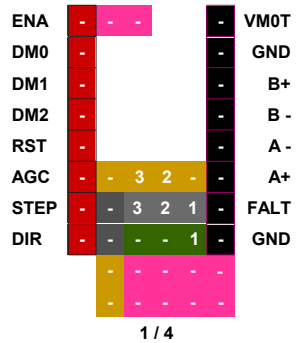


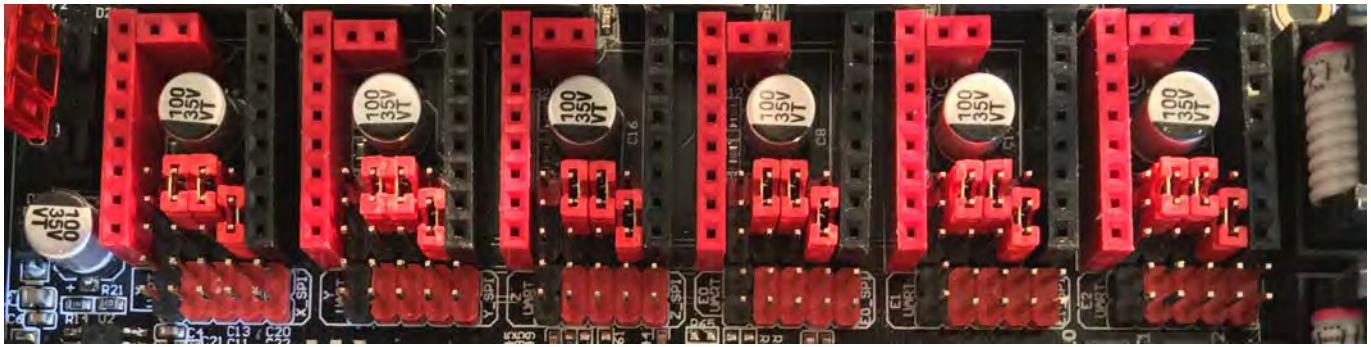
POLOLU TB67S249FTG

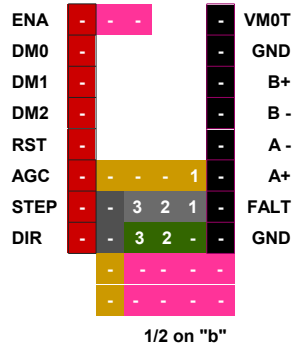
Note: **“a” and “b” referred to a non-circular, and circular half step. Please understand that I do not know what this means and did not see a description about this in the vendor data. If you click on the title of this page the datasheet is available.**

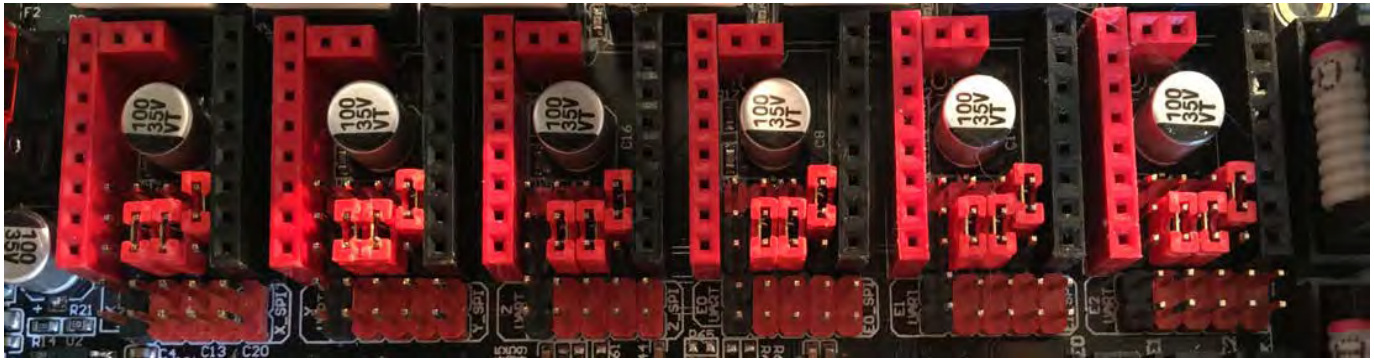






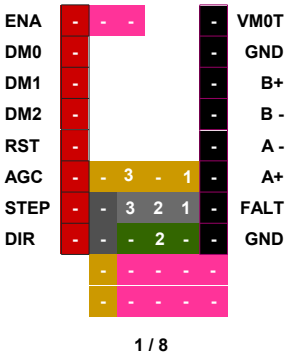


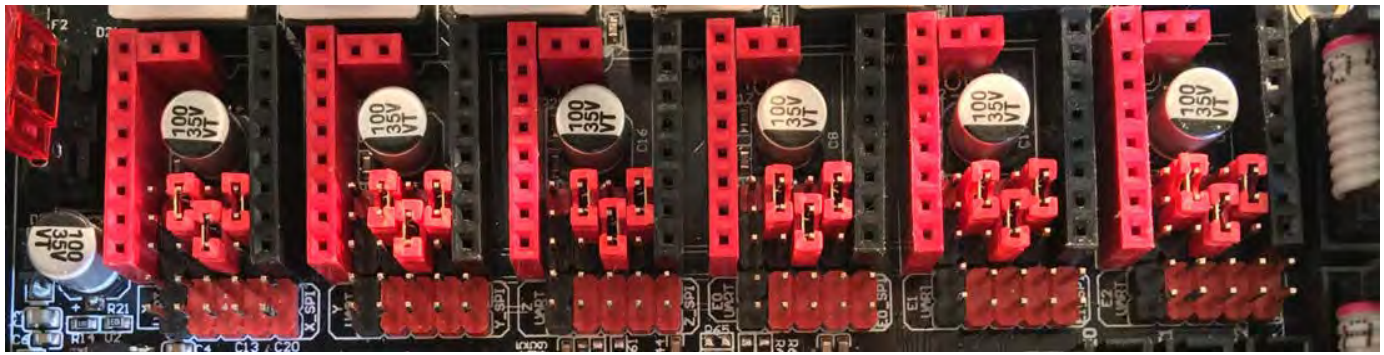


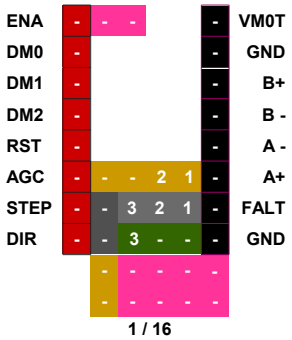


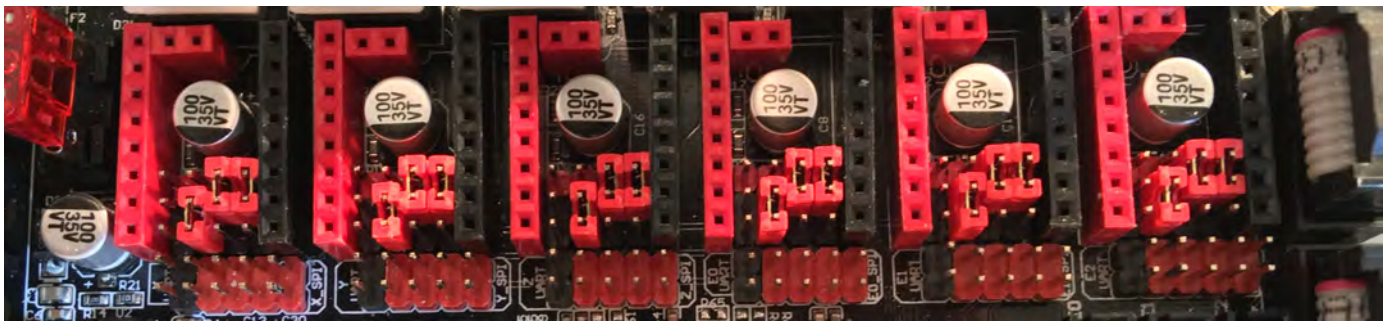
POLOLU TB67S249FTG

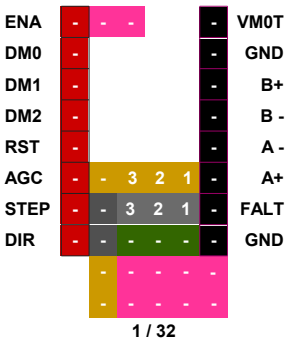
Note: **“a” and “b” referred to a non-circular, and circular half step. Please understand that I do not know what this means and did not see a description about this in the vendor data. If you click on the title of this page the datasheet is available.**

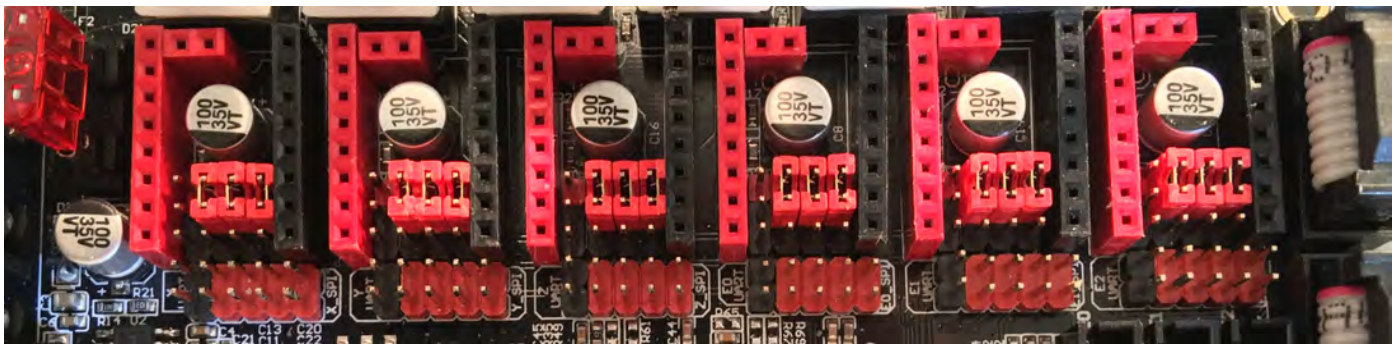








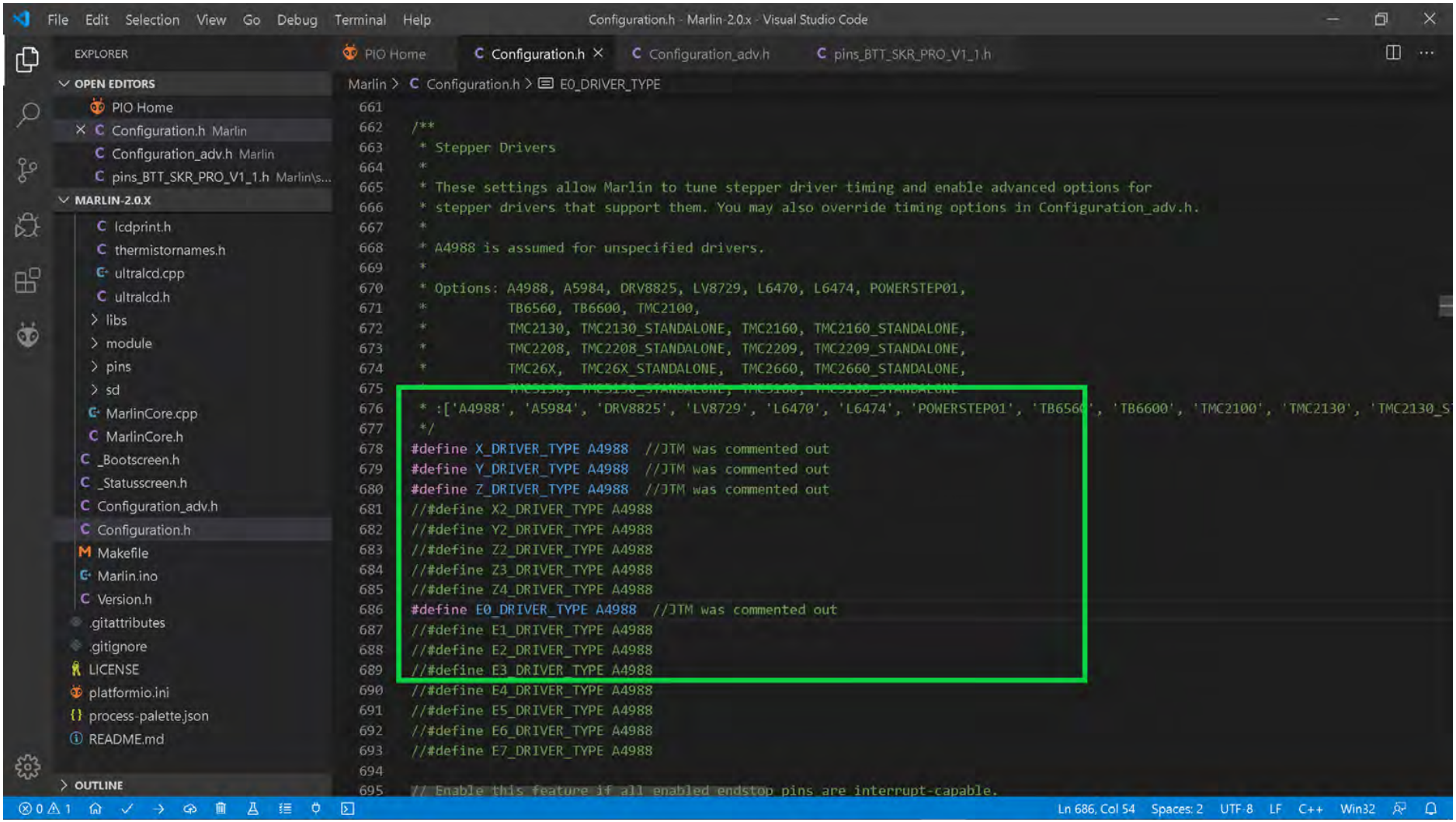




The (latest release of) Marlin Setup for POLOLU TB67S249FTG Drivers

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

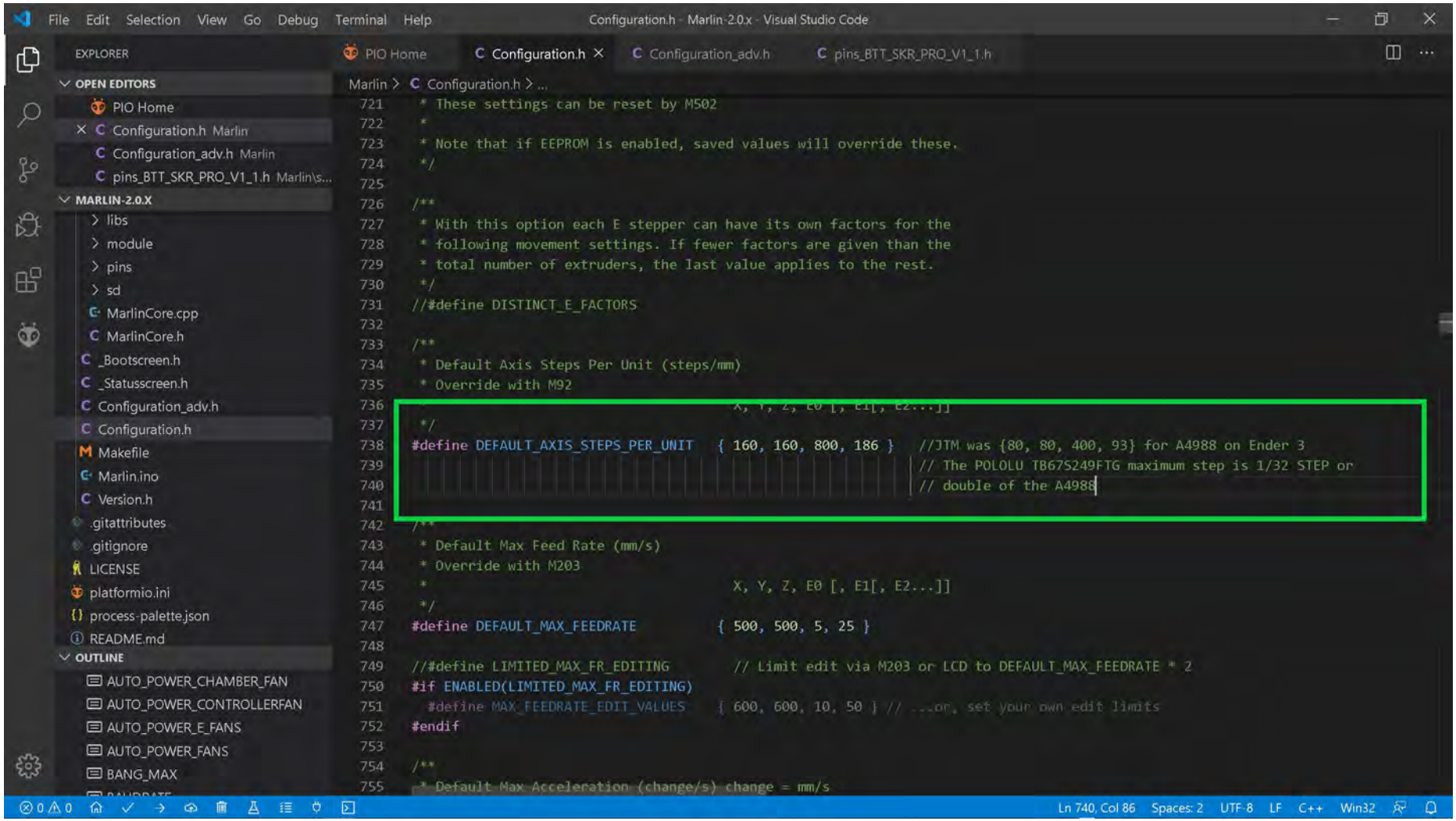
- Change the stepper motor drivers so that Marlin knows you are using POLOLU TB67S249FTG drivers. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use POLOLU TB67S249FTG drivers. When two "//" appear at the beginning of a line that 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.



- Go to the next page.

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

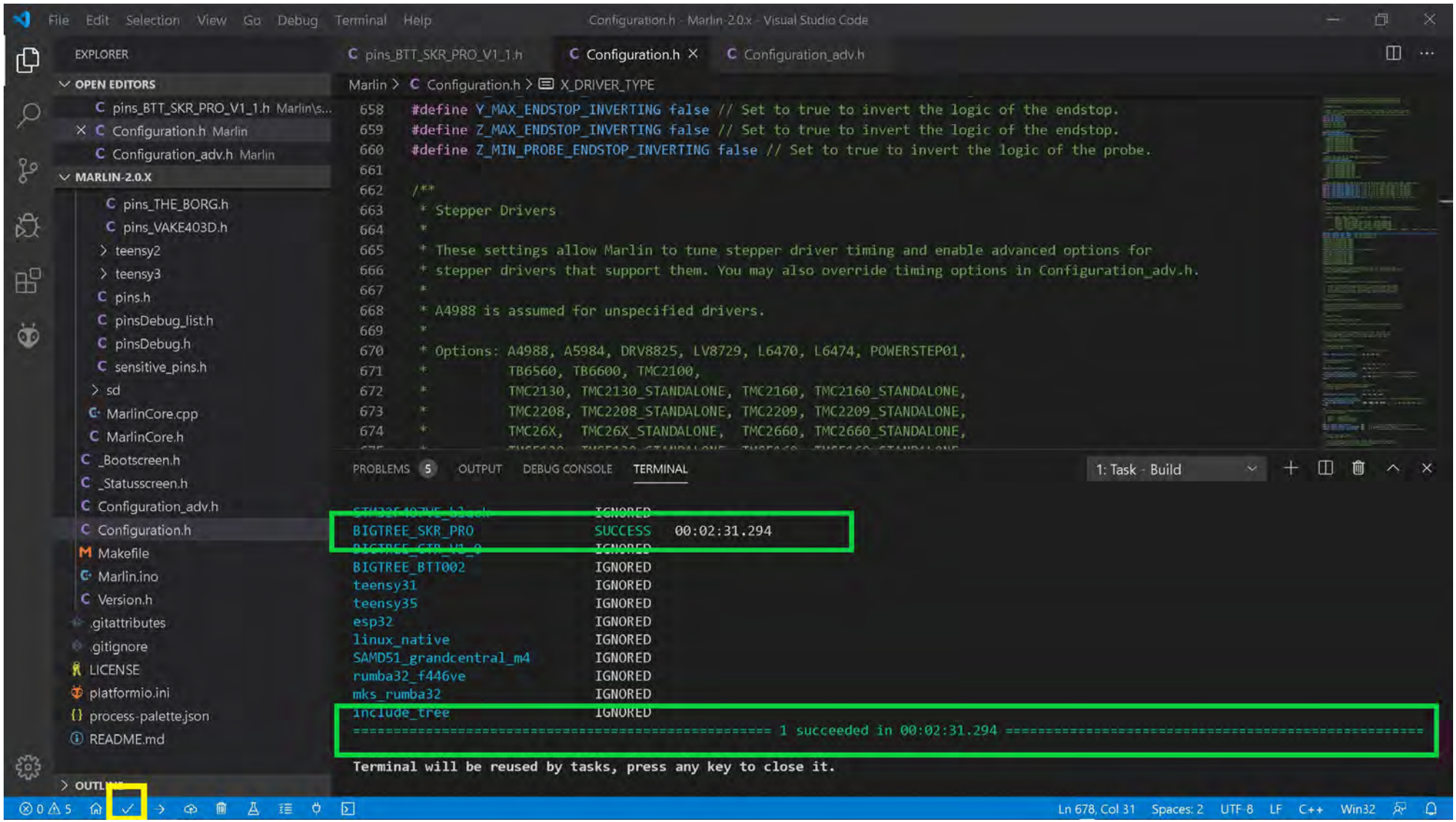
- Since we are changing from A4988 stepper motor drivers on the Ender 3 to for POLOLU TB67S249FTG stepper motor drivers for each axis and the extruder stepper motor driver, we will be going from 1/16 stepping to 1/32 stepping. So we are doubling our STEPS. Therefore, we must adjust our "DEFAULT_AXIS_STEPS_PER_UNIT" 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.



- Go to the next page.

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

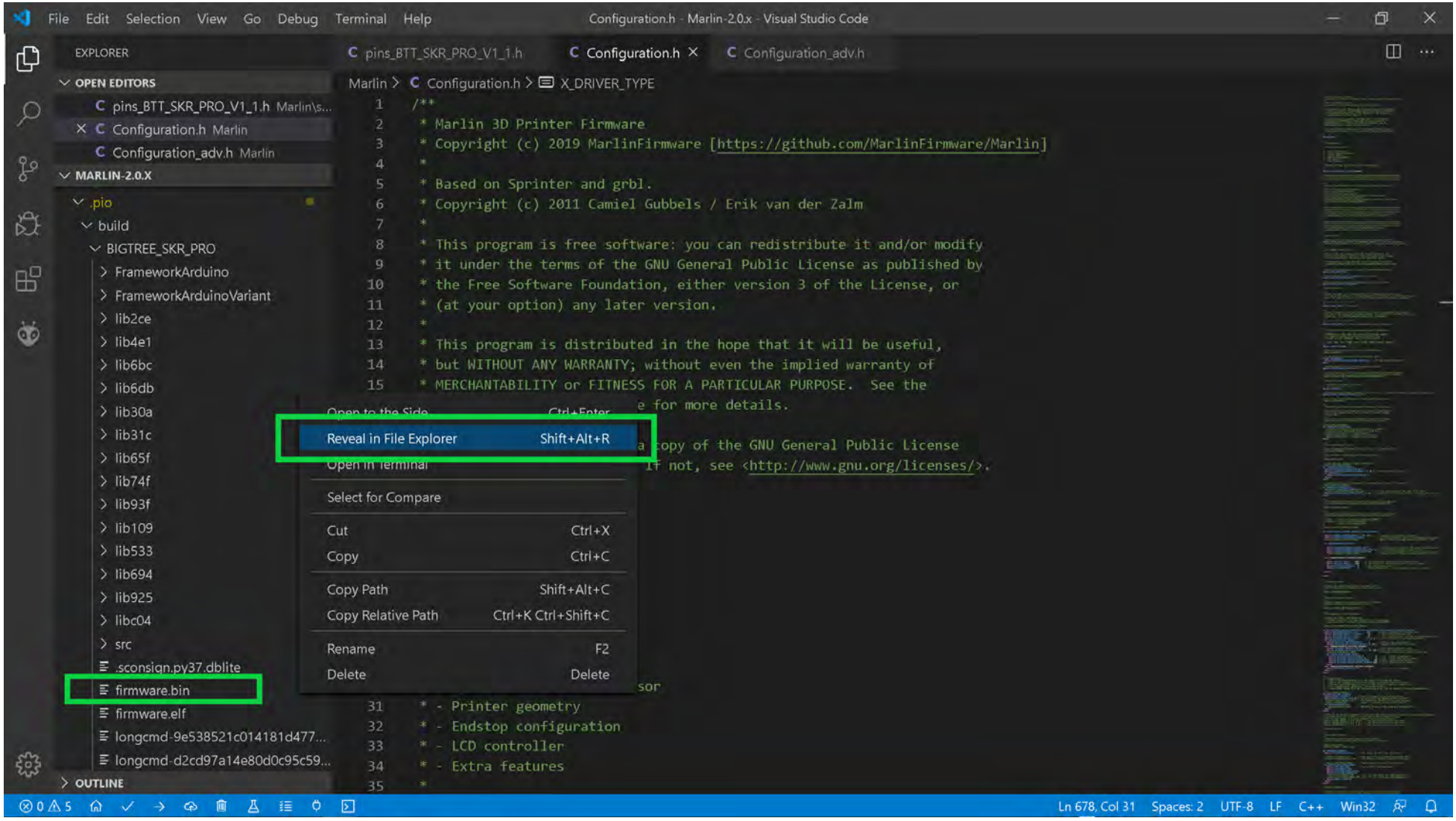
- The end of Marlin setup for POLOLU TB67S249FTG drivers. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages ,as shown in the **GREEN** boxes below.



- 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

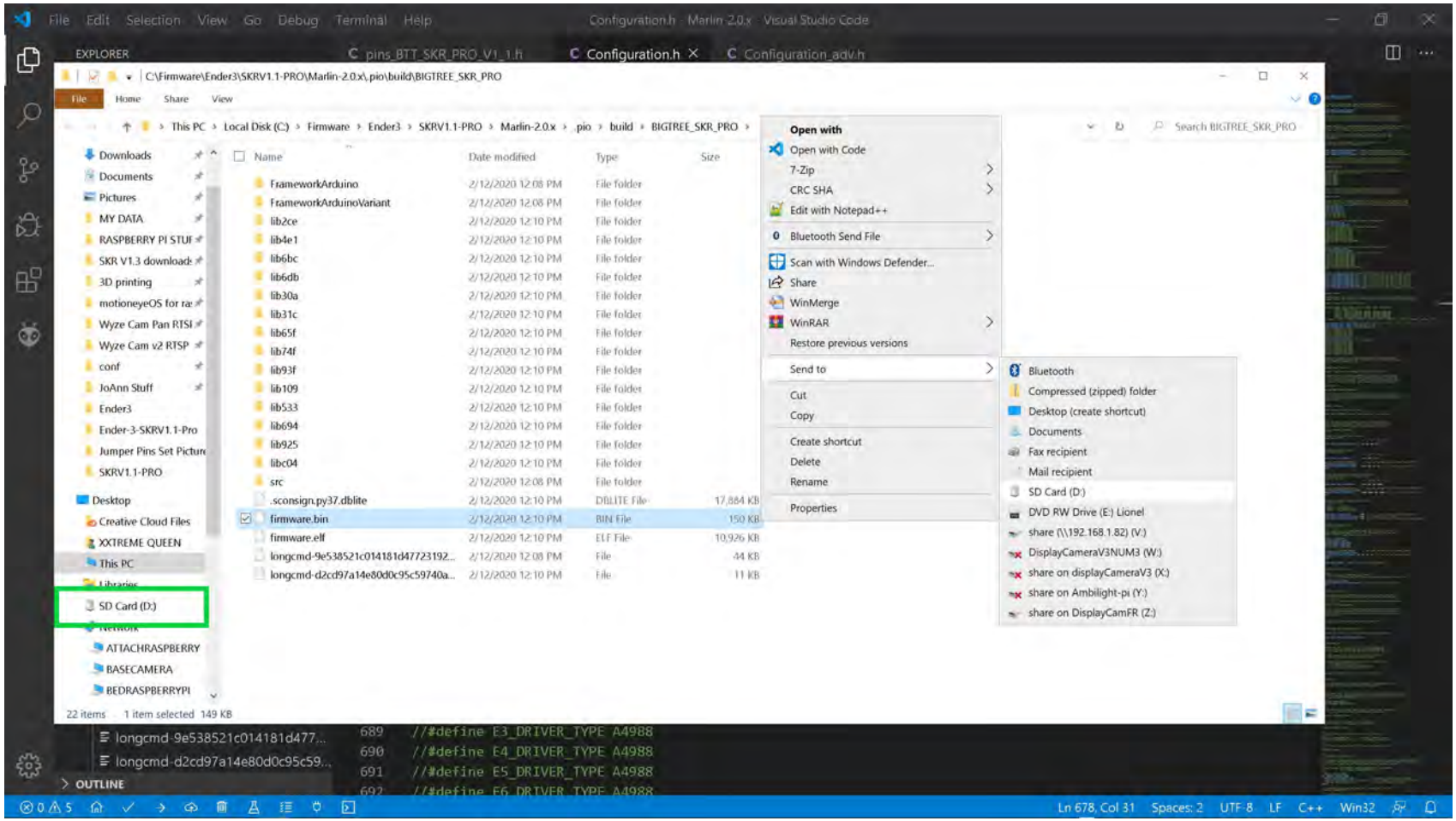
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



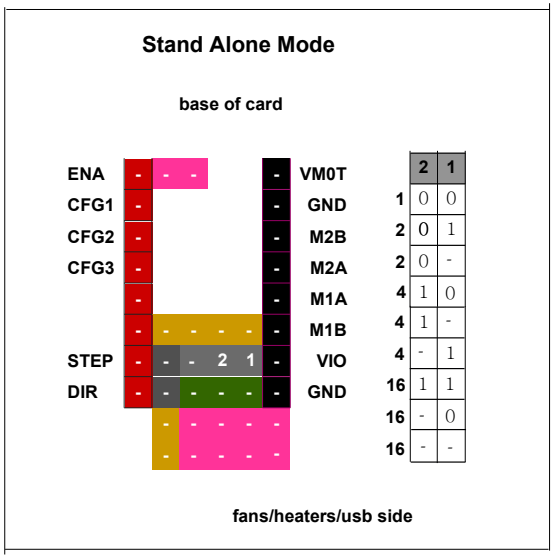
- Go to the next page.

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

- Ensure your micro-SD card that 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 and renamed to "firmware.bin" on the micro-SD card.



BIQU MKS TMC2100

Stand Alone Mode

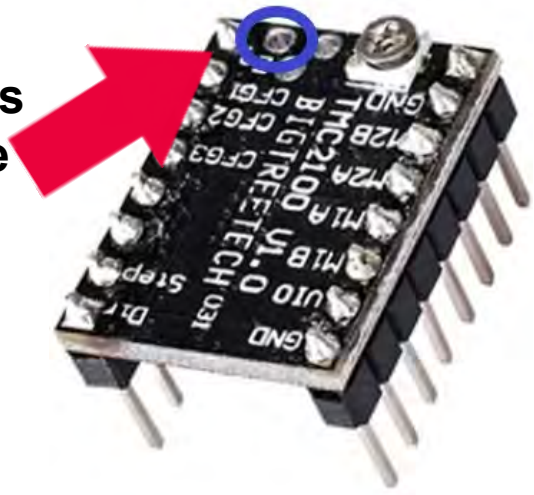
Driver Chip	CFG2	CFG1	Steps	Interpolation	Mode
TMC2100 Standalone Mode Maximum subdivision 16 5.5V - 46V DC 1.4A	GND	GND	1 (full step)	none	spreadCycle
	GND	VIO	2 (half-step)	none	spreadCycle
	GND	open	2 (half-step)	256 µ-steps	spreadCycle
	VIO	GND	4 (quarter-step)	none	spreadCycle
	VIO	open	4 (quarter-step)	256 µ-steps	spreadCycle
	open	VIO	4 (quarter-step)	256 µ-steps	stealthChop
	VIO	VIO	16 µ-steps	none	spreadCycle
	open	GND	16 µ-steps	256 µ-steps	spreadCycle
	open	open	16 µ-steps	256 µ-steps	stealthChop
Driving current calculation formula	$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$			$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$	

Note: Use 90% of the calculated Vref when tuning the stepper driver board

Note: Use the potentiometer (POT) on the top of the board (or use the board's "Vref Test point") to set your Vref. See the appendix for instructions on how to set the Vref 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

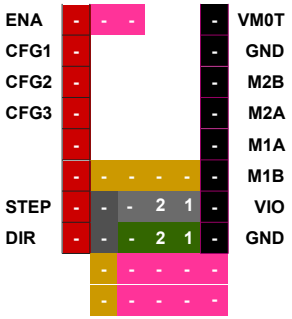
Note: "Vref Test point" location is on the top of the driver board, as shown in BLUE



BIQU MKS TMC2100

Stand Alone Mode

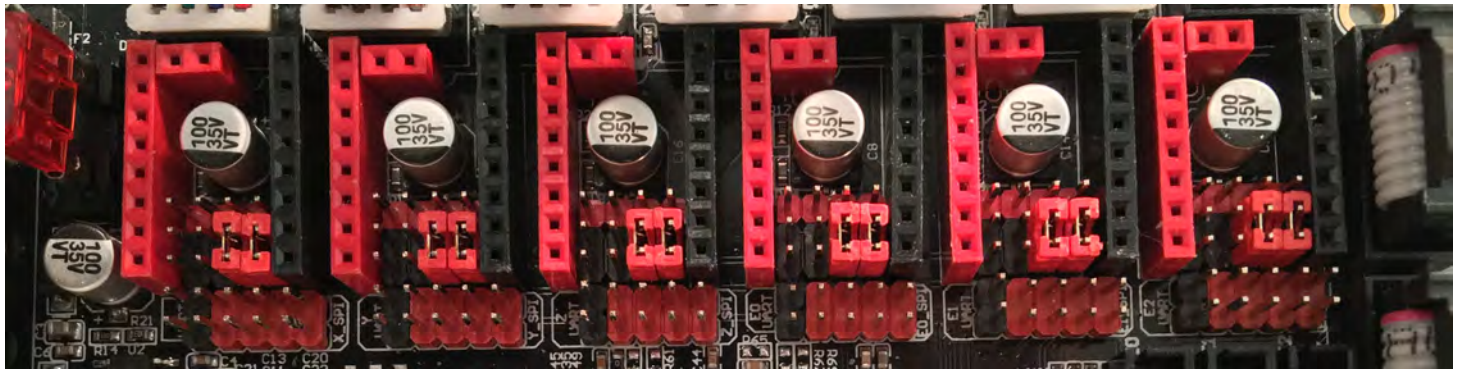
Stand Alone Mode



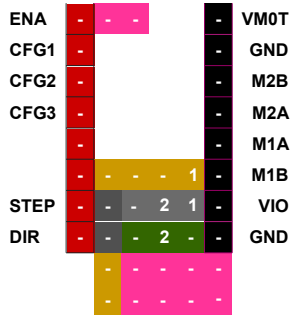
STEP

Interpolation: none

SpreadCyle



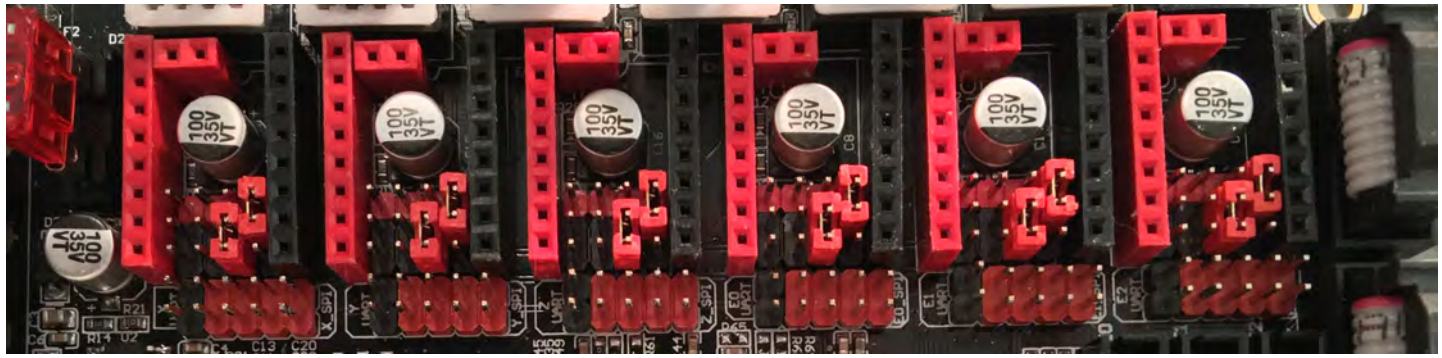
Stand Alone Mode



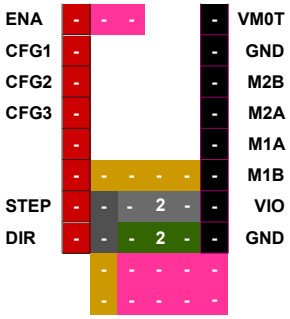
1/2

Interpolation: none

SpreadCyle



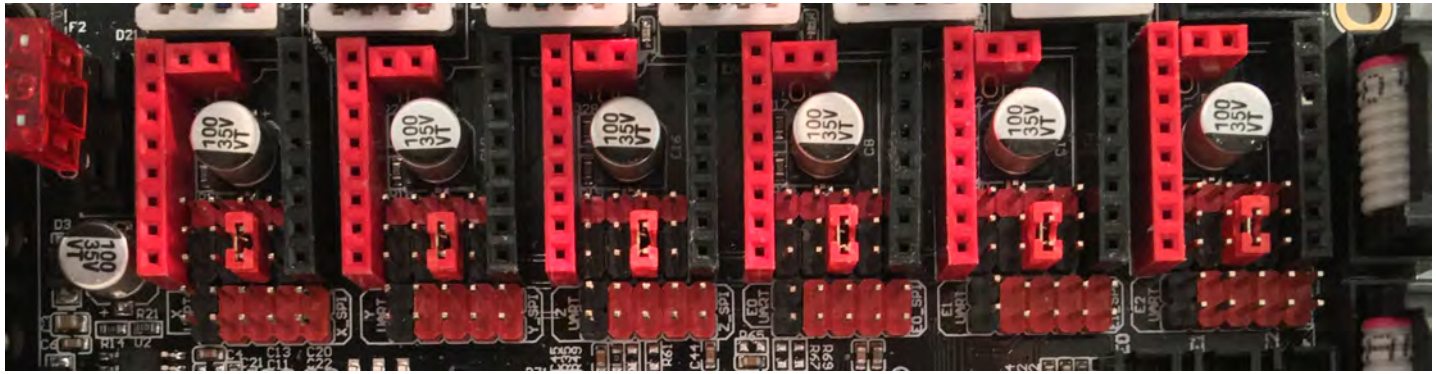
Stand Alone Mode



1/2

Interpolation: 1/256

SpreadCyle



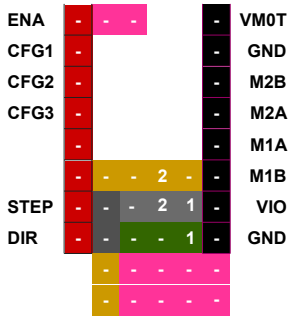
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

BIQU MKS TMC2100

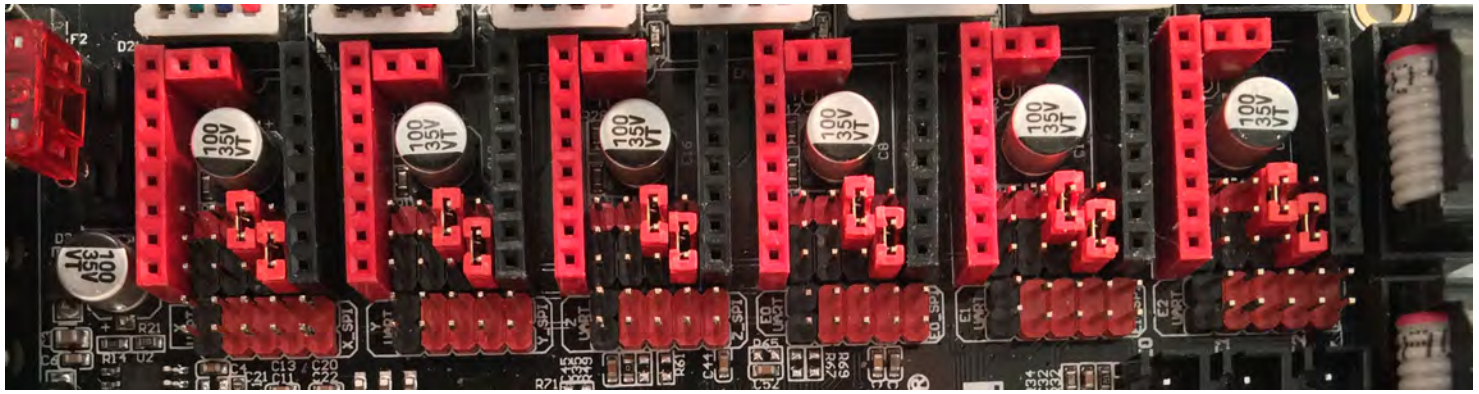
Stand Alone Mode

Stand Alone Mode

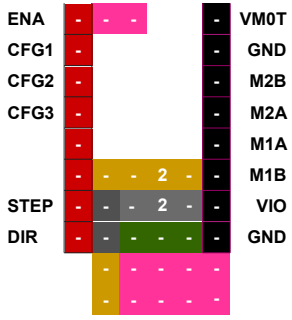
Stand Alone Mode



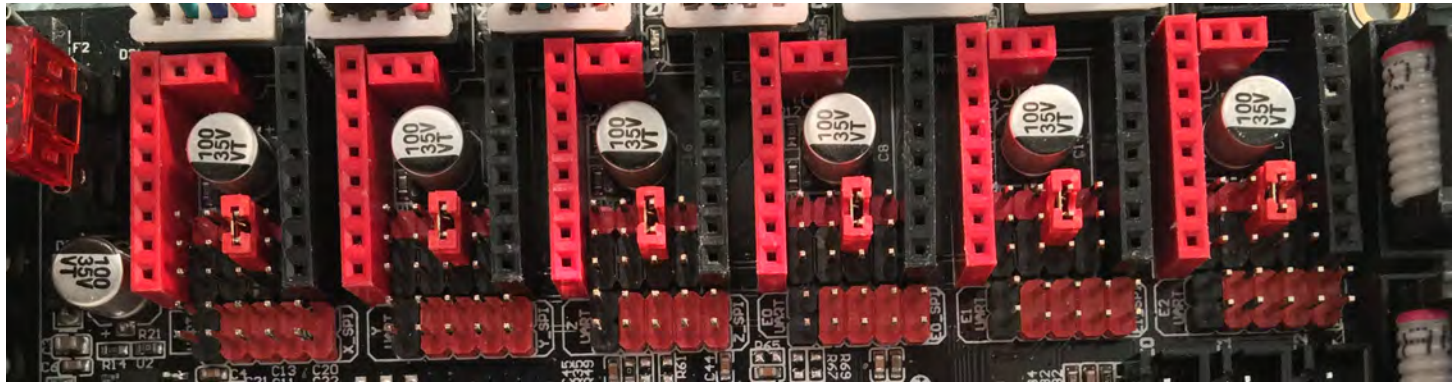
1/4
Interpolation: none
SpreadCyle



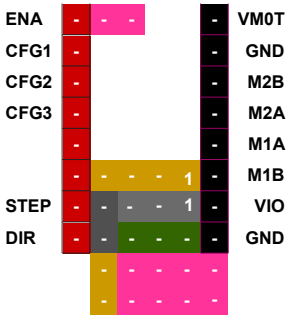
Stand Alone Mode



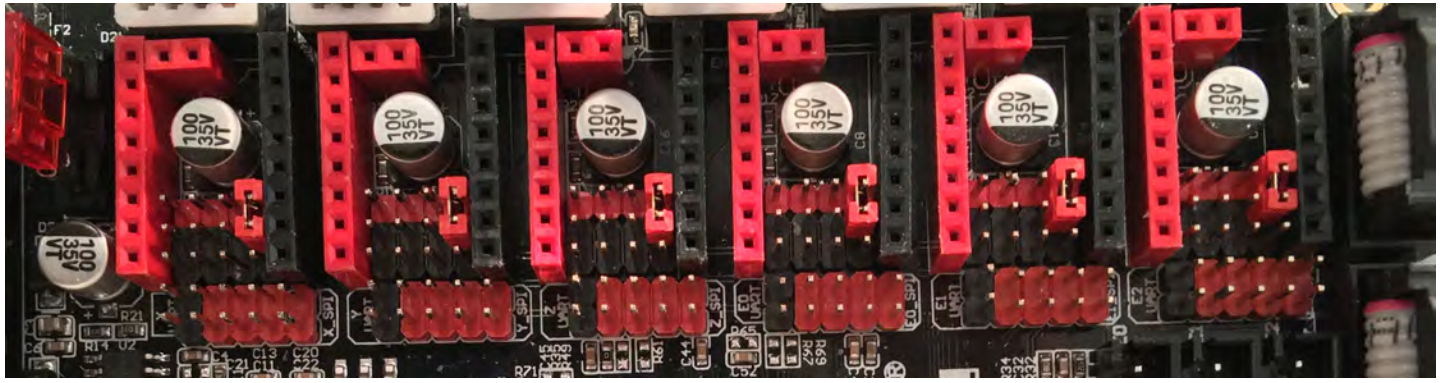
1/4
Interpolation: 1/256
SpreadCyle



Stand Alone Mode



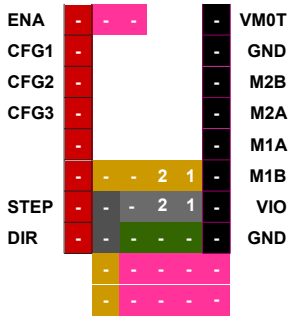
1/4
Interpolation: 1/256
StealthChop



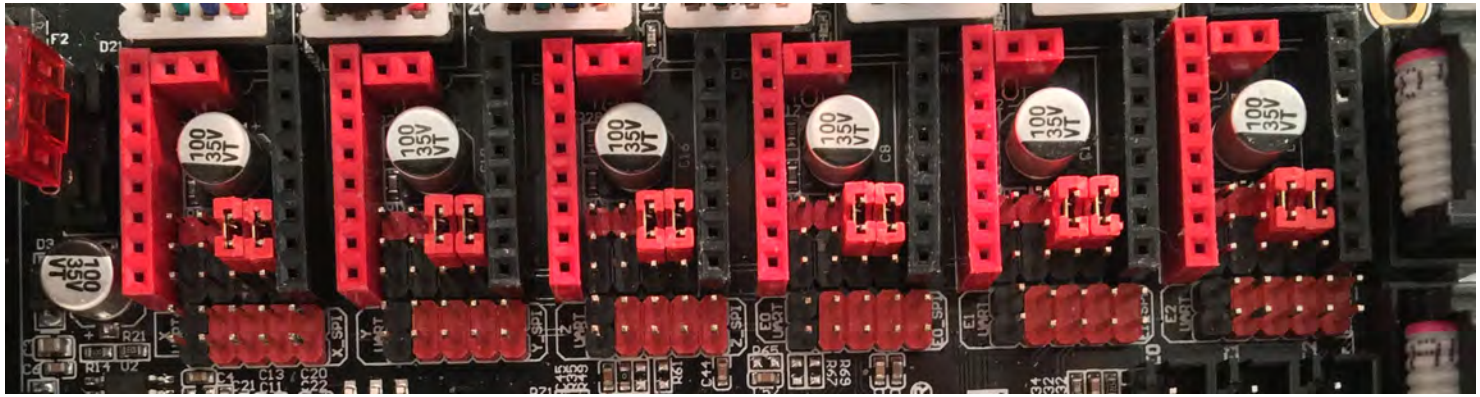
BIQU MKS TMC2100

Stand Alone Mode

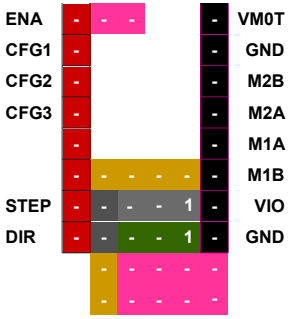
Stand Alone Mode



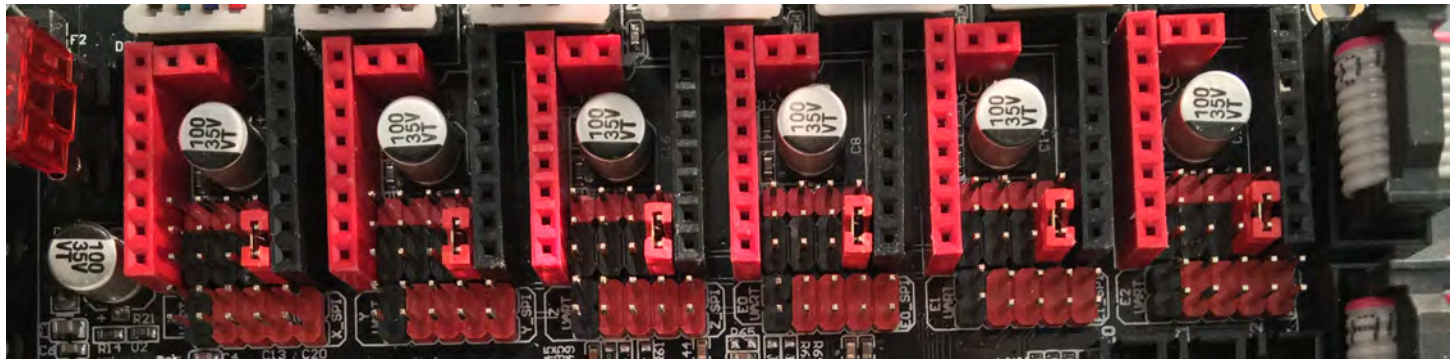
1/16
Interpolation: none
SpreadCyle



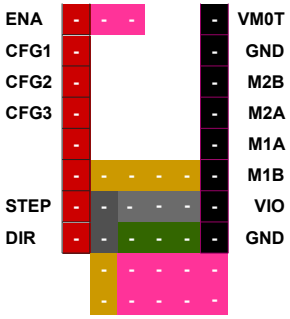
Stand Alone Mode



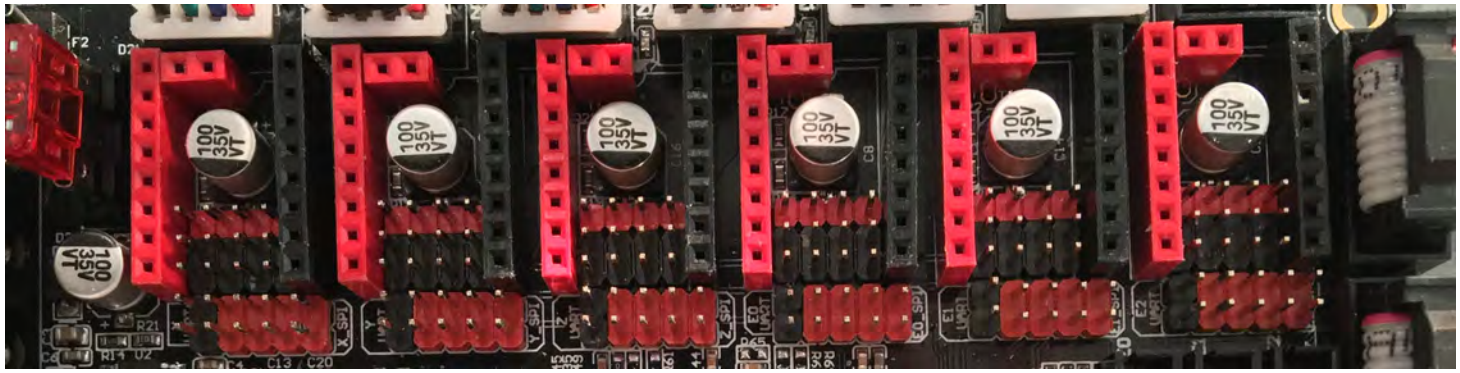
1/16
Interpolation: 1/256
SpreadCyle



Stand Alone Mode



1/16
Interpolation: 1/256
StealthChop

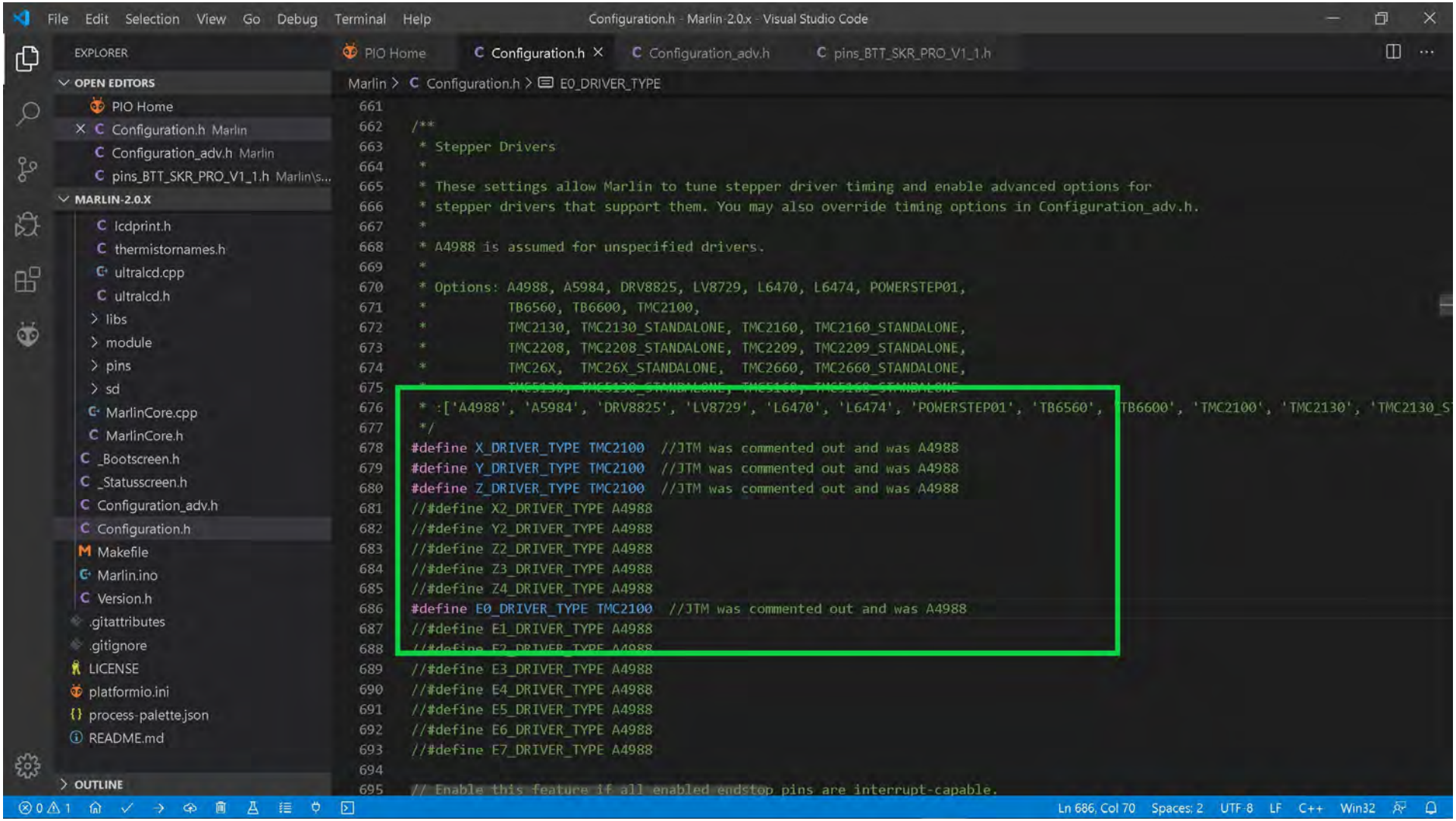


NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

The (latest release of) Marlin Setup for BIQU MKS TMC2100 Drivers in Stand Alone Mode

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

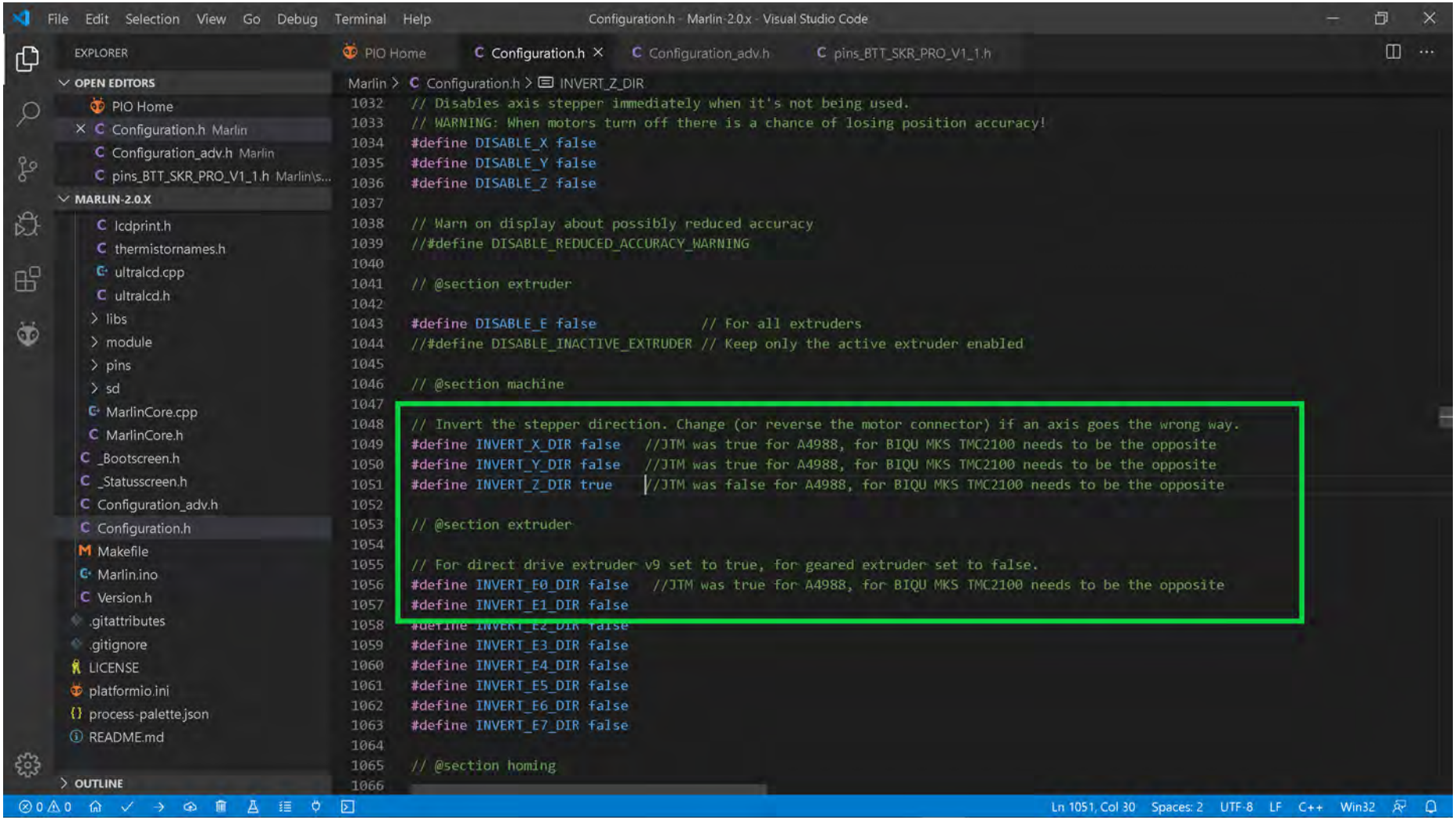
- Change the stepper motor drivers so that Marlin knows you are using TMC2100 drivers in stand alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2100 drivers in stand alone mode. When two "//" appear at the beginning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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU MKS TMC2100 Drivers in Stand Alone Mode

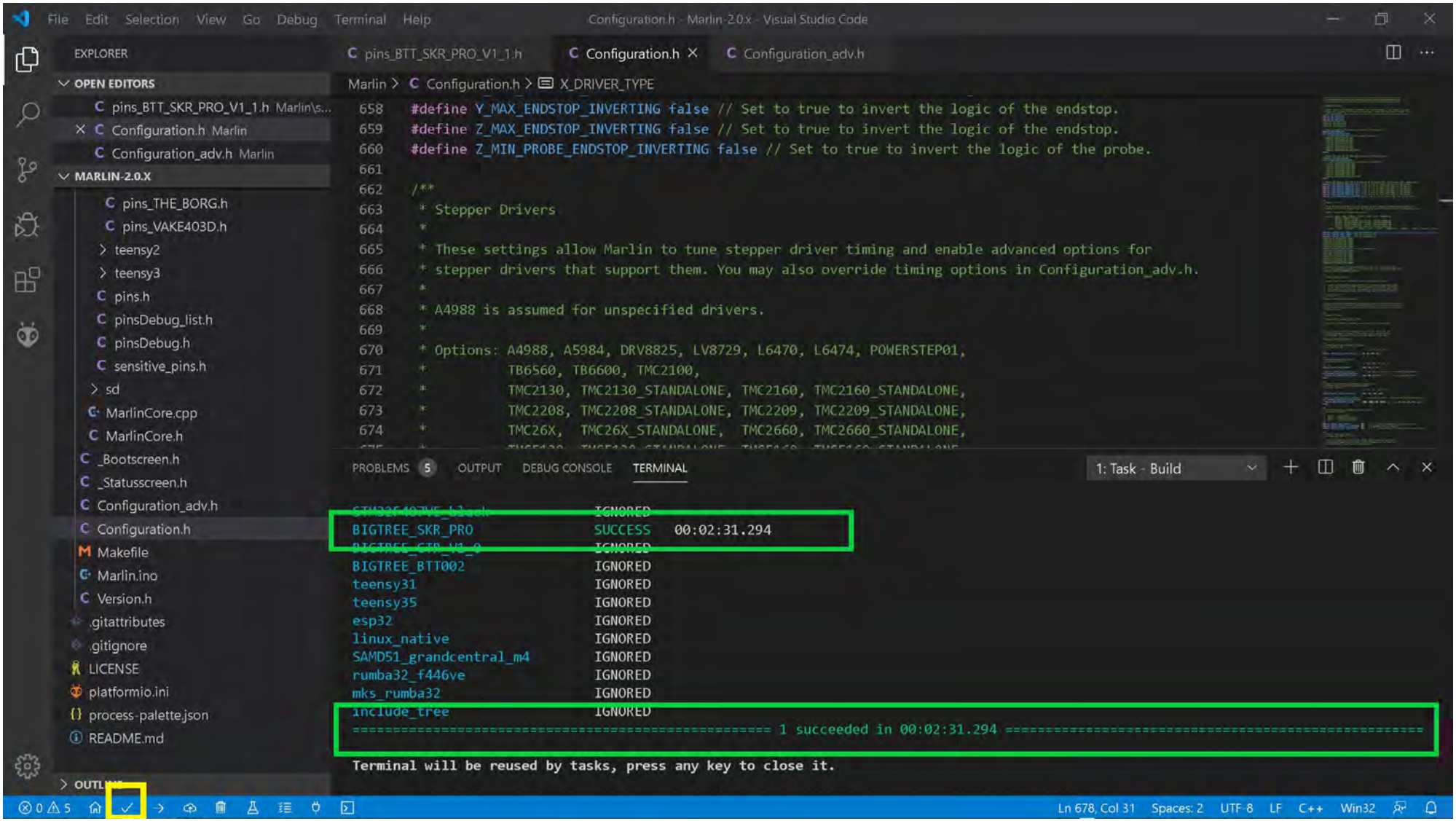
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2100 drivers, I must invert the stepper motor direction because the TMC2100 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2100 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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU MKS TMC2100 Drivers in Stand Alone Mode

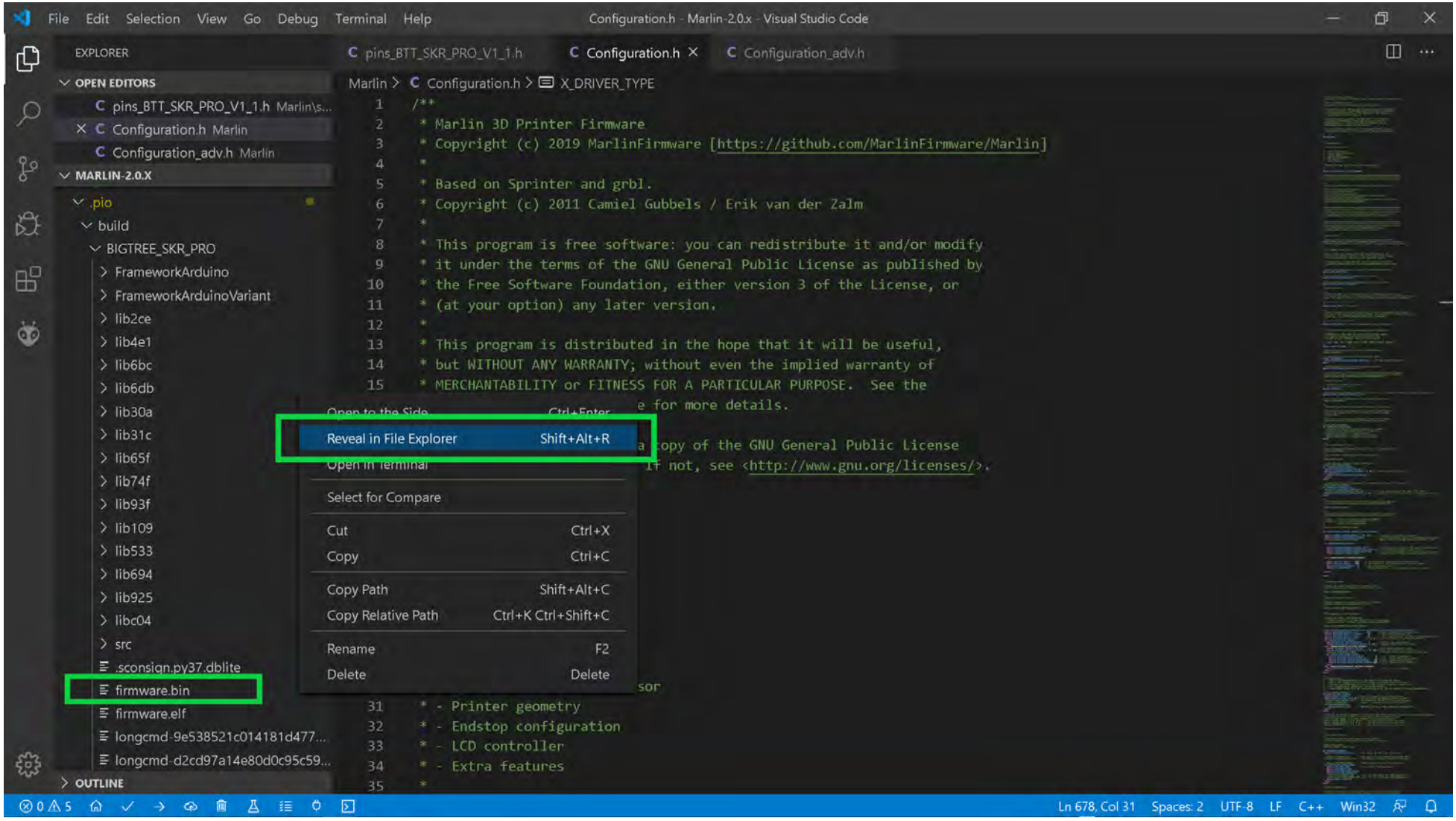
- The end of Marlin setup for BIQU MKS TMC2100 drivers in stand alone mode . Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages ,as shown in the **GREEN** boxes below.



- 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 MKS TMC2100 Drivers in Stand Alone Mode

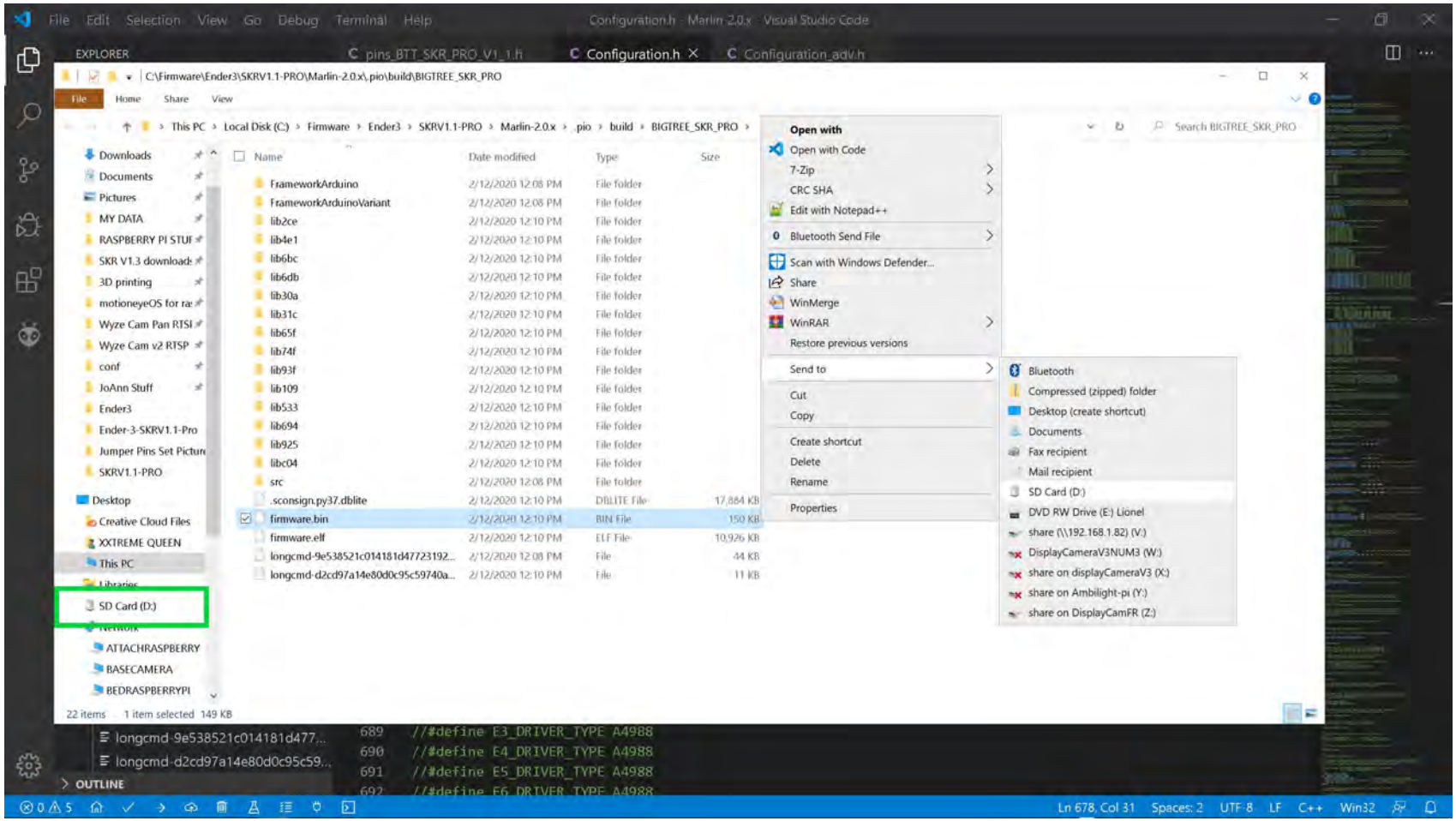
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU MKS TMC2100 Drivers in Stand Alone Mode

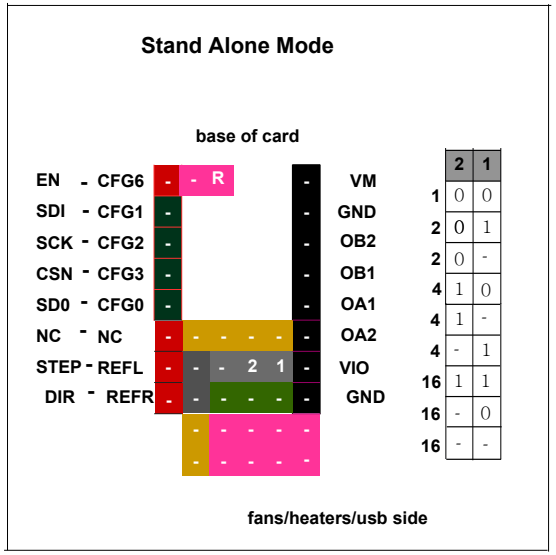
- Ensure your micro-SD card that came with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD 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 and renamed to "firmware.bin" on the micro-SD card.

BIQU TMC2130

Stand Alone Mode



2	1
0	0
0	1
0	-
1	0
1	-
-	1
1	1
-	0
-	-

Driver Chip	CFG2	CFG1	Steps	Interpolation	Mode
TMC2130 Standalone Mode Solder the SPI jumper on the bottom of the Driver Board to the adjacent pad to obtain Standalone Mode 5.5V - 46V DC 1.4A Maximum subdivision 16	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	$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$		$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$		

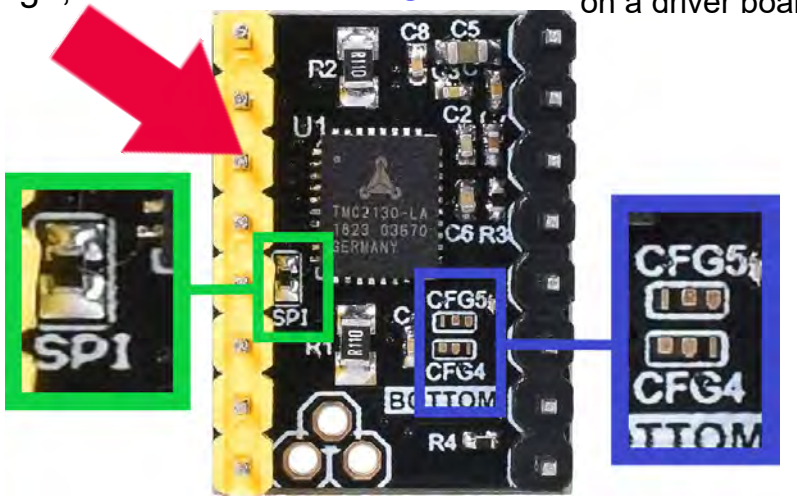
Note: Use 90% of the calculated Vref when tuning the stepper driver board

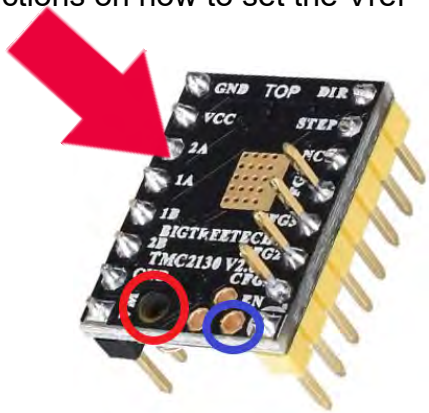
To place the BIQU TMC2130 into Standalone Mode:

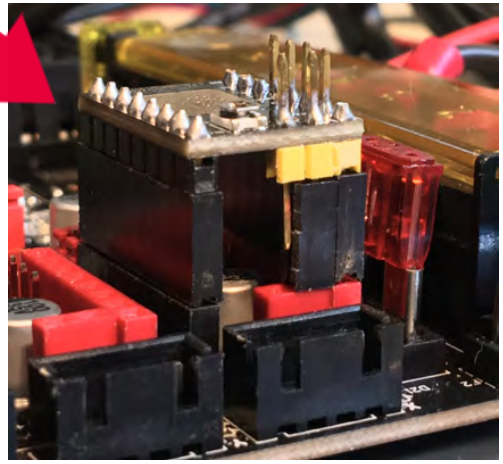
Solder the SPI Jumper together, on the bottom of the driver board to the adjacent pad, as shown in the GREEN box below. Ensure that at CFG4 location and CFG5 location that those pads are NOT soldered together to form a bridge, as shown in the BLUE.

NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref, as shown in RED; OR use the "Vref Test point" location on the top of the driver board, as shown in BLUE . See the appendix for instructions on how to set the Vref on a driver board

Note: When the stall-guard function is not used, the stall-guard pin of theTMC2130 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







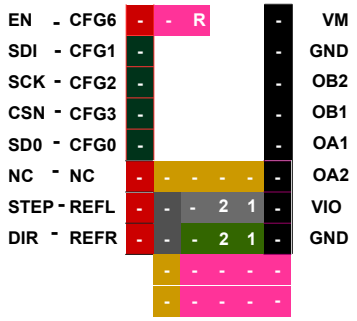
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

BIQU TMC2130

Stand Alone Mode

Stand Alone Mode

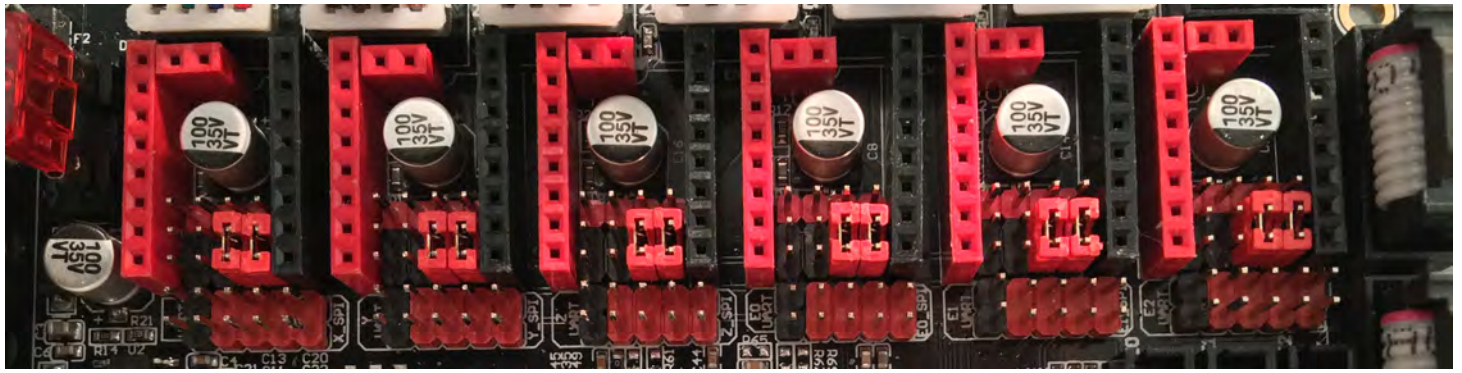
Stand Alone Mode



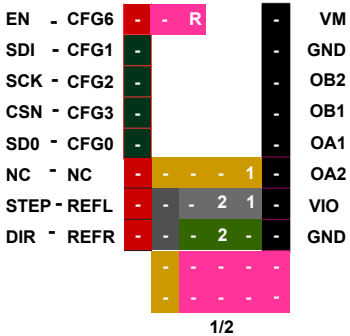
STEP

Interpolation: none

SpreadCyle



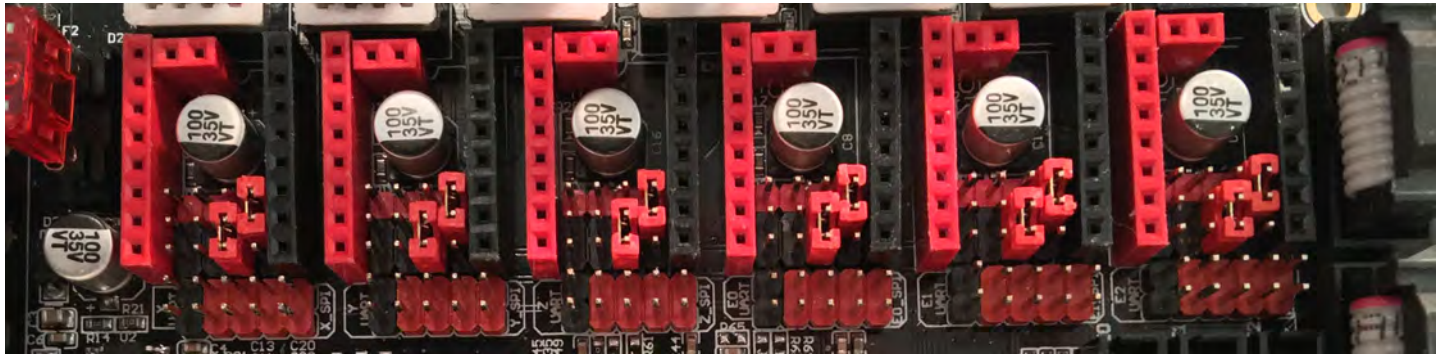
Stand Alone Mode



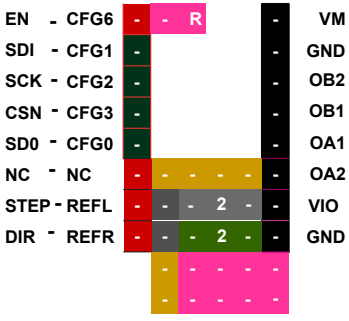
1/2

Interpolation: none

SpreadCyle



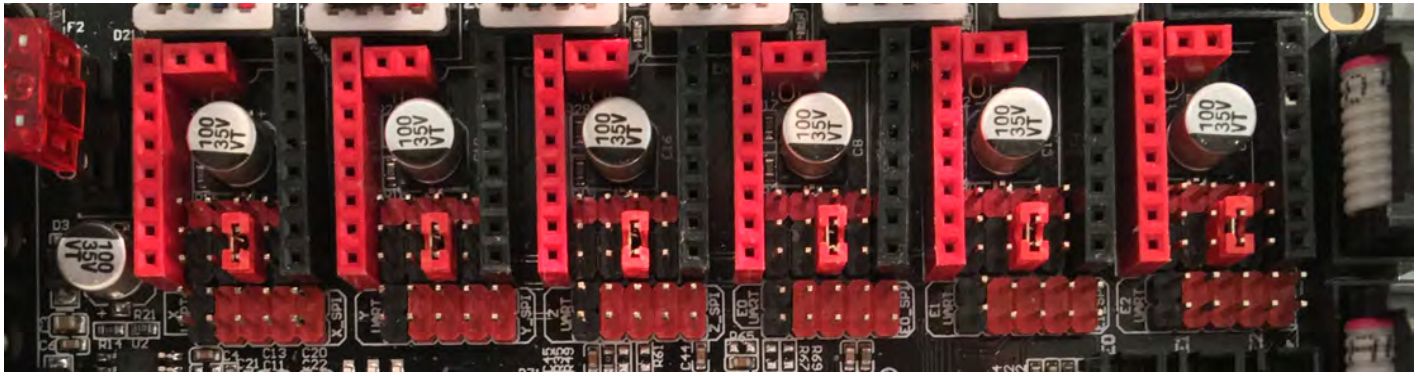
Stand Alone Mode



1/2

Interpolation: 1/256

SpreadCyle

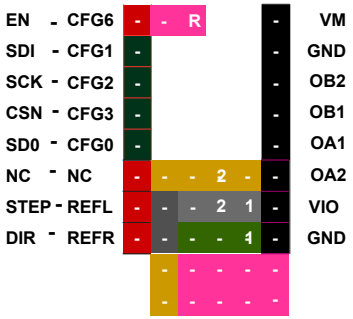


NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

BIQU TMC2130

Stand Alone Mode

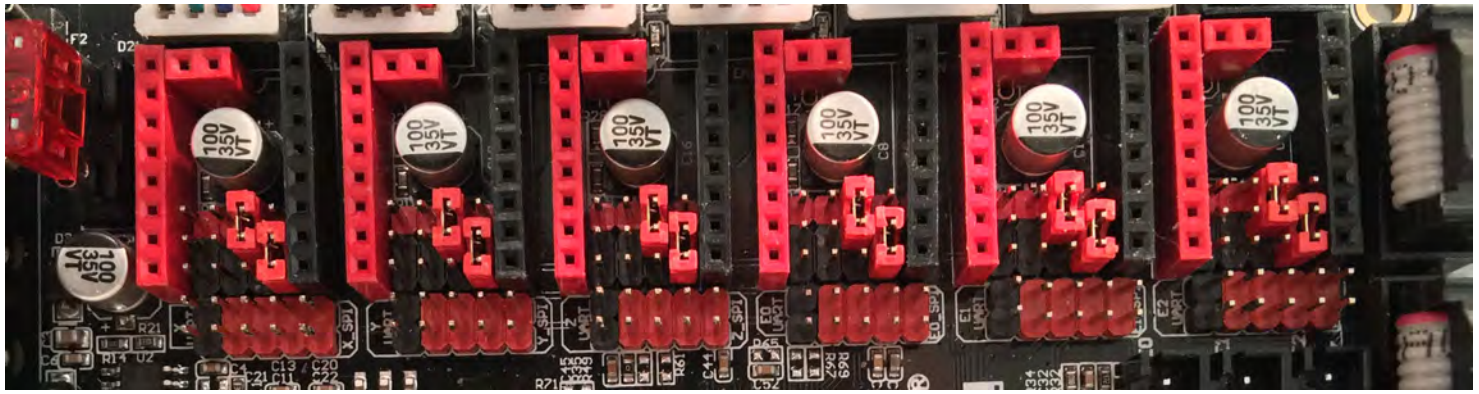
Stand Alone Mode



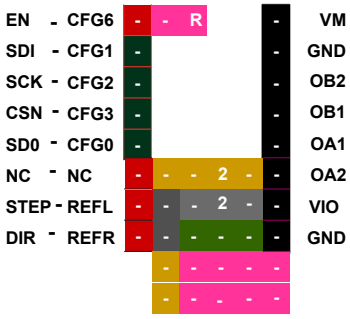
1/4

Interpolation: none

SpreadCyle



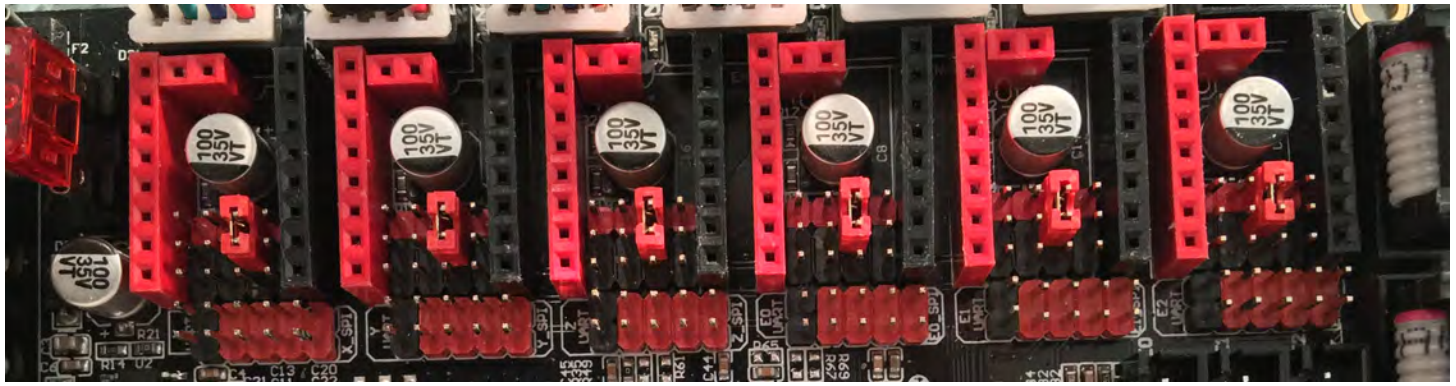
Stand Alone Mode



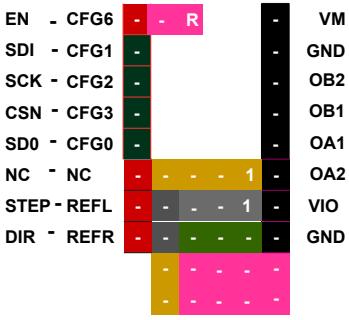
1/4

Interpolation: 1/256

SpreadCyle



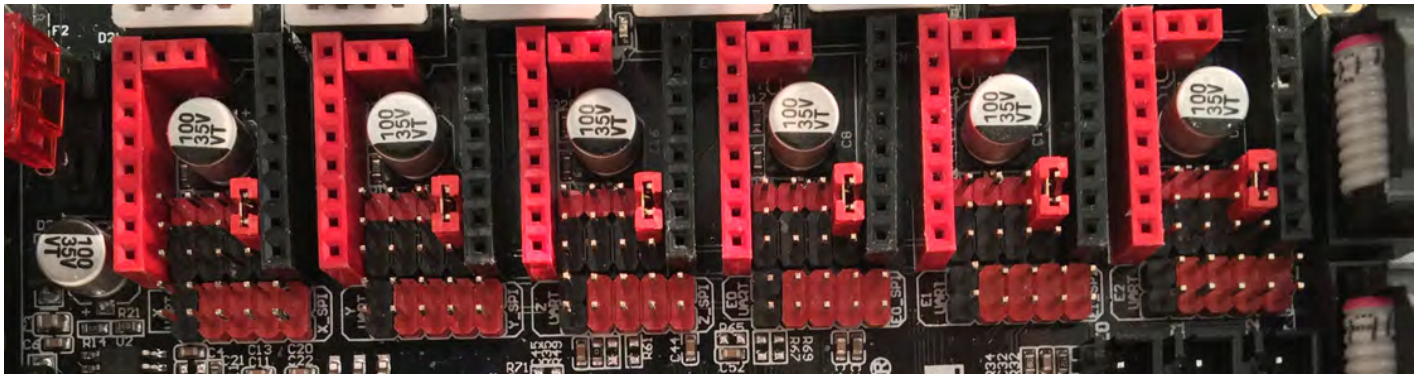
Stand Alone Mode



1/4

Interpolation: 1/256

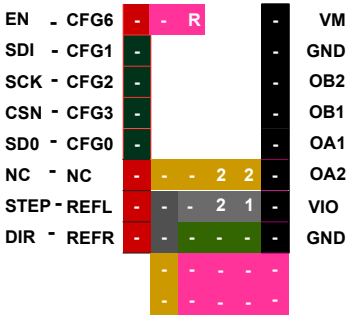
StealthChop



BIQU TMC2130

Stand Alone Mode

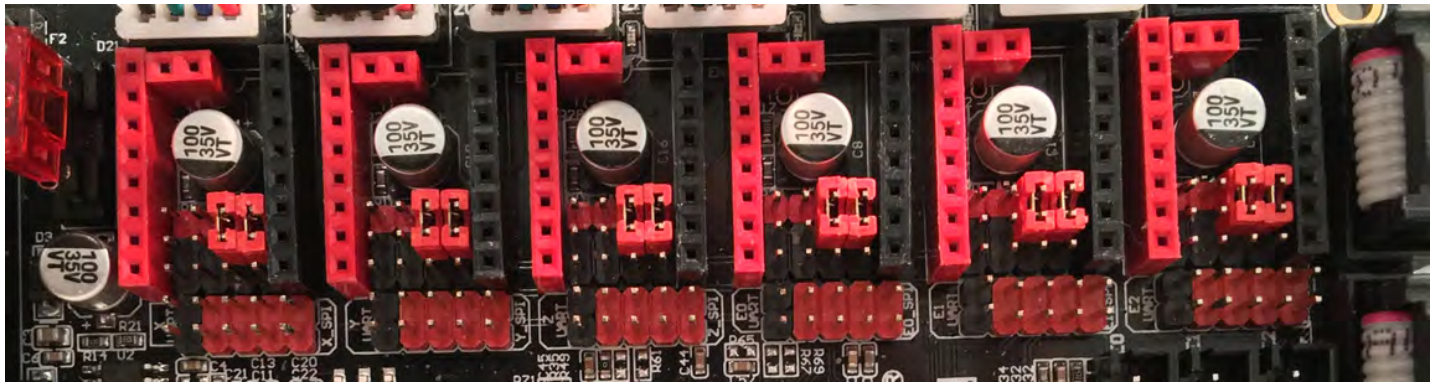
Stand Alone Mode



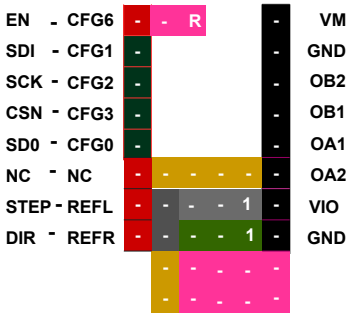
1/16

Interpolation: none

SpreadCyle



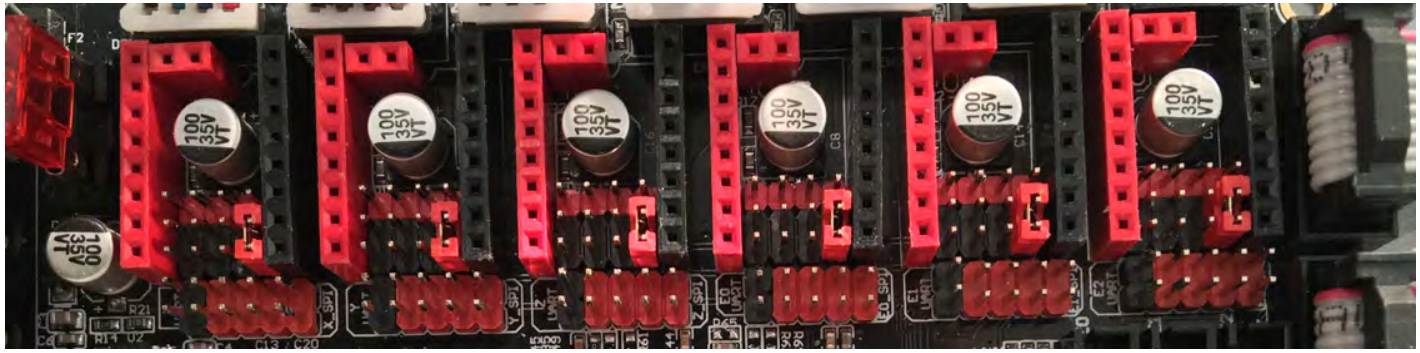
Stand Alone Mode



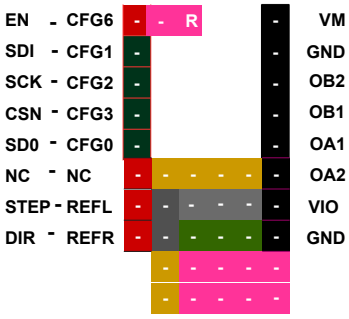
1/16

Interpolation: 1/256

SpreadCyle



Stand Alone Mode



1/16

Interpolation: 1/256

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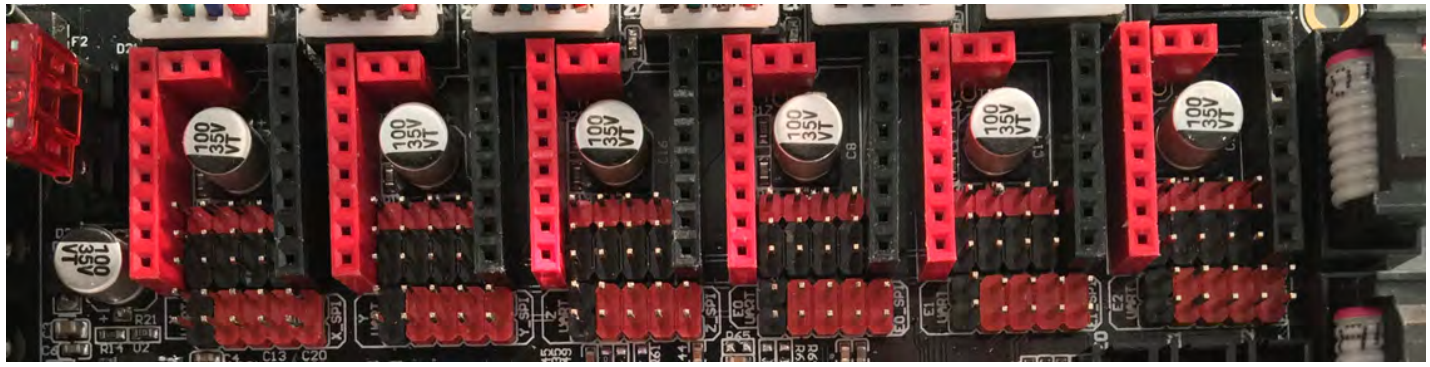

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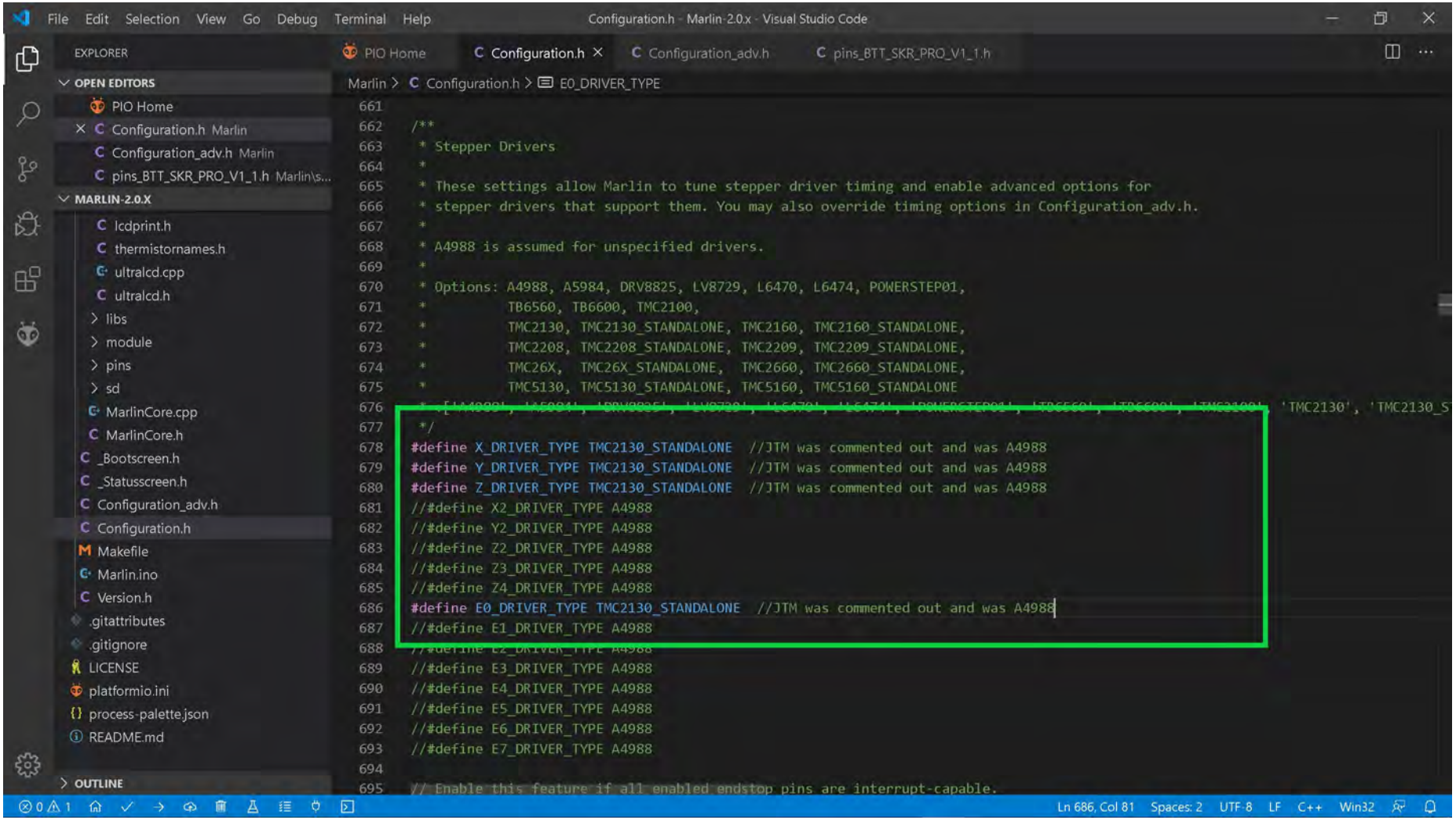
The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in Stand Alone Mode

NOTE: Go to Appendix C 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 ("//").



- Go to the next page.

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

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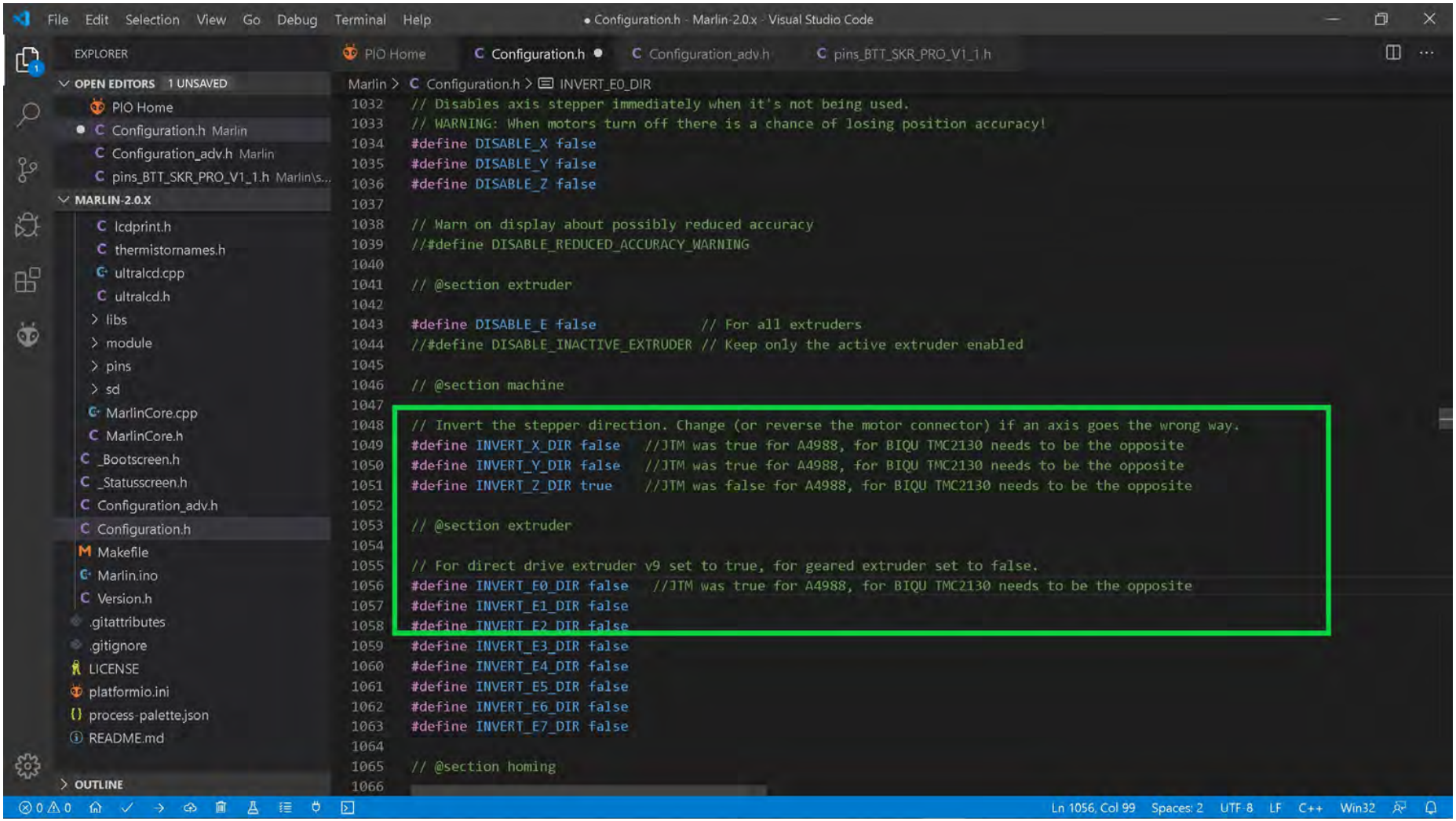
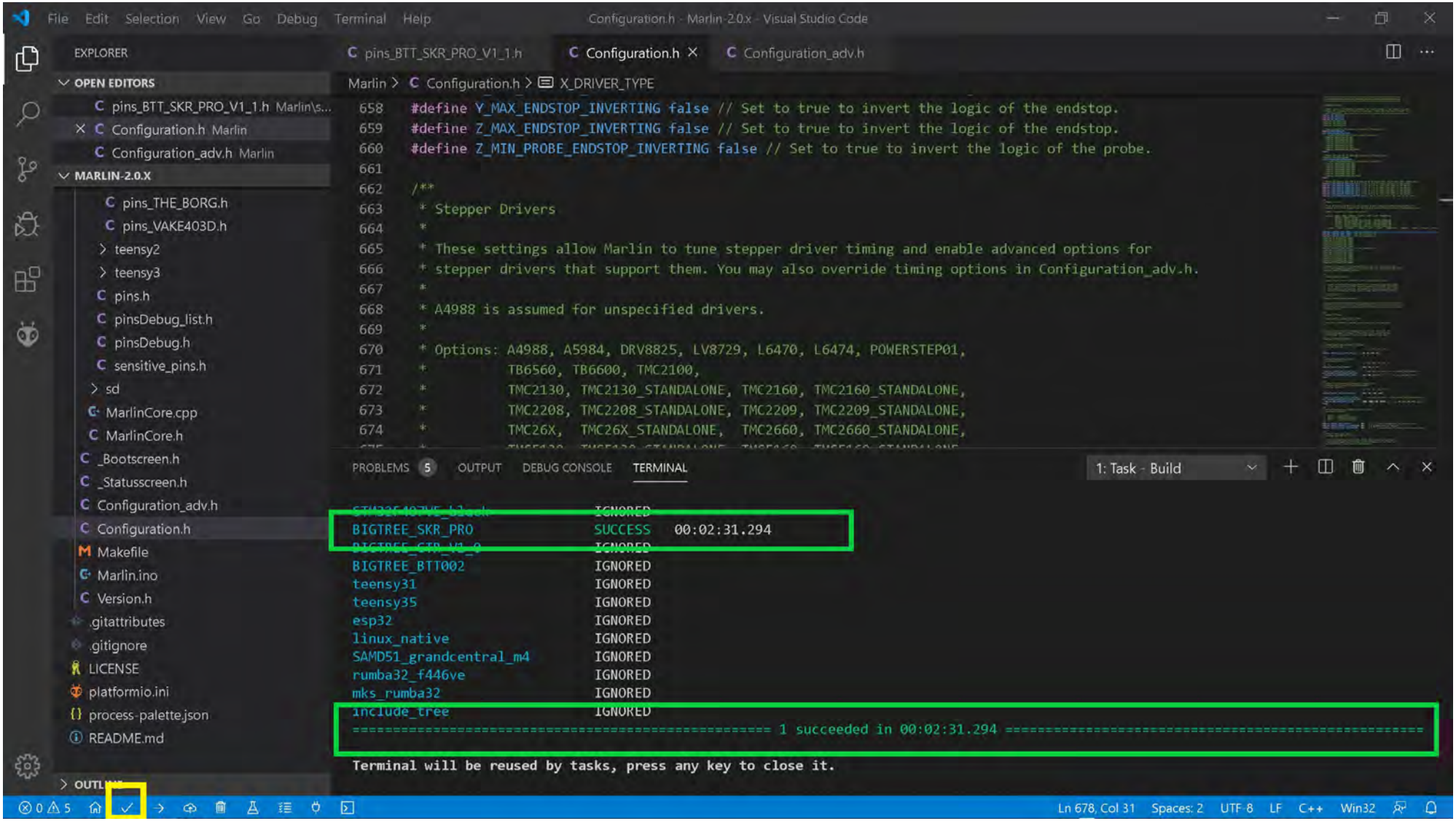


- Go to the next page.

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.



- 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.

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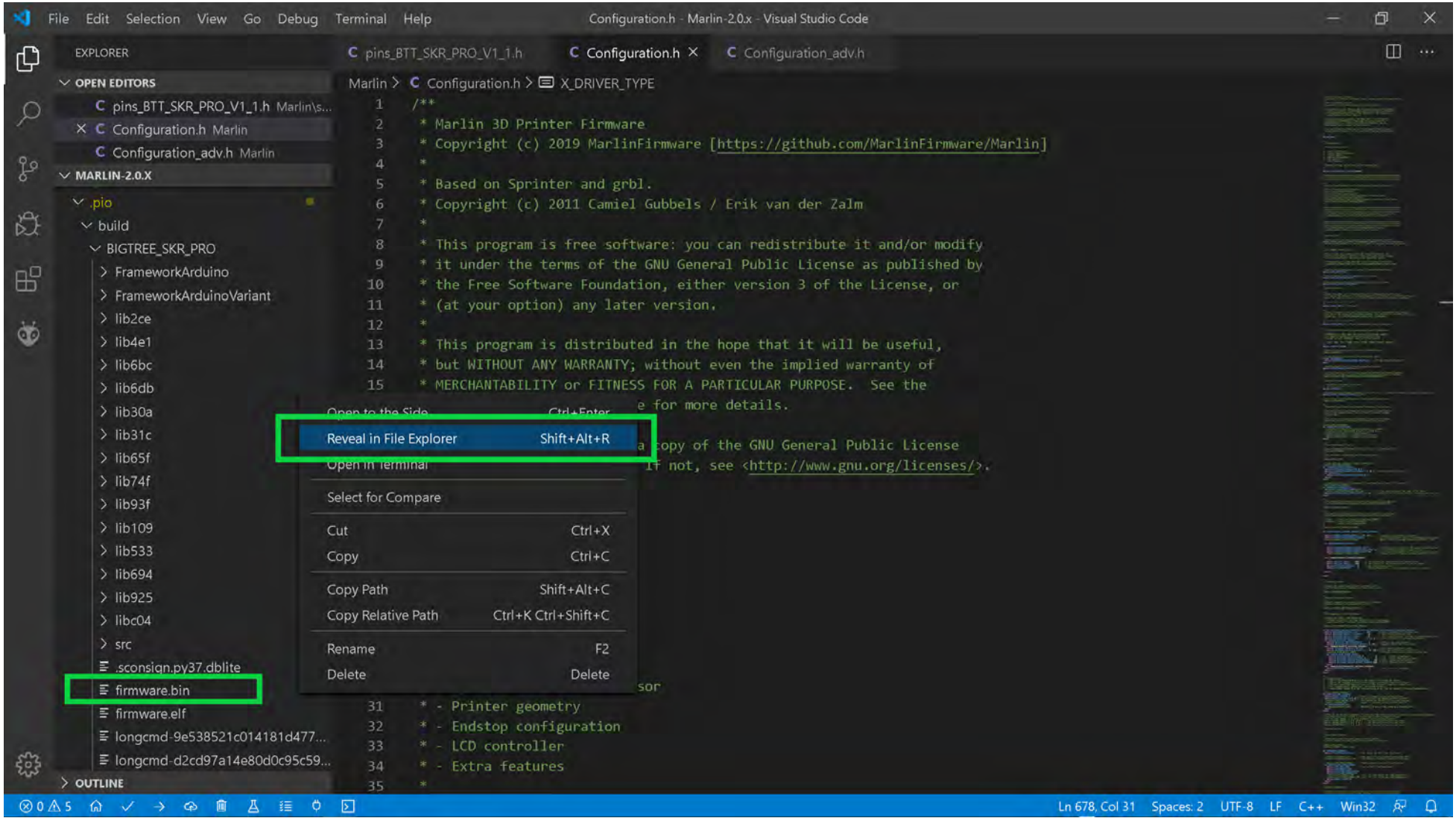
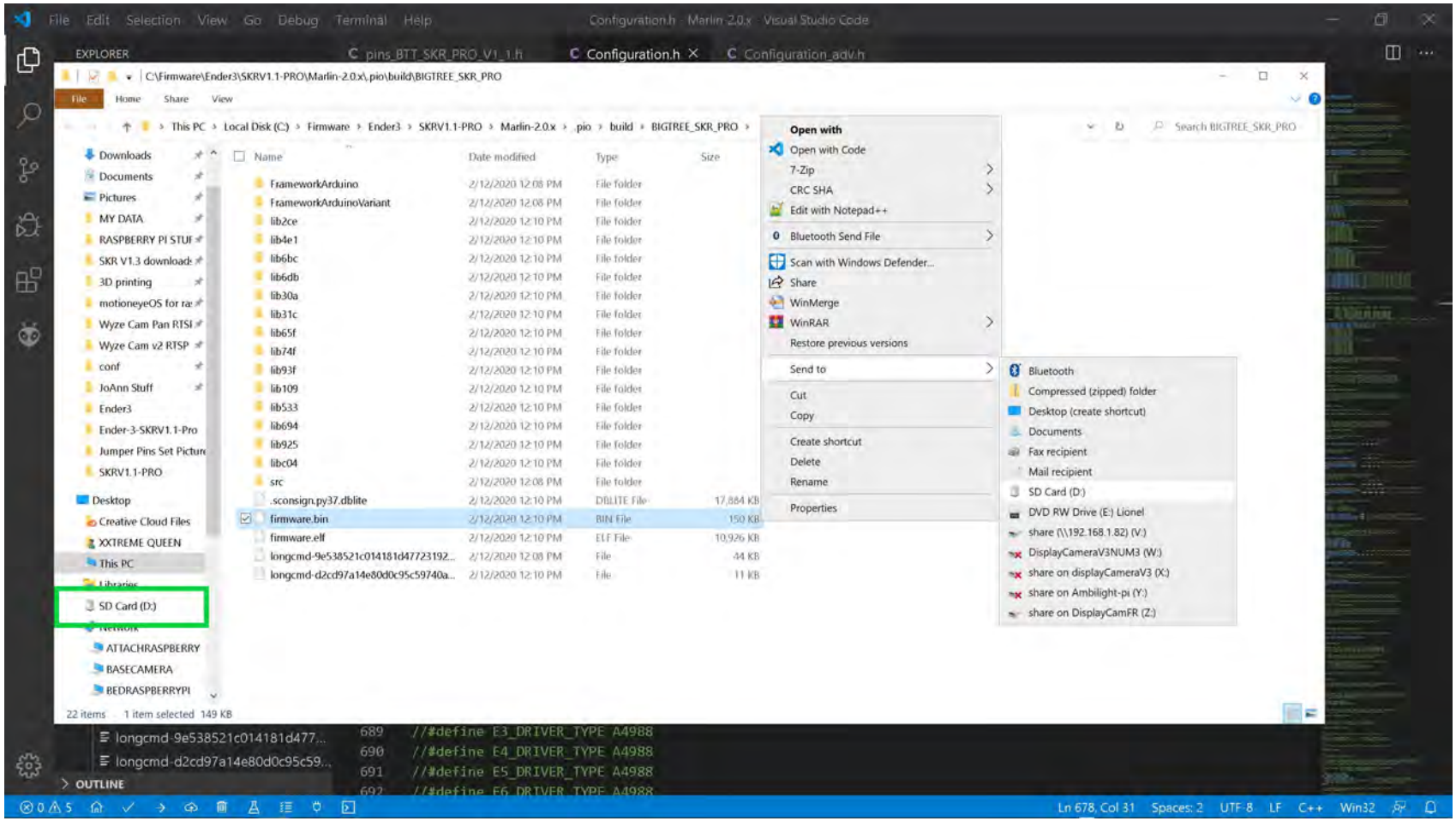
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Windows machine open a file explorer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



- Go to the next page.

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

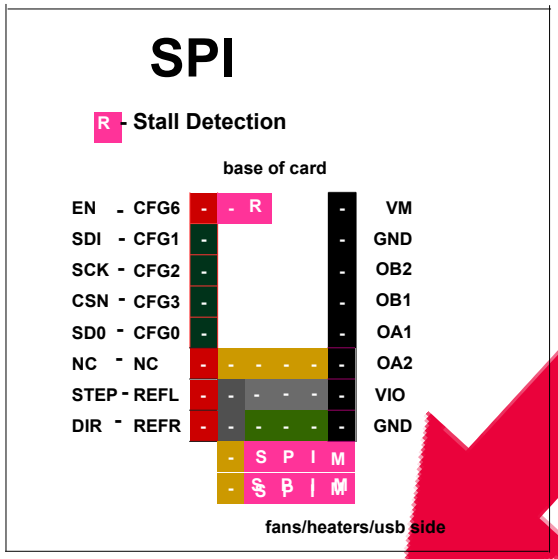
- Ensure your micro-SD card that came with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD 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 and renamed to "firmware.bin" on the micro-SD card.

BIQU TMC2130

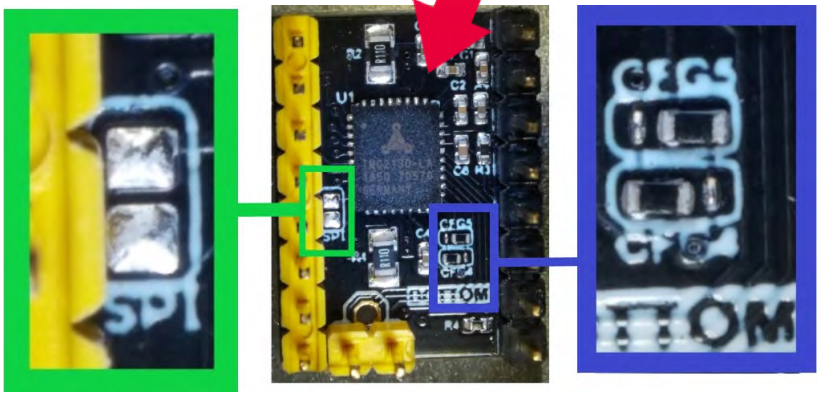
SPI Mode



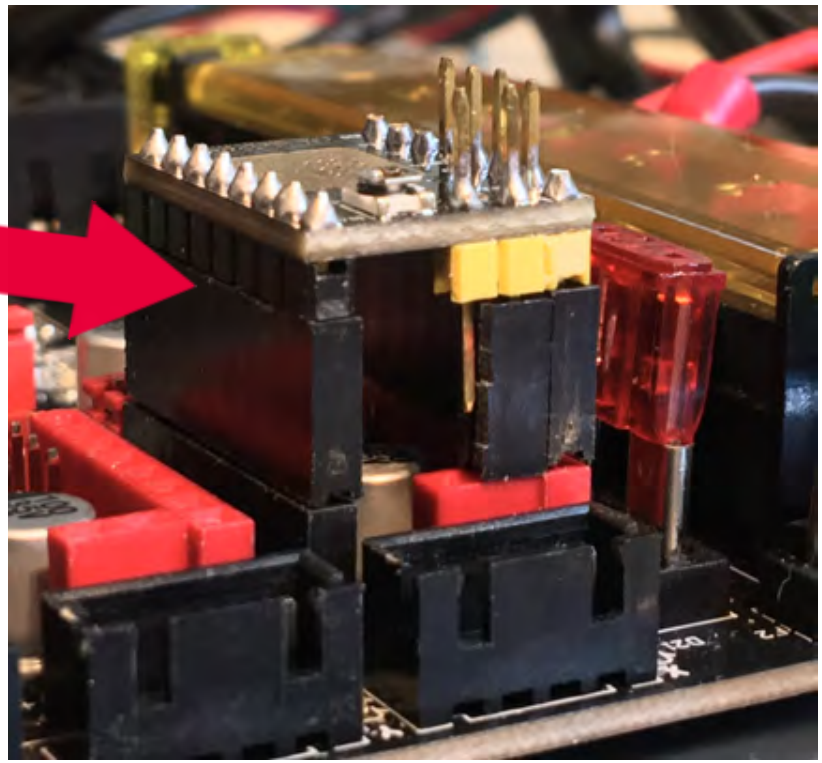
Driver Chip		
TMC2130 **SPI Mode** SPI jumper (two pads) on the bottom of the Driver board MUST BE OPEN to obtain SPI Mode Maximum subdivision 256 5.5V - 46V DC 1.4A	**Steps are set inside of your Firmware**	
Driving current calculation formula	$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$	$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$

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 that the correct two pads are soldered together to form a bridge, as shown in the BLUE box below.



Note: When the stall-guard function is not used, the stall-guard pin 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



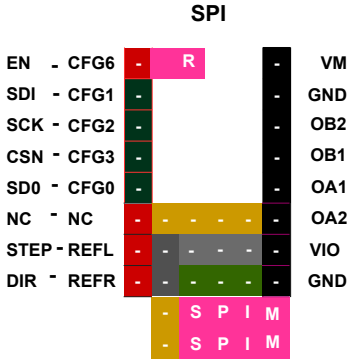
Note: You can use 50% to 90% of the calculated Irms (Imax/1.414) when tuning ("X_CURRENT", "Y_CURRENT", etc.) the stepper motor driver in the firmware.

BIQU TMC2130

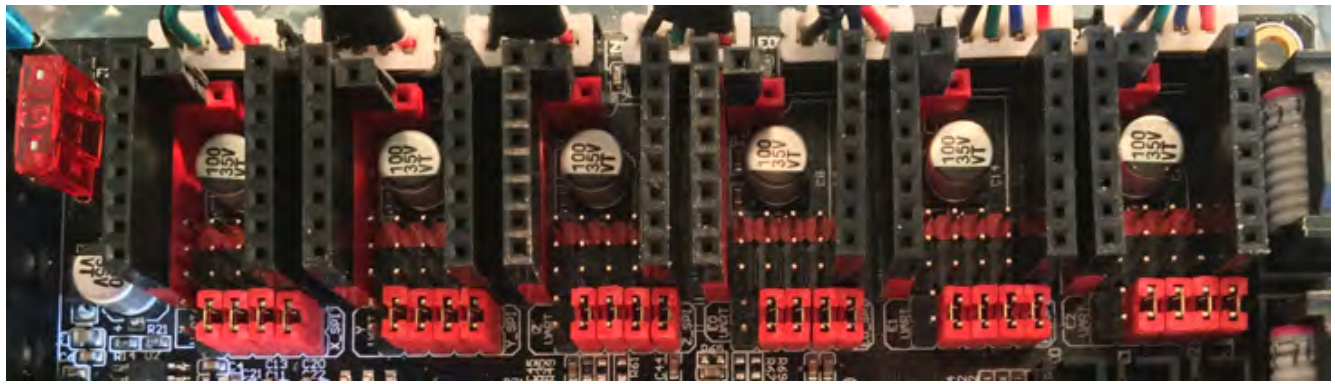
SPI Mode

SPI

R - Stall Detection



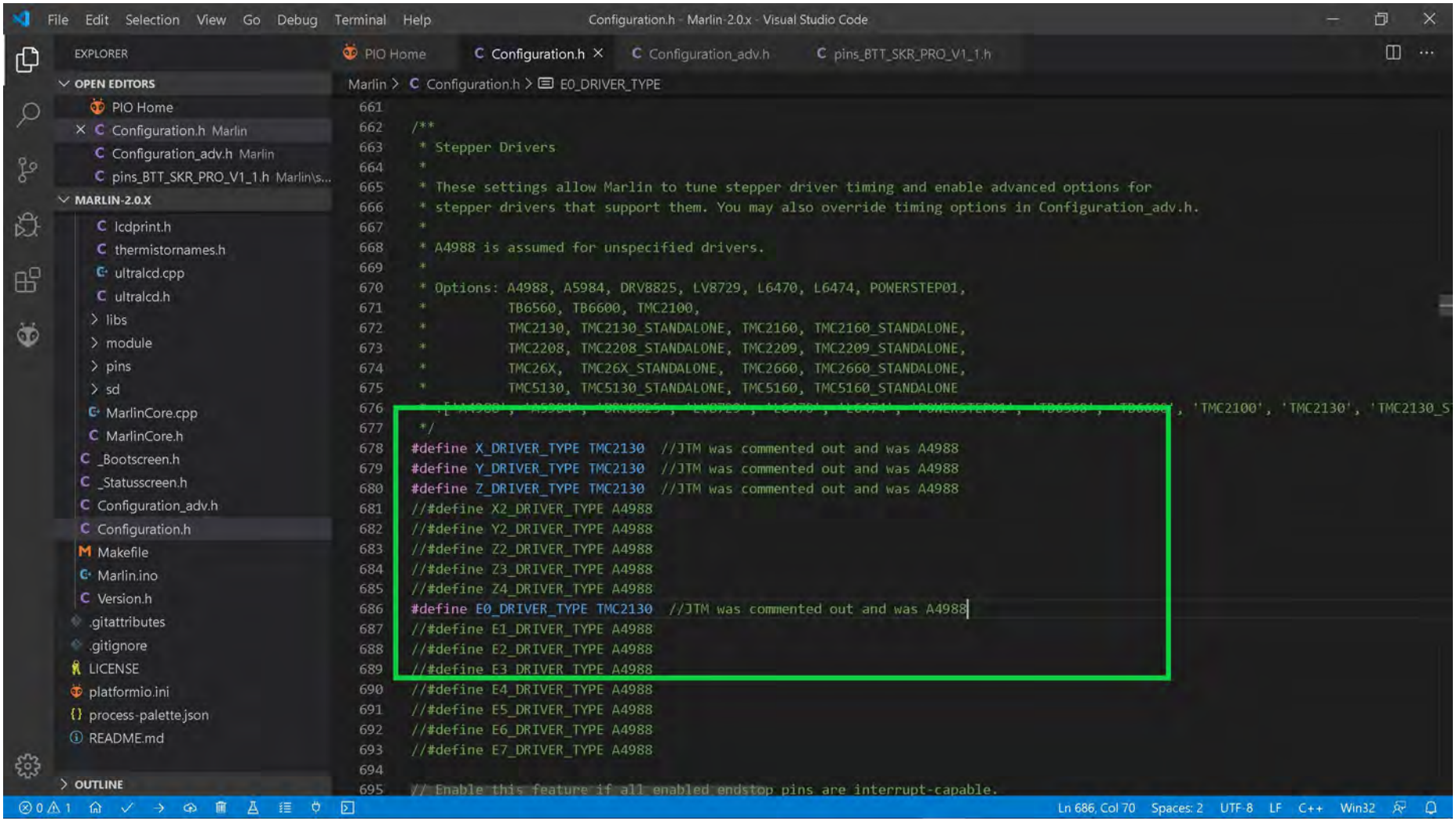
Note: Set JUMPERS "S","P","I","M" on the board!!



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

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

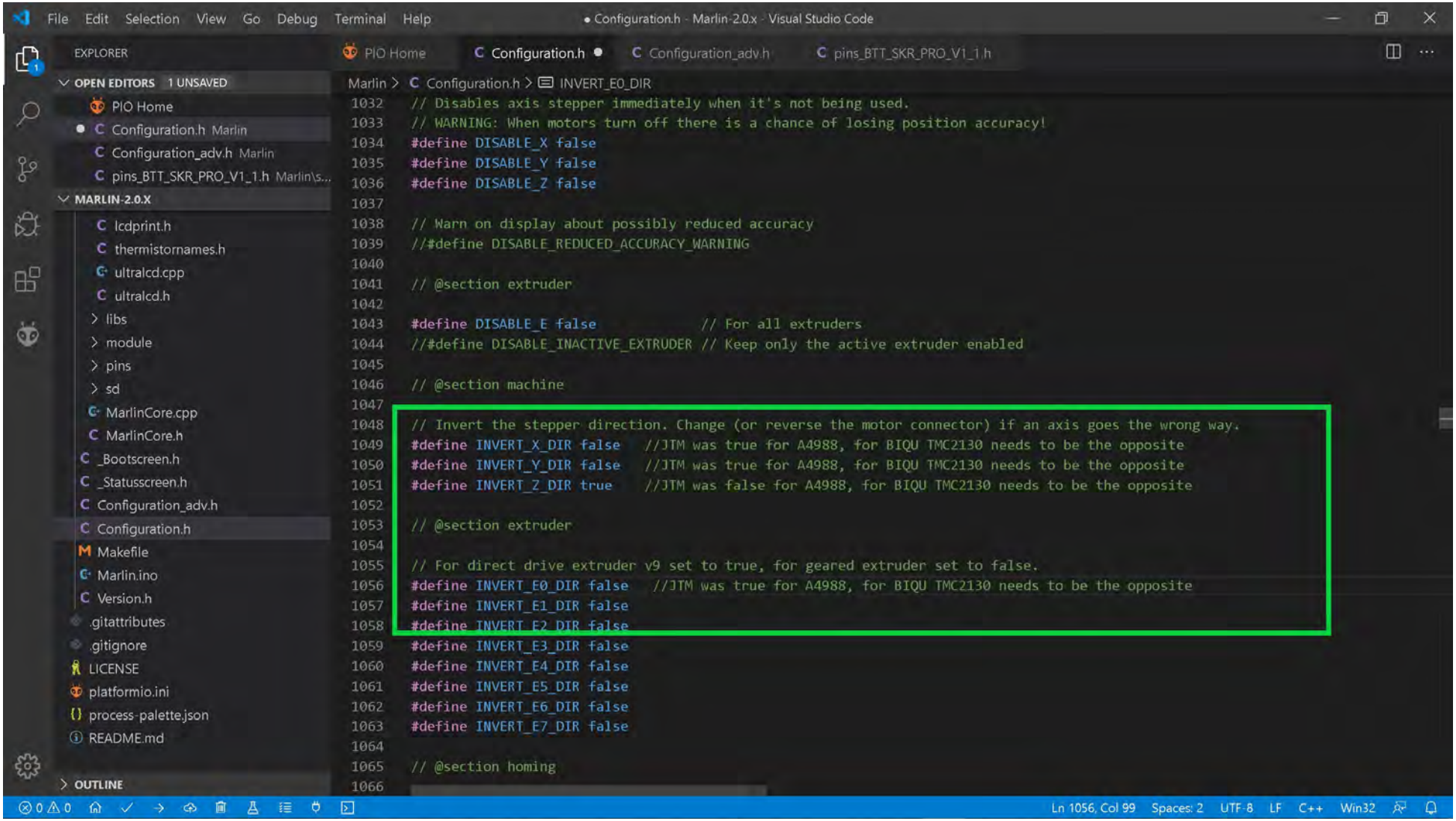
- Change the stepper motor drivers so that Marlin knows you are using TMC2130 drivers in SPI mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2130 drivers in SPI mode. When two "//" appear at the beginning of a line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



- Go to the next page.

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

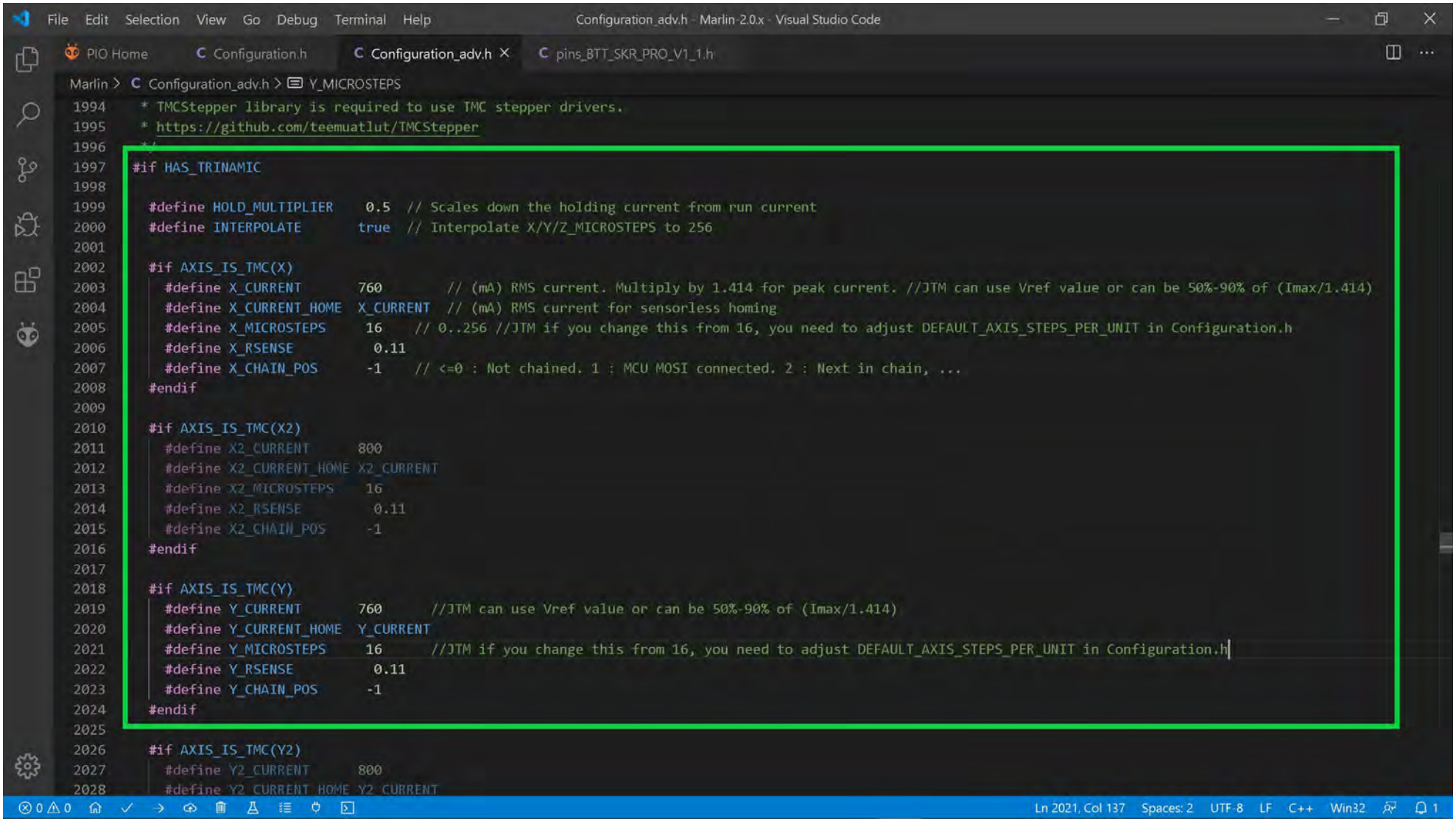
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2130 drivers, I must invert the stepper motor direction because the TMC2130 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2130 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



- Go to the next page.

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

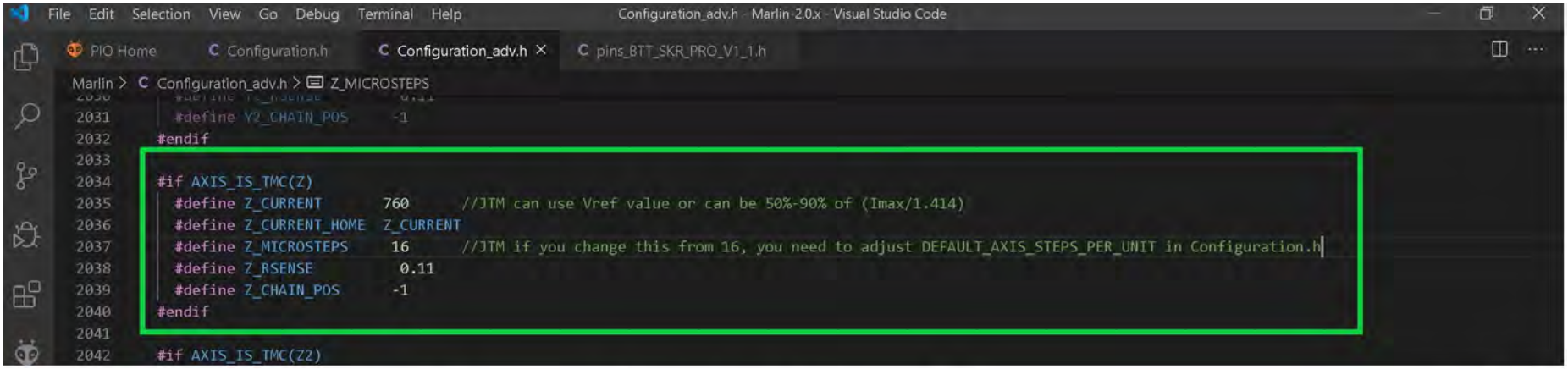
- next you want to set your Vref in the Marlin firmware for each axis that has the TMC2130 driver, as seen in the GREEN box below. I changed the "X_CURRENT" to be the calculated Vref for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated Vref for my Y-Axis, which is 760mV on the Ender 3.

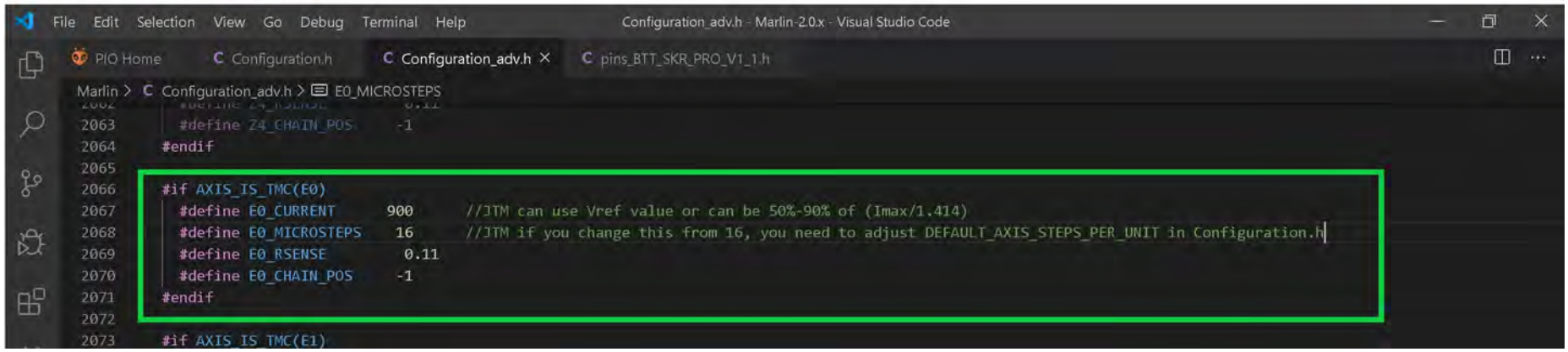


- Go to the next page.

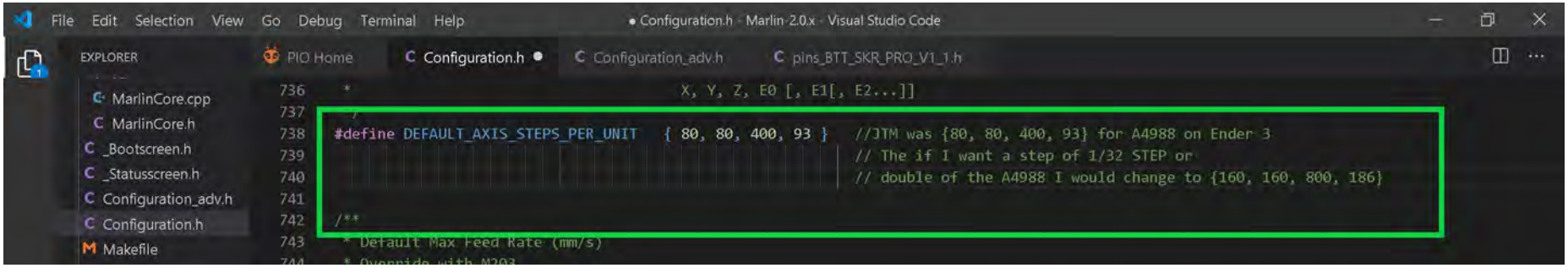
The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Now, I am setting the Vref for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated Vref for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated Vref for my Extruder, which is 900mV on the Ender 3.





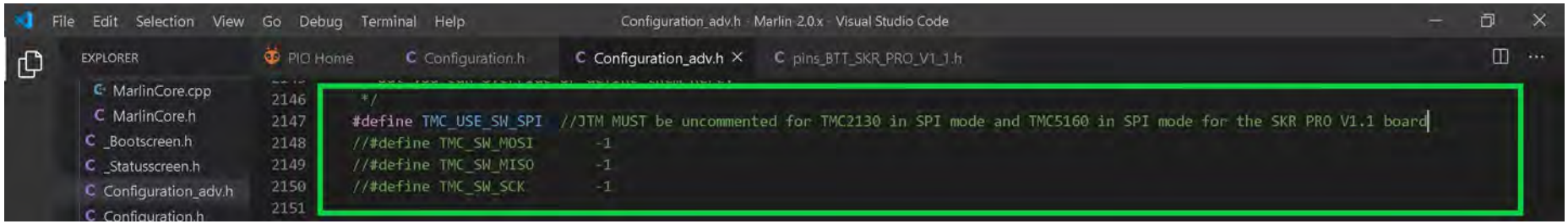
- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



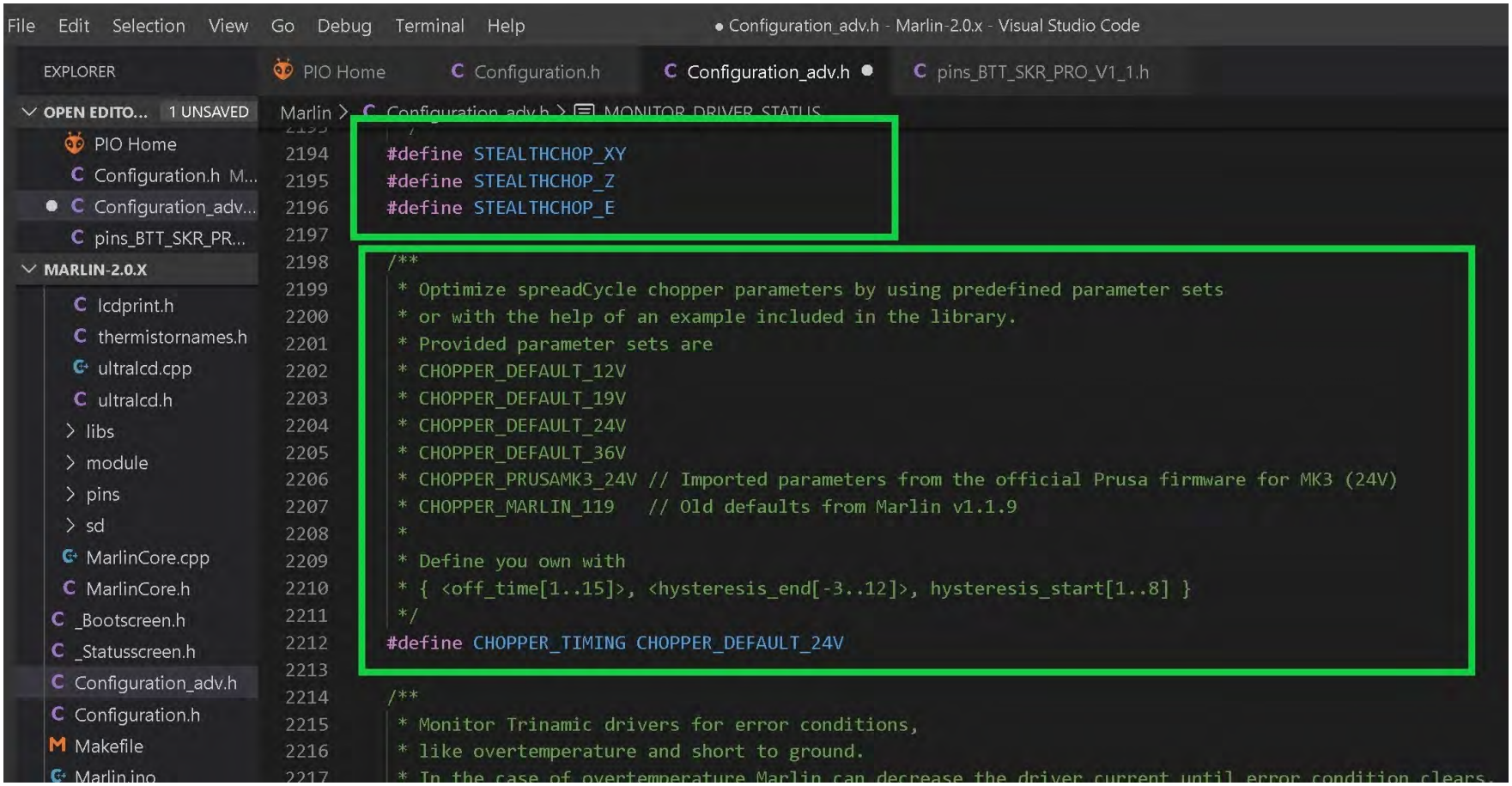
- Go to the next page.

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 it's SPI pins



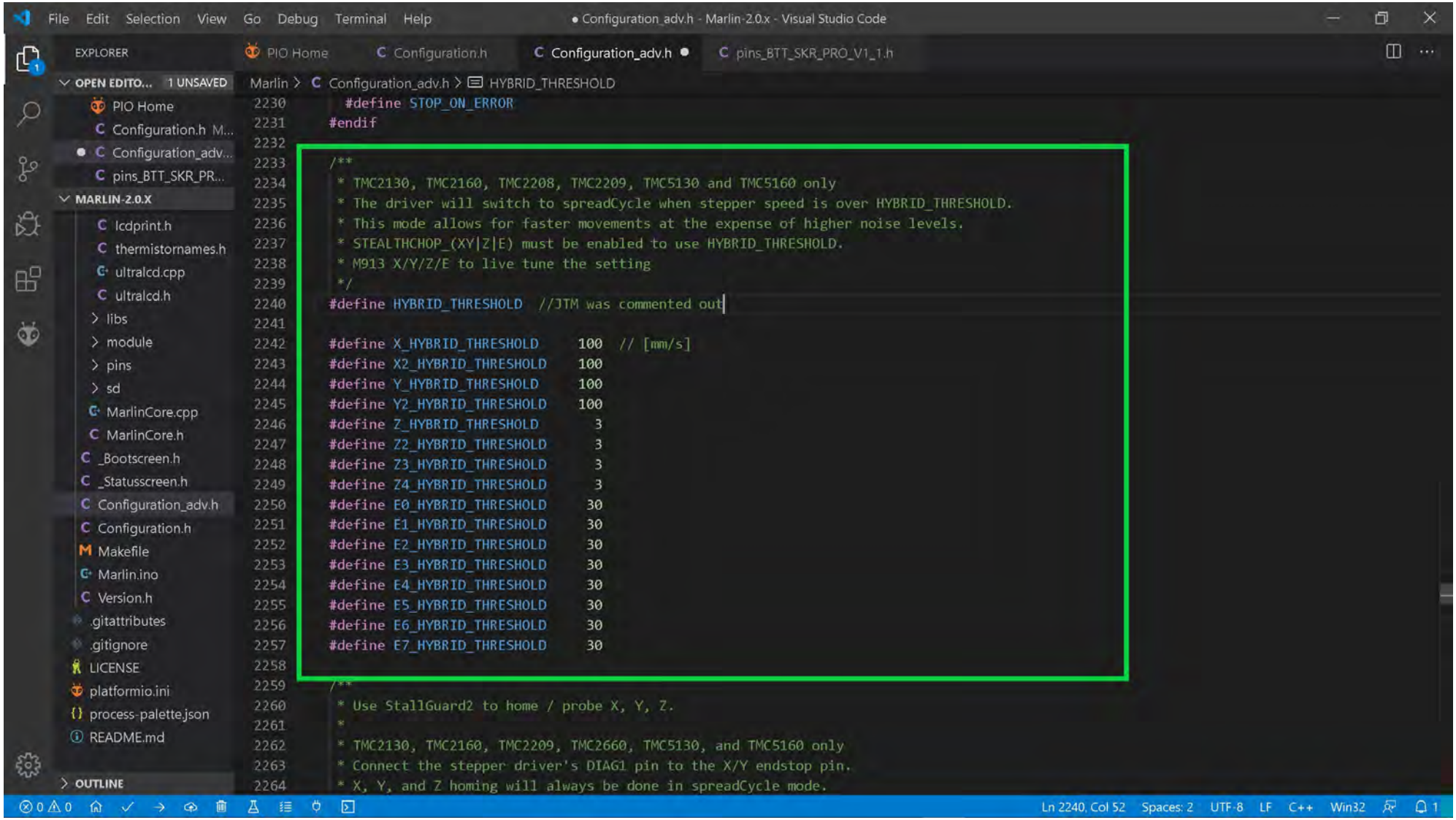
- By default stealthChop in enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.



- Go to the next page.

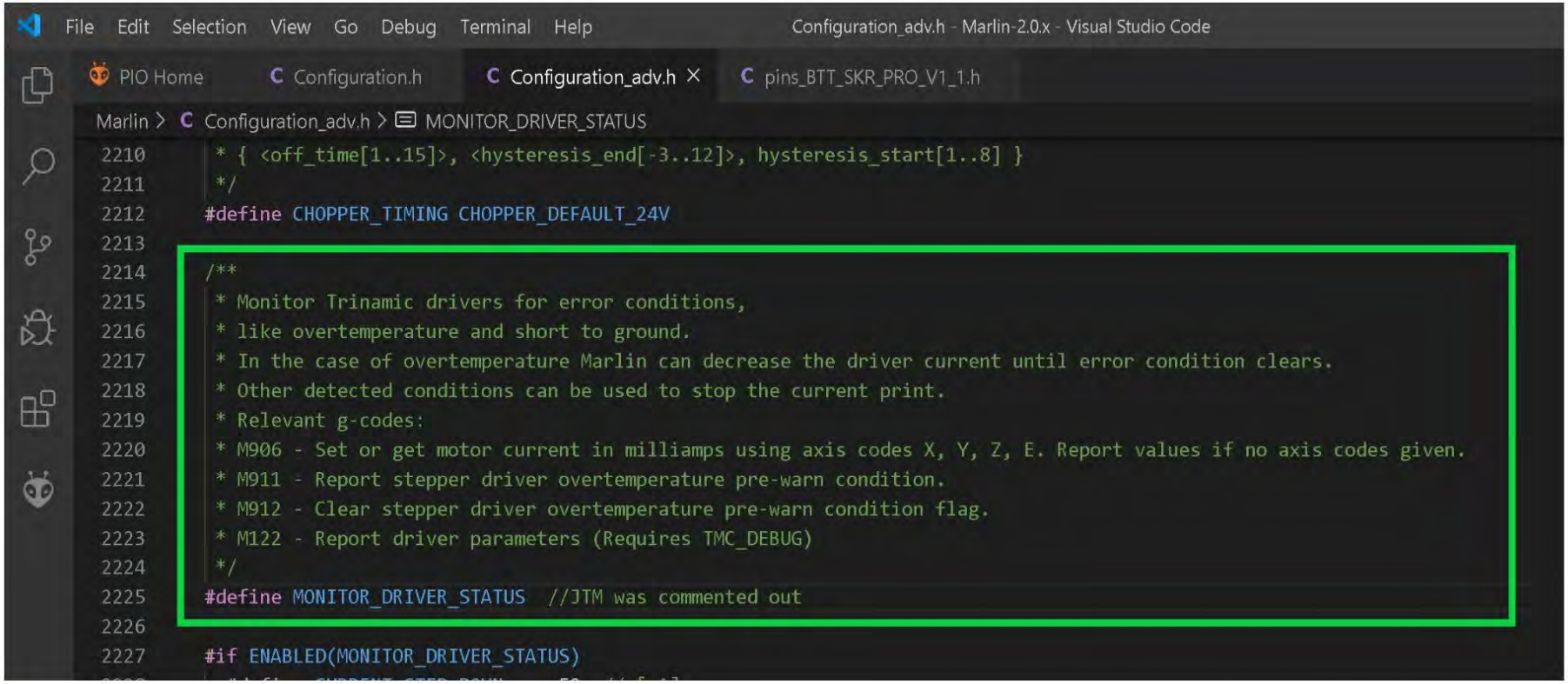
The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

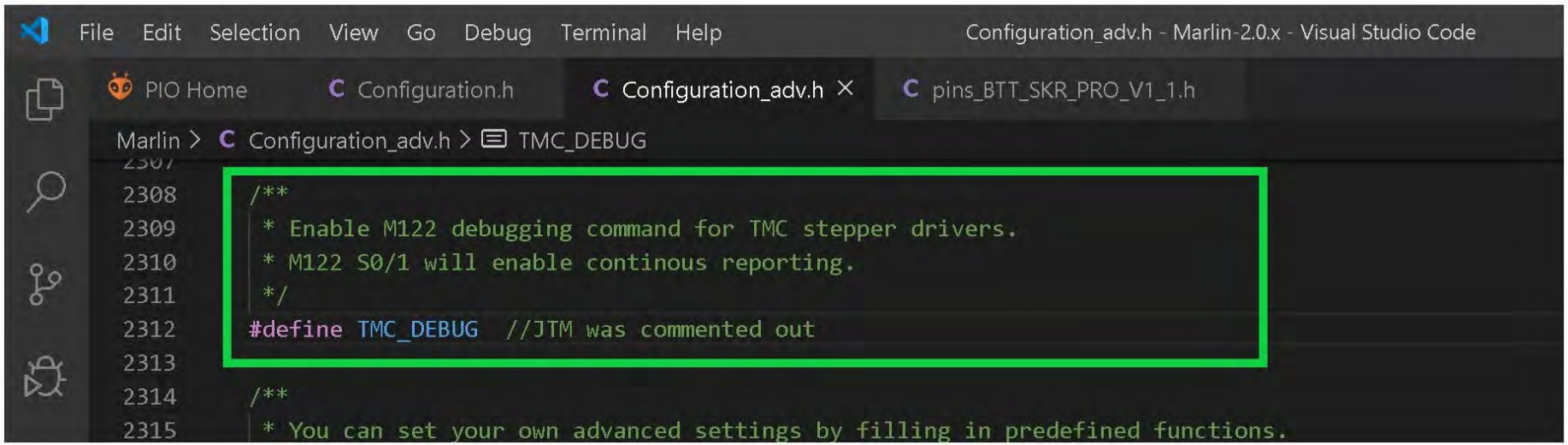
- Now you either enable "HYBRID_THRESHOLD" or disable it. By default it is disabled. "HYBRID_THERSHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



- 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.
- Go to the next page.

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

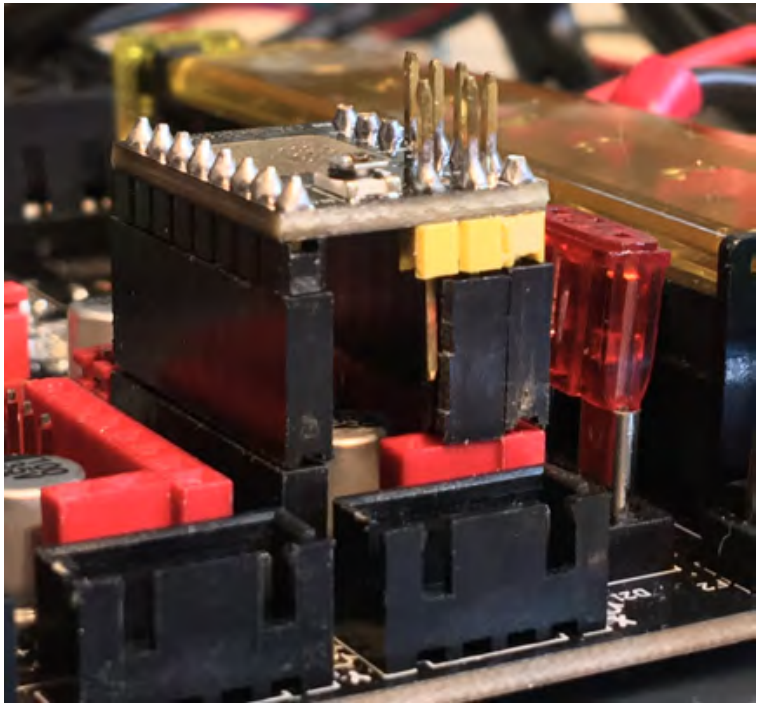




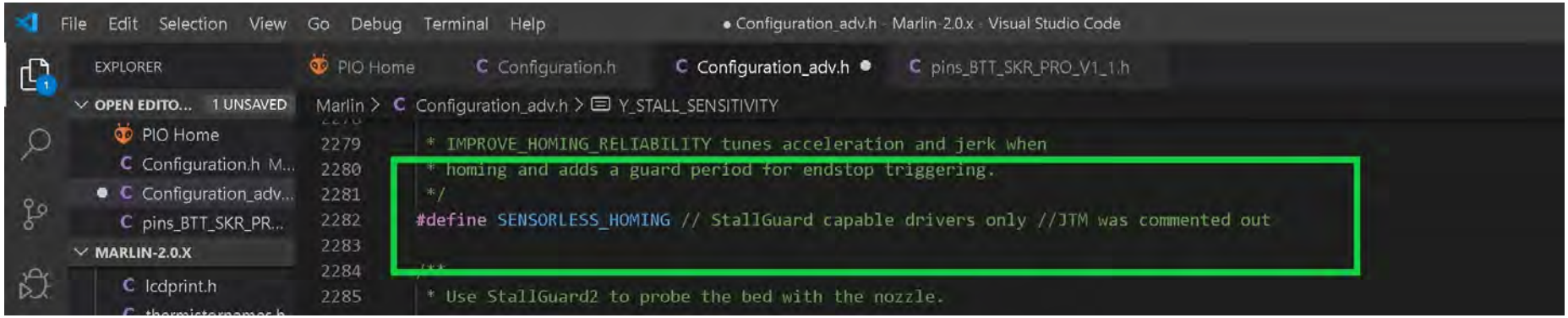
- Go to the next page.

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 DIAG 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 DIAG 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



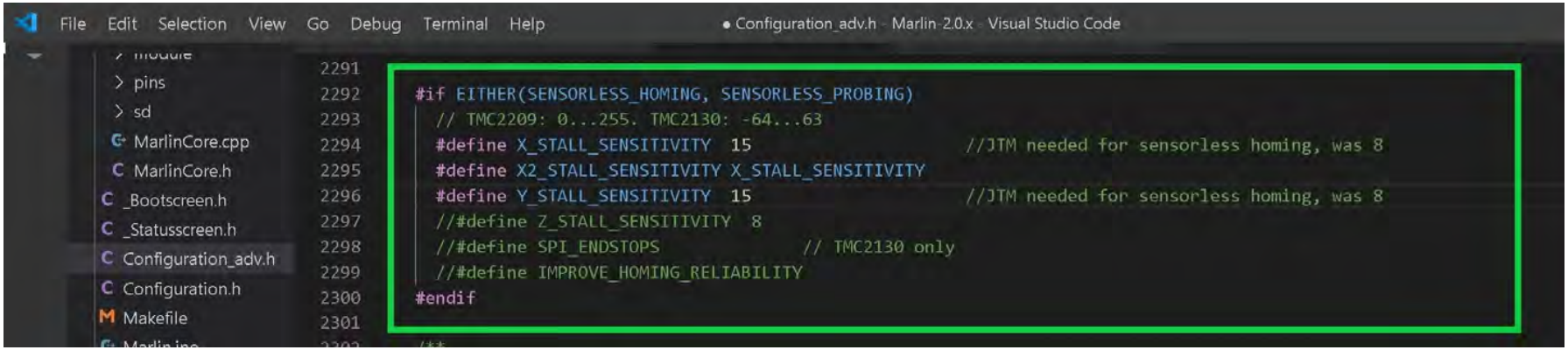
- Sensorless homing is commented out by default. So I remove the two leading "//" to un-comment "SENSORLESS_HOMING"



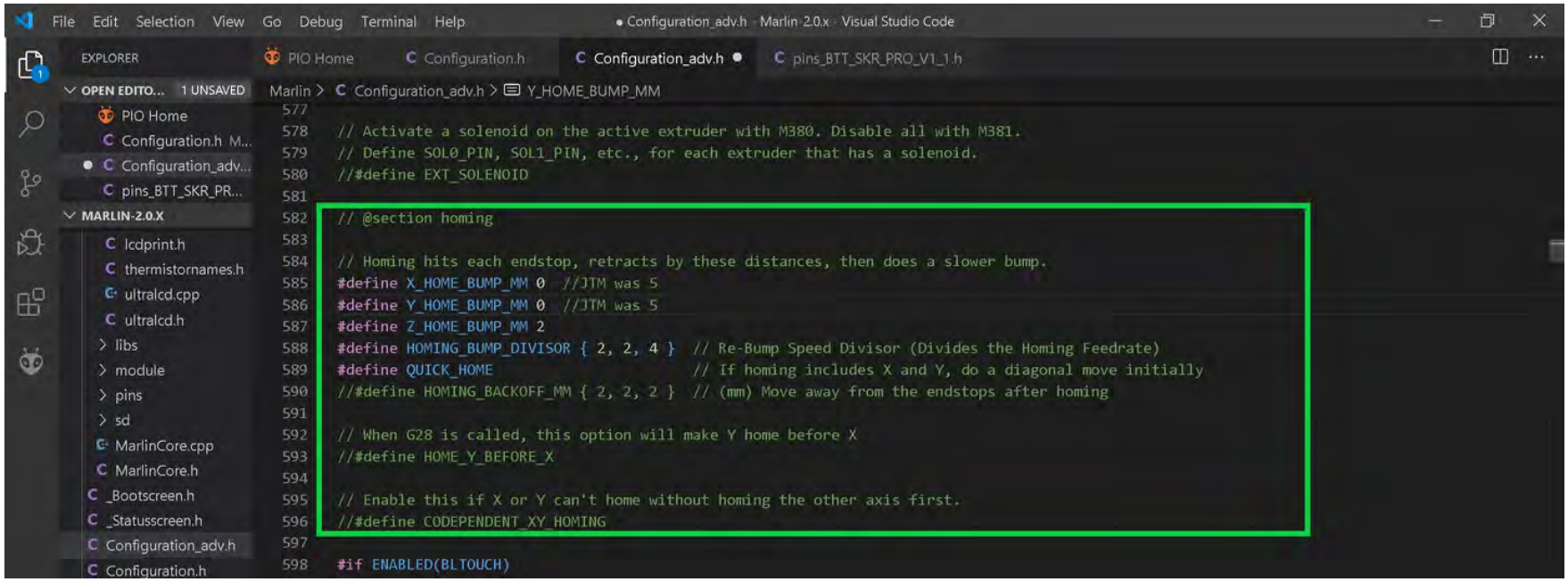
- Go to the next page.

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

- Next we set a "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".



- 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.



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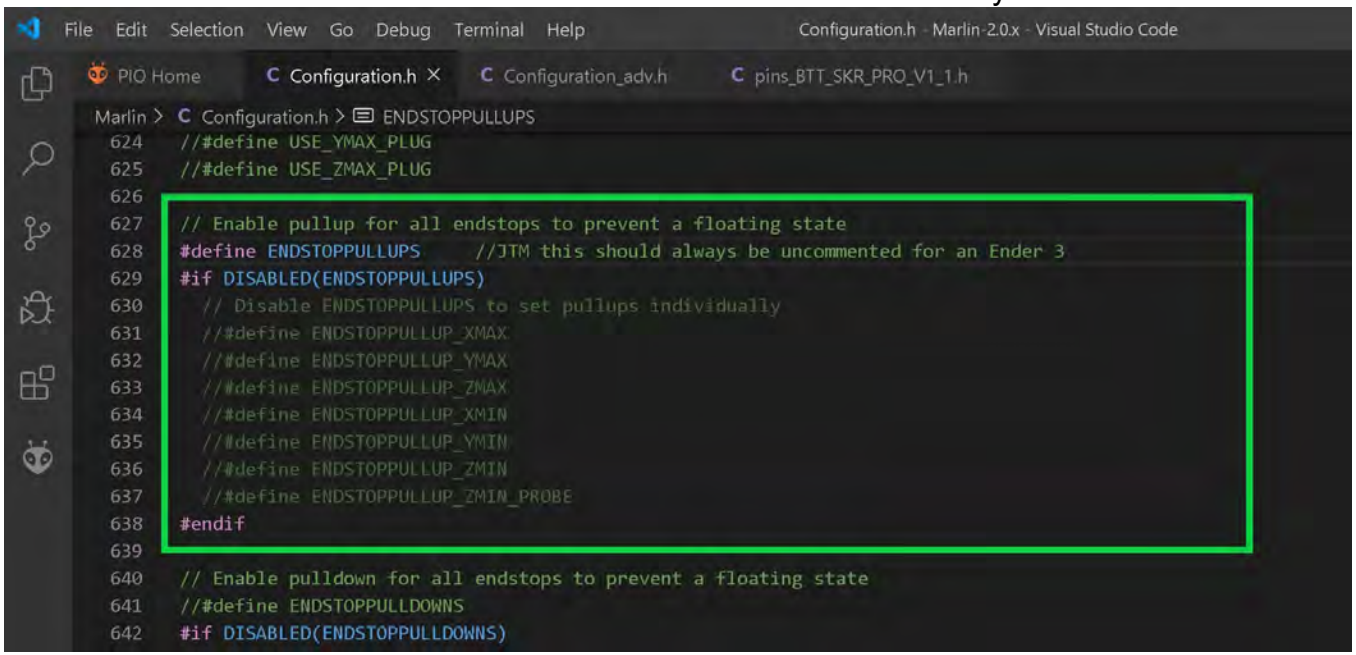
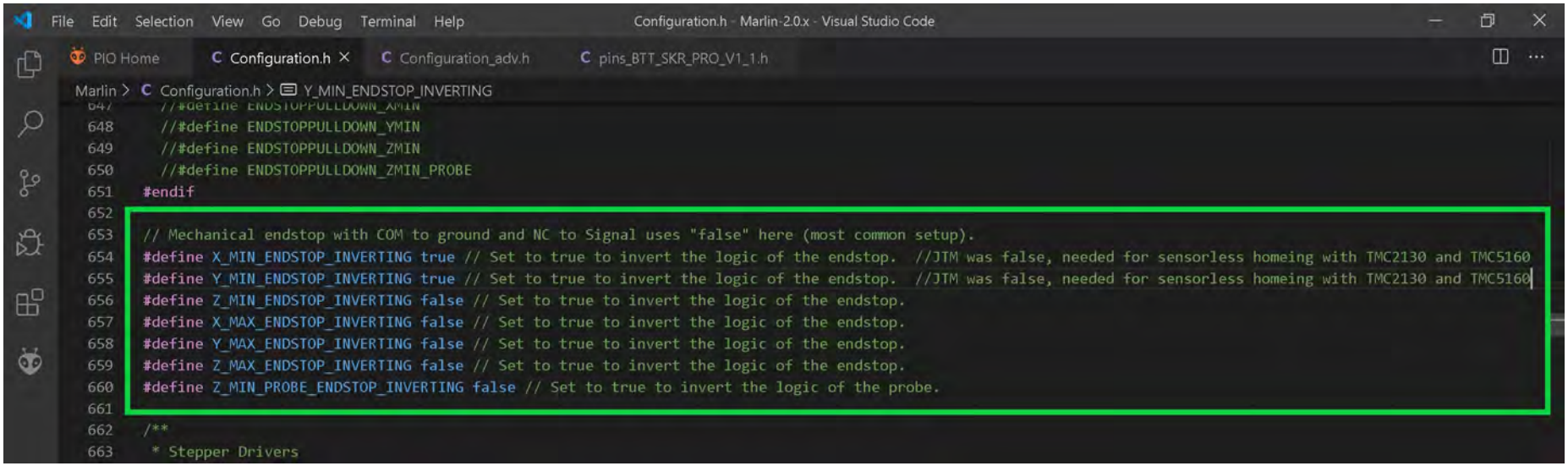
The (latest release of) Marlin Setup for BIQU TMC2130 Drivers in SPI Mode

- Let's check the firmware to ensure that "ENDSTOPPULLUPS" is enabled. It is by default.



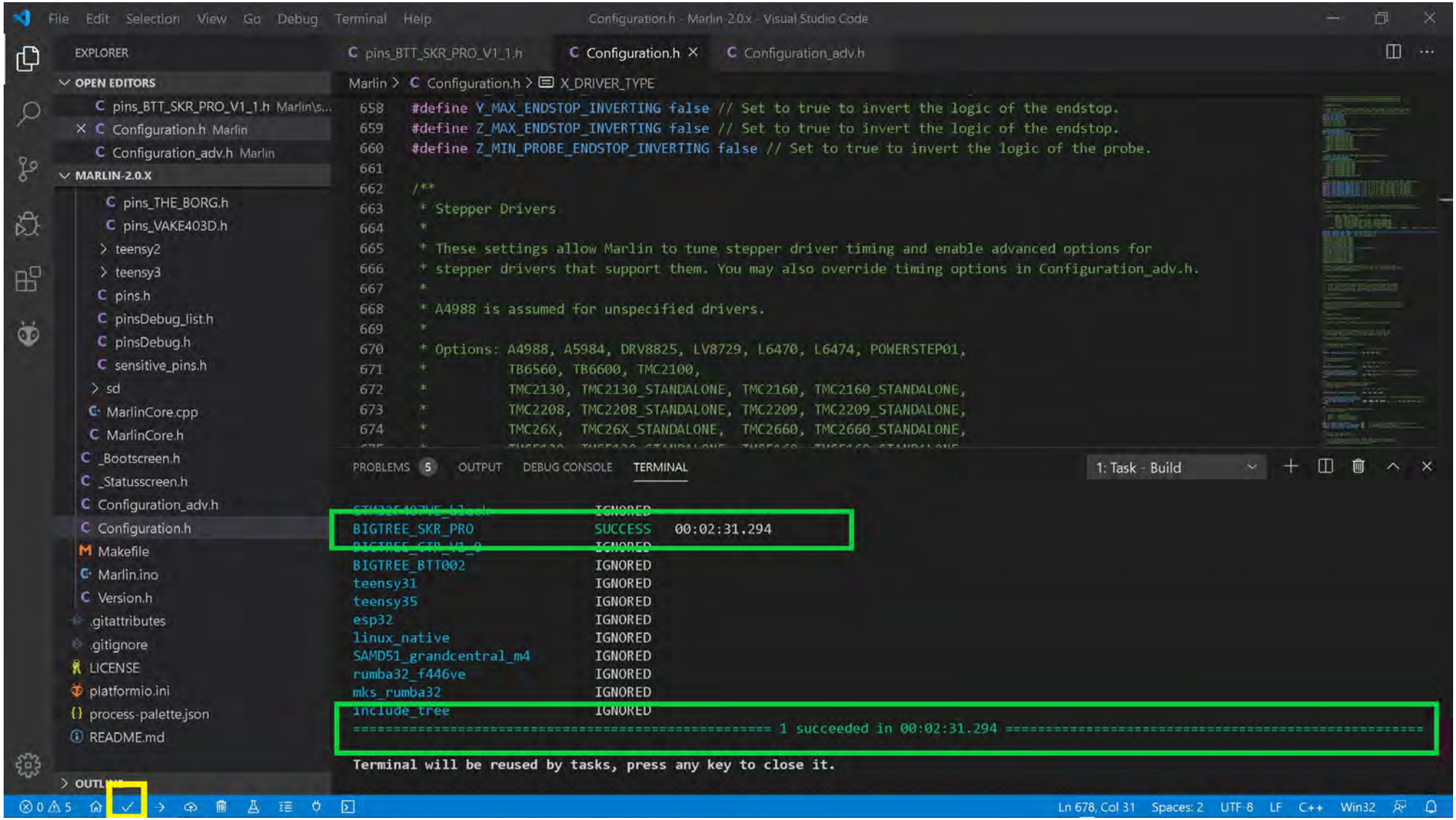
- Next to allow sensor-less homing to work we need to change our end stop logic. Therefore I set "X_MIN_ENDSTOP_INVERTING" to true and "Y_MIN_ENSTOP_INVERTING" to true. If you want sensor-less homing on the Z axis, you will need to set "Z_MIN_ENDSTOP_INVERTING" to true. But since I do not want sensor-less homing on the Z axis I will leave "Z_MIN_ENDSTOP_INVERTING" set to false.



- Go to the next page.

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

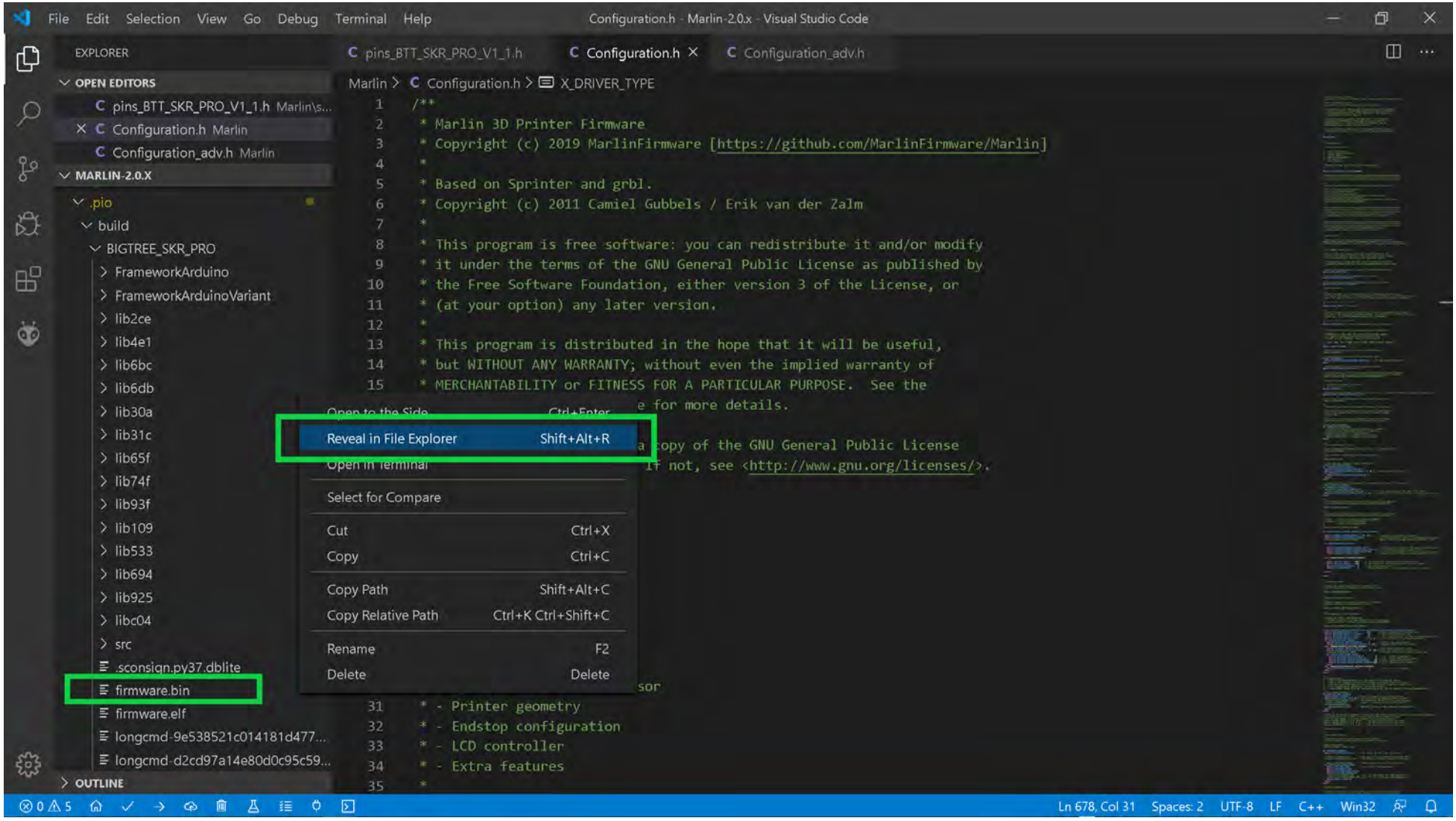
- The end of Marlin setup for BIQU TMC2130 drivers in SPI mode . Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages ,as shown in the **GREEN** boxes below.



- 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

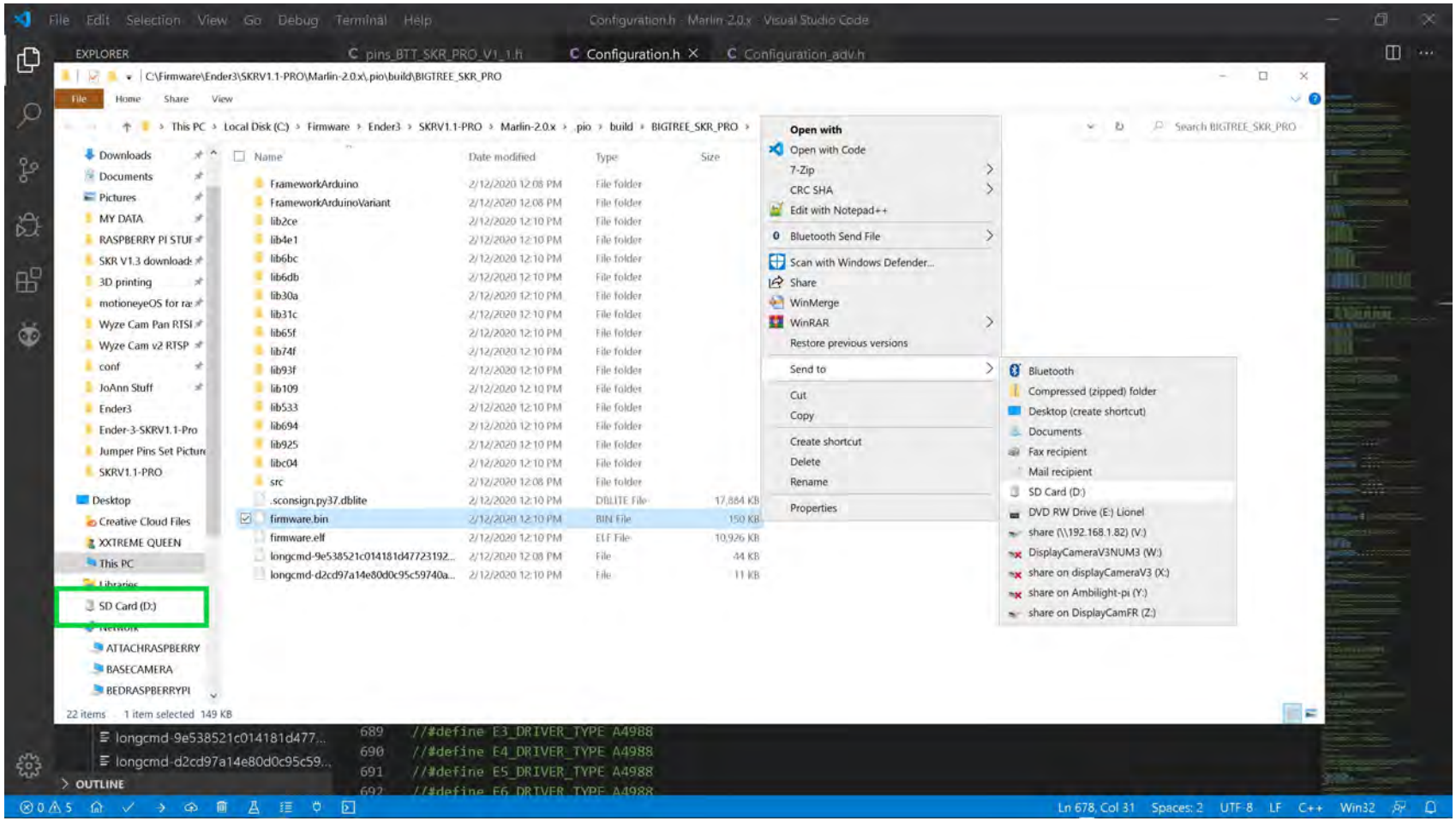
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



- Go to the next page.

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

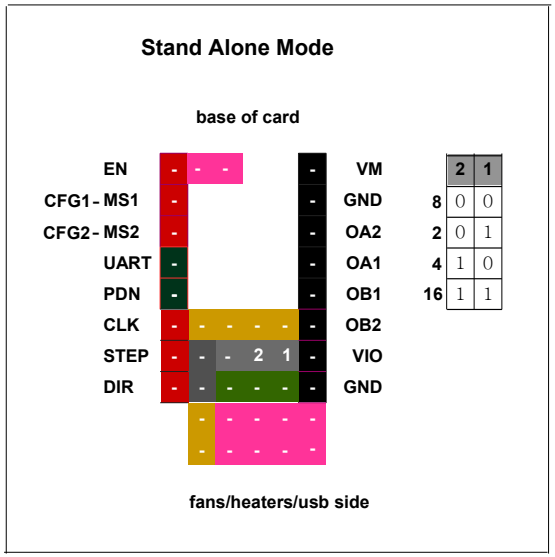
- Ensure your micro-SD card that came with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD 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 and renamed to "firmware.bin" on the micro-SD card.

BIQU TMC2208 V3.0

Stand Alone Mode



Driver Chip	CFG2/MS2	CFG1/MS1	Steps	Interpolation	Mode
TMC2208 Standalone Mode	GND	GND	1/8	1/256	stealthChop
5.5V - 35V DC 1.7A	GND	VIO	1/2	1/256	stealthChop
Maximum subdivision 16	VIO	GND	1/4	1/256	stealthChop
	VIO	VIO	1/16	1/256	stealthChop

Driving current calculation formula

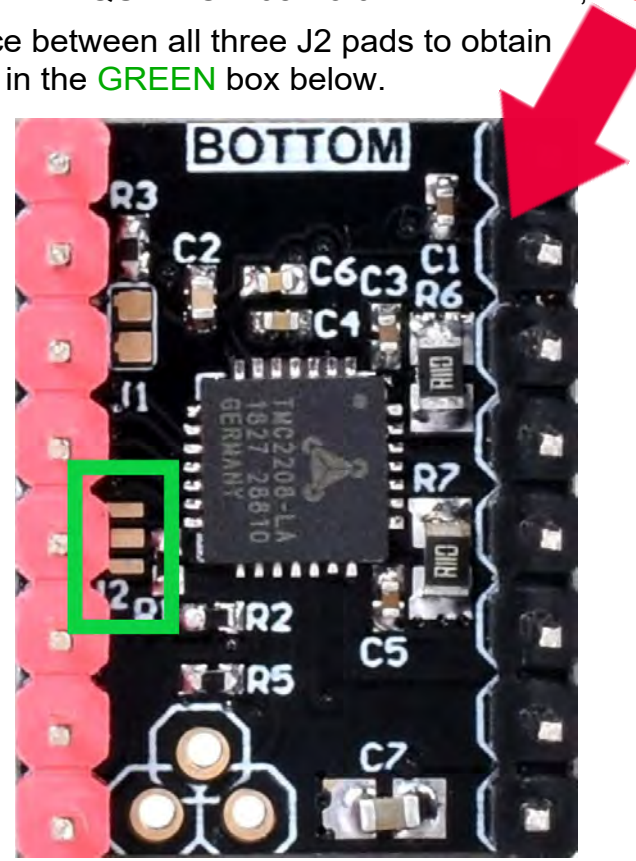
$$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$$

Note: Use 90% of the calculated Vref when tuning the stepper driver board

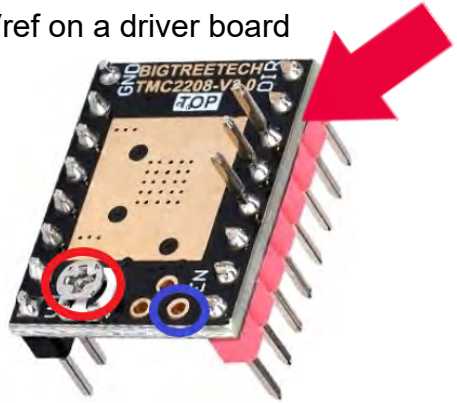
$$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$$

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).

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 Standalone Mode for the TMC2208 V3.0, as seen in the GREEN box below.



NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref, as shown in RED; OR use the "Vref Test point" location on the top of the driver board, as shown in BLUE . See the appendix for instructions on how to set the Vref on a driver board



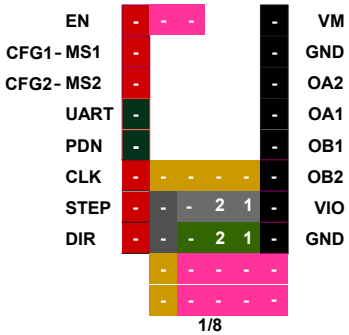
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

BIQU TMC2208 V3.0

Stand Alone Mode

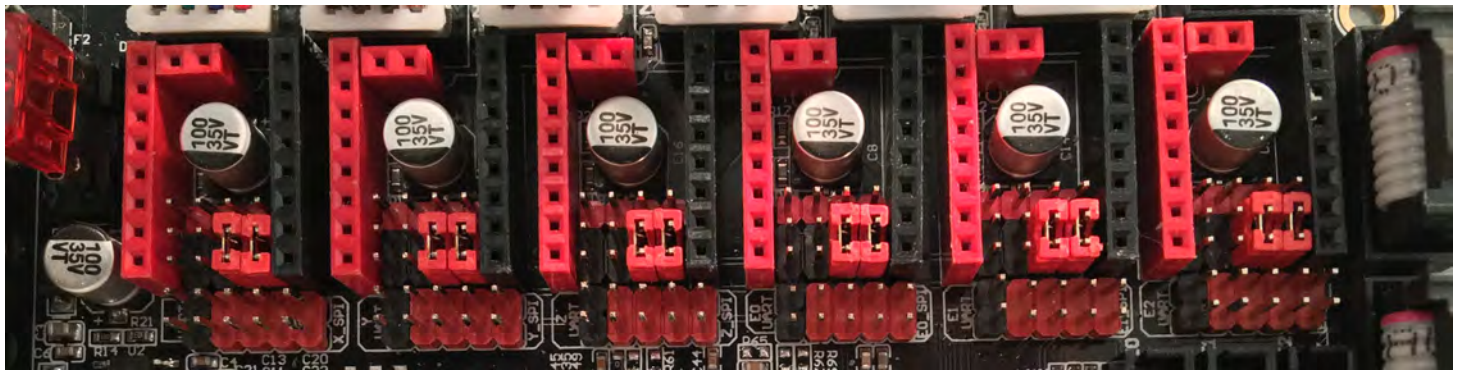
Stand Alone Mode

Stand Alone Mode

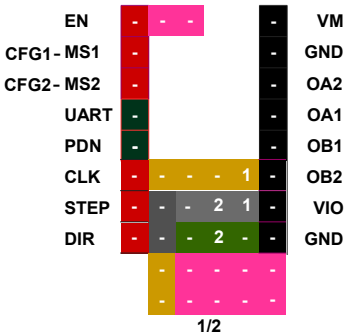


Interpolation: 1/256

StealthChop

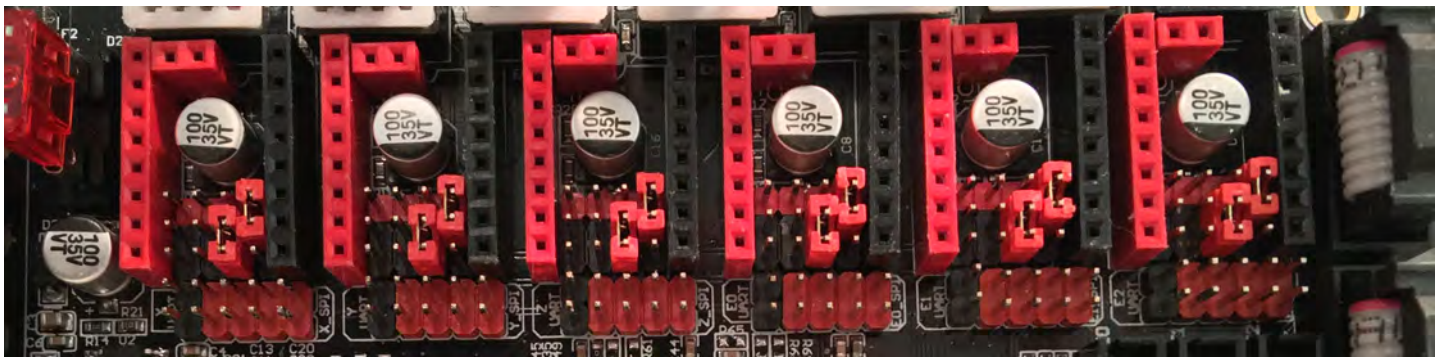


Stand Alone Mode



Interpolation: 1/256

StealthChop



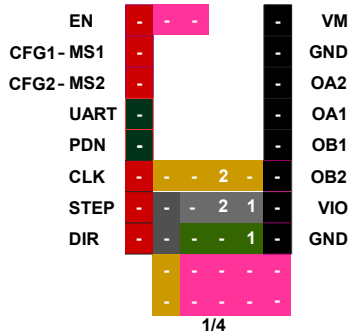
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

BIQU TMC2208 V3.0

Stand Alone Mode

Stand Alone Mode

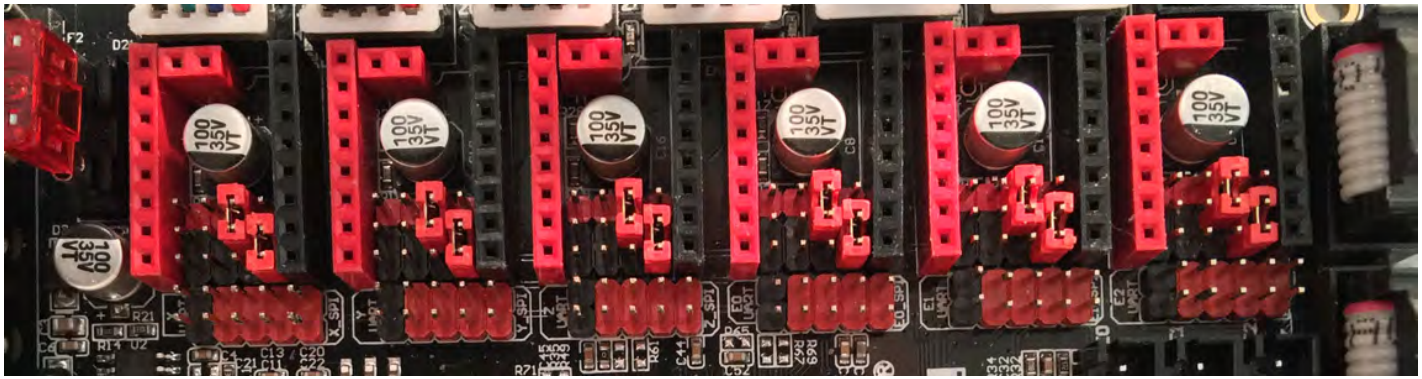
Stand Alone Mode



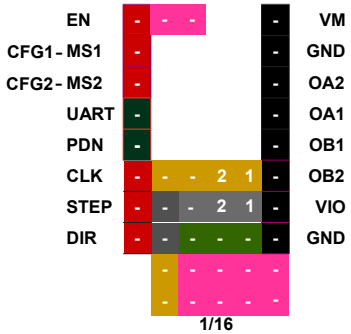
1/4

Interpolation: 1/256

StealthChop



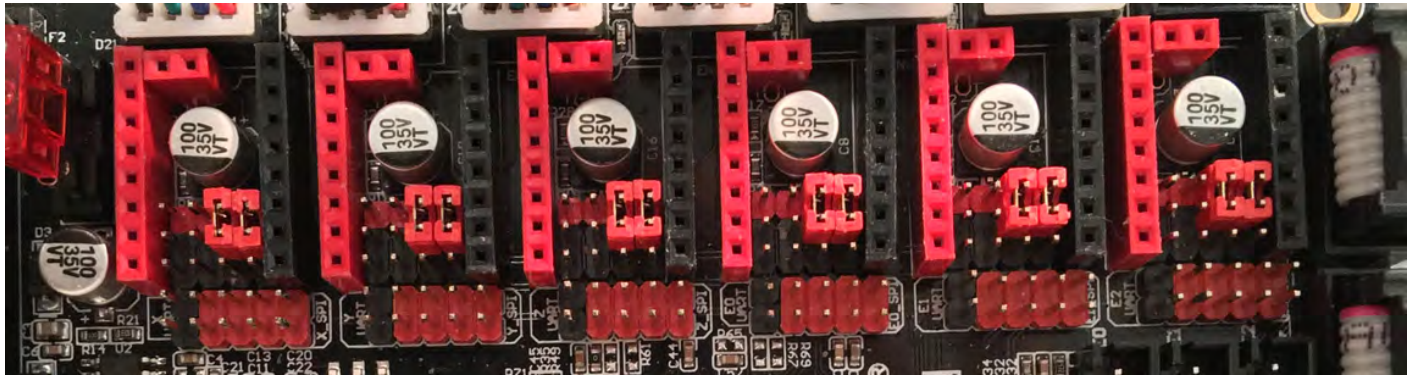
Stand Alone Mode



1/16

Interpolation: 1/256

StealthChop

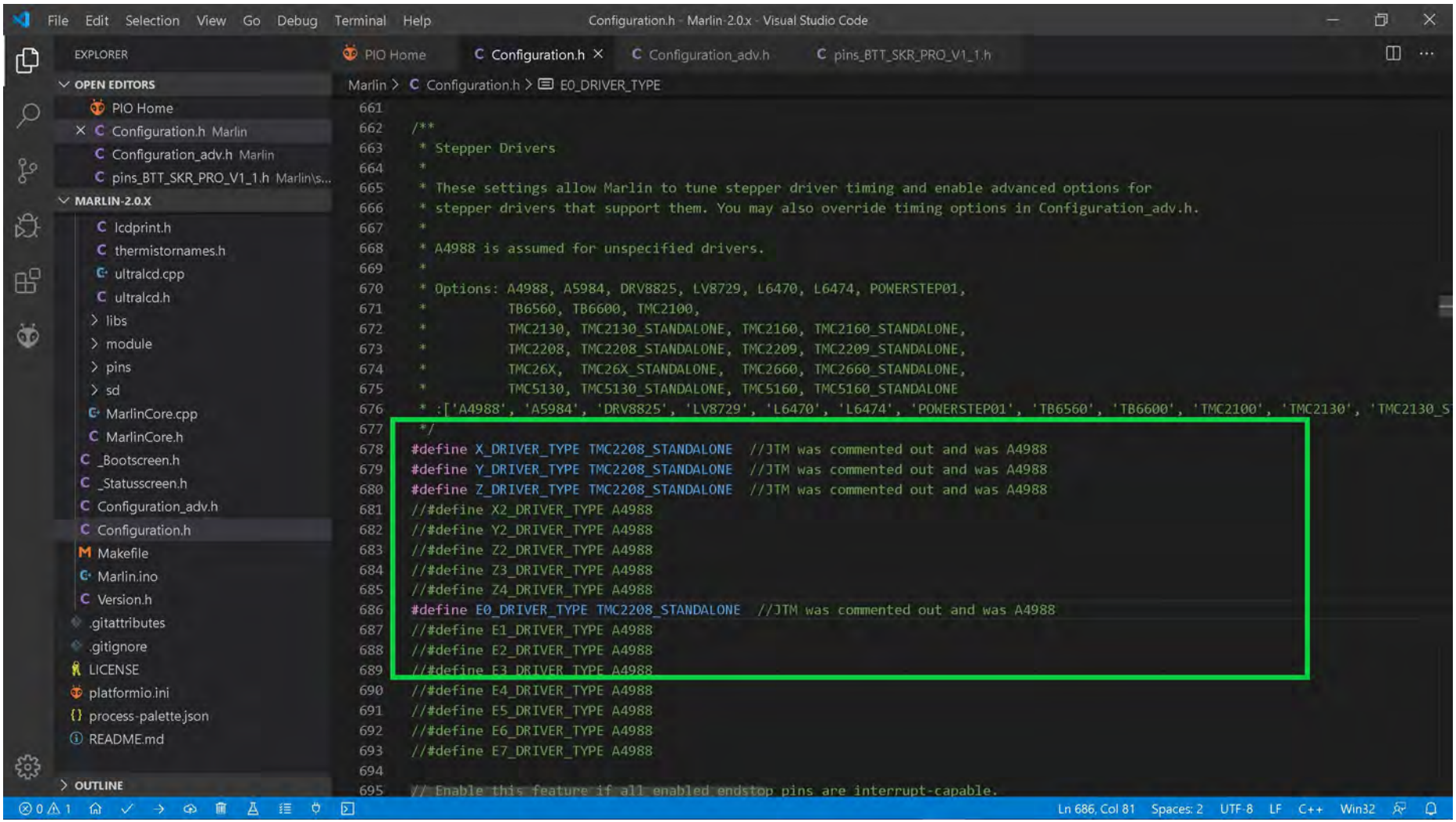


NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand Alone Mode

NOTE: Go to Appendix C then come back here for the changes to Marlin for BIQU TMC2208 stepper motor drivers in stand alone mode.

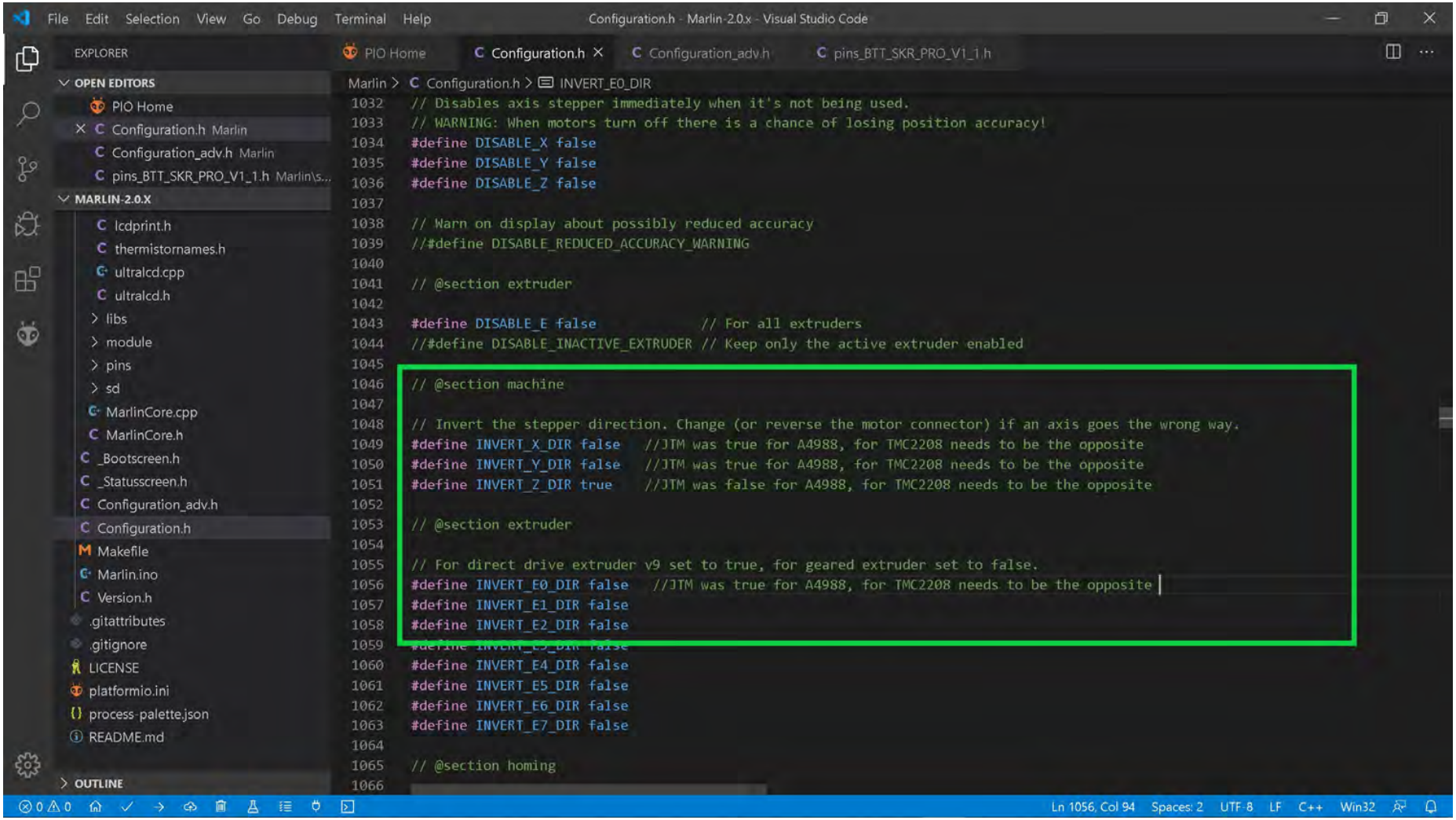
- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in stand alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in stand alone mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand Alone Mode

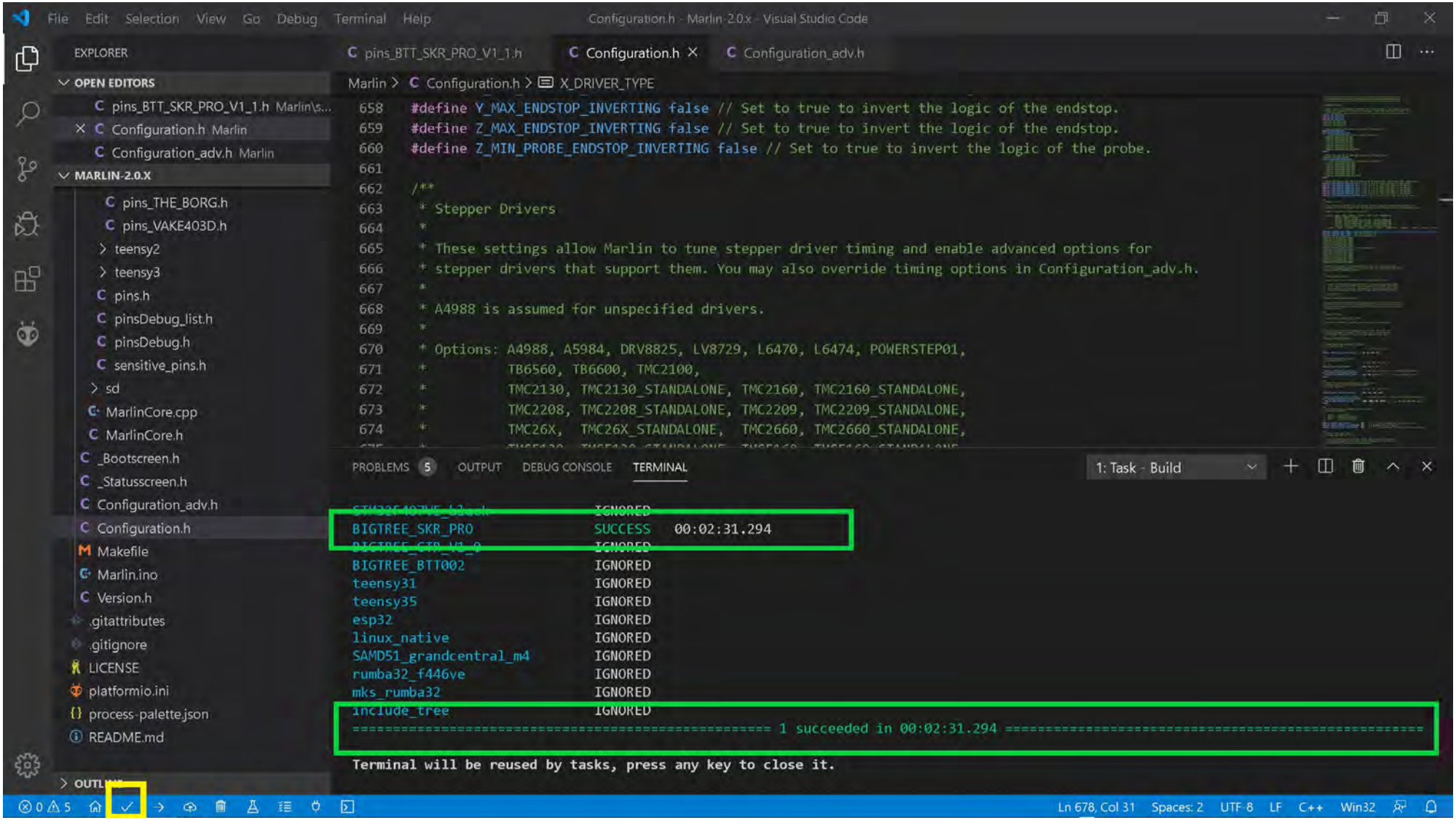
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand Alone Mode

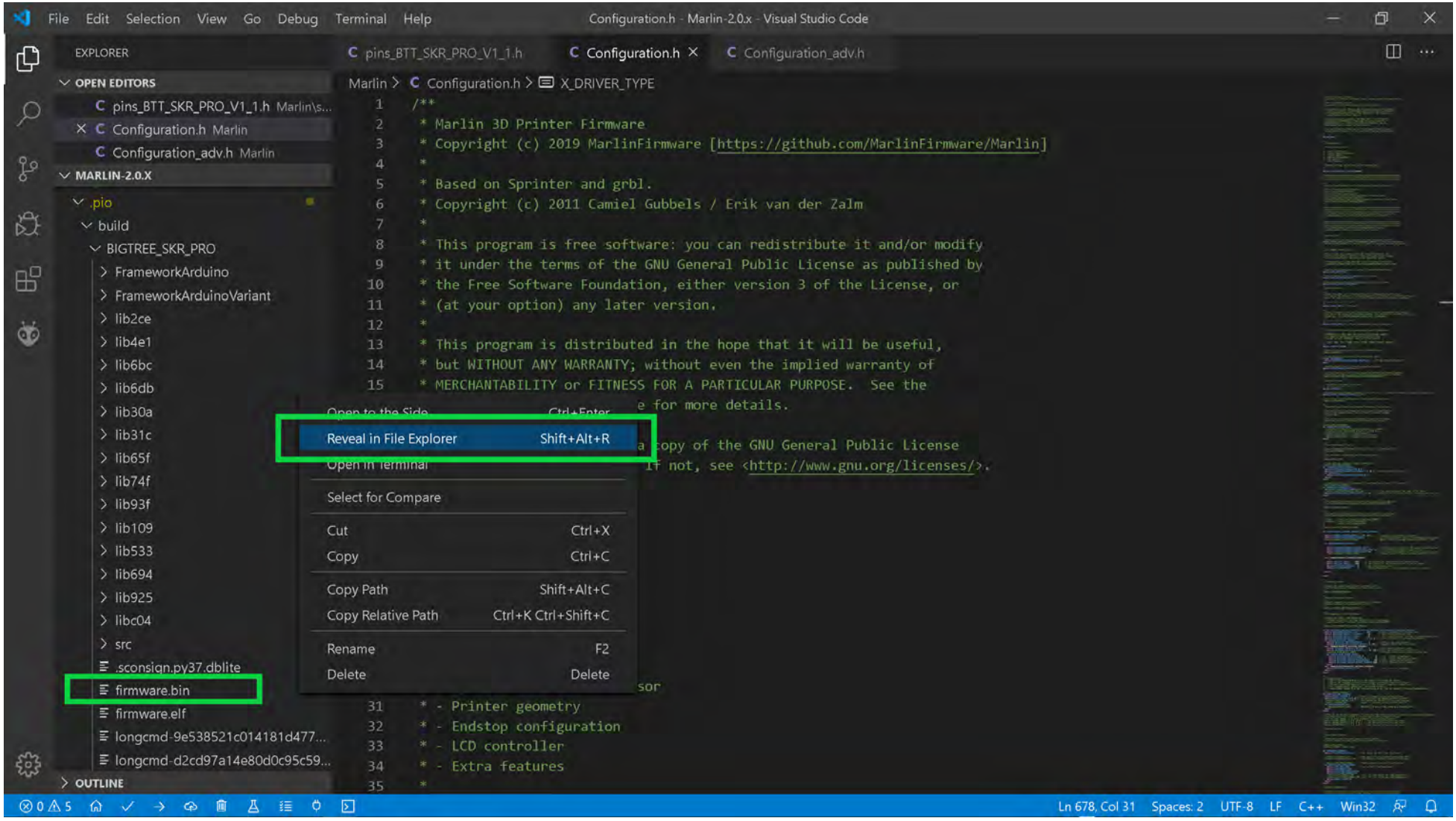
- The end of Marlin setup for BIQU TMC2208 V3.0 drivers in stand alone mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

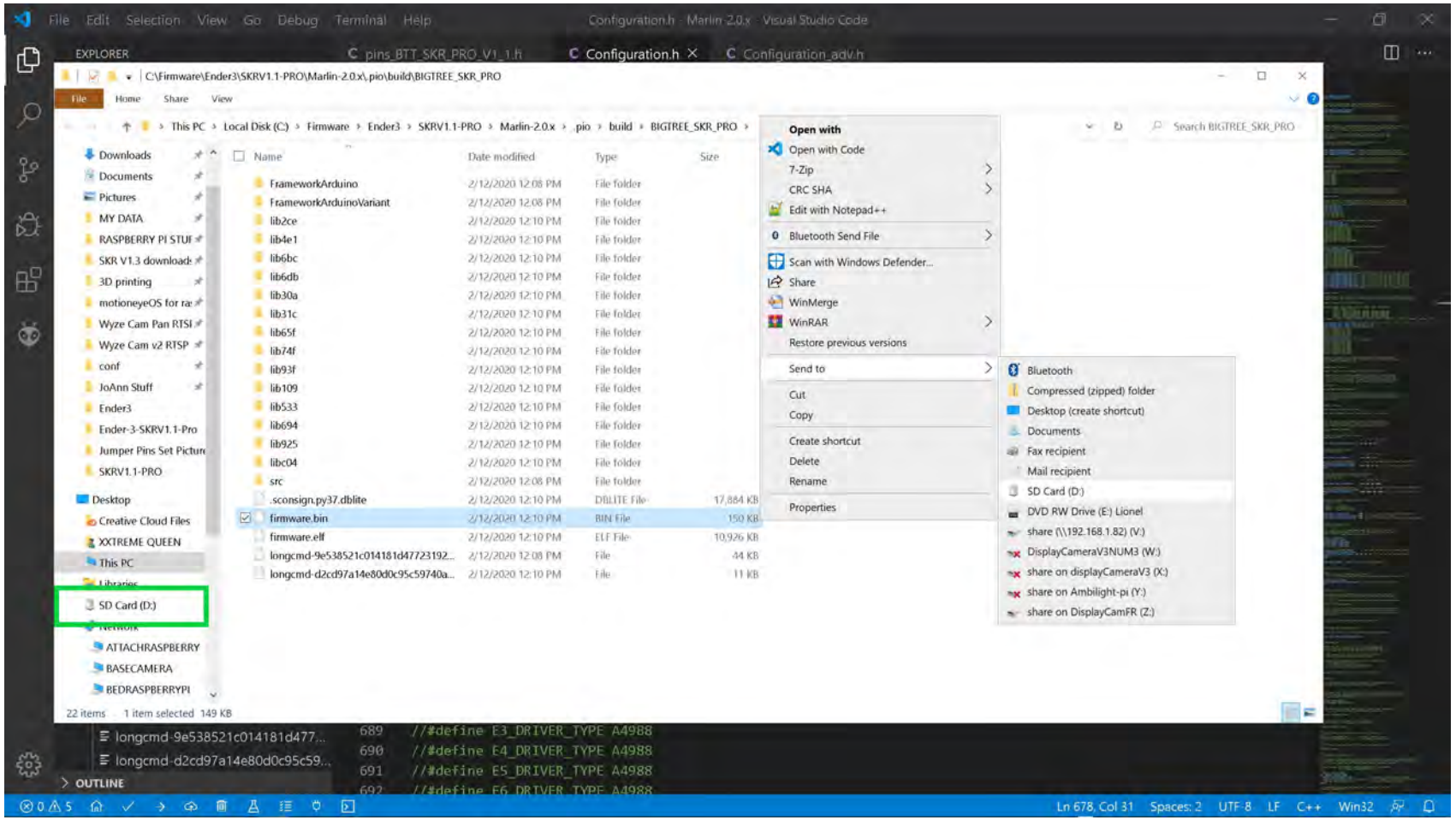
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in Stand Alone Mode

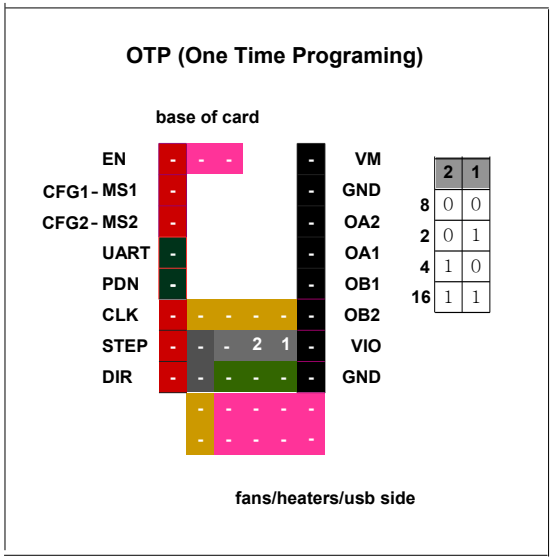
- Ensure your micro-SD card that came with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD 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 and renamed to "firmware.bin" on the micro-SD card.

BIQU TMC2208 V3.0

One Time Programming (OTP) Mode



Driver Chip	CFG2/MS2	CFG1/MS1	Steps	Interpolation	Mode
TMC2208 OTP Mode 5.5V - 35V DC 1.7A Maximum subdivision 16	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

$$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$$

Note: Use 90% of the calculated Vref when tuning the stepper driver board

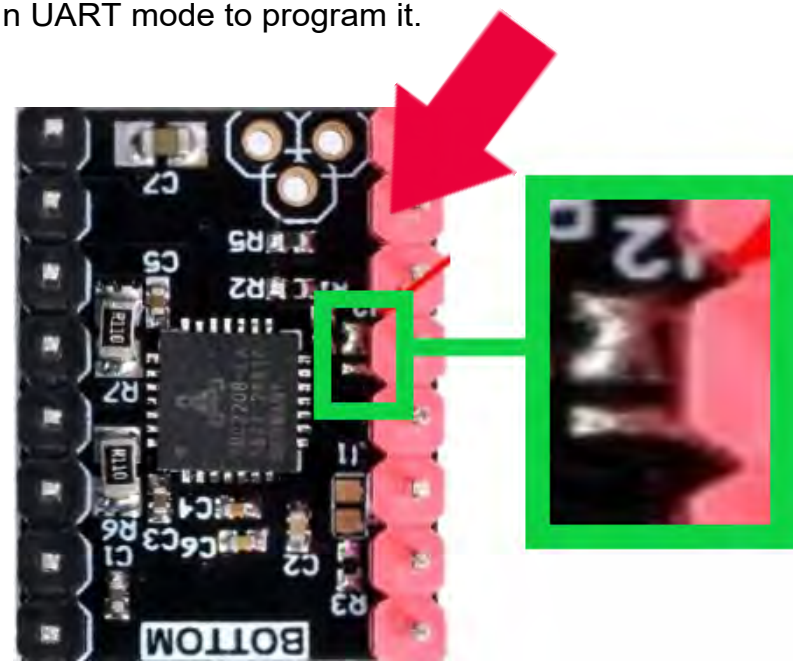
$$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$$

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.**

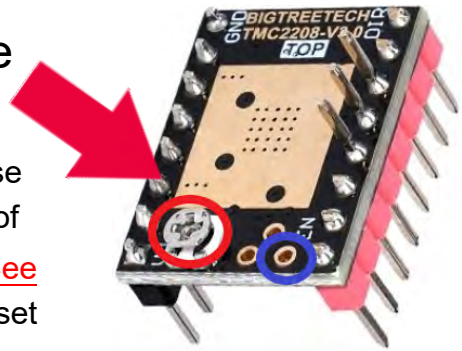
Important: To place BIQU TMC2208 V3.0 into OTP Mode, at J2,

you must solder the top two pads together OR solder the bottom two pads together on the bottom of the driver board. As an example, the picture below 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.

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).



NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref, as shown in RED; OR use the "Vref Test point" location on the top of the driver board, as shown in BLUE . See the appendix for instructions on how to set the Vref on a driver board



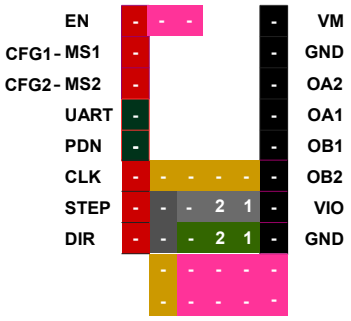
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

BIQU TMC2208 V3.0

One Time Programming (OTP) Mode

OTP (One Time Programing)

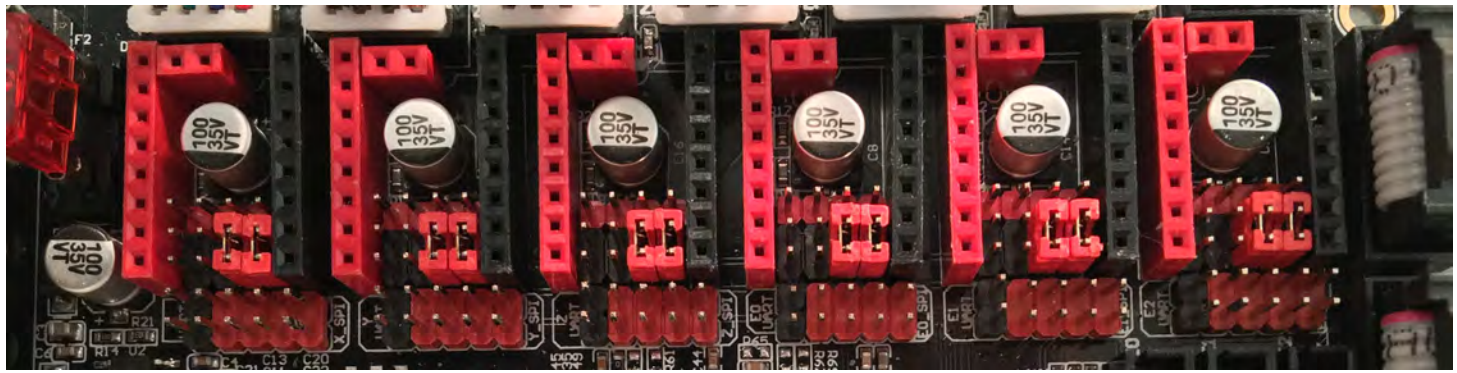
OTP (One Time Programing)



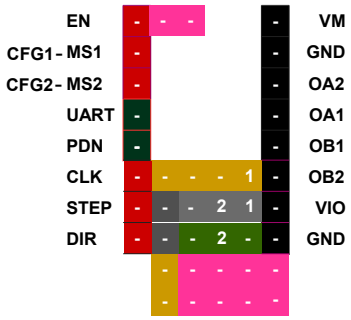
1/8

Interpolation: 1/256

SpreadCycle



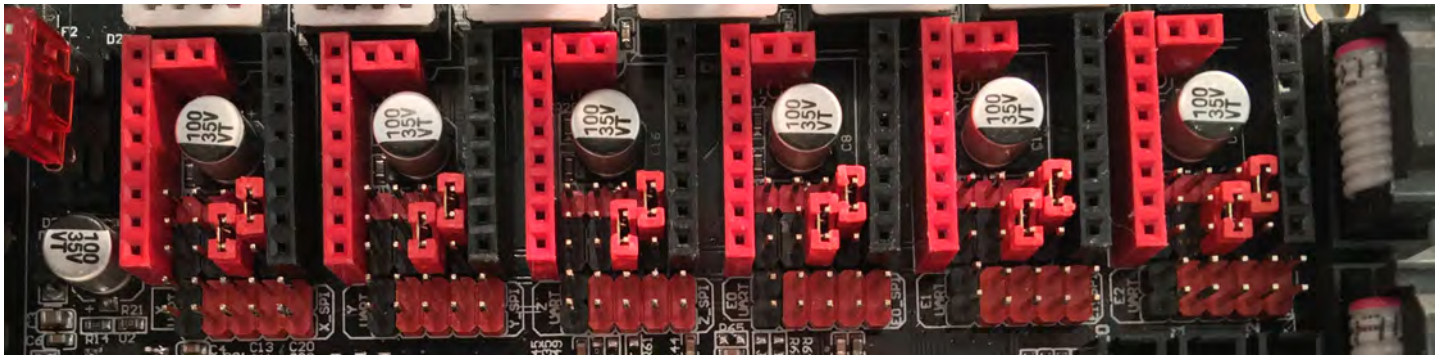
OTP (One Time Programing)



1/2

Interpolation: 1/256

SpreadCycle



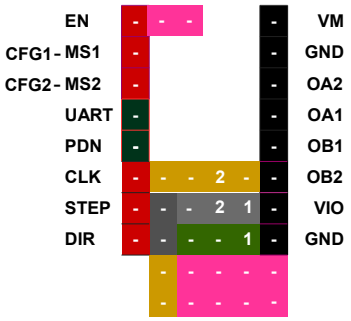
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

BIQU TMC2208 V3.0

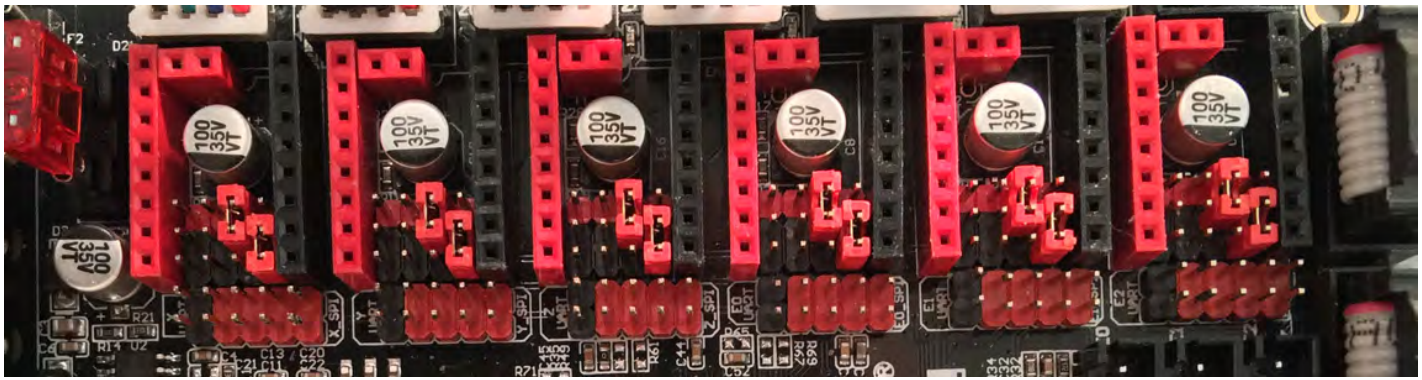
One Time Programming (OTP) Mode

OTP (One Time Programing)

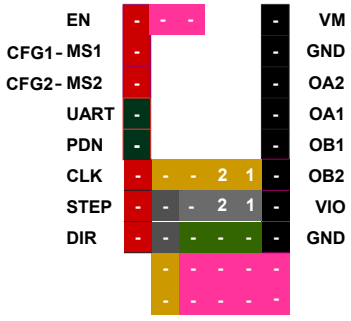
OTP (One Time Programing)



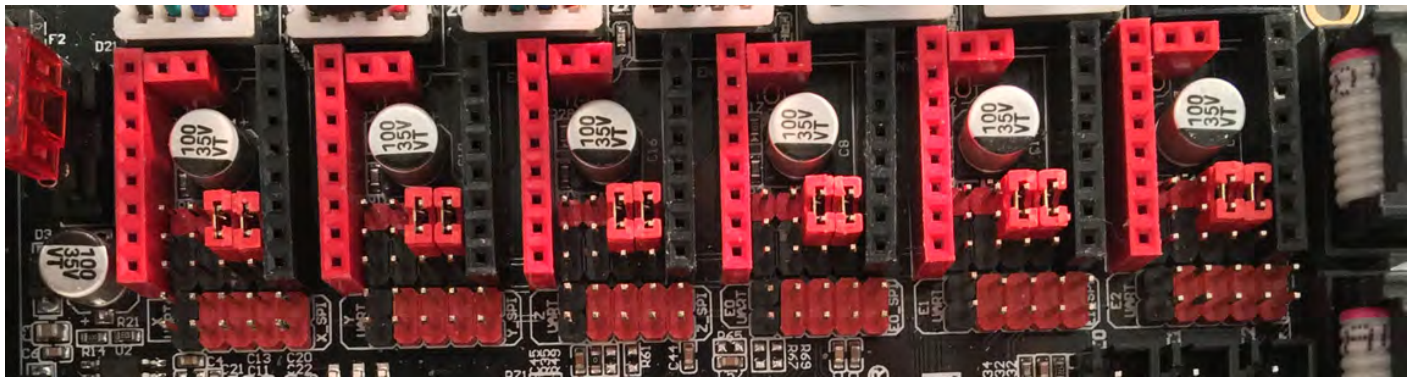
1/4
Interpolation: 1/256
SpreadCycle



OTP (One Time Programing)



1/16
Interpolation: 1/256
SpreadCycle



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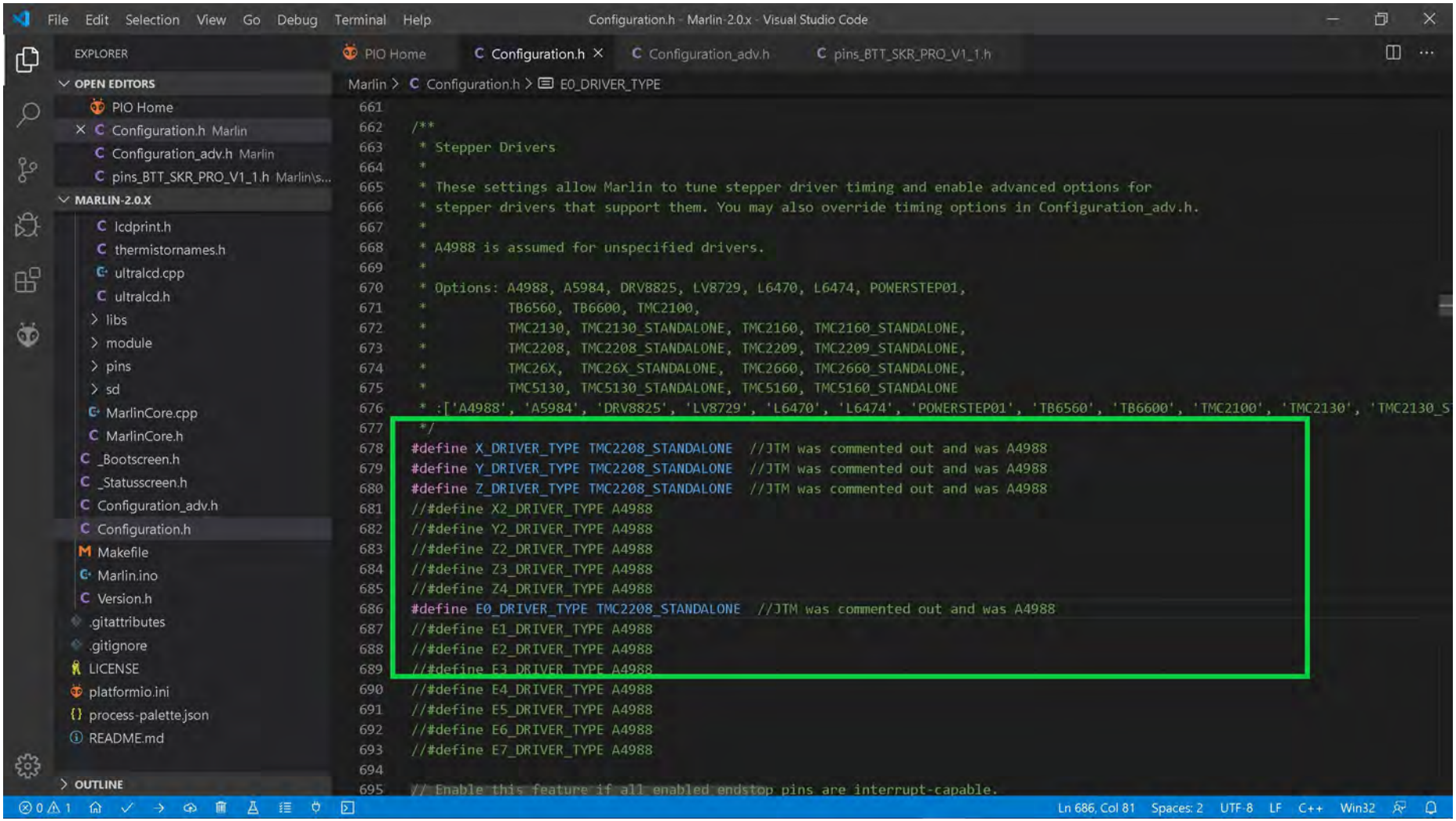
The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

NOTE: Go to Appendix C then come back here for the changes to Marlin for BIQU TMC2208 stepper motor drivers in OTP mode.

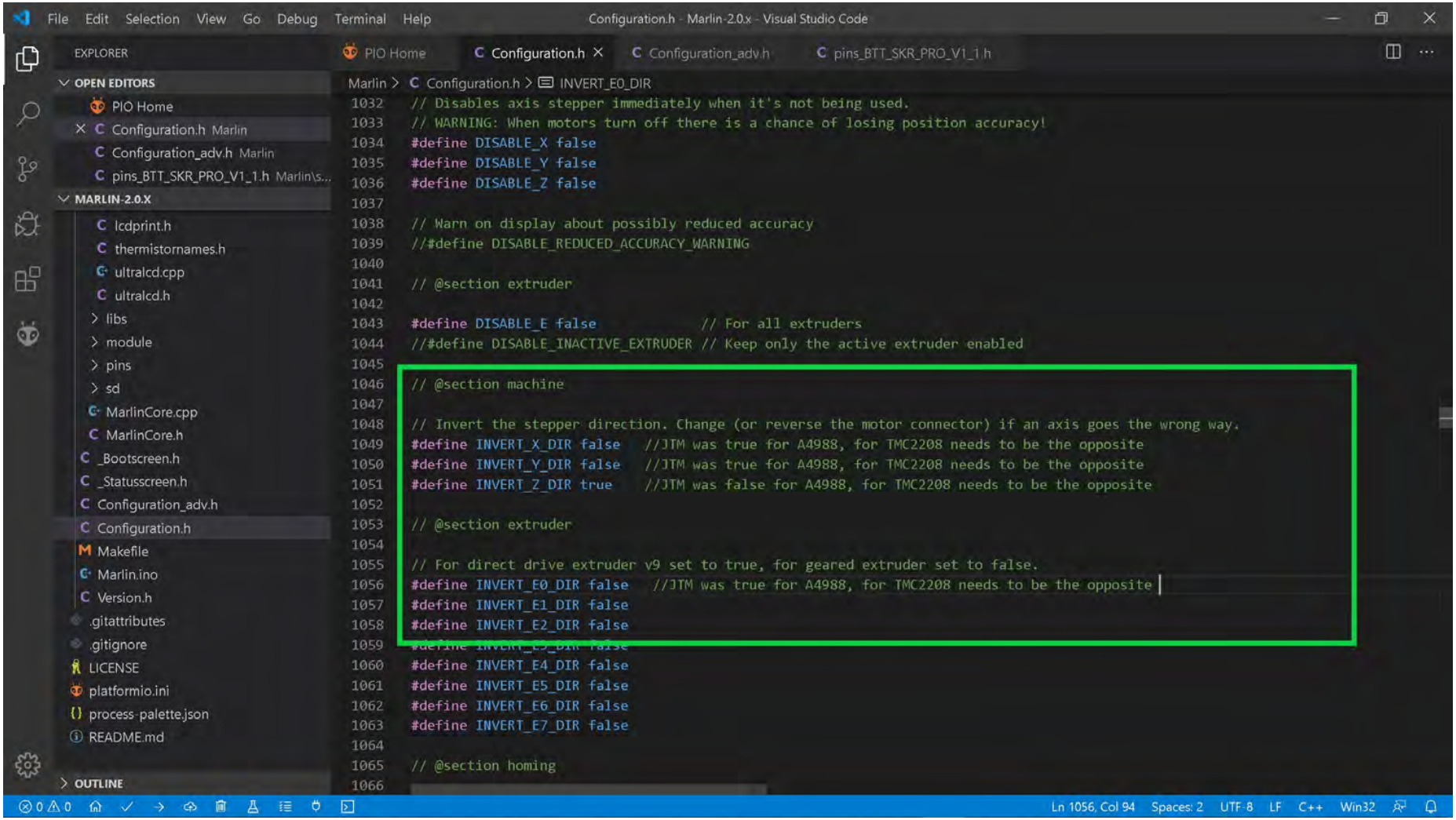
- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in OTP mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in OTP mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



- 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



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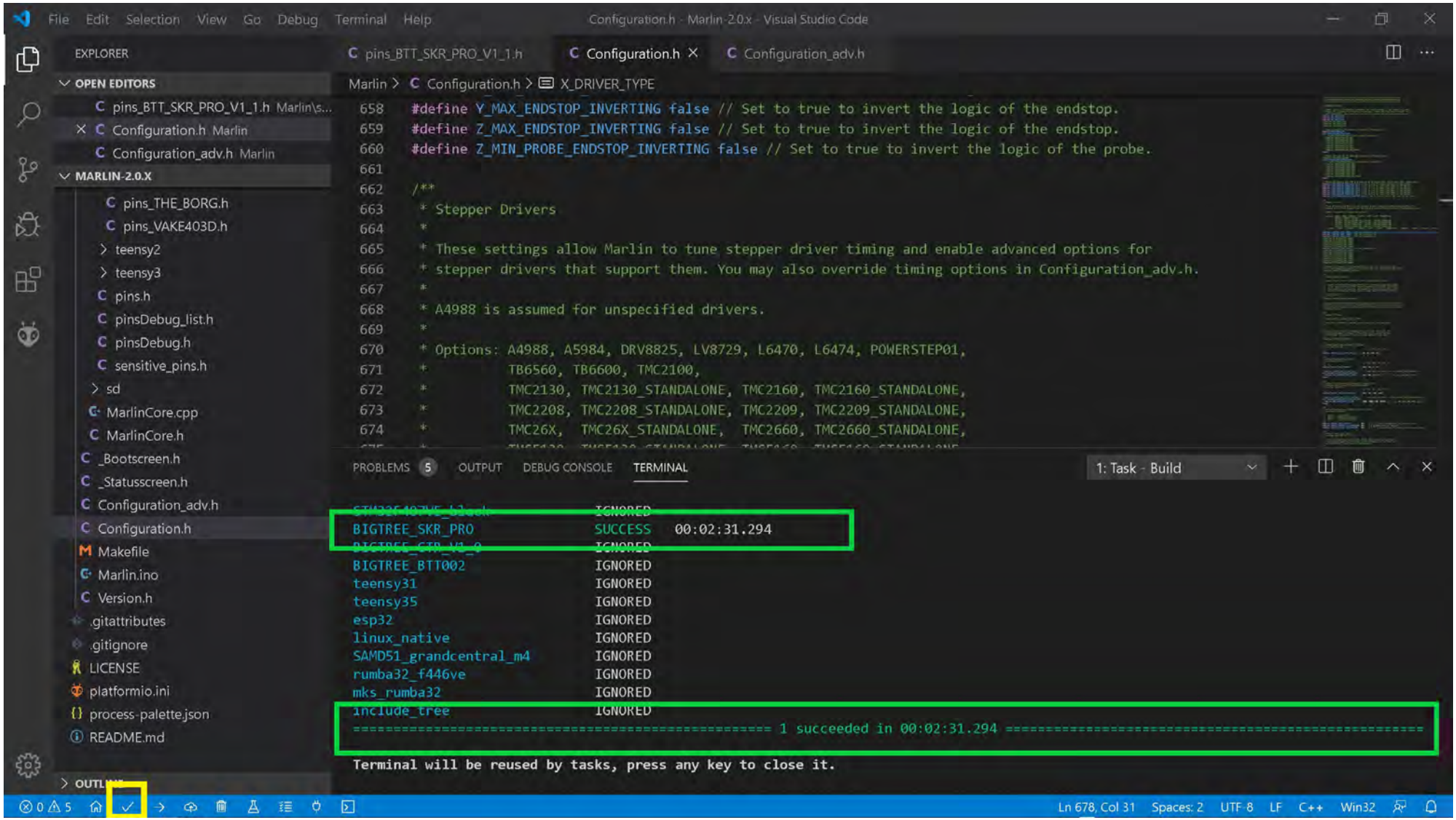
The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

- 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.



- 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

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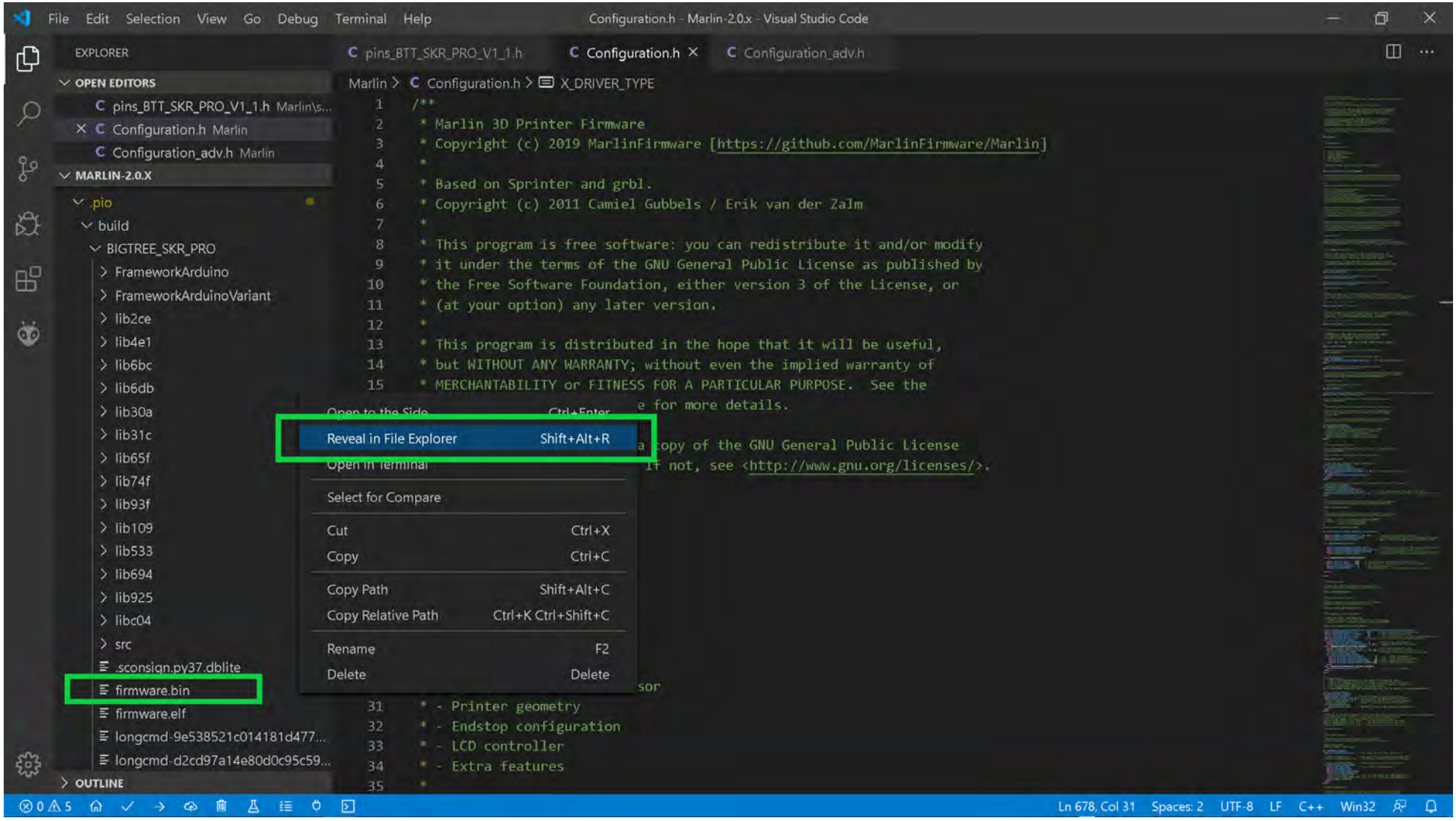

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The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in One Time Programming (OTP) Mode

- Ensure your micro-SD card that 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.
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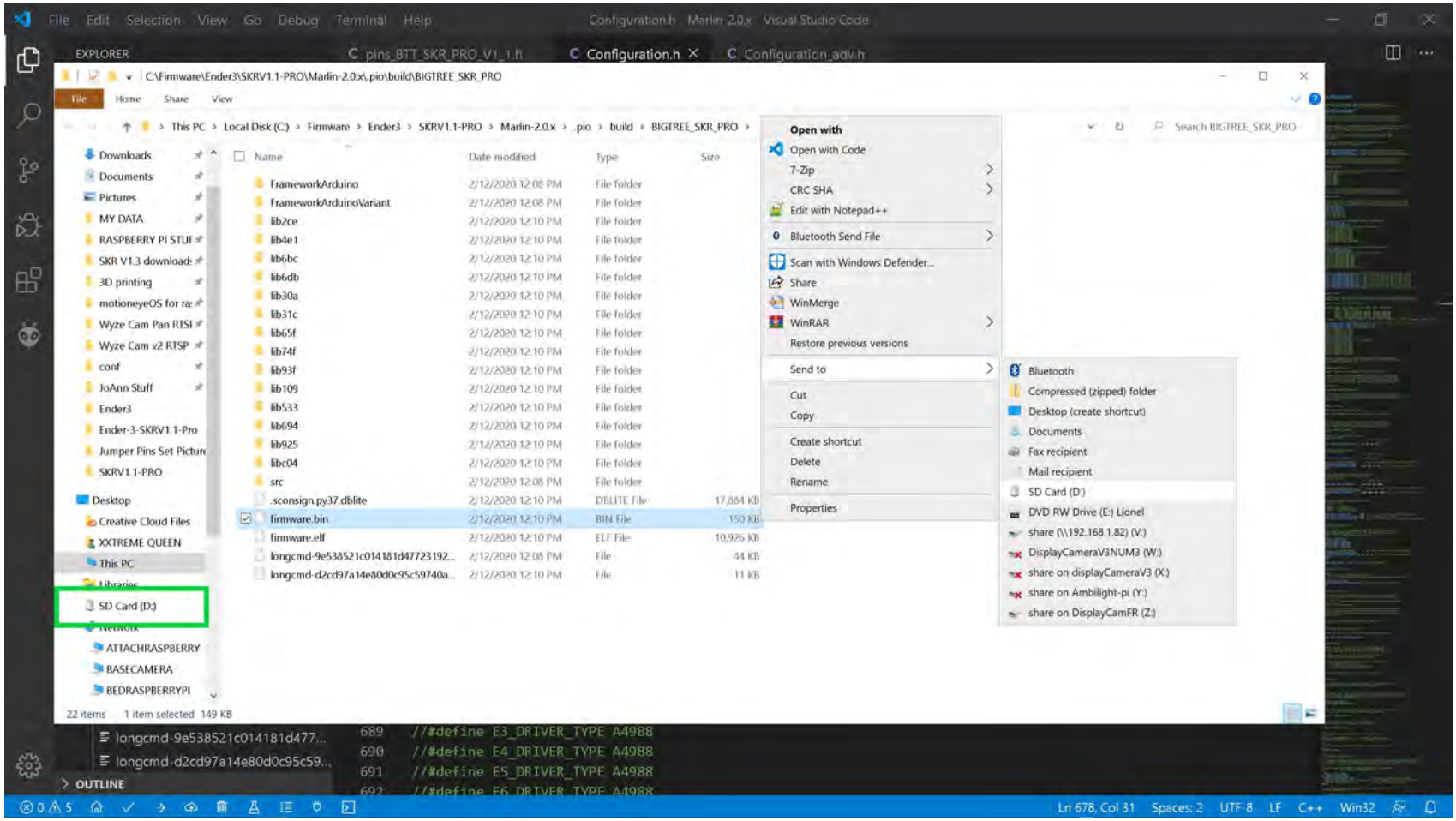
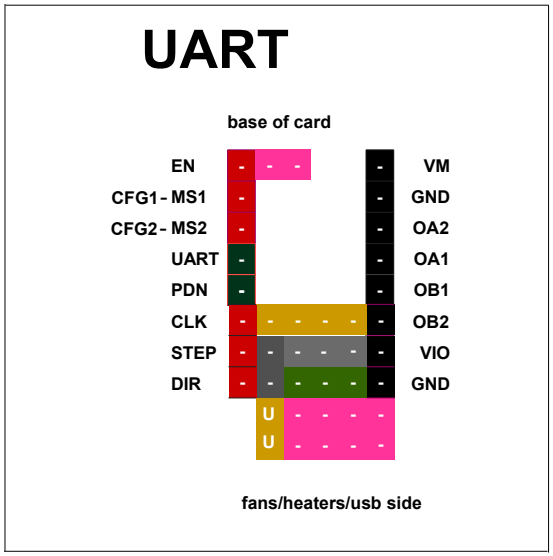


- Right click on the SD card reader, as seen in the GREEN box above, and select "Eject" from the context menu. Take the micro-SD card out of the adapter and place it into the micro-SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR"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

BIQU TMC2208 V3.0

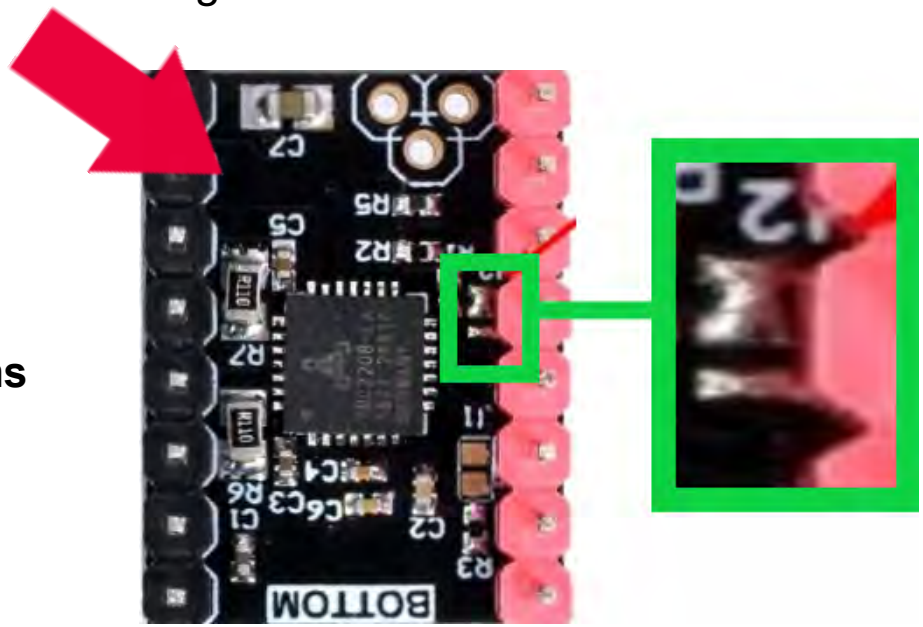
UART Mode



Driver Chip	**Steps are set inside of your Firmware**
TMC2208 UART mode 5.5v - 35v DC 1.7A Maximum subdivision 256	
Driving current calculation formula	$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$ $V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$

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. An example is shown in the picture below.

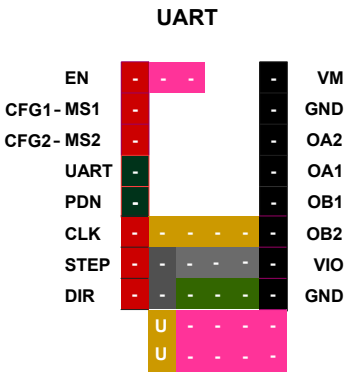
MOST BIQU TMC2208 V3.0 driver boards, when purchased for UART mode, will have two adjacent J2 pads already soldered together (located on the bottom of the driver board).



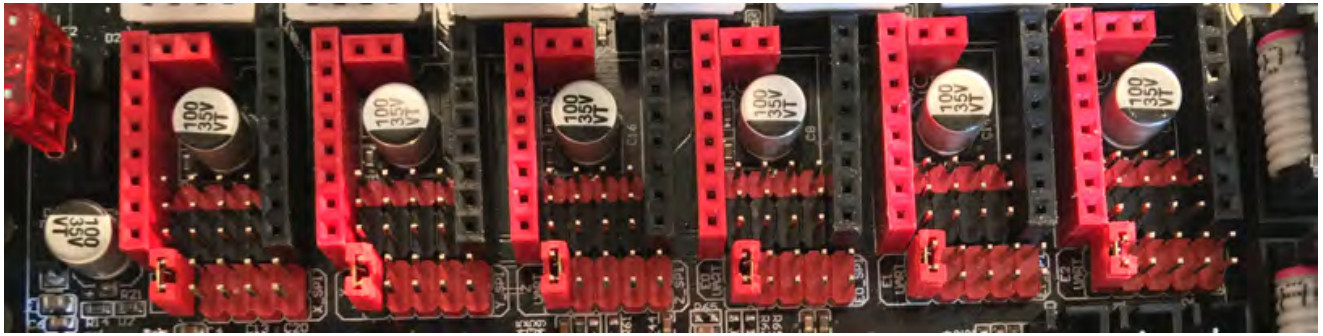
Note: You can use 50% to 90% of the calculated Irms (Imax/1.414) when tuning ("X_CURRENT", "Y_CURRENT", etc.) the stepper motor driver in the firmware.

UART

BIQU TMC2208 V3.0
UART Mode



Note: Set Jumper "U" for UART MODE!!

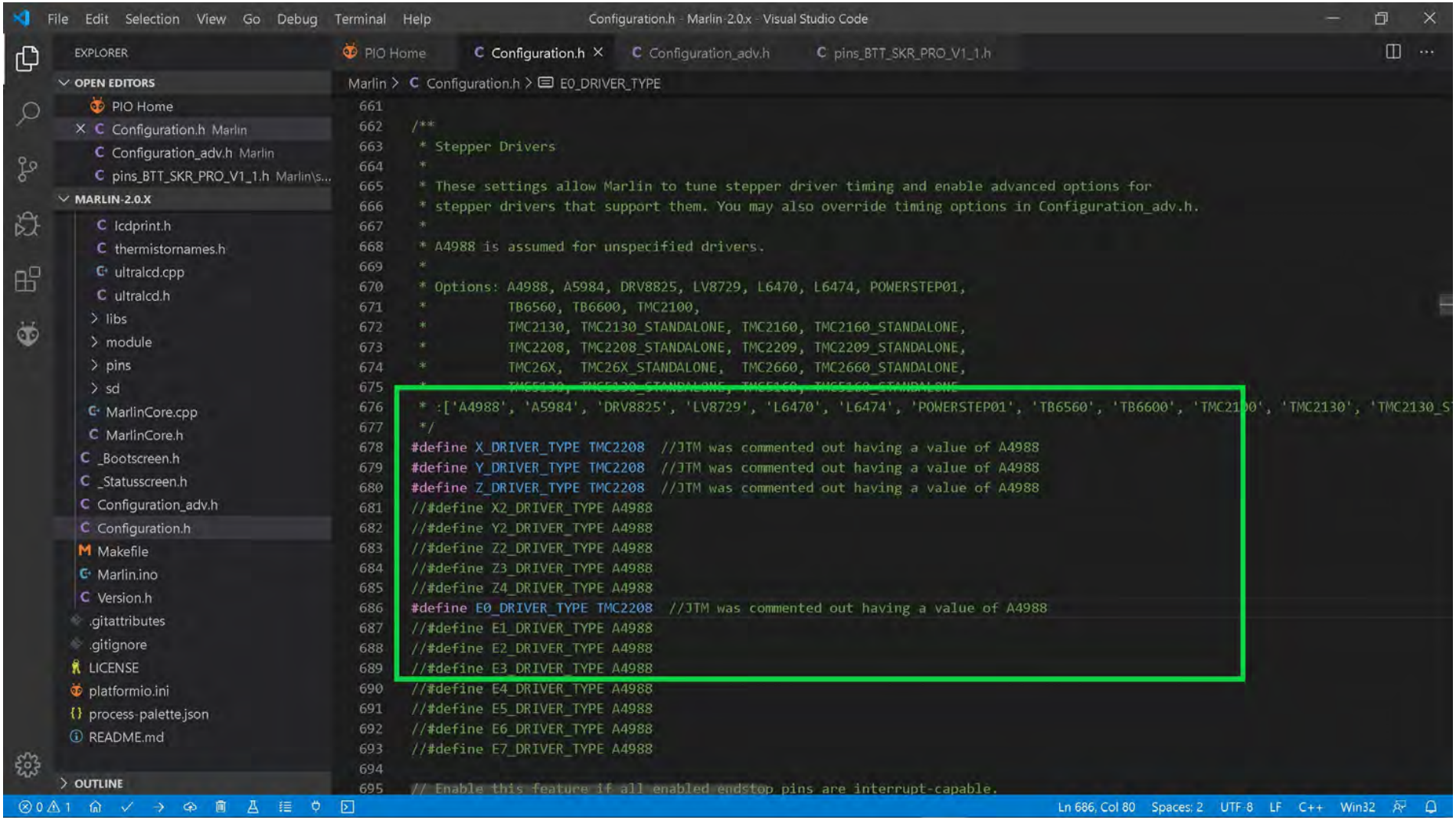


NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

NOTE: Go to Appendix C then come back here for the changes to Marlin for BIQU TMC2208 V3.0 stepper motor drivers in UART mode.

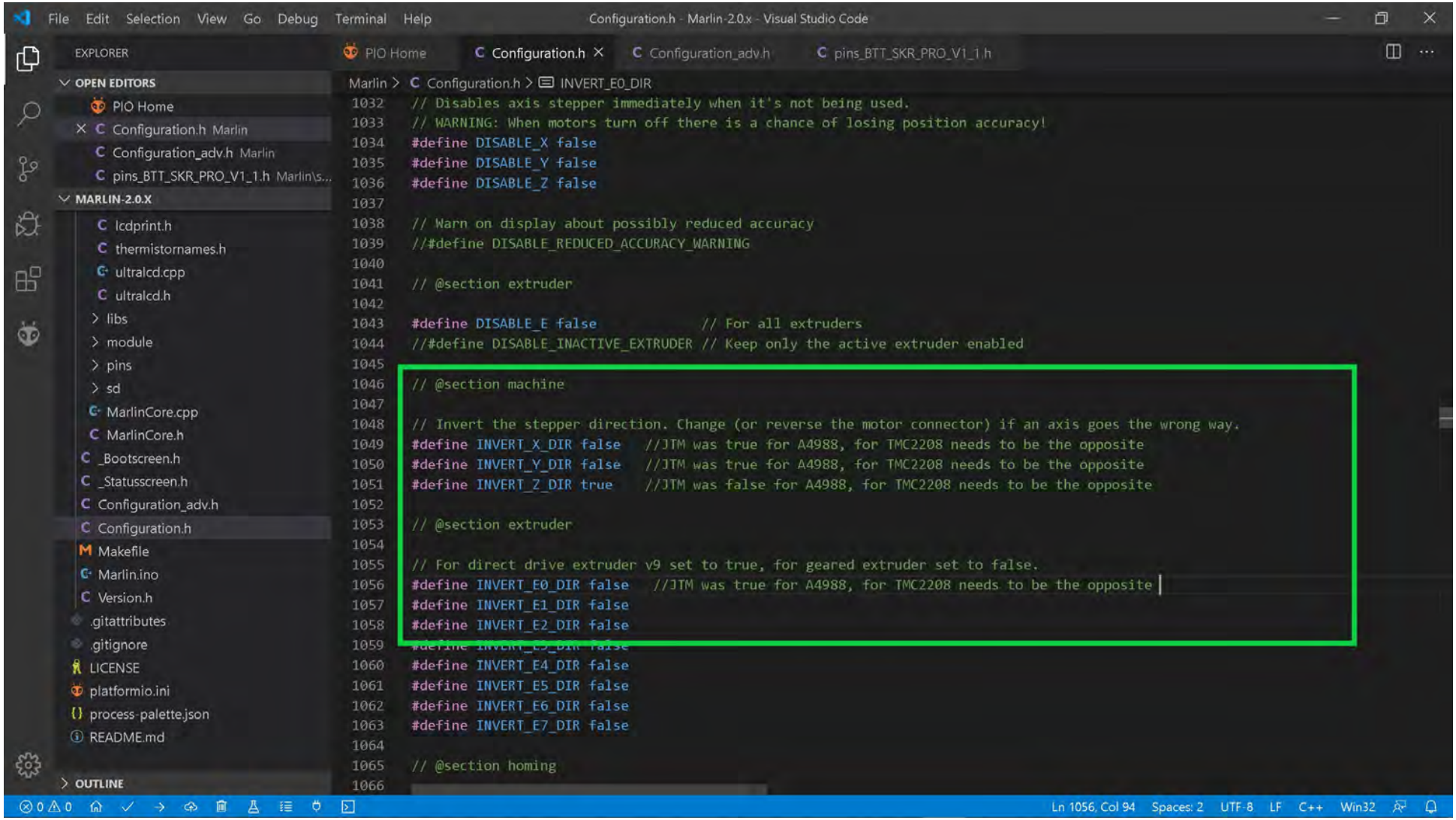
- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in UART mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in UART mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

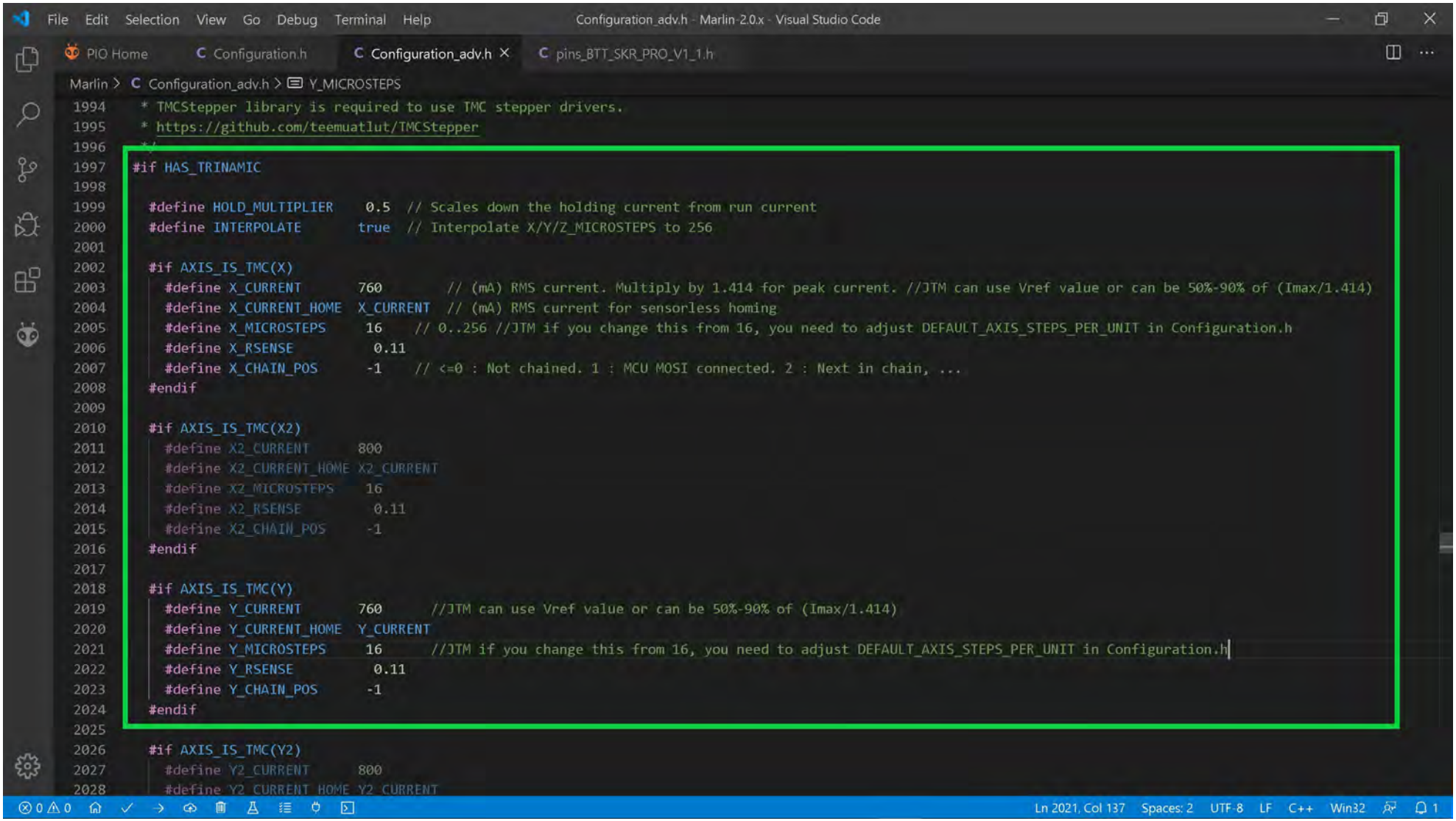
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

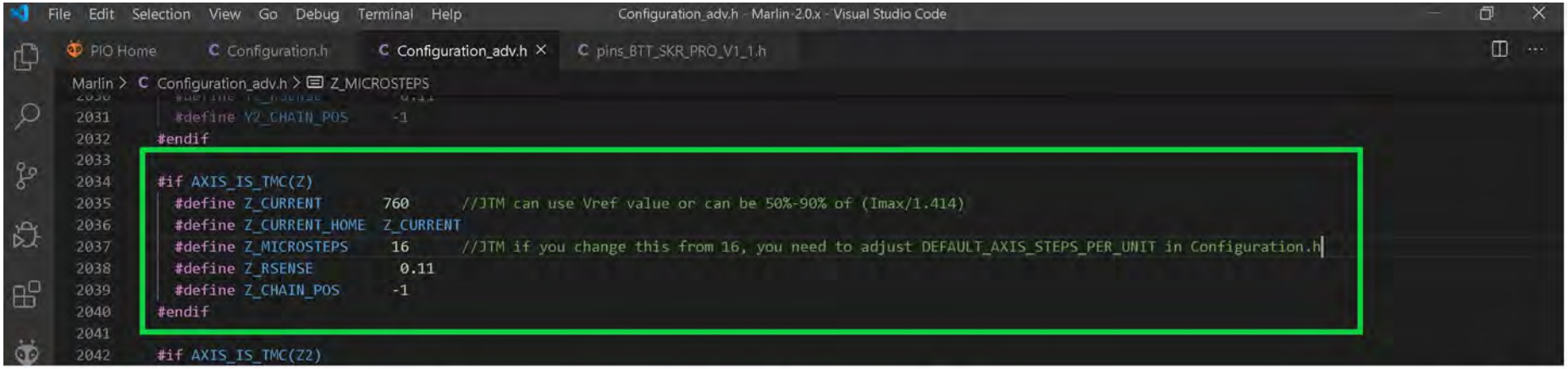
- next you want to set your Vref in the Marlin firmware for each axis that has the TMC2208 driver, as seen in the GREEN box below. I changed the "X_CURRENT" to be the calculated Vref for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated Vref for my Y-Axis, which is 760mV on the Ender 3.

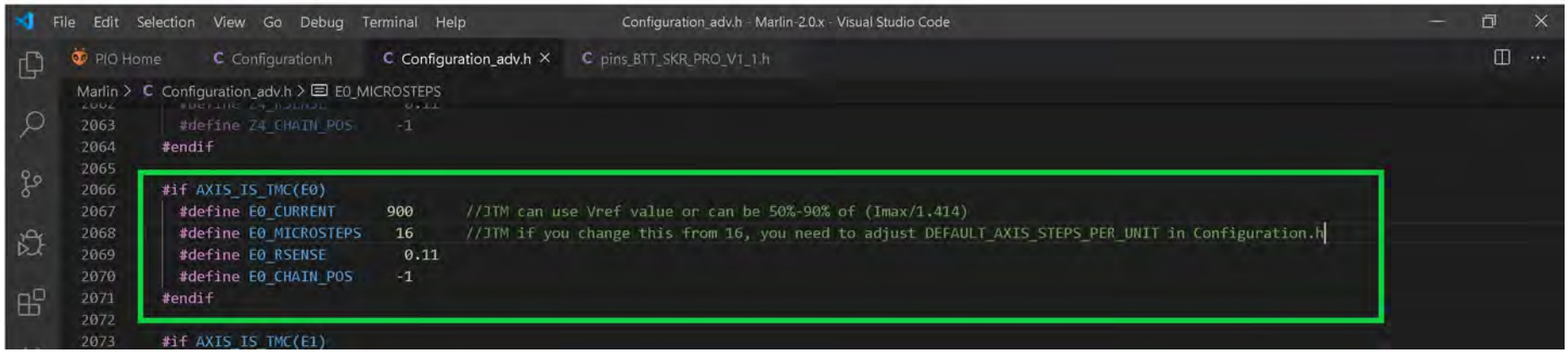


- Go to the next page.

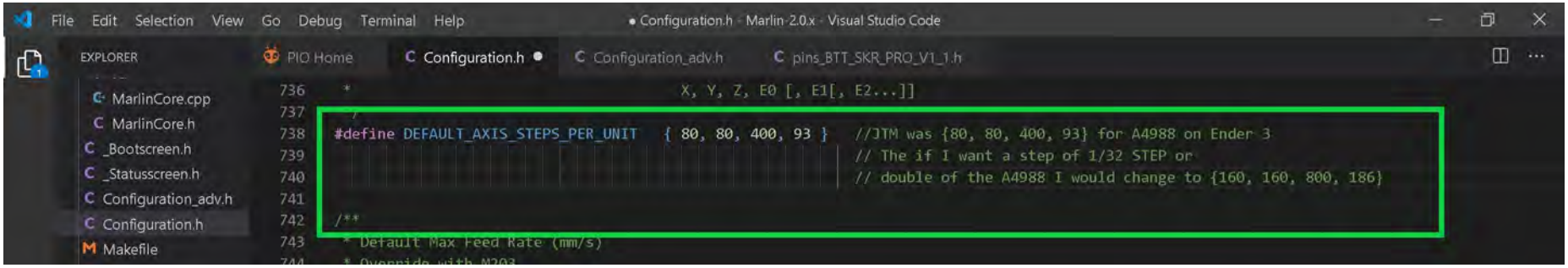
The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

- Now, I am setting the Vref for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated Vref for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated Vref for my Extruder, which is 900mV on the Ender 3.





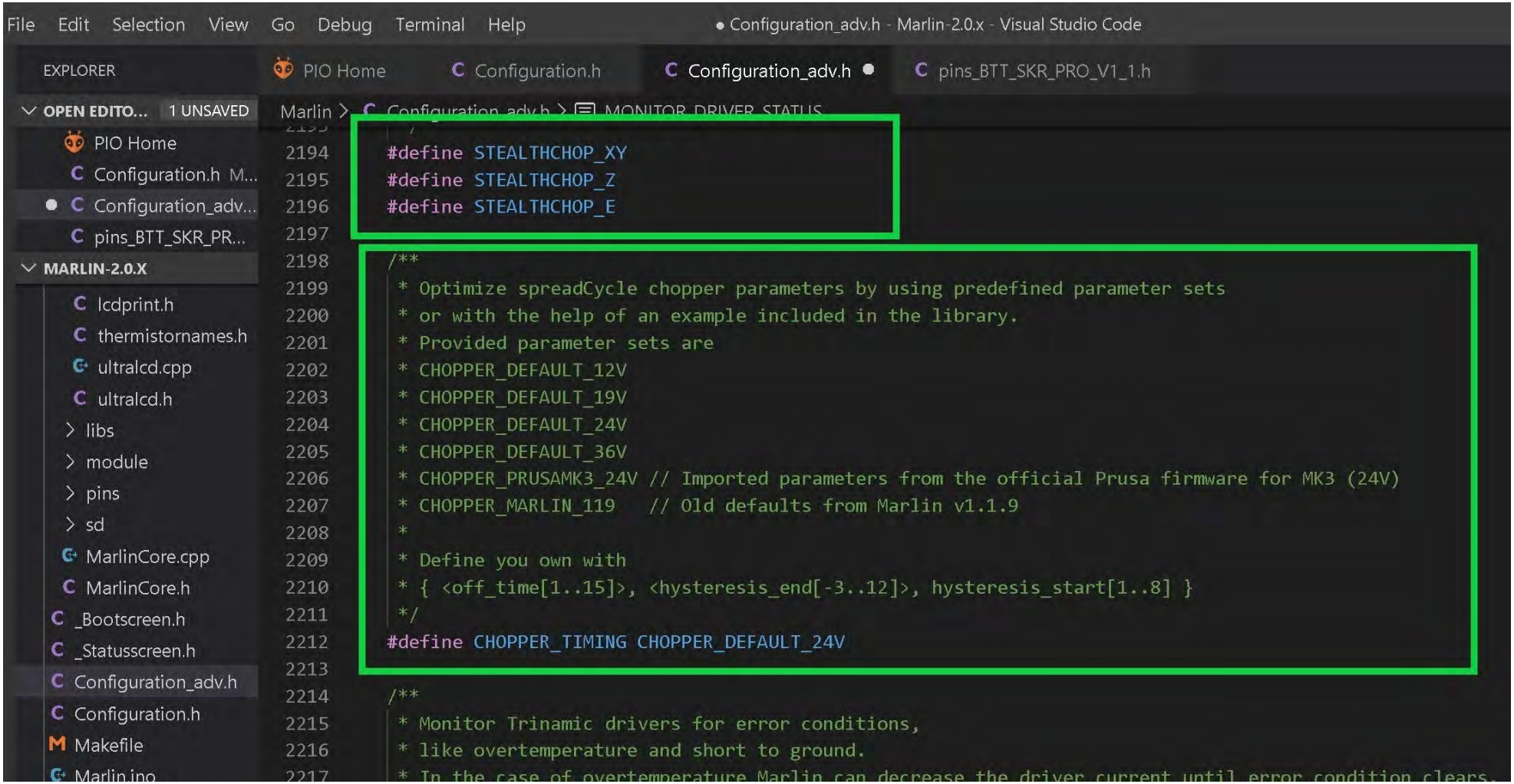
- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

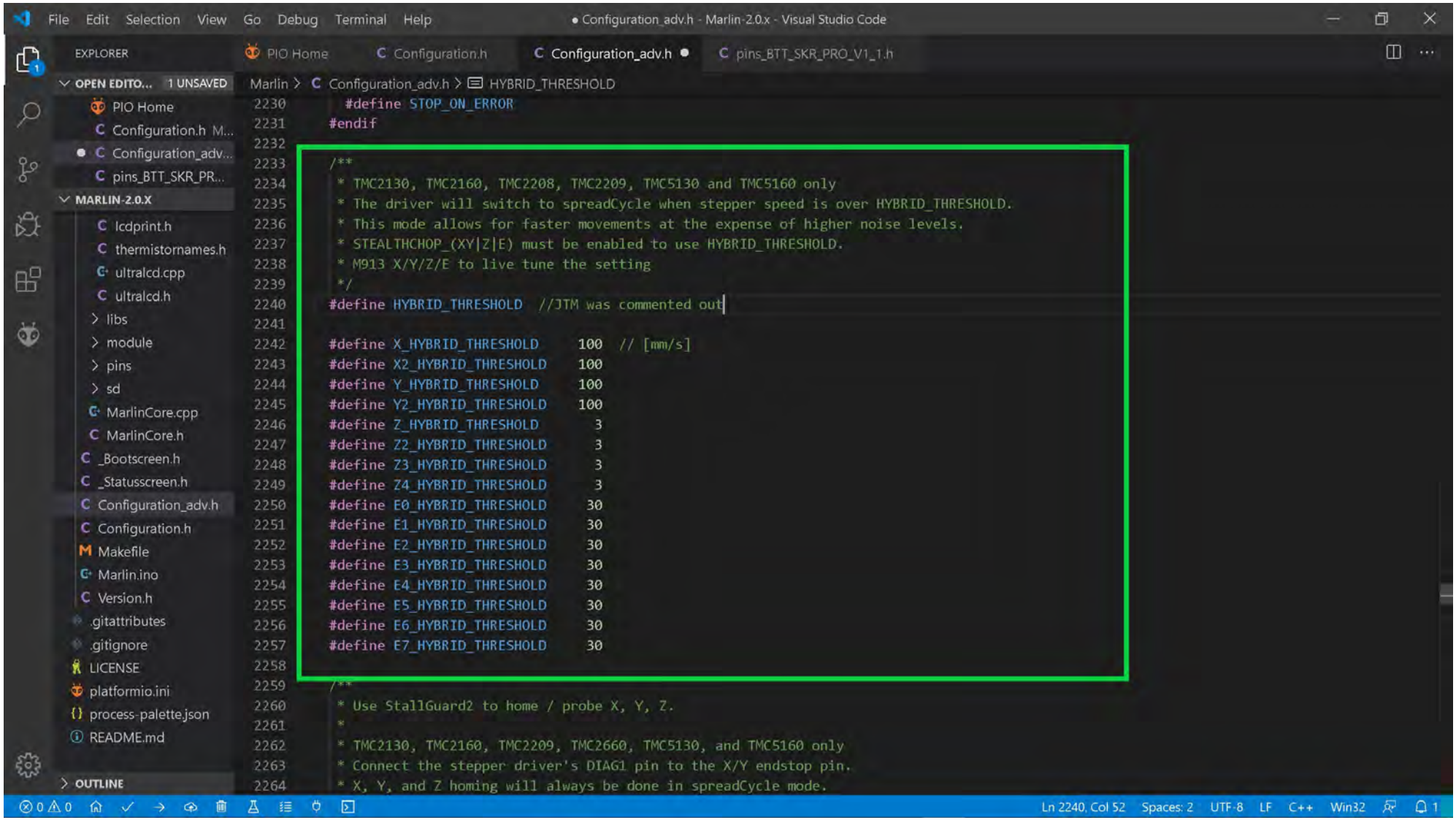
- By default stealthChop in enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.



- Go to the next page.

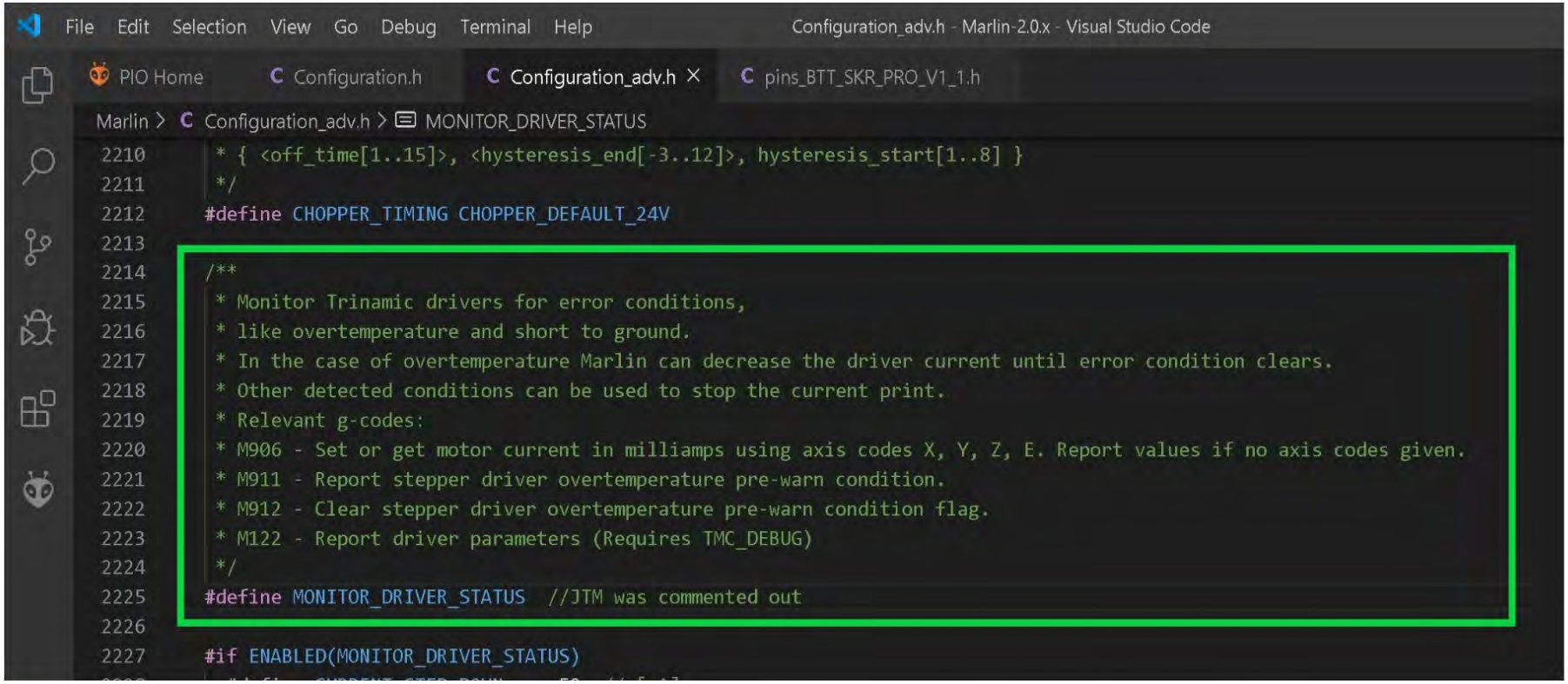
The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

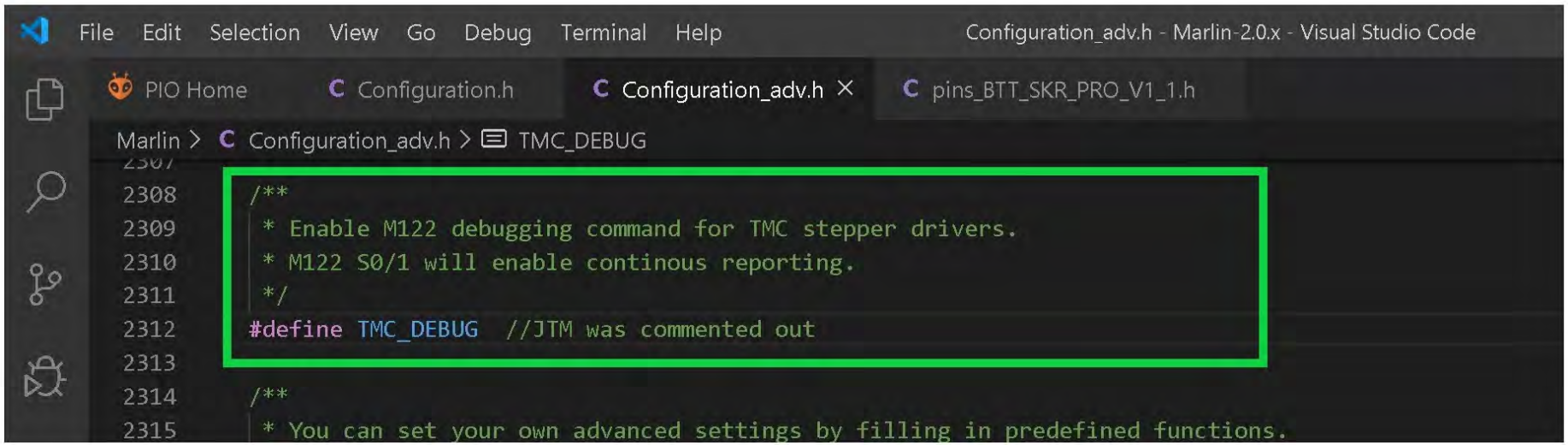
- Now you either enable "HYBRID_THRESHOLD" or disable it. By default, it is disabled. "HYBRID_THERSHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



- 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.
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

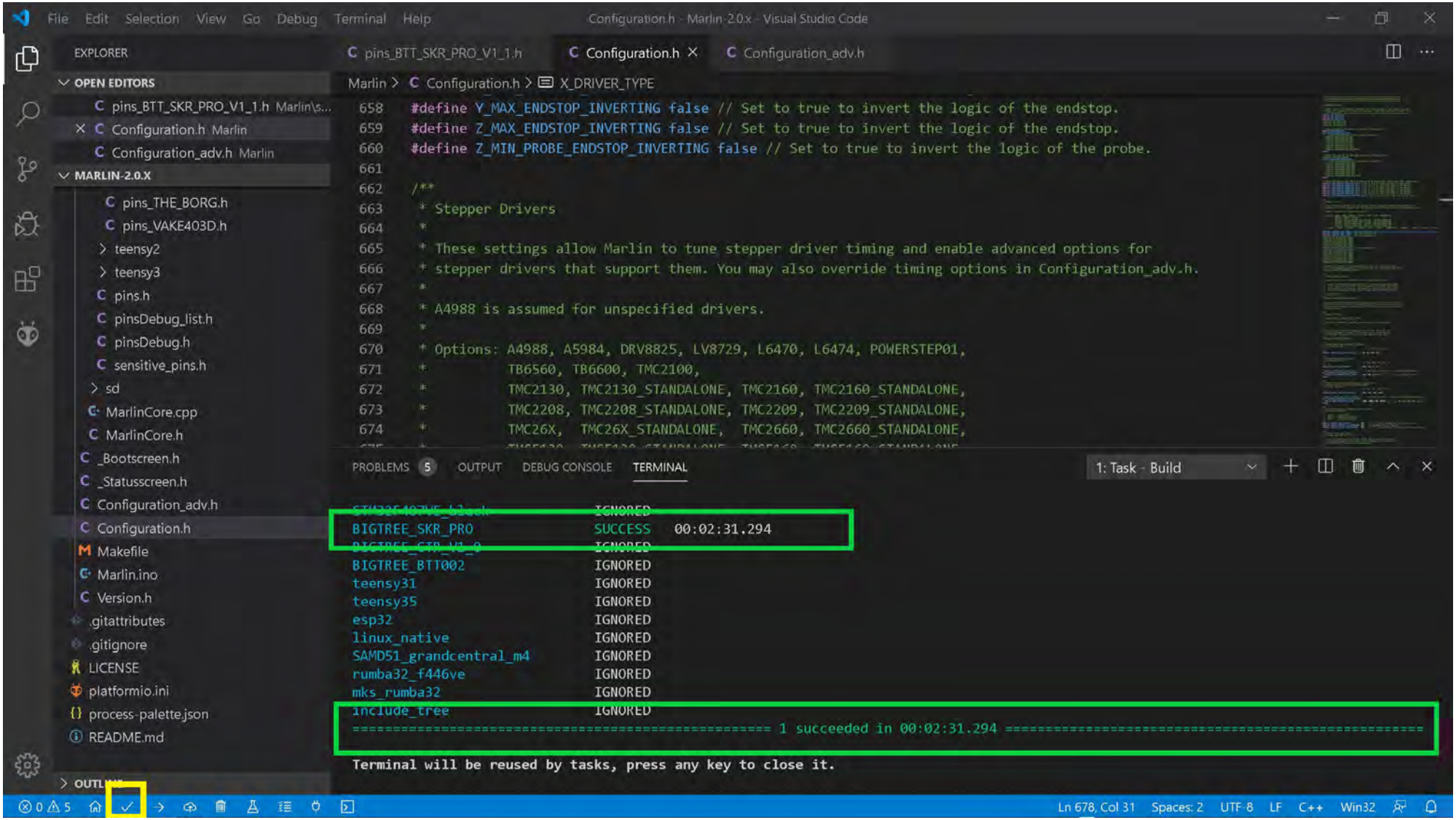




- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

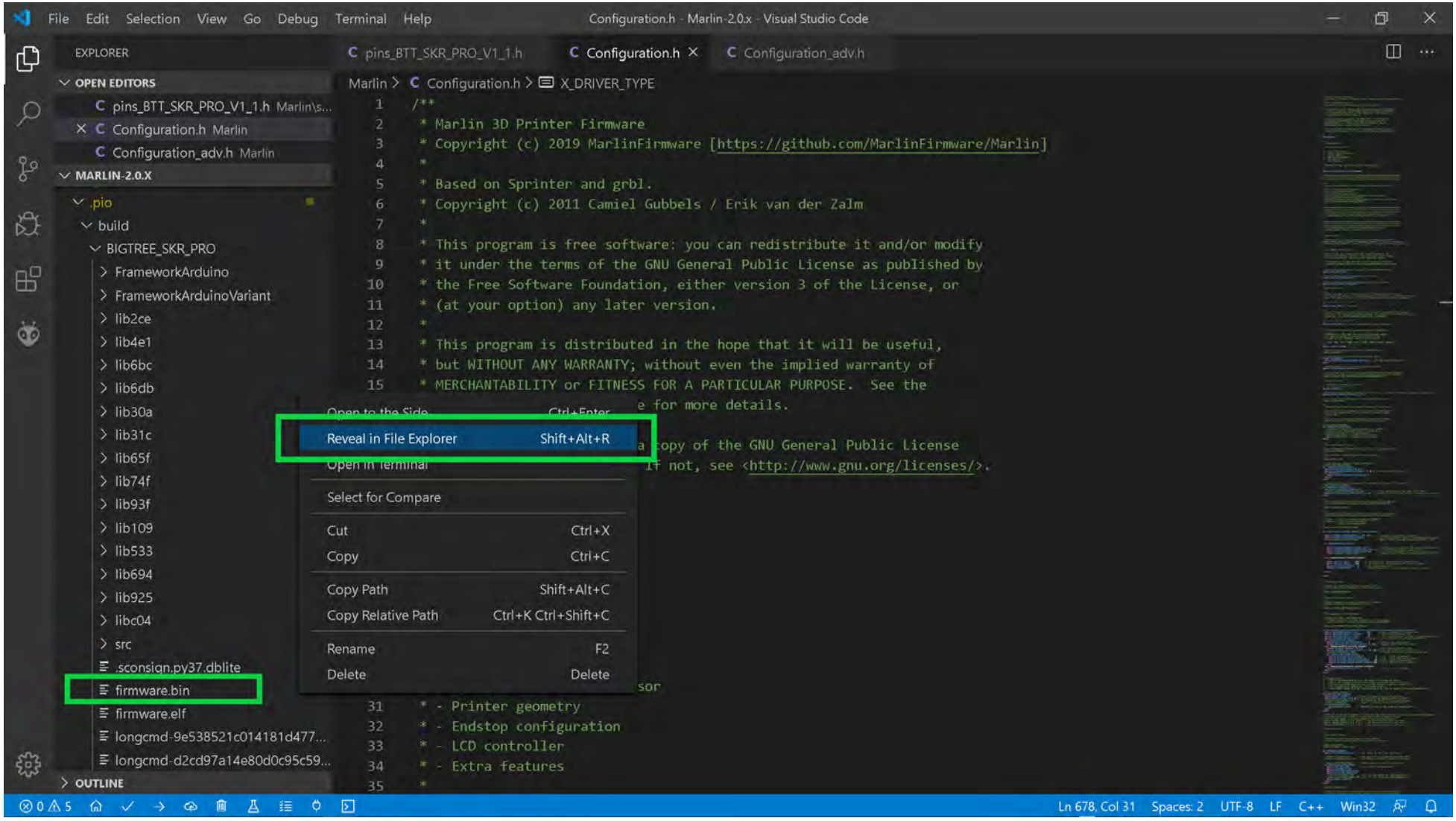
- The end of Marlin setup for BIQU TMC2208 V3.0 drivers in UART mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

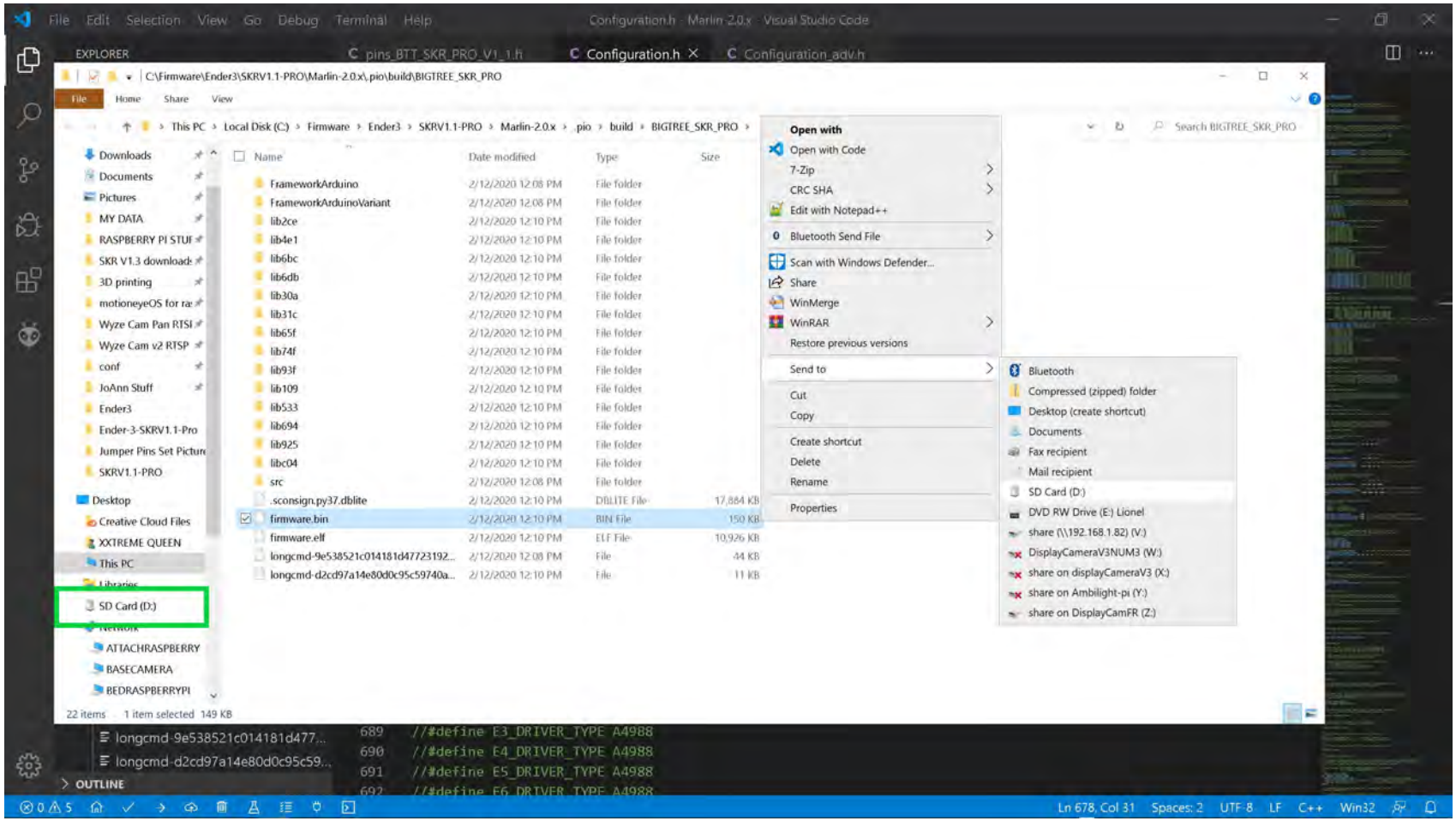
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window'ss machine open a file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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2208 V3.0 Drivers in UART Mode

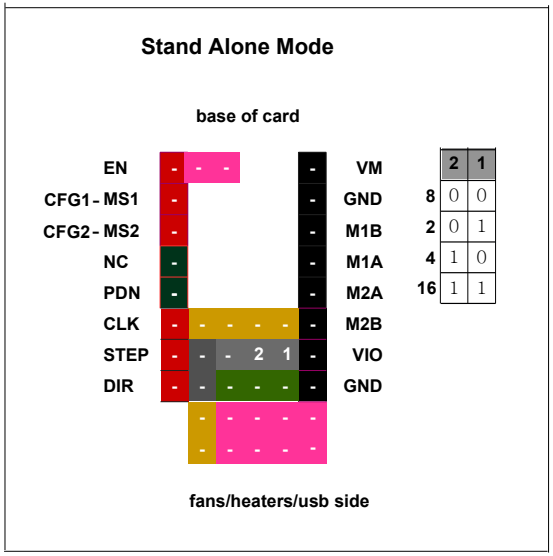
- Ensure your micro-SD card that came with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD 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 and renamed to "firmware.bin" on the micro-SD card.

FYSETC TMC2208 V1.2

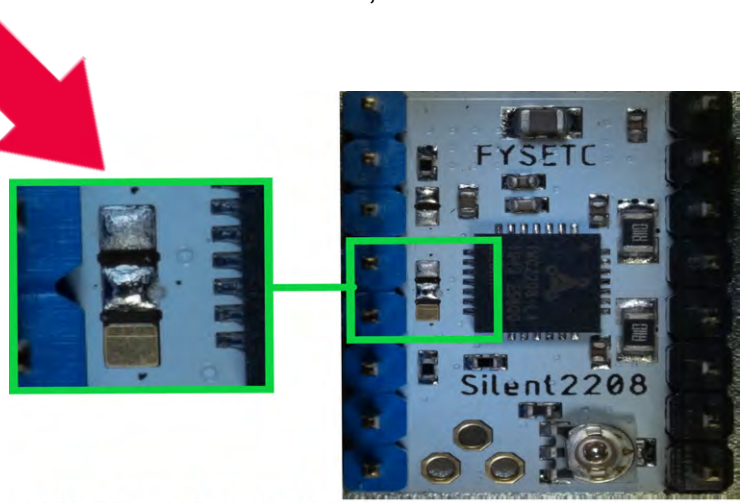
Stand Alone Mode



Driver Chip	CFG2/MS2	CFG1/MS1	Steps	Interpolation	Mode
FYSETC TMC2208 Standalone Mode 5.5V - 36V DC 2.0A Maximum subdivision 16	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	$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$				
Note: Use 90% of the calculated Vref when tuning the stepper driver board	$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$				

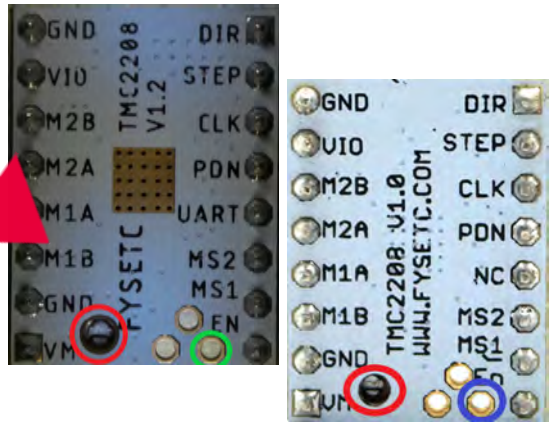
Note: To determine if your driver board is in UART mode, check the bottom of the driver board for three pads, located in the same position as shown in the picture below. There could be two or three pads located at this position (let's call it the "J2" position)!. To have the driver board in STANDALONE 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.

MOST FYSETC TMC2208 board 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!!



FYSETC TMC2208 V1.2 for Standalone Mode

NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref, as shown in RED; OR use the "Vref Test point" location on the top of the driver board, as shown in BLUE . See the appendix for instructions on how to set the Vref on a driver board

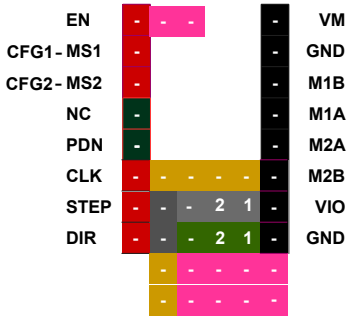


FYSETC TMC2208 V1.2

Stand Alone Mode

Stand Alone Mode

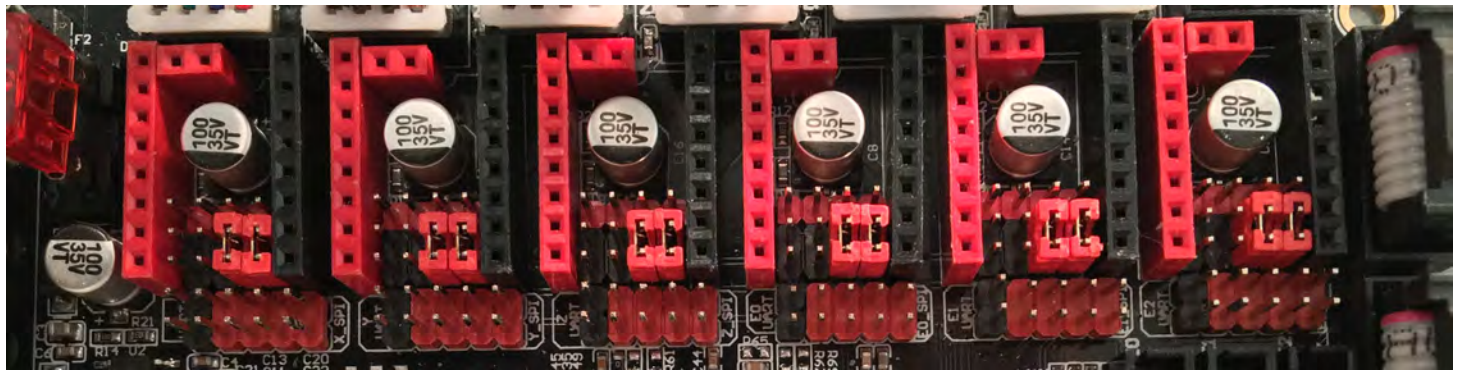
Stand Alone Mode



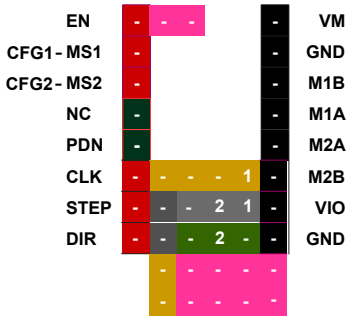
1/8

Interpolation: 1/256

StealthChop



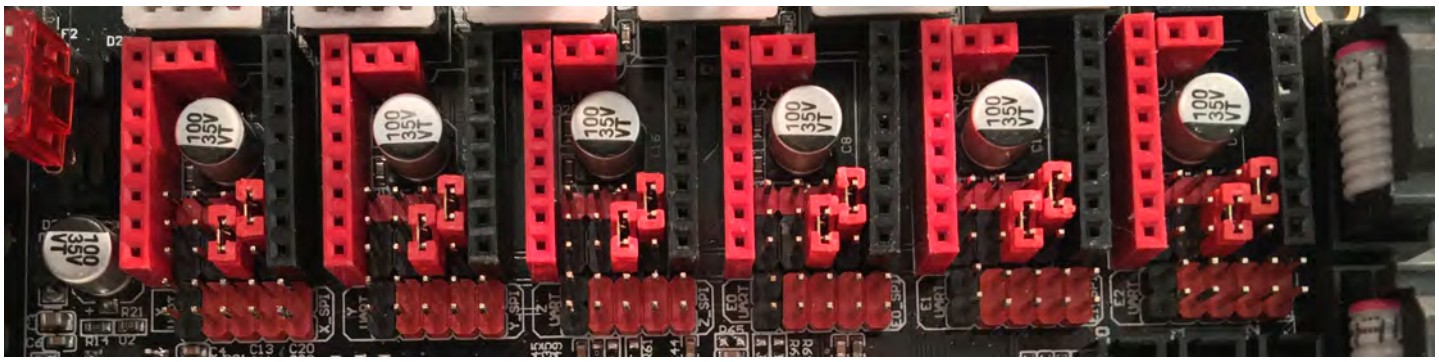
Stand Alone Mode



1/2

Interpolation: 1/256

StealthChop

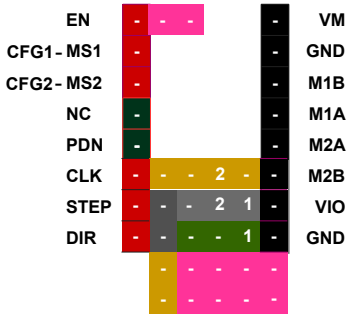


FYSETC TMC2208 V1.2

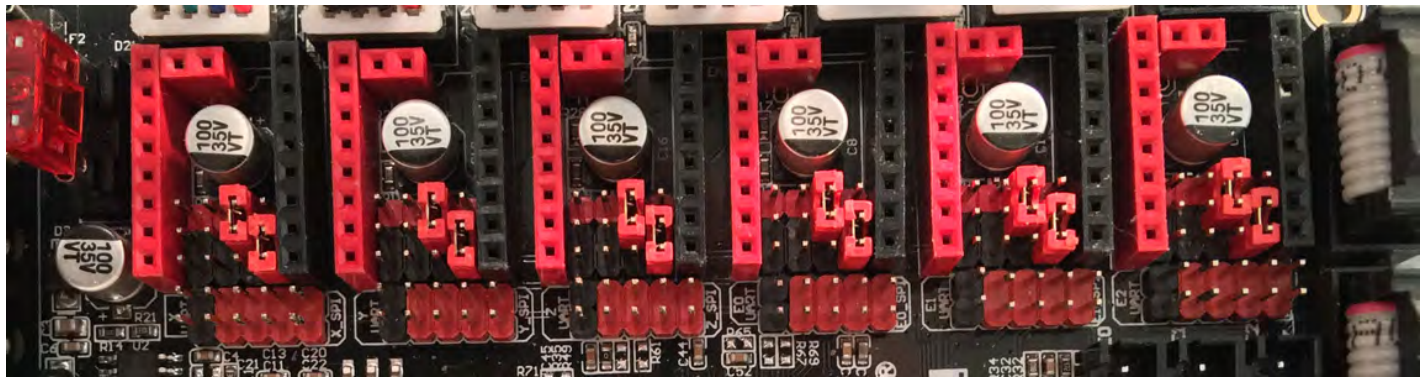
Stand Alone Mode

Stand Alone Mode

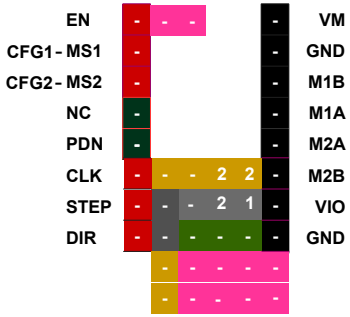
Stand Alone Mode



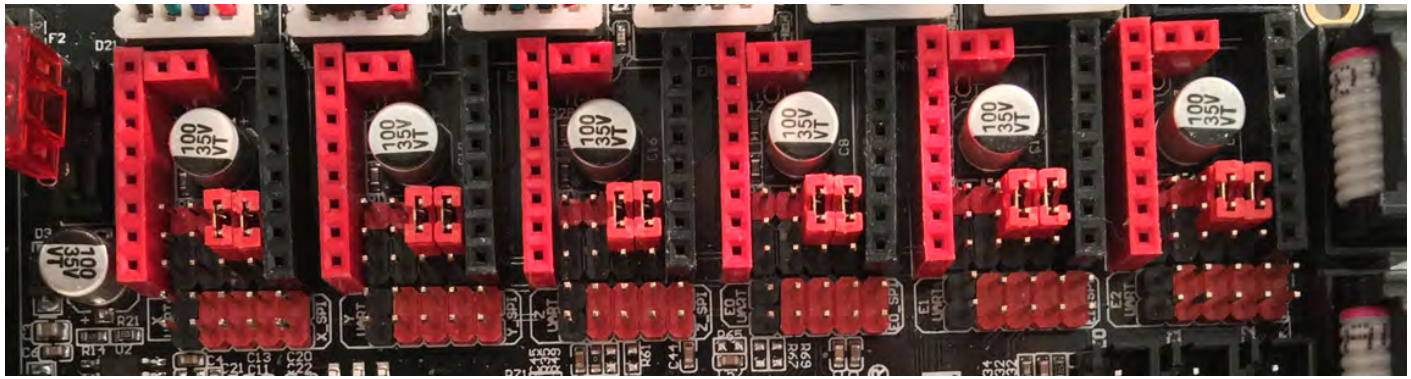
1/4
Interpolation: 1/256
StealthChop



Stand Alone Mode



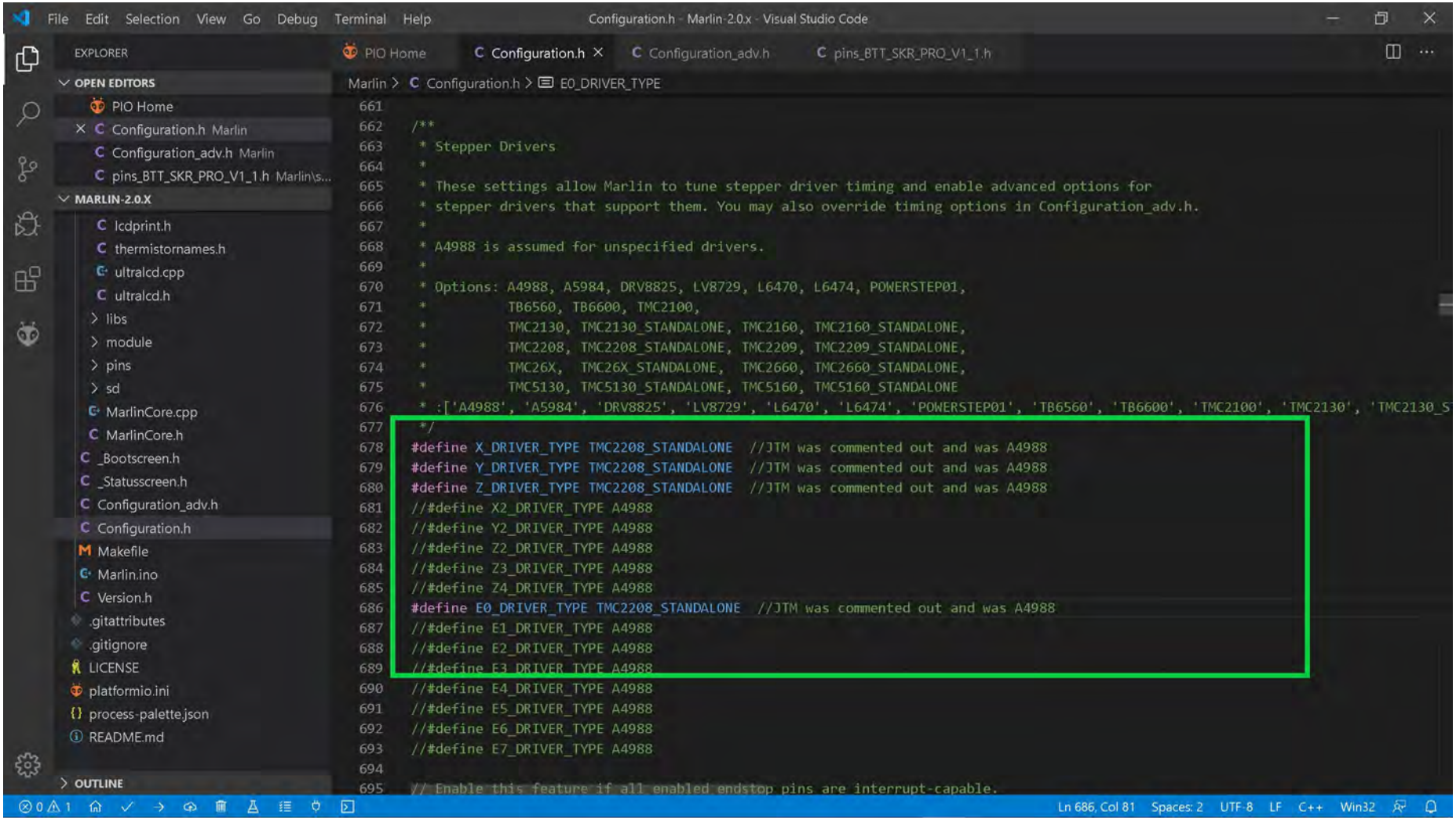
1/16
Interpolation: 1/256
StealthChop



The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand Alone Mode

NOTE: Go to Appendix C then come back here for the changes to Marlin for FYSETC TMC2208 V1.2 stepper motor drivers in stand alone mode.

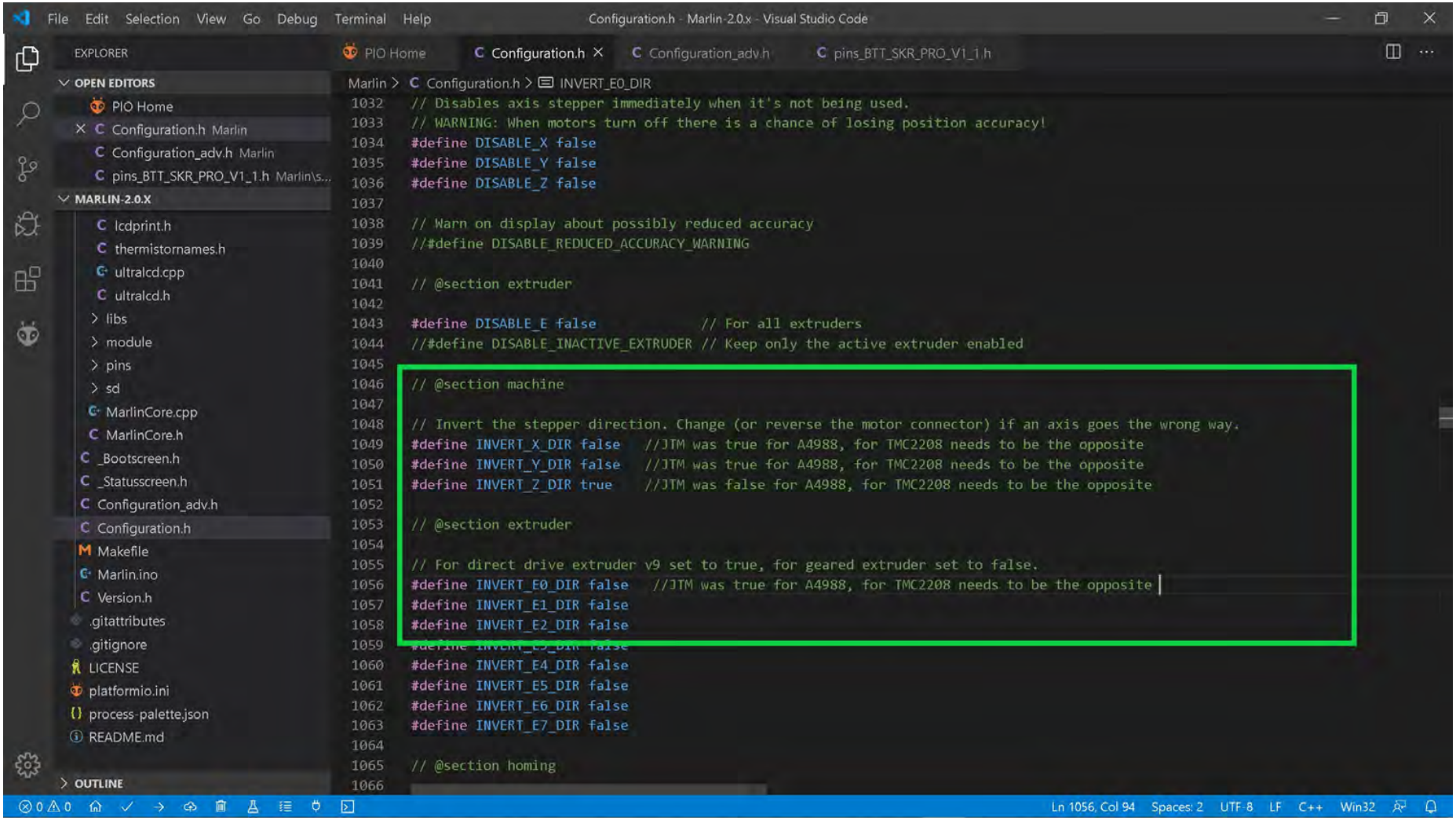
- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in stand alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in stand alone mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand Alone Mode

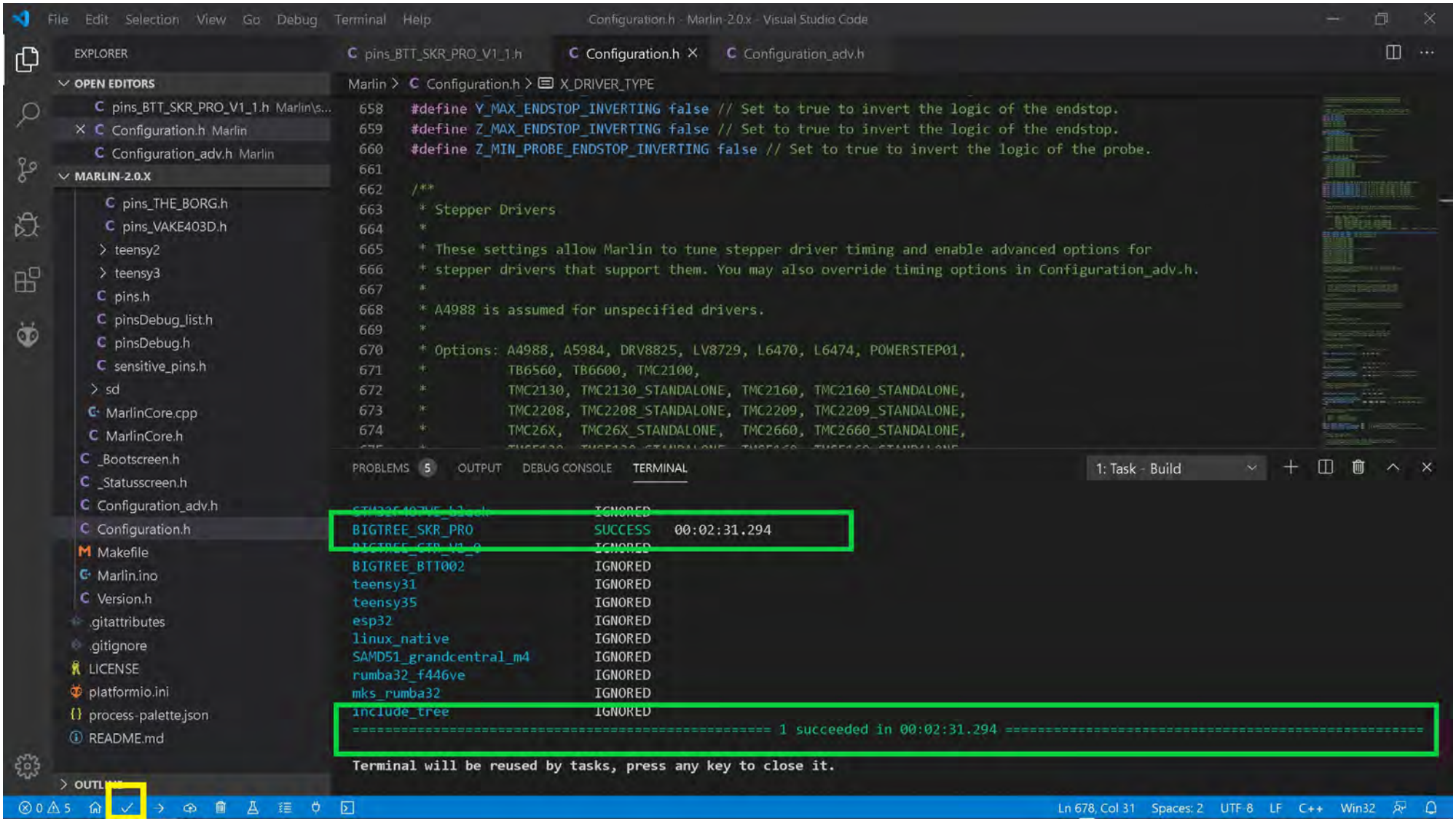
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 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



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand Alone Mode

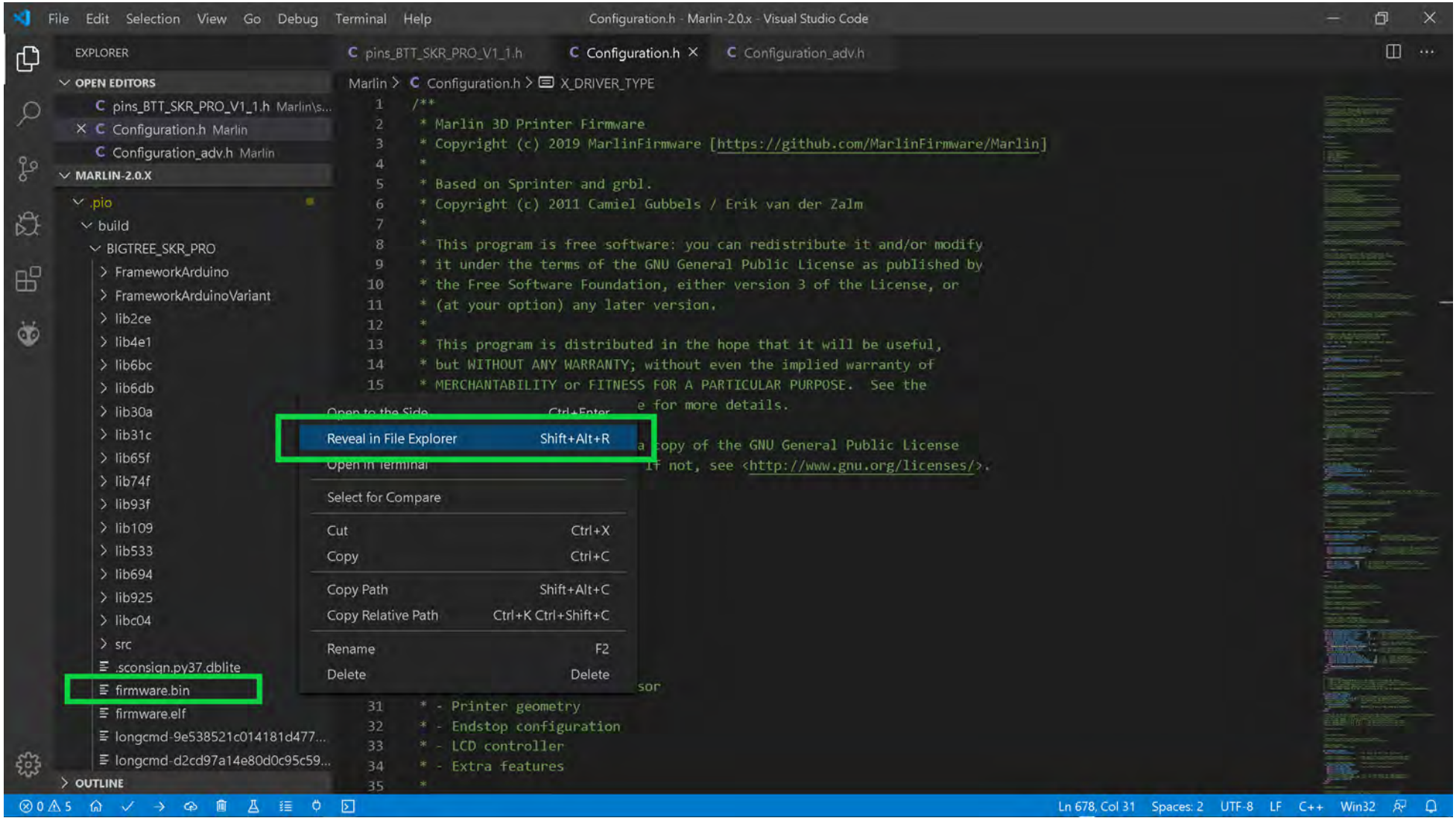
- The end of Marlin setup for FYSETC TMC2208 V1.2 drivers in stand alone mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

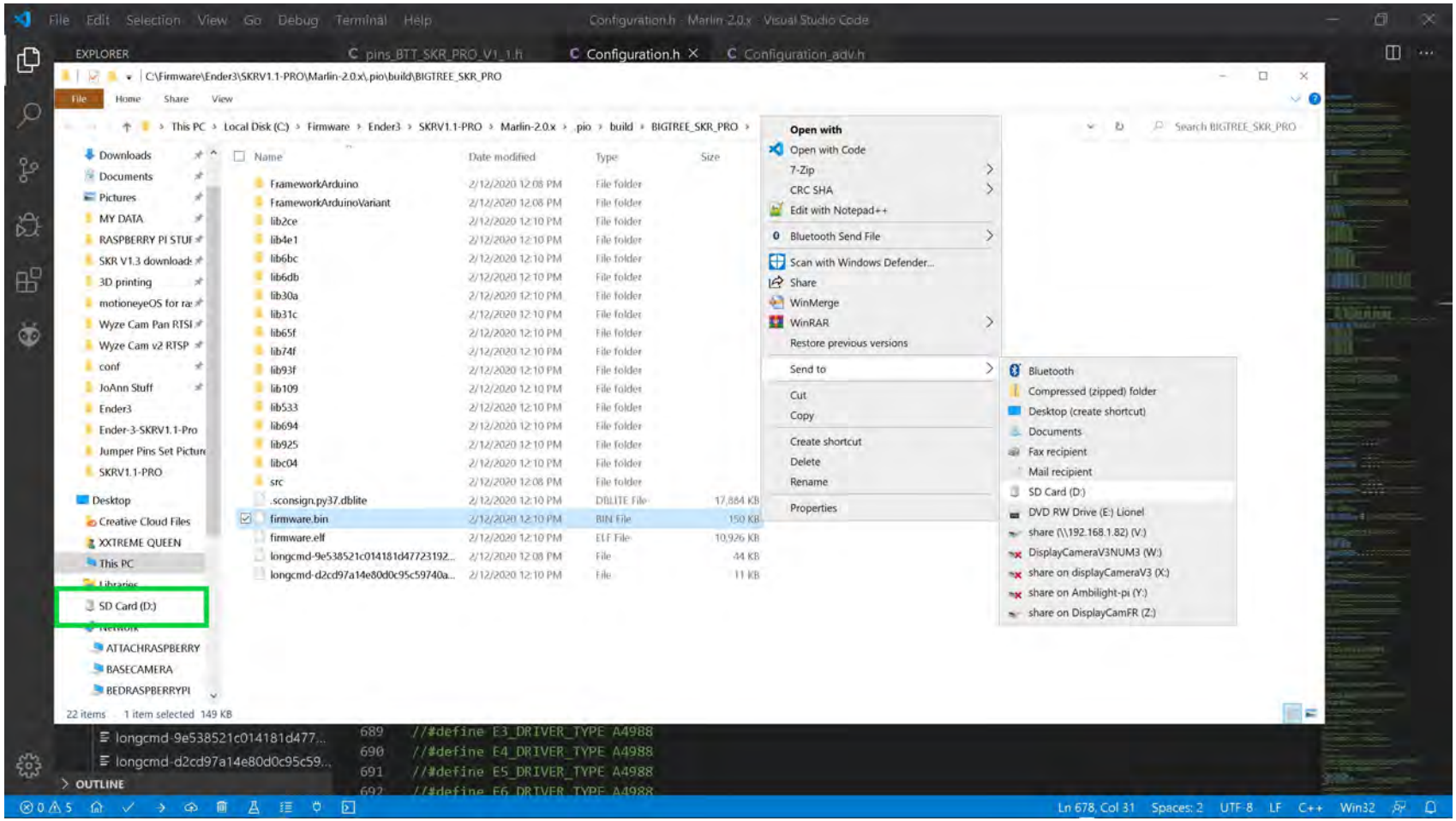
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in Stand Alone Mode

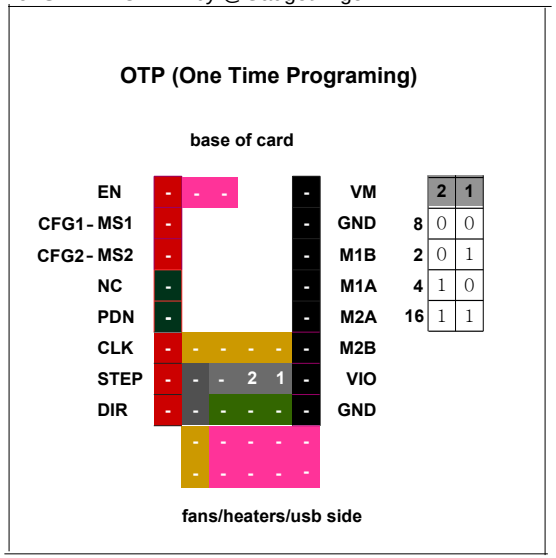
- Ensure your micro-SD card that came with your SKR PRO V1.1 board is in a micro-to-SD-card adapter and plugged into your Window's SD card reader.
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD 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 and renamed to "firmware.bin" on the micro-SD card.

FYSETC TMC2208 V1.2

One Time Programming (OTP) Mode



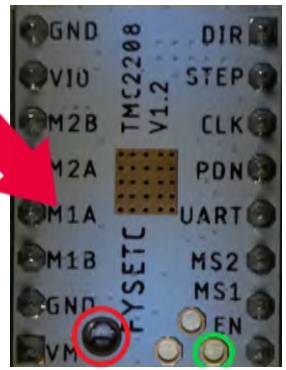
Driver Chip	CFG2/MS2	CFG1/MS1	Steps	Interpolation	Mode
FYSETC TMC2208 OPT Mode 5.5V - 36V DC 2.0A Maximum subdivision 16	GND	GND	1/8	1/256	spreadCycle
	GND	VIO	1/2	1/256	spreadCycle
	VIO	GND	1/4	1/256	spreadCycle
	VIO	VIO	1/16	1/256	spreadCycle
Driving current calculation formula	$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$				
Note: Use 90% of the calculated Vref when tuning the stepper driver board	$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$				

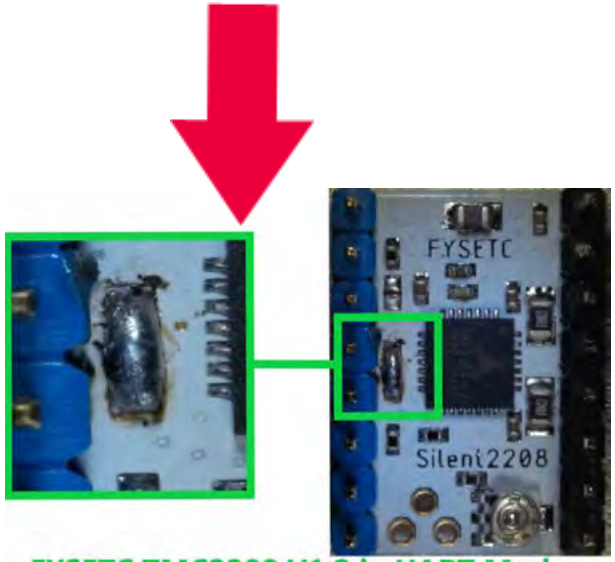
NOTE: Stand Alone Mode by default uses StealthChop, if you want SpreadCycle, you MUST use OTP mode. Here are the directions for running the TMC220x Configurator: https://wiki.fysetc.com/TMC2208/#to-run-the-program. See TMC220x Configurator for One-Time-Programming Information: TMC220x Configurator.

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.

MOST FYSETC TMC2208 board 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)!**

NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref, as shown in RED; OR use the "Vref Test point" location on the top of the driver board, as shown in BLUE . See the appendix for instructions on how to set the Vref on a driver board





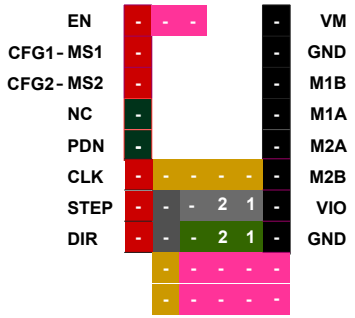
FYSETC TMC2208 V1.2 in UART Mode

FYSETC TMC2208 V1.2

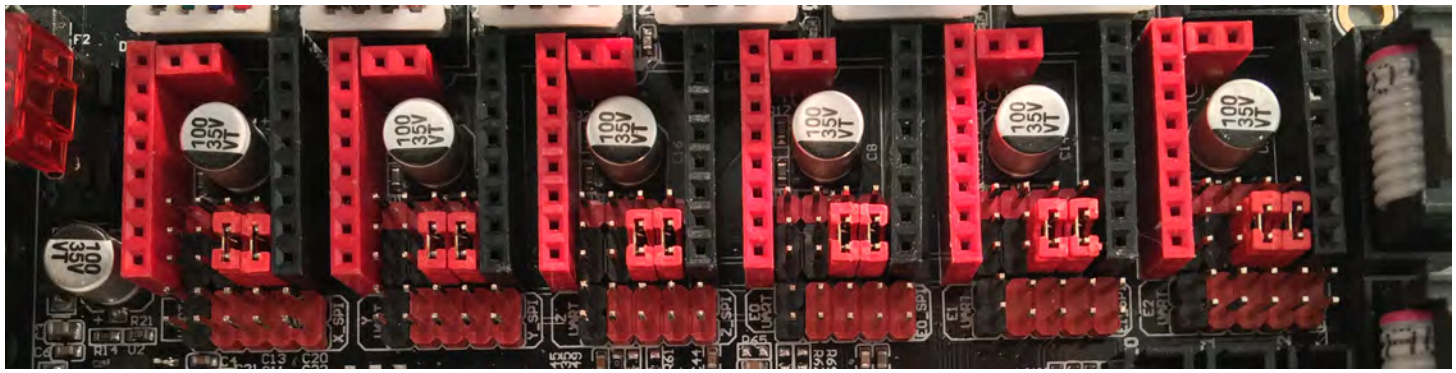
One Time Programming (OTP) Mode

OTP (One Time Programing)

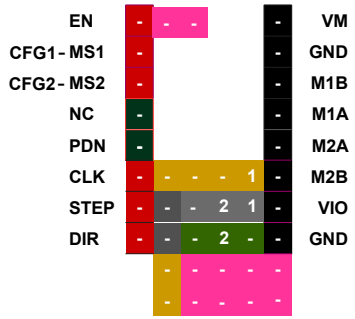
OTP (One Time Programing)



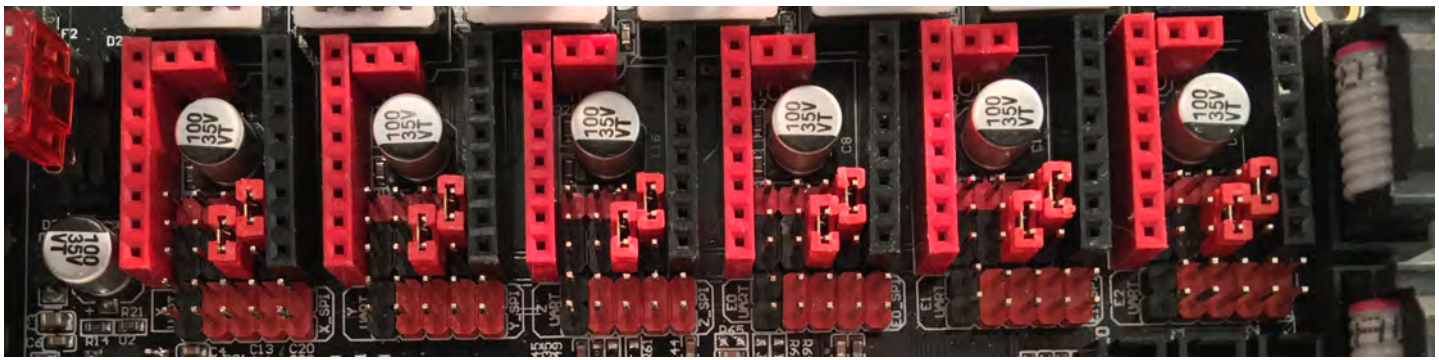
1/8
Interpolation: 1/256
SpreadCycle



OTP (One Time Programing)



1/2
Interpolation: 1/256
SpreadCycle



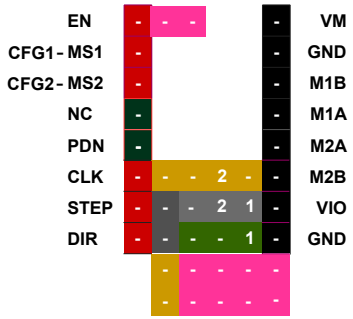
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

FYSETC TMC2208 V1.2

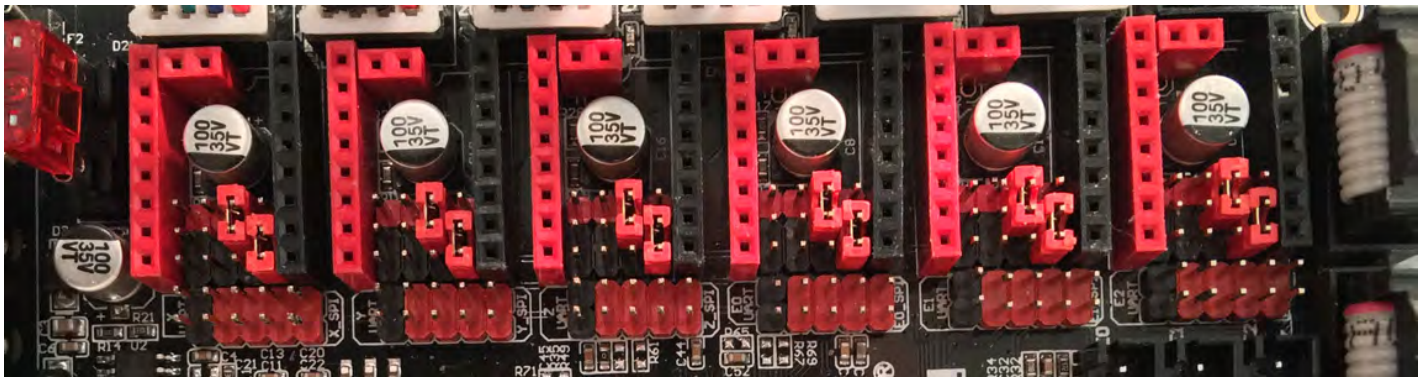
One Time Programming (OTP) Mode

OTP (One Time Programing)

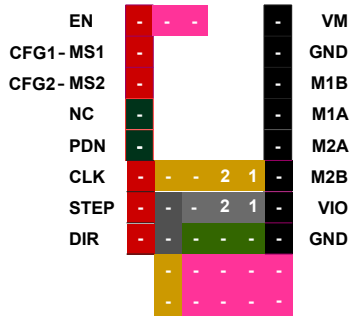
OTP (One Time Programing)



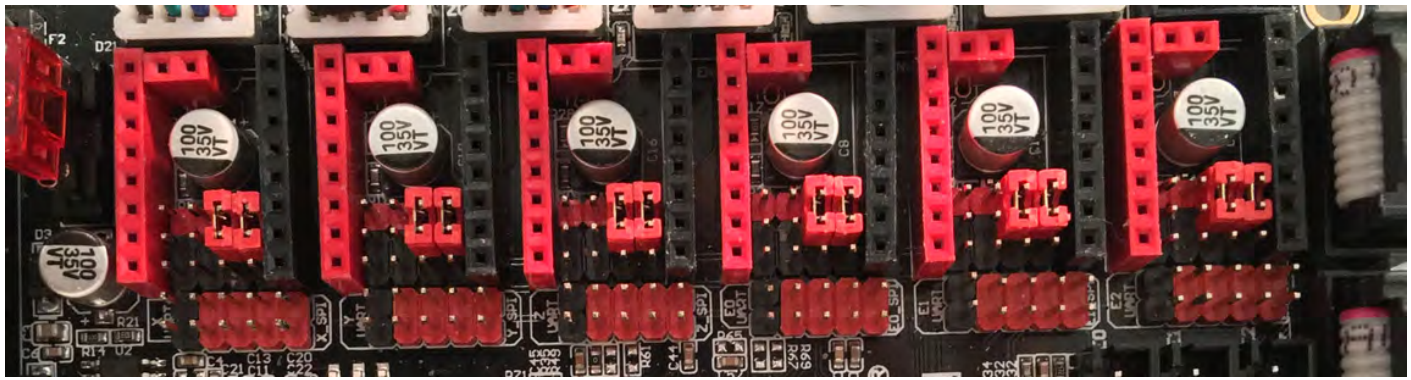
1/4
Interpolation: 1/256
SpreadCycle



OTP (One Time Programing)



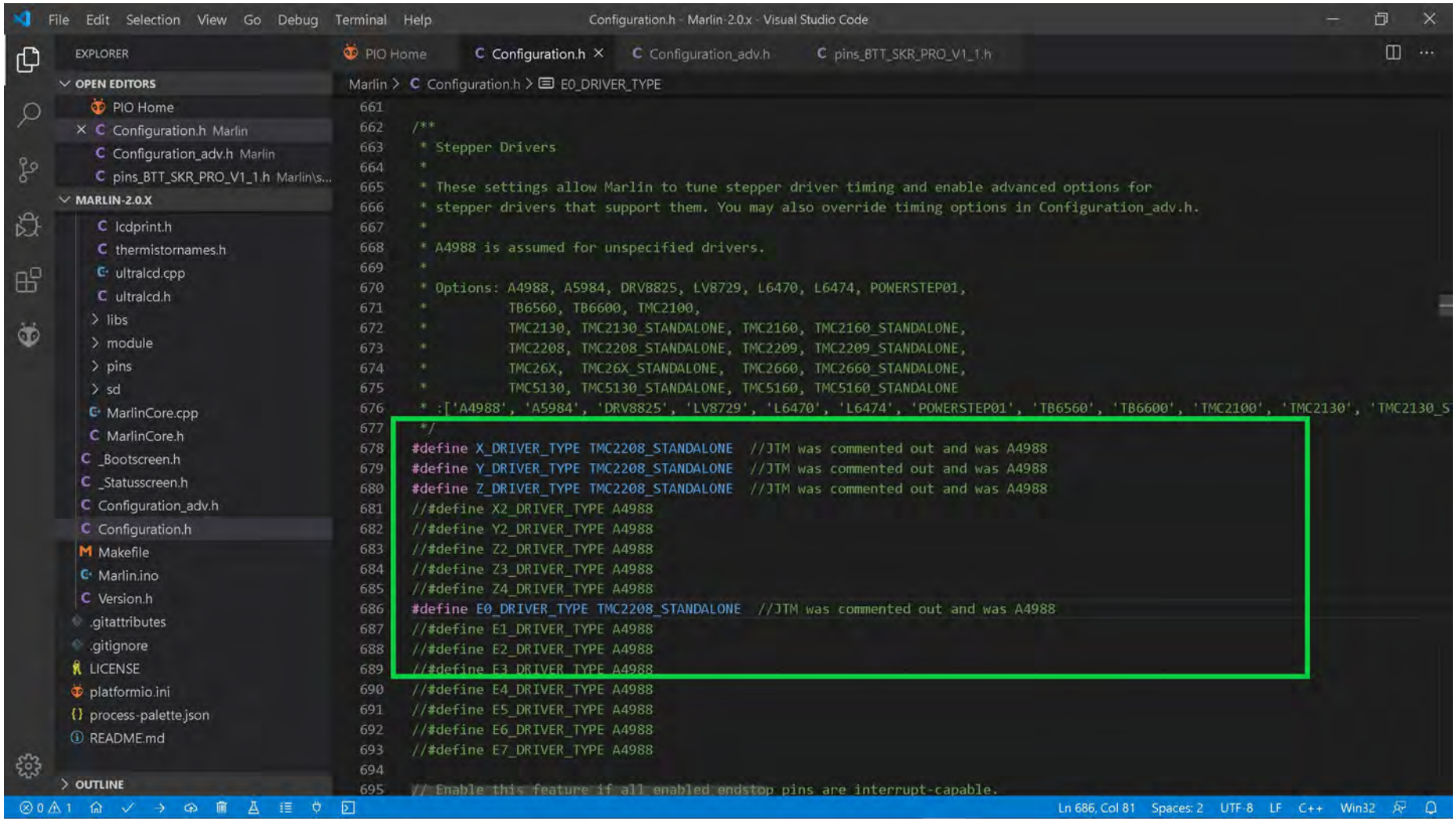
1/16
Interpolation: 1/256
SpreadCycle



The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

NOTE: Go to Appendix C then come back here for the changes to Marlin for FYSETC TMC2208 V1.2 stepper motor drivers in OTP mode.

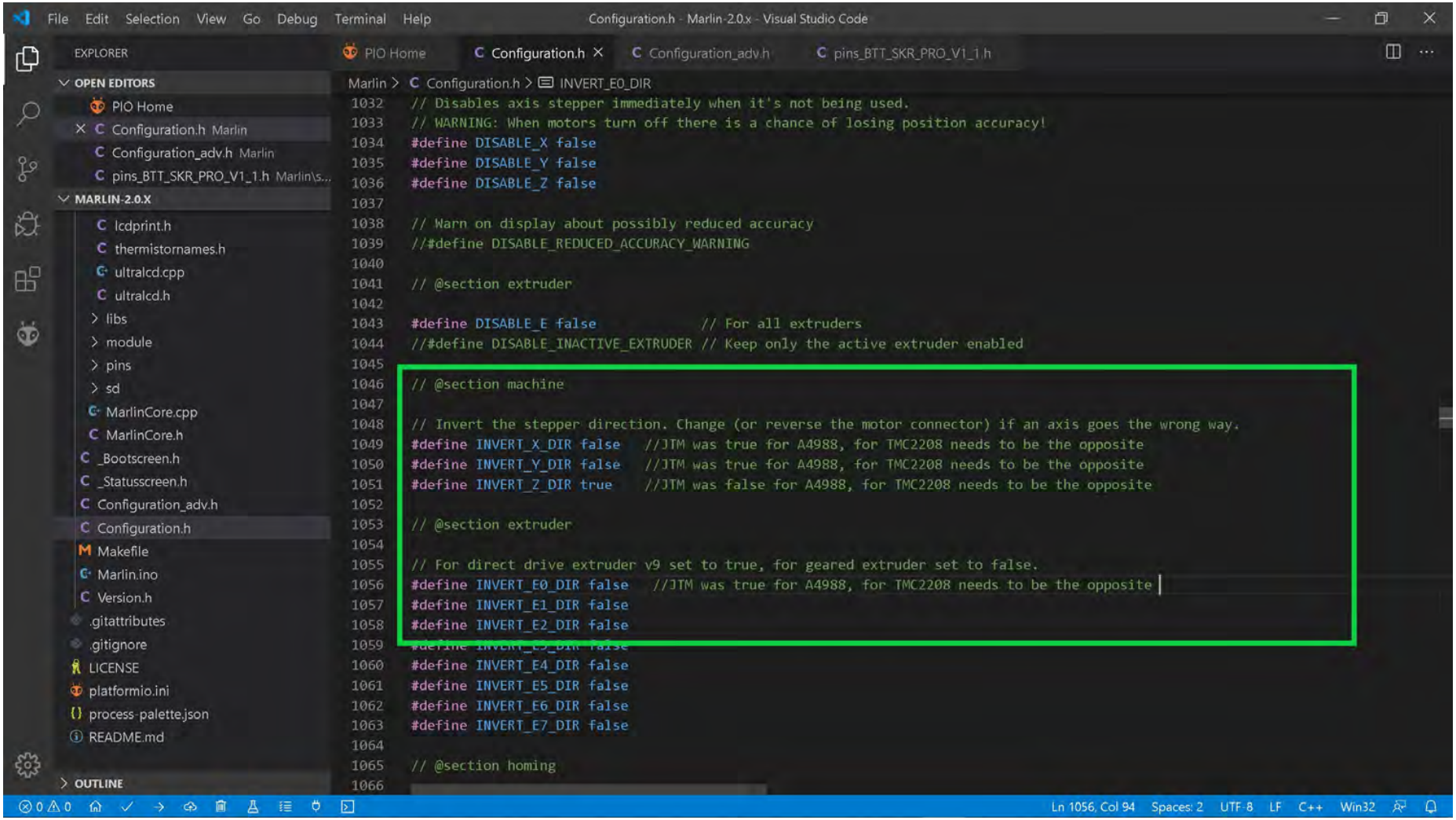
- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in OTP mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in OTP mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

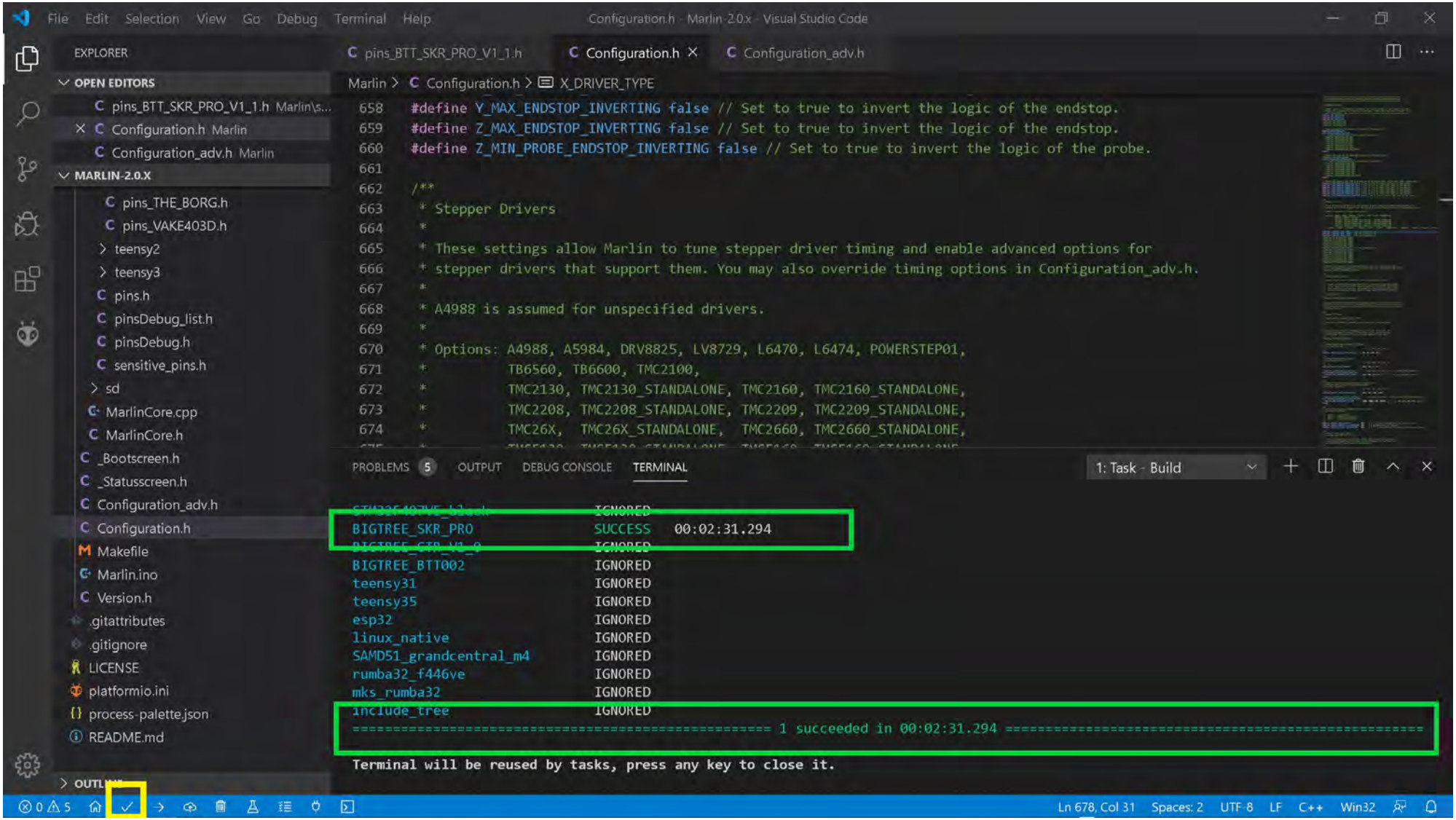
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 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



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

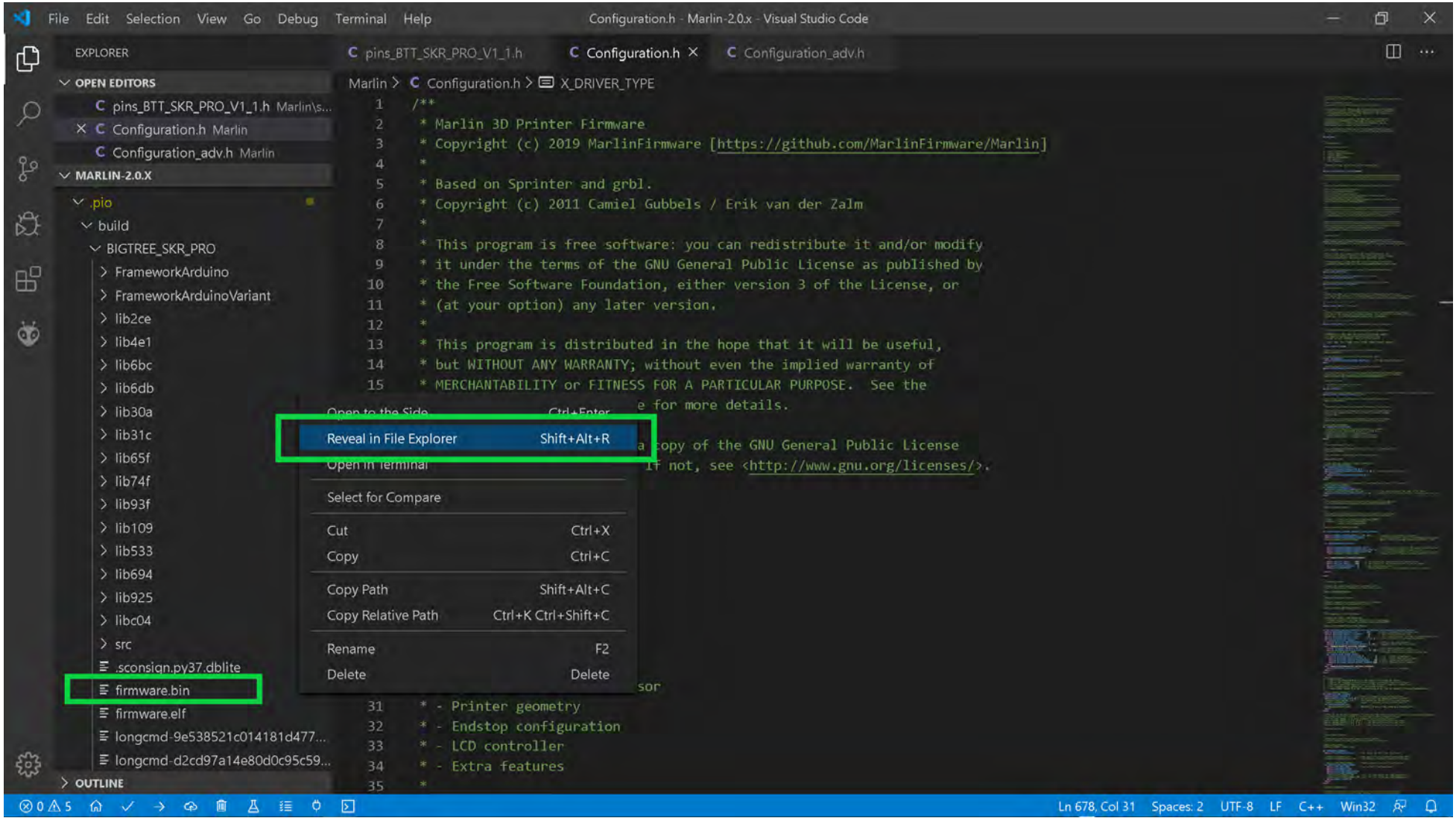
- The end of Marlin setup for FYSETC TMC2208 V1.2 drivers in OTP mode. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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.

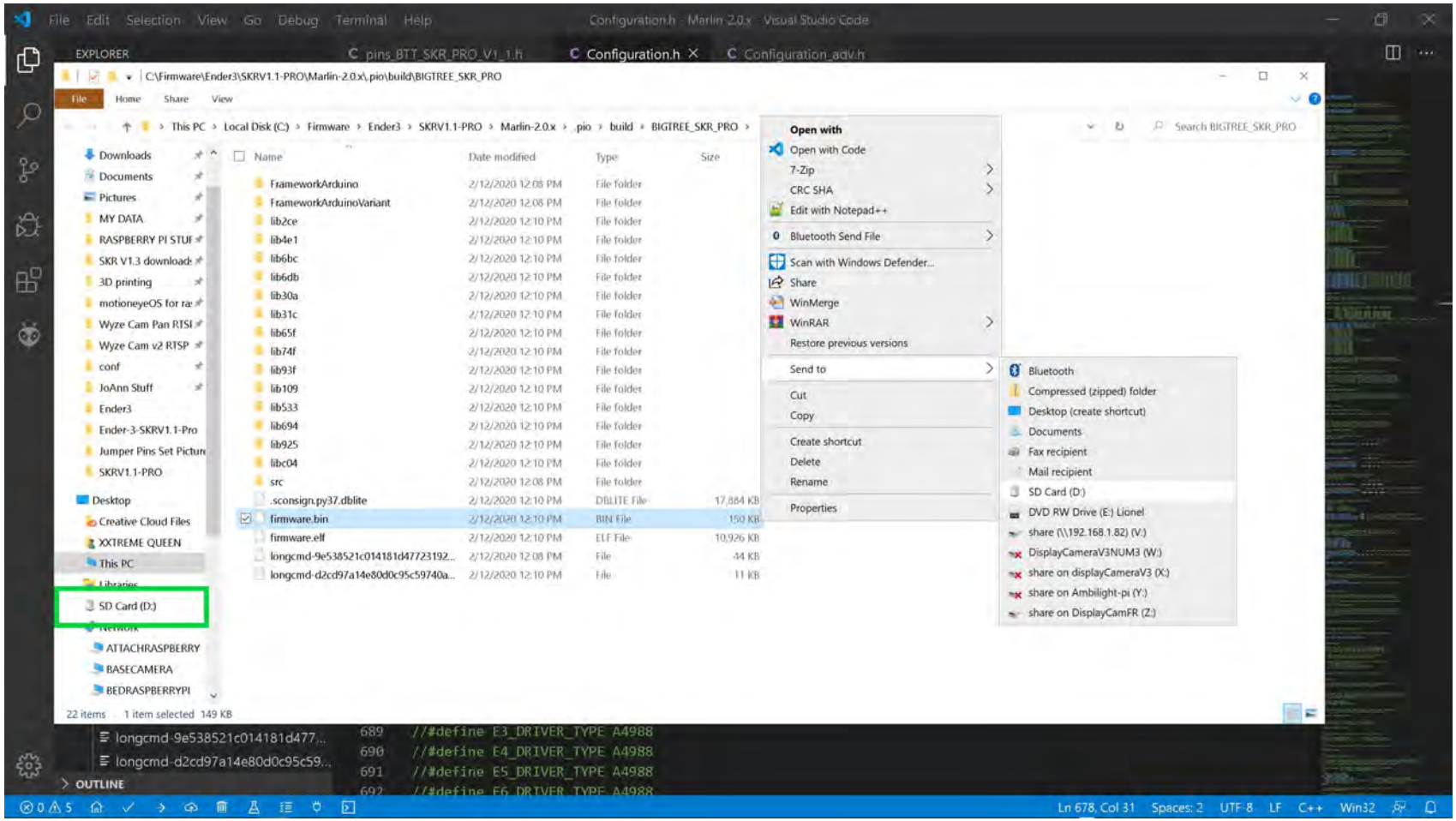


- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in One Time Programming (OTP) Mode

- Ensure your micro-SD card that 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.

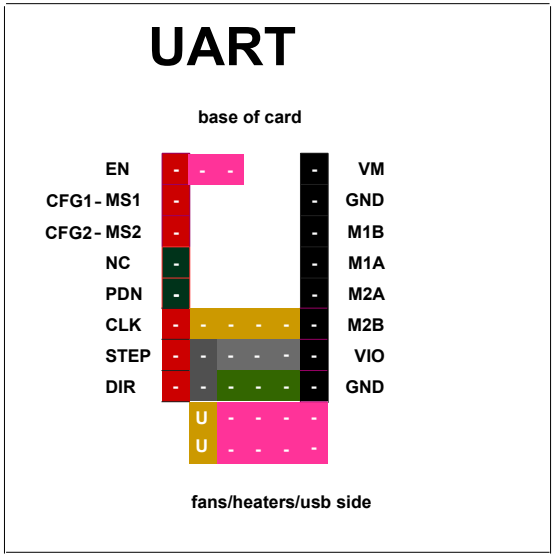
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



- 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 and renamed to "firmware.bin" on the micro-SD card.

FYSETC TMC2208 V1.2

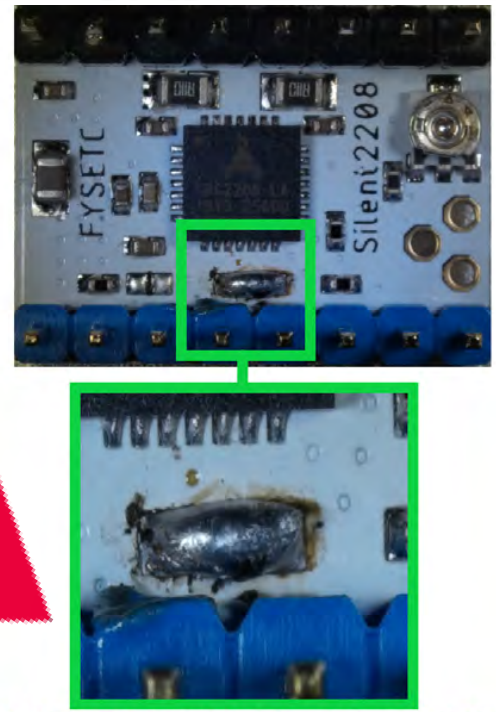
UART Mode



Driver Chip	Steps are set inside of your Firmware
FYSETC TMC2208 UART mode 5.5V - 36V DC 2.0A Maximum subdivision 256	
Driving current calculation formula	$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$ $V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$

MOST FYSETC TMC2208 board 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!

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 GREEN box below.



FYSETC TMC2208 V1.2 in UART Mode

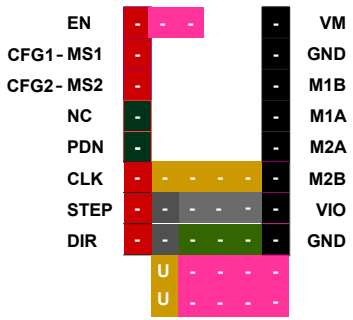
Note: You can use 50% to 90% of the calculated Irms (Imax/1.414) when tuning ("X_CURRENT", "Y_CURRENT", etc.) the stepper motor driver in the firmware.

NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

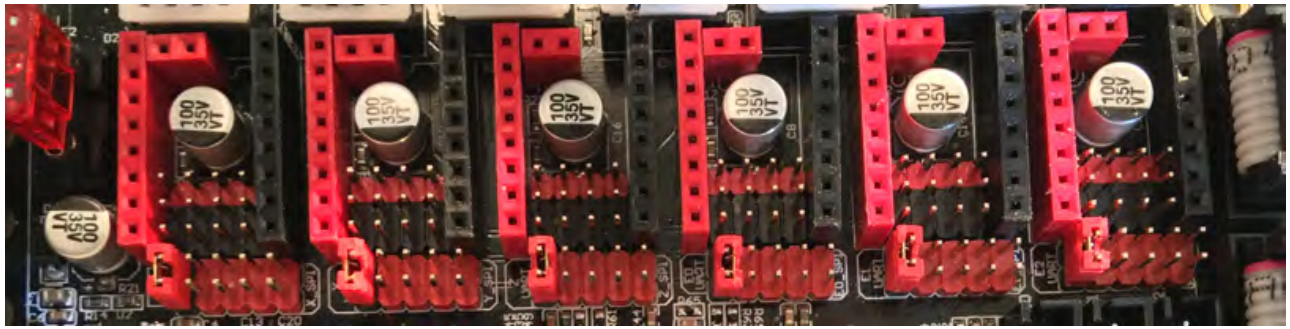
FYSETC TMC2208 V1.2

UART Mode

UART



Note: Set Jumper "U" for UART MODE!!

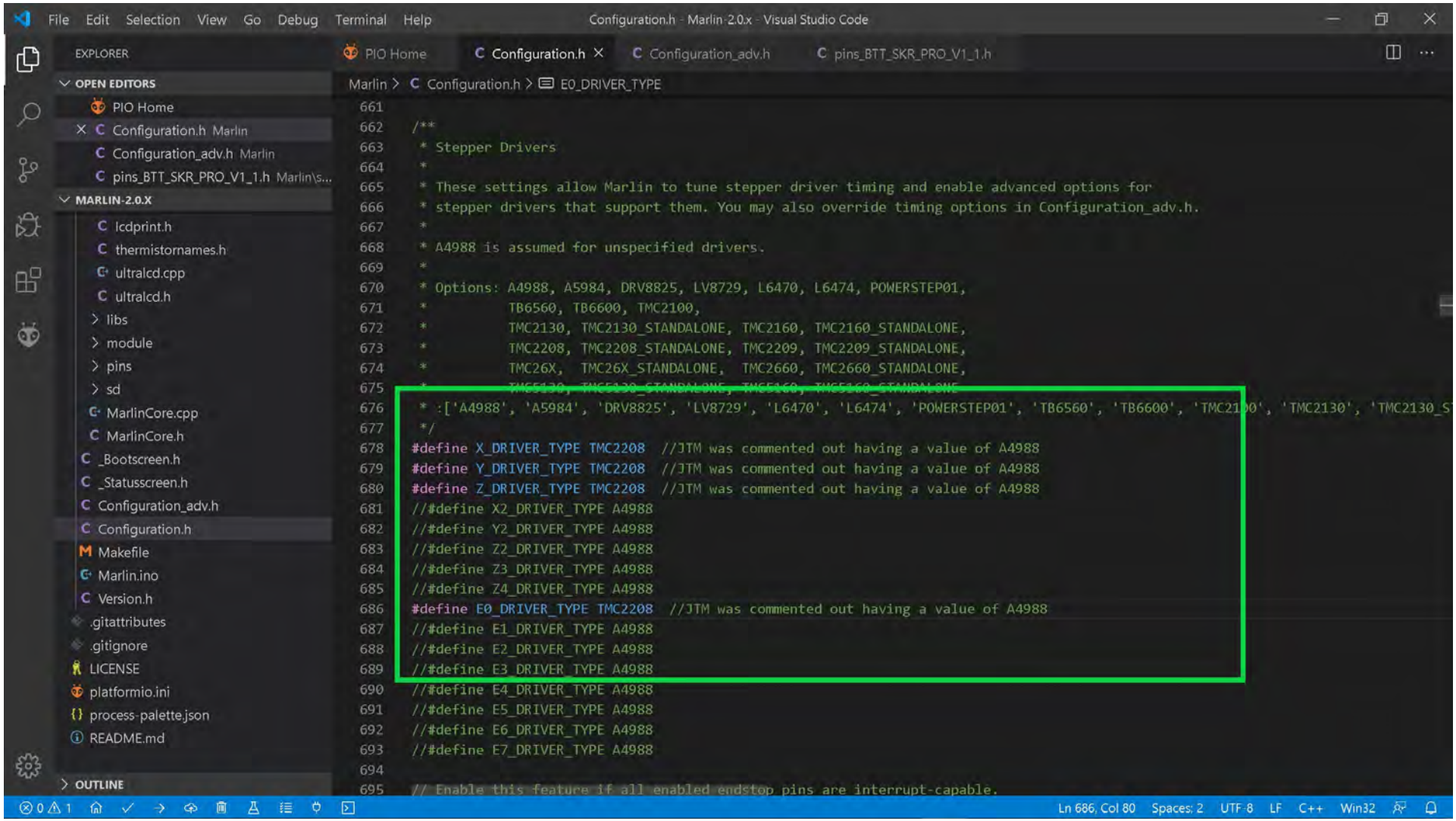


NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

NOTE: Go to Appendix C then come back here for the changes to Marlin for FYSETC TMC2208 stepper motor drivers in UART mode.

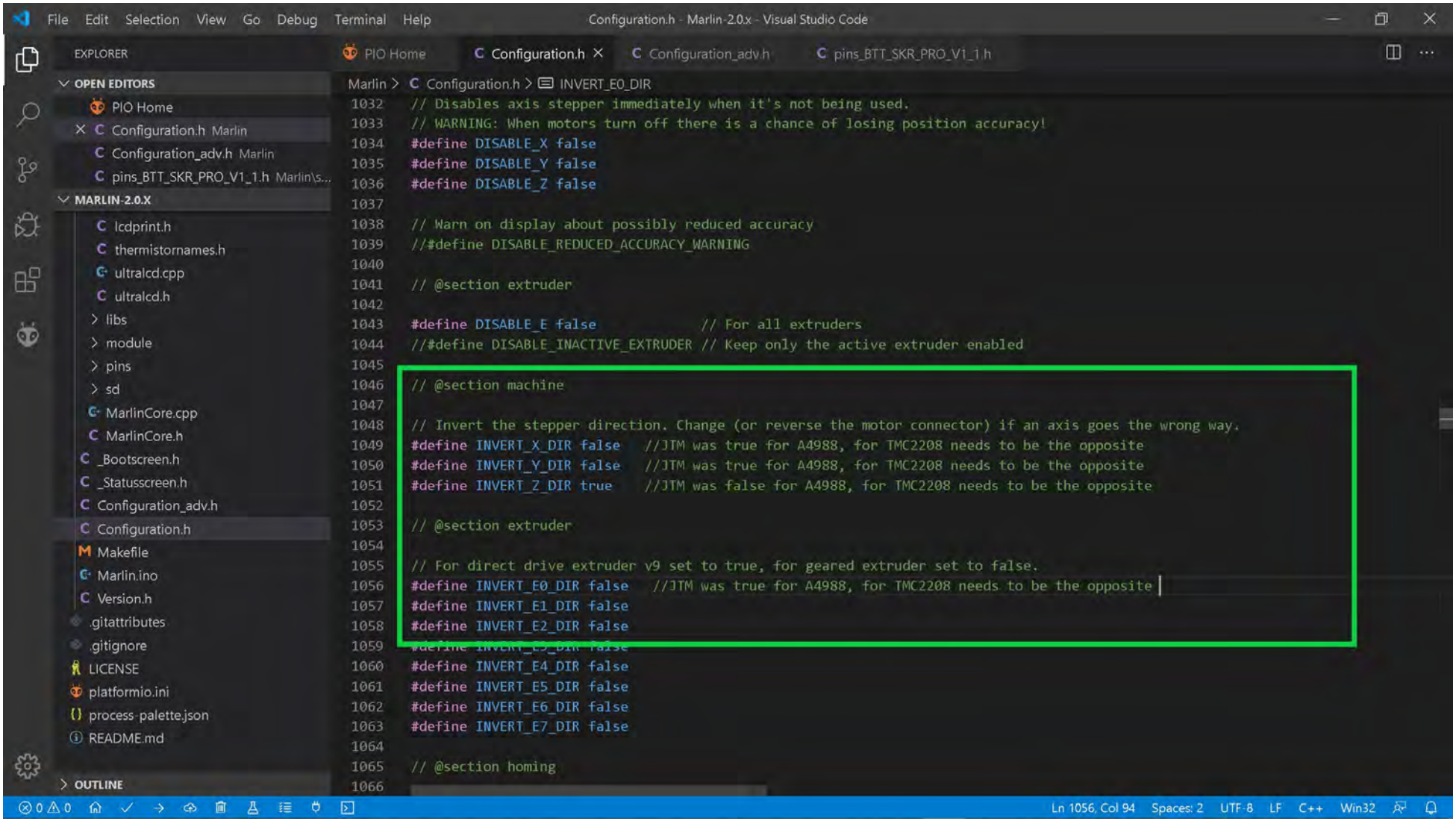
- Change the stepper motor drivers so that Marlin knows you are using TMC2208 drivers in UART mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2208 drivers in UART mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

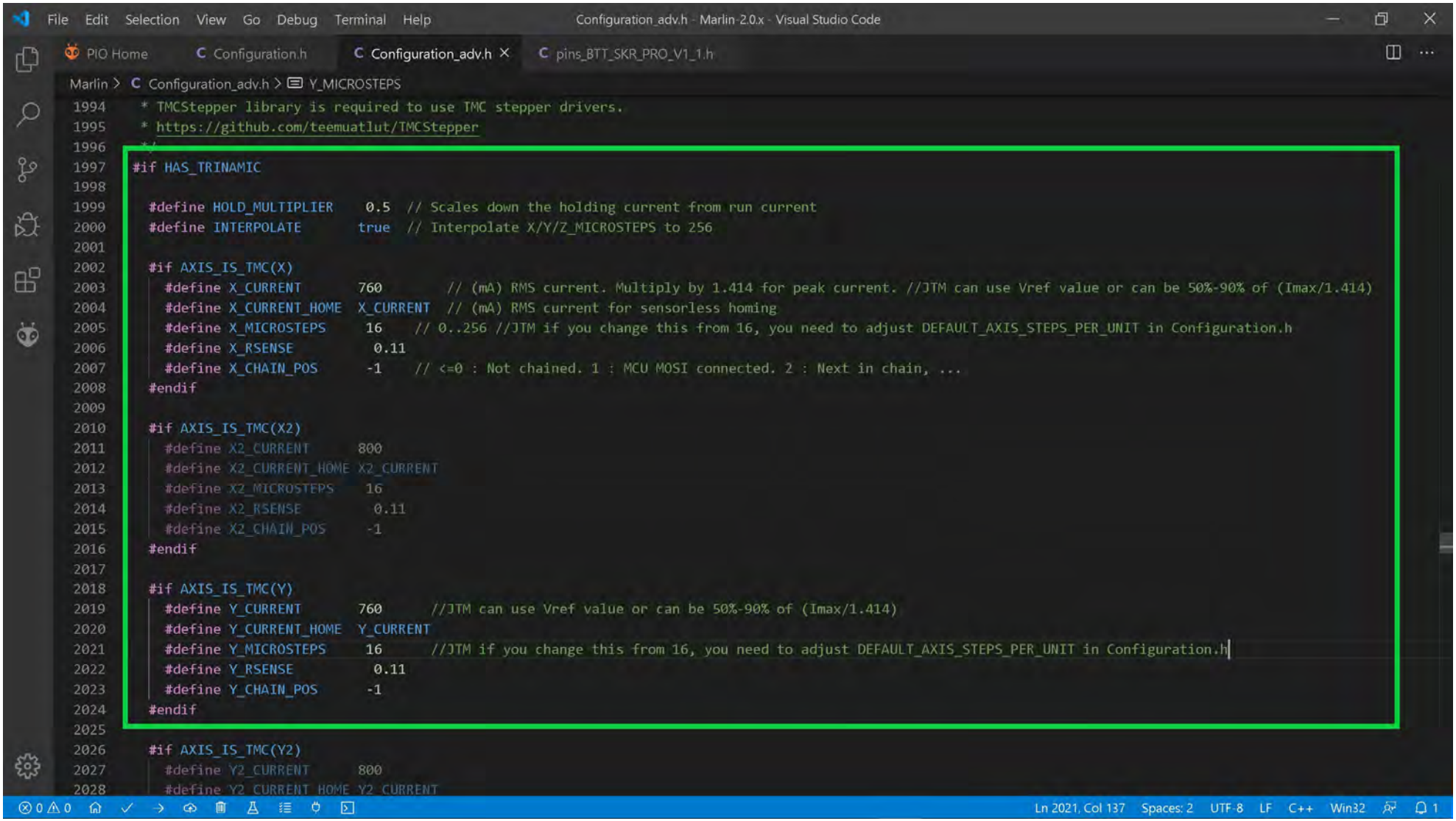
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2208 drivers, I must invert the stepper motor direction because the TMC2208 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2208 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



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

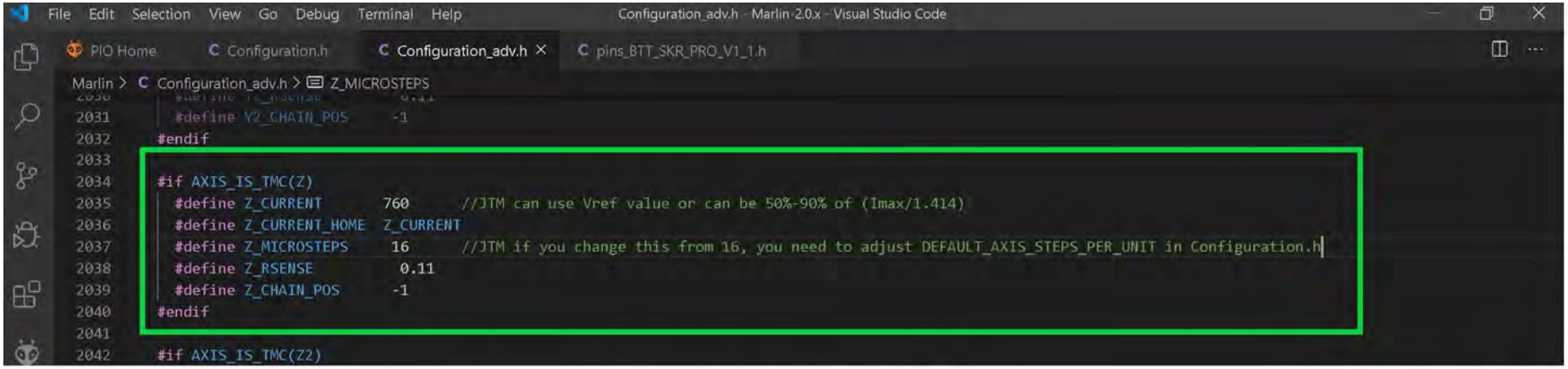
- next you want to set your Vref in the Marlin firmware for each axis that has the TMC2208 driver. As seen in the GREEN box below. I changed the "X_CURRENT" to be the calculated Vref for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated Vref for my Y-Axix, which is 760mV on the Ender 3.

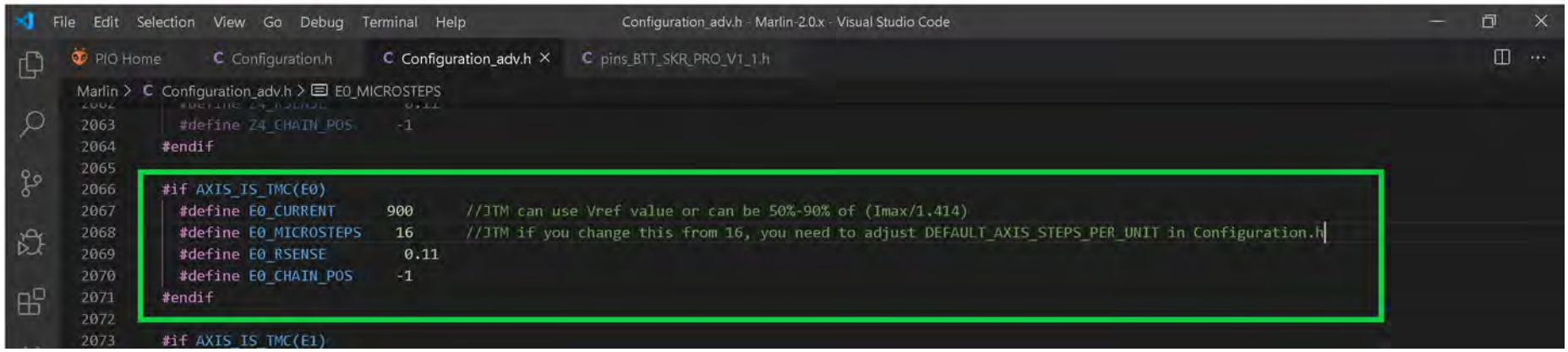


- Go to the next page.

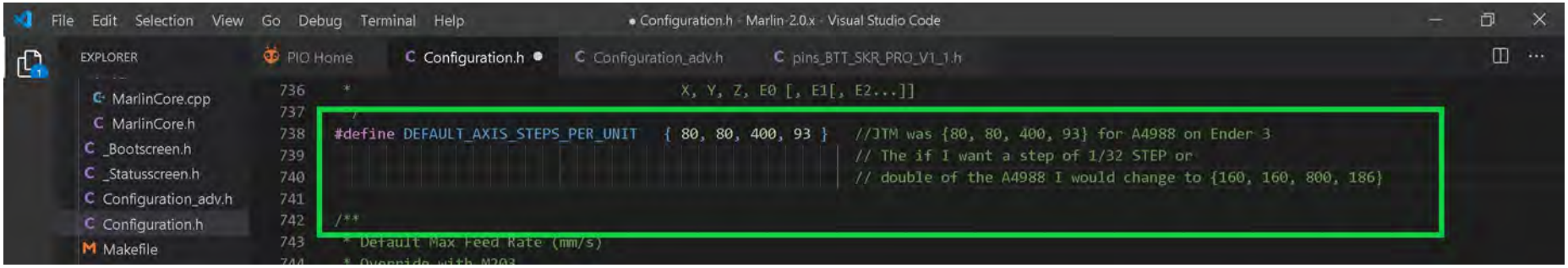
The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- Now, I am setting the Vref for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated Vref for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated Vref for my Extruder, which is 900mV on the Ender 3.





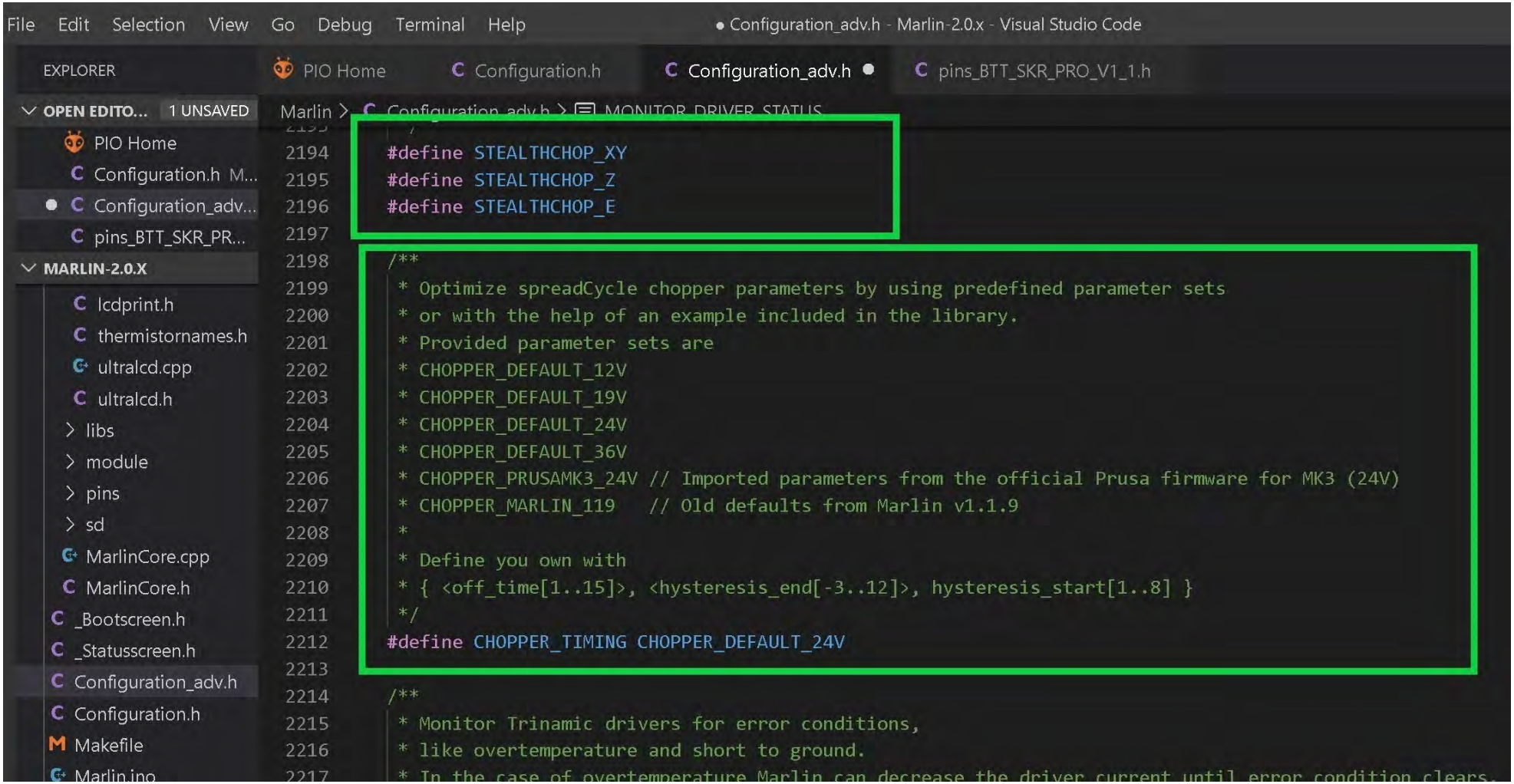
- If you changed the "MICROSTEPS" for any of the Axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

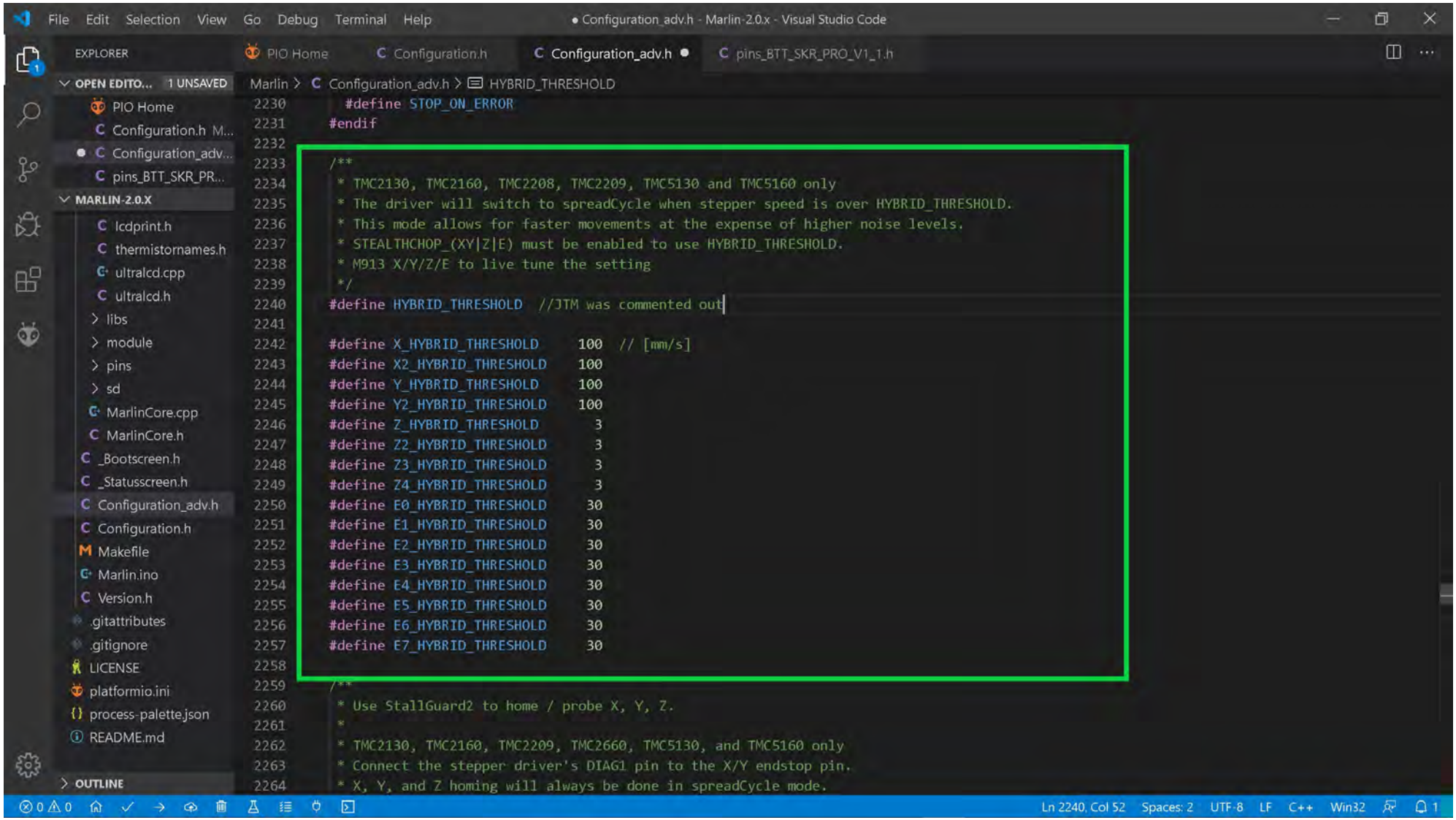
- By default stealthChop in enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.



- Go to the next page.

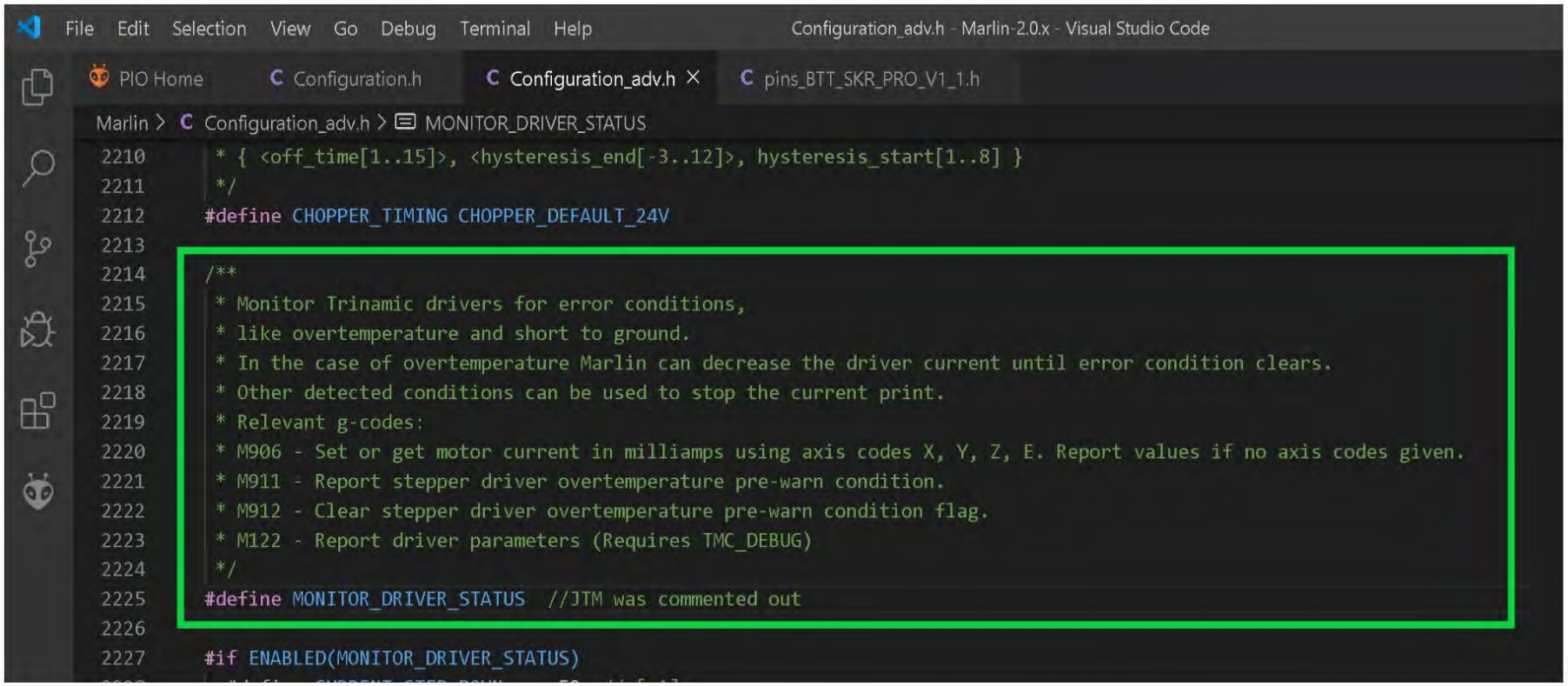
The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

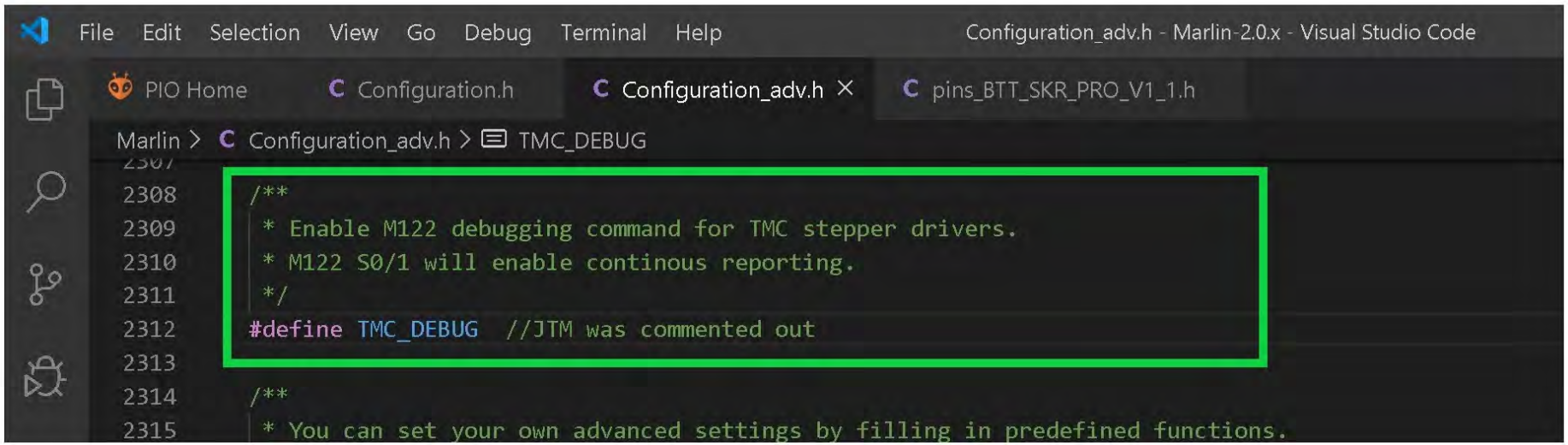
- Now you either enable "HYBRID_THRESHOLD" or disable it. By default it is disabled. "HYBRID_THERSHOLD" allows the printer to change between stealthChop and spreadCycle dynamically depending on the print speed. I want "HYBRID_THRESHOLD" enabled so I need to remove the two leading "//", which uncomments the line in the Marlin firmware.



- 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.
- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

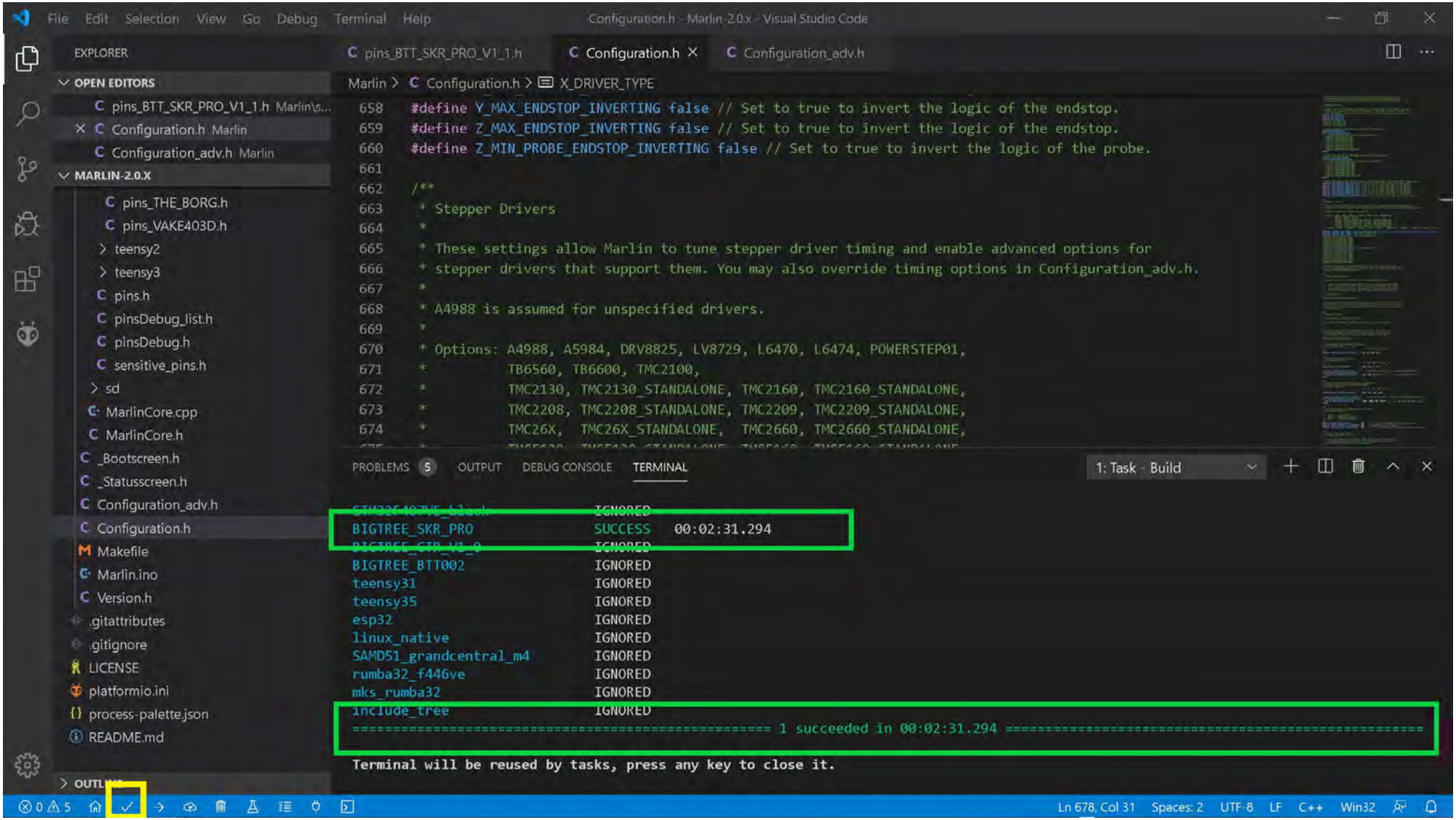




- Go to the next page.

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.



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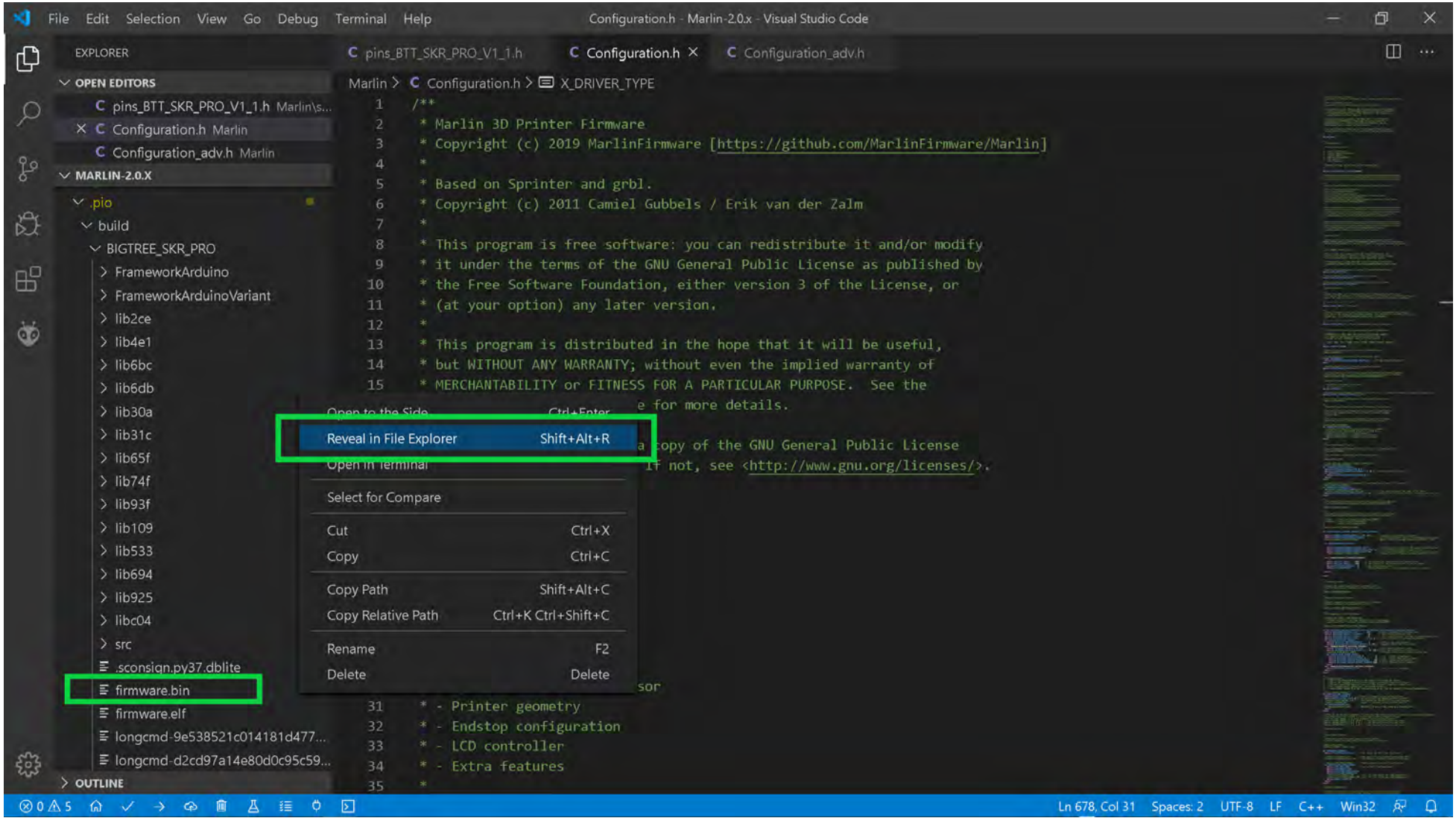
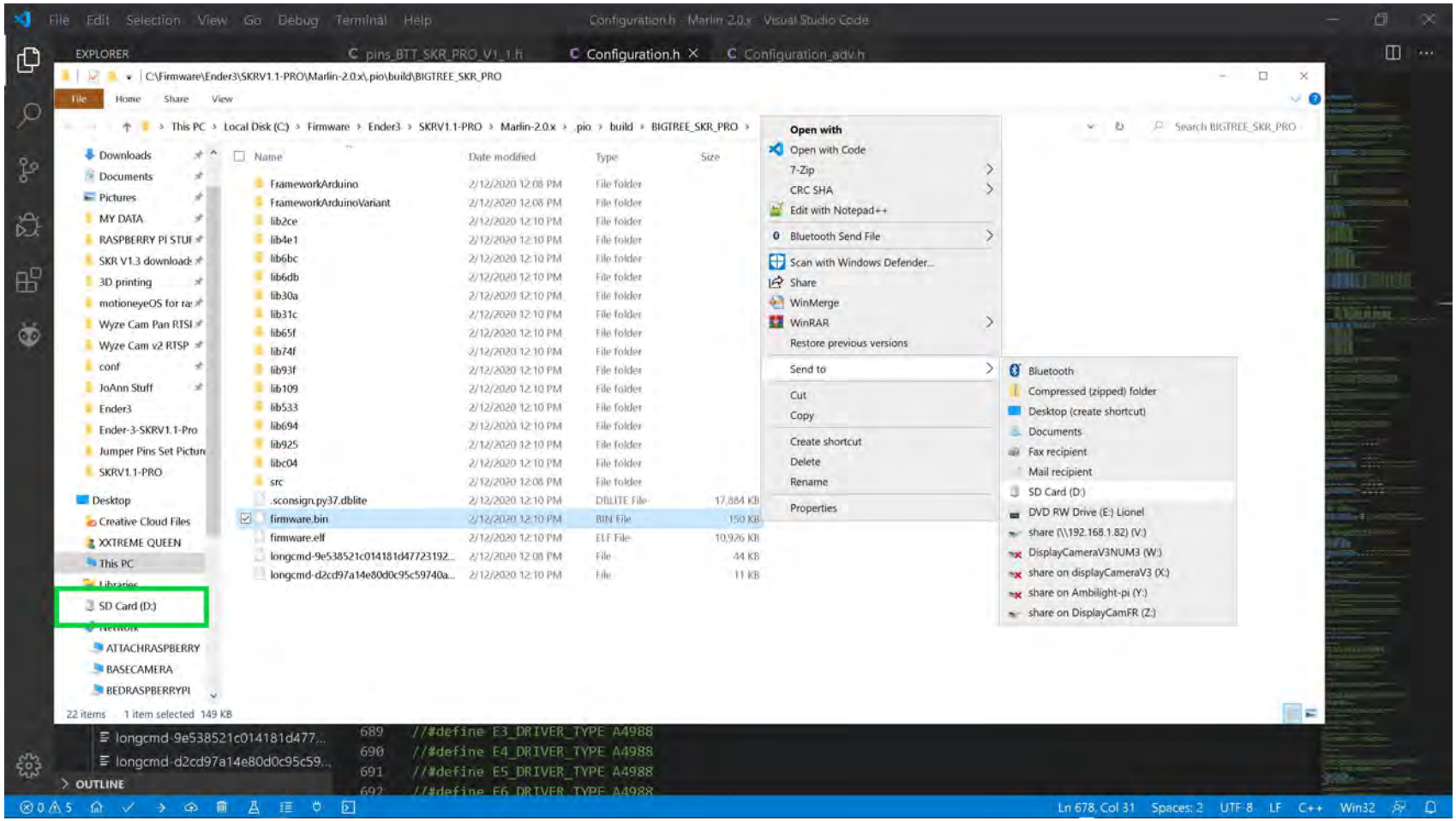


- Go to the next page.

The (latest release of) Marlin Setup for FYSETC TMC2208 V1.2 Drivers in UART Mode

- Ensure your micro-SD card that 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".

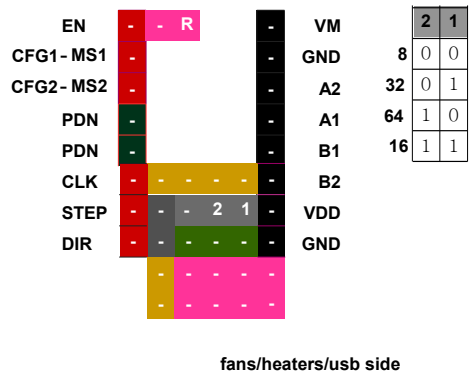


- Right click on the SD card reader, as seen in the GREEN box above, and select "Eject" from the context menu. Take the micro-SD card out of the adapter and place it into the micro-SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR"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

BIQU TMC2209 V1.2

Stand Alone Mode for StealthChop

Stand Alone Mode - StealthChop



Driver Chip

TMC2209

Standalone Mode

Maximum subdivision 64

5.5V - 28V DC

2.8A

Driving current calculation formula

SPRE	CFG2/MS2	CFG1/MS1	Steps	Interpolation	Mode
GND	GND	GND	1/8	1/256	stealthChop
GND	GND	VIO	1/32	1/256	stealthChop
GND	VIO	GND	1/64	1/256	stealthChop
GND	VIO	VIO	1/16	1/256	stealthChop
VIO	GND	GND	1/8	1/256	spreadCycle
VIO	GND	VIO	1/32	1/256	spreadCycle
VIO	VIO	GND	1/64	1/256	spreadCycle
VIO	VIO	VIO	1/16	1/256	spreadCycle

$$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$$

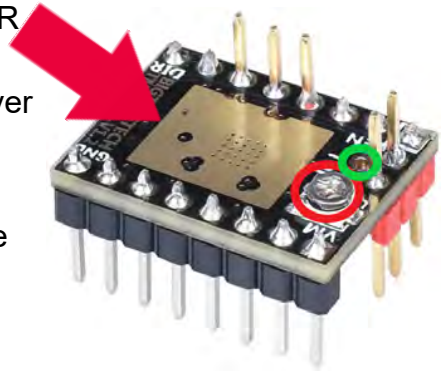
Note: Use 90% of the calculated Vref when tuning the stepper driver board

$$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$$

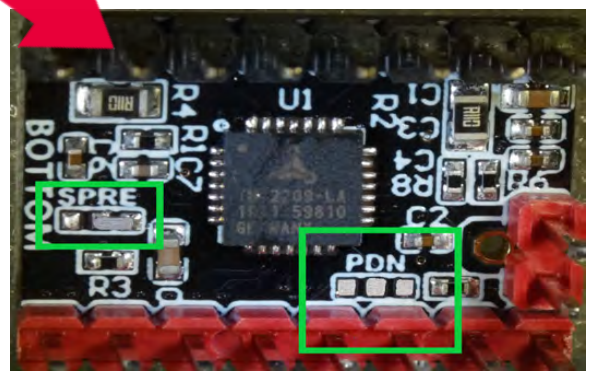
MOST BIQU TMC2209 V1.2 driver boards, when purchased for UART mode, will have the correct PDN pads already soldered together, located on the bottom of the driver board.

NOTE: 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.

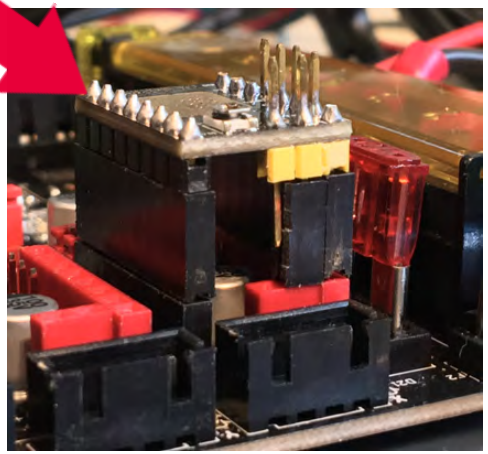
NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref, as shown in RED; OR use the "Vref Test point" location on the top of the driver board, as shown in BLUE . See the appendix for instructions on how to set the Vref on a driver board



Note: To switch to Standalone, none of the PDN pads should be bridged. The picture below shows Standalone Mode with StealthChop.



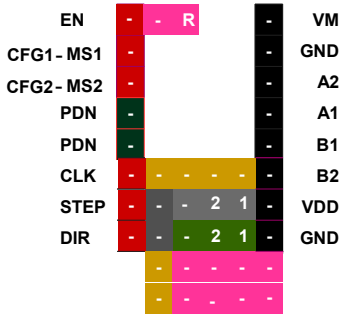
Note: When the stall-guard function is not used, the stall-guard pin of the TMC2209 must be removed (desoldered) or use long pin header risers so that the"R" pin does not connect to the SKR PRO V1.1 board



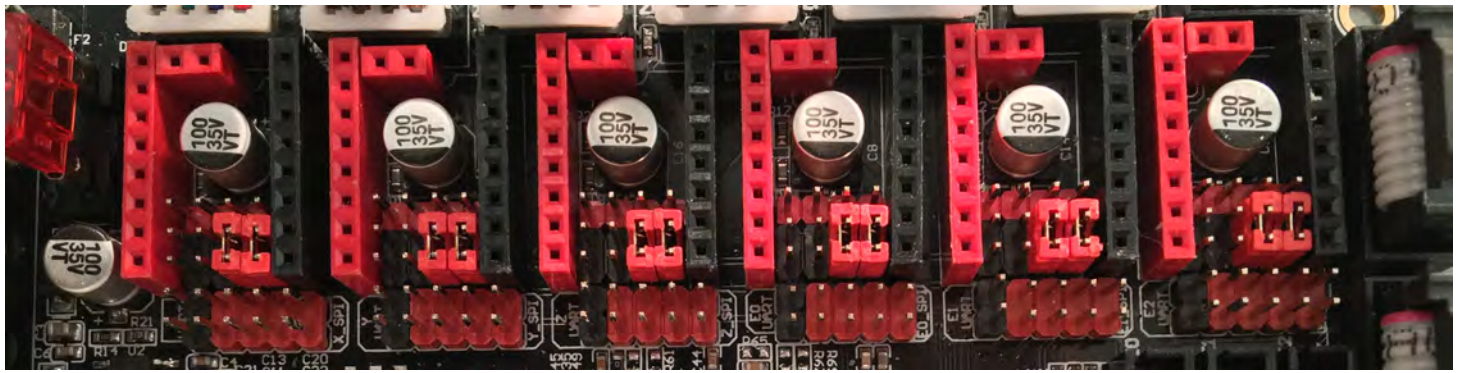
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

Stand Alone Mode - StealthChop

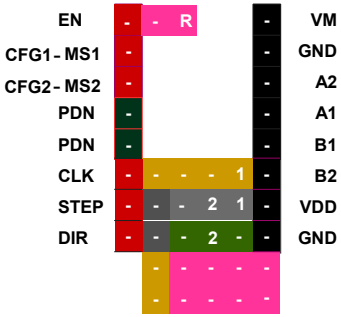
Stand Alone Mode - StealthChop



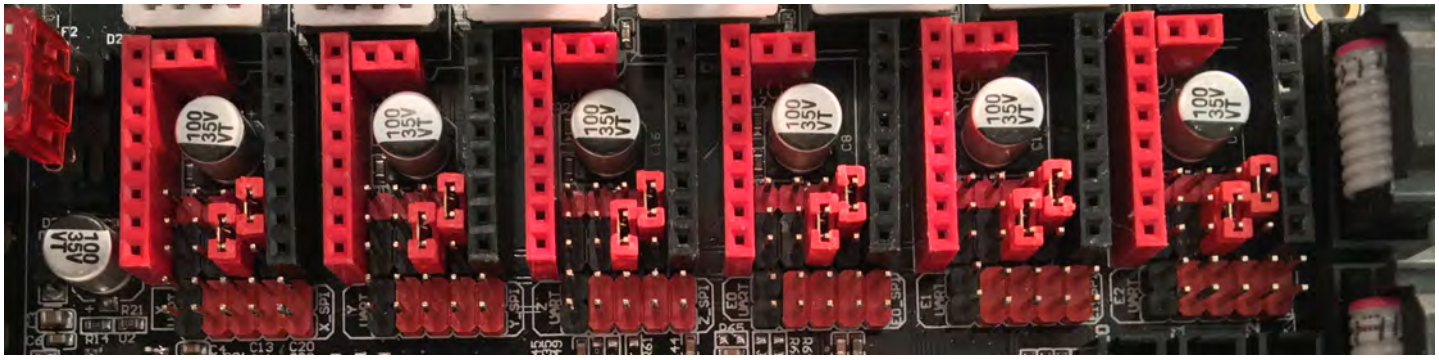
1/8
Interpolation: 1/256
StealthChop



Stand Alone Mode - StealthChop

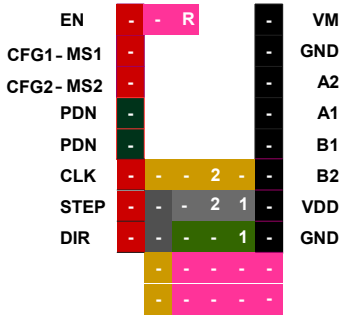


1/32
Interpolation: 1/256
StealthChop

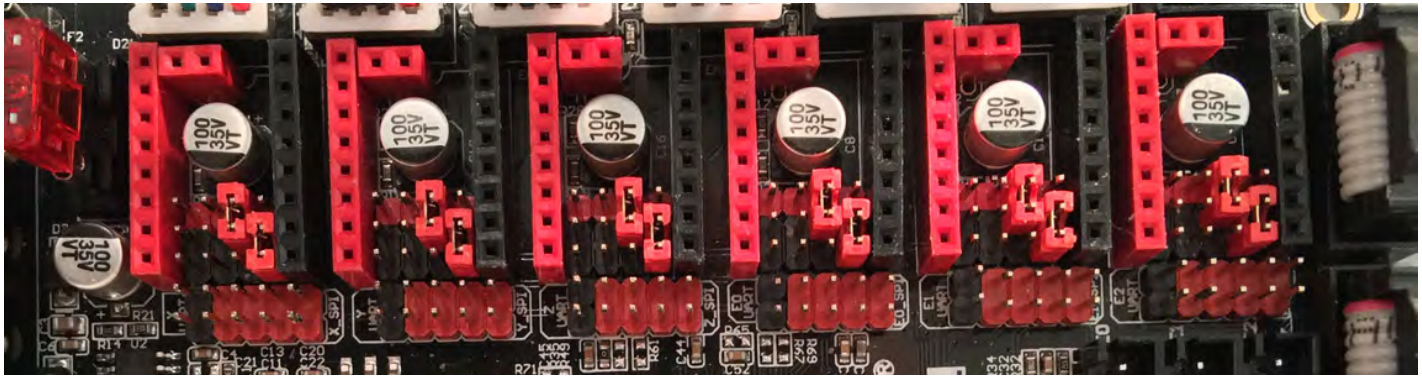


Stand Alone Mode - StealthChop

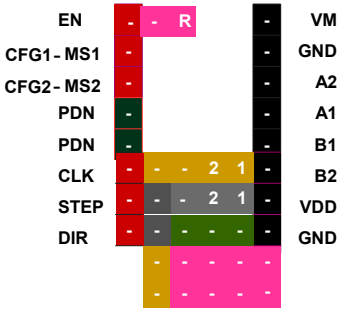
Stand Alone Mode - StealthChop



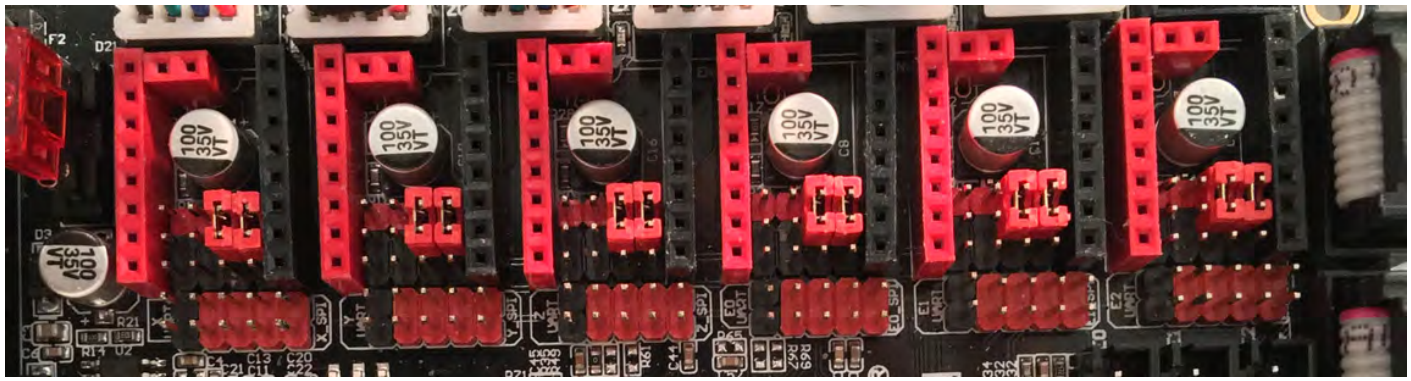
1/64
Interpolation: 1/256
StealthChop



Stand Alone Mode - StealthChop



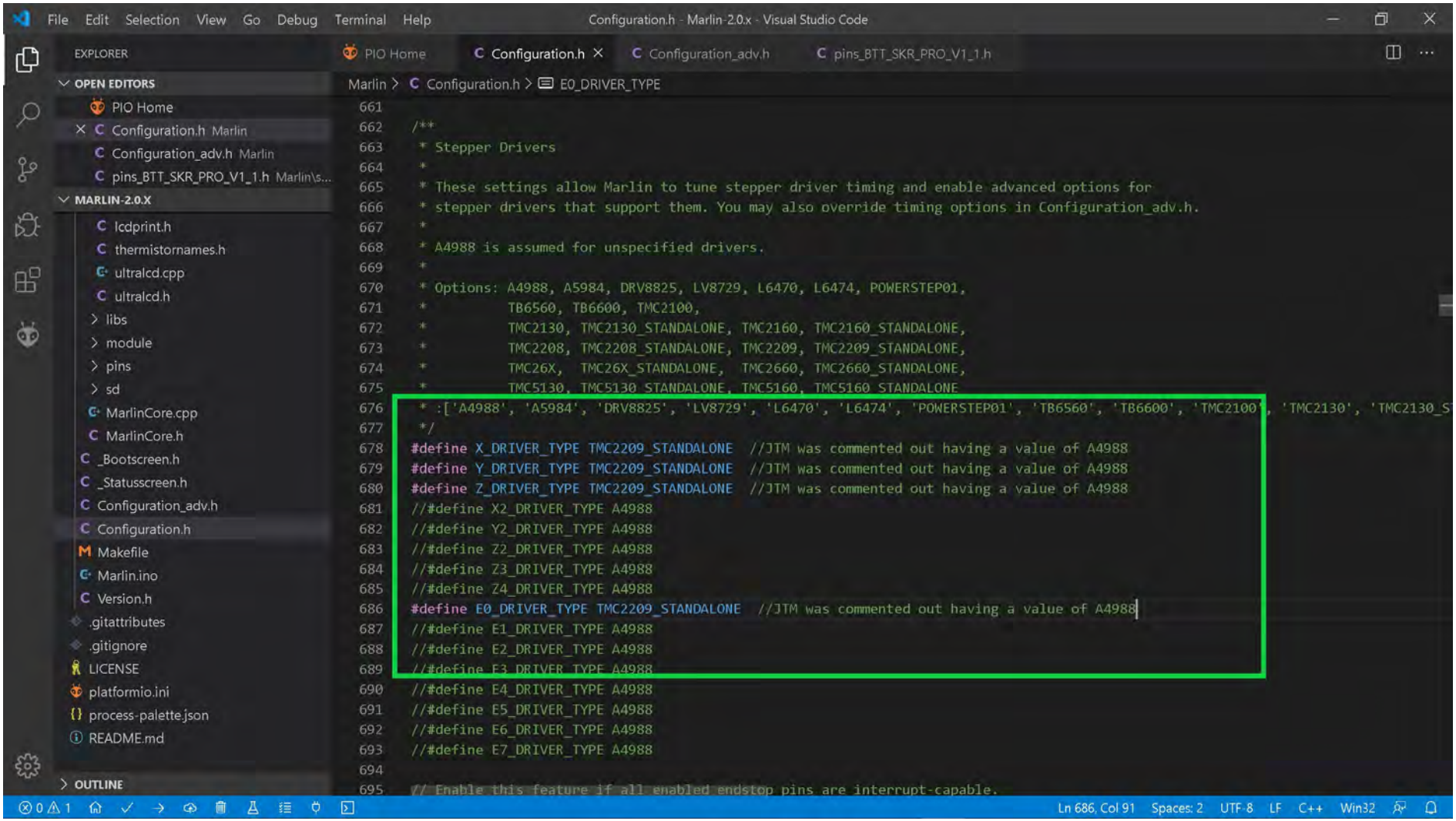
1/16
Interpolation: 1/256
StealthChop



The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand Alone Mode for StealthChop

NOTE: Go to Appendix C then come back here for the changes to Marlin for BIQU TMC2209 V1.2 stepper motor drivers in stand alone mode for stealthChop.

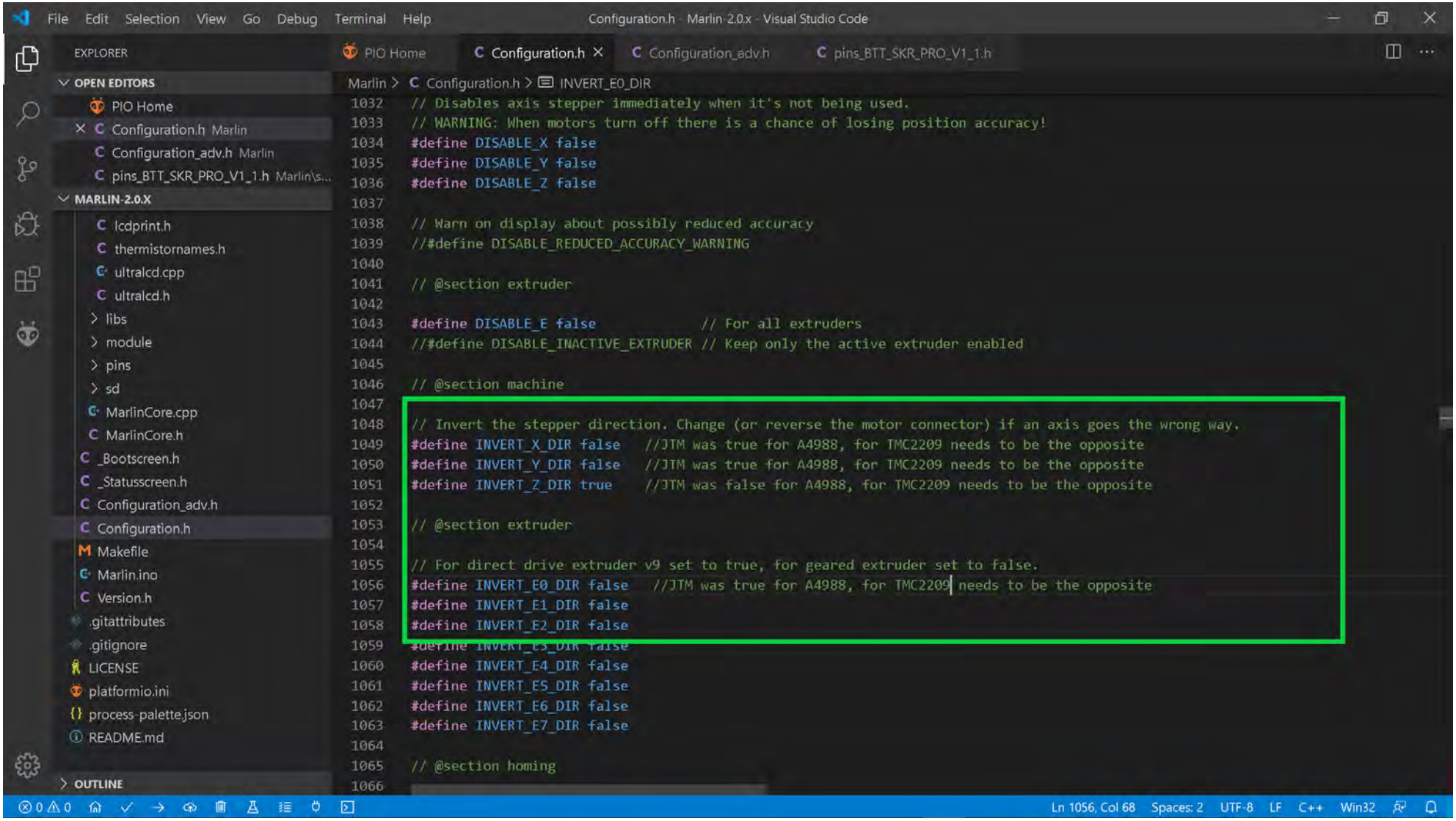
- Change the stepper motor drivers so that Marlin knows you are using TMC2209 drivers in stand alone mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC2209 drivers in stand alone mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand Alone Mode for StealthChop

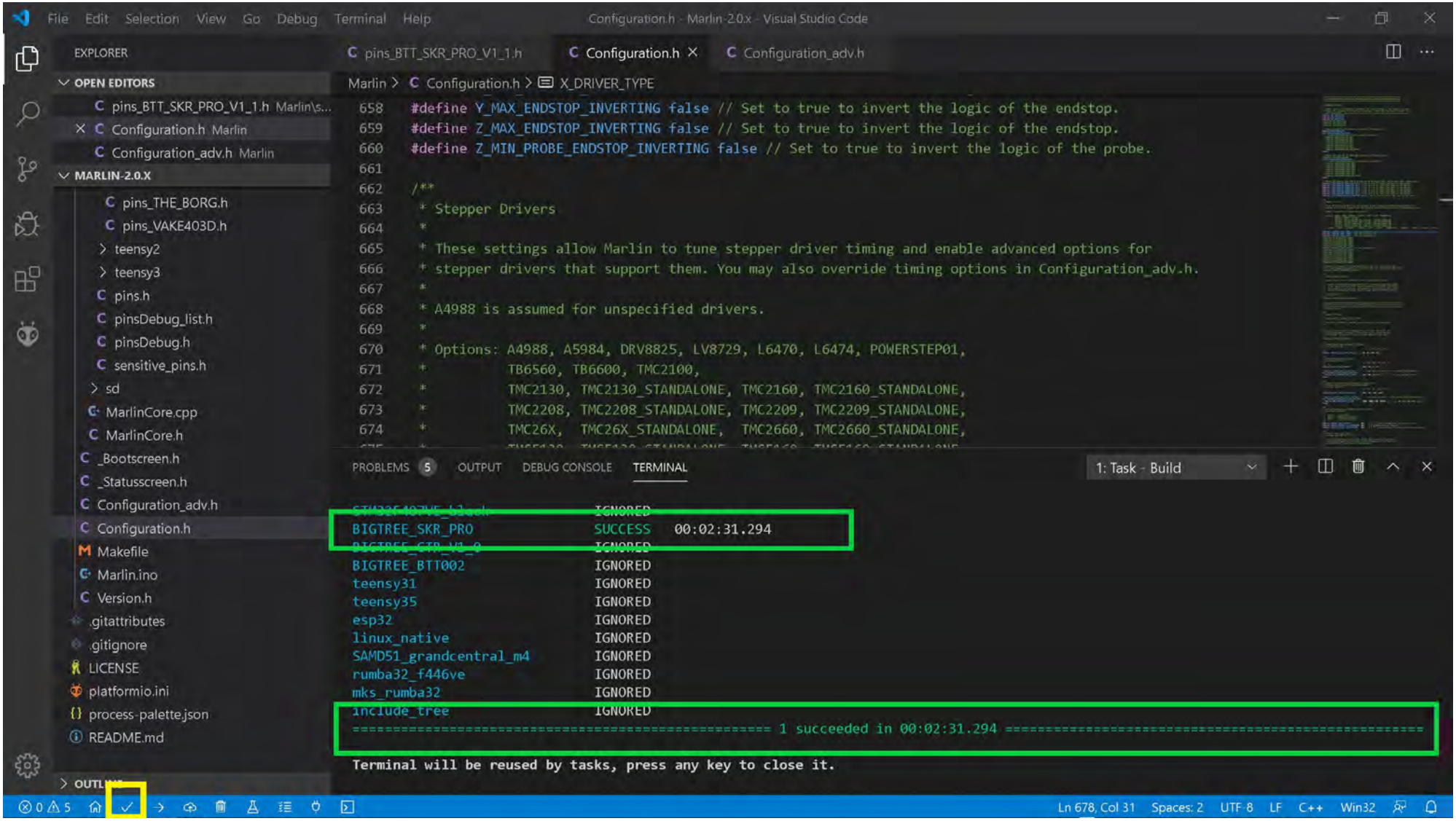
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2209 drivers, I must invert the stepper motor direction because the TMC2209 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2209 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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand Alone Mode for StealthChop

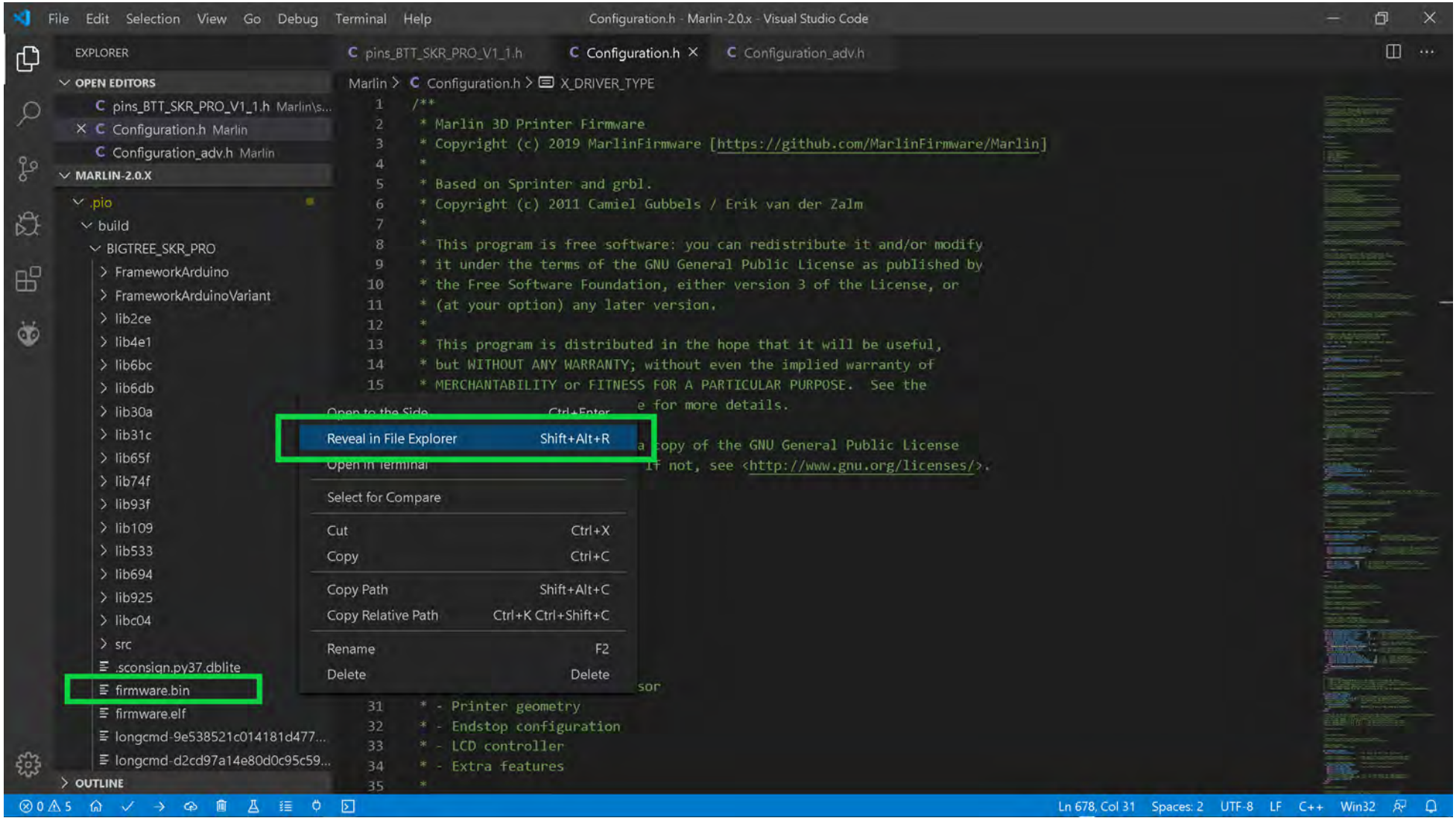
- The end of Marlin setup for BIQU TMC2209 V1.2 drivers in stand alone mode for stealthChop. Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

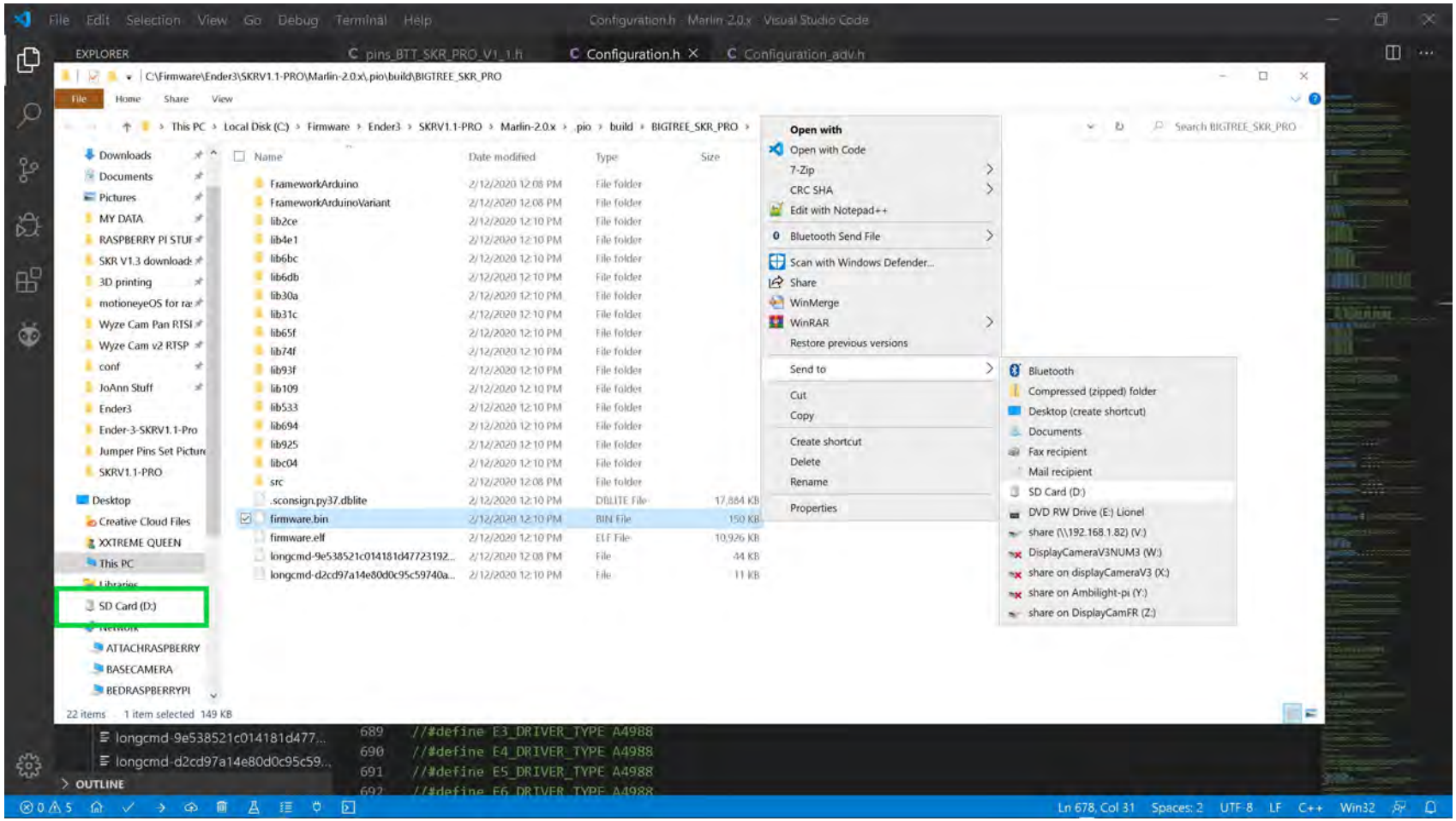
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand Alone Mode for StealthChop

- Ensure your micro-SD card that 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".

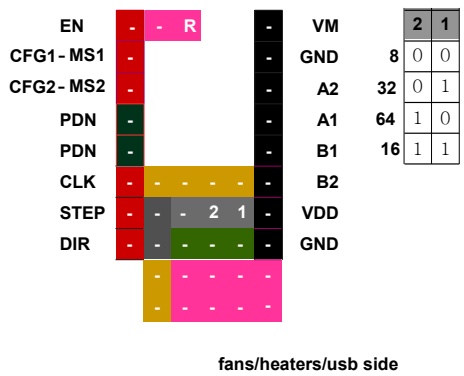


- Right click on the SD card reader, as seen in the GREEN box above, and select "Eject" from the context menu. Take the micro-SD card out of the adapter and place it into the micro-SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR"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

BIQU TMC2209 V1.2

Stand Alone Mode for SpreadCycle

Stand Alone Mode - SpreadCycle



Driver Chip	SPRE	CFG2/MS2	CFG1/MS1	Steps	Interpolation	Mode
TMC2209	GND	GND	GND	1/8	1/256	stealthChop
Standalone Mode	GND	GND	VIO	1/32	1/256	stealthChop
Maximum subdivision 64	GND	VIO	GND	1/64	1/256	stealthChop
5.5V - 28V DC	GND	VIO	VIO	1/16	1/256	stealthChop
2.8A	VIO	GND	GND	1/8	1/256	spreadCycle
	VIO	GND	VIO	1/32	1/256	spreadCycle
	VIO	VIO	GND	1/64	1/256	spreadCycle
	VIO	VIO	VIO	1/16	1/256	spreadCycle

Driving current calculation formula

$$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$$

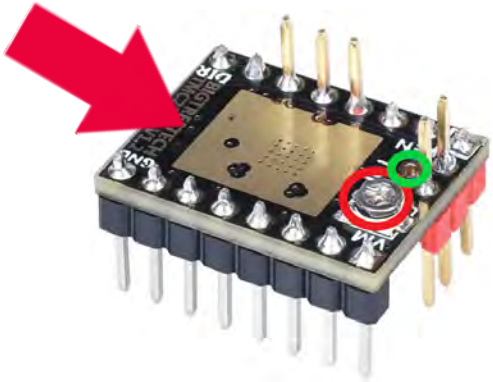
Note: Use 90% of the calculated Vref when tuning the stepper driver board

$$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$$

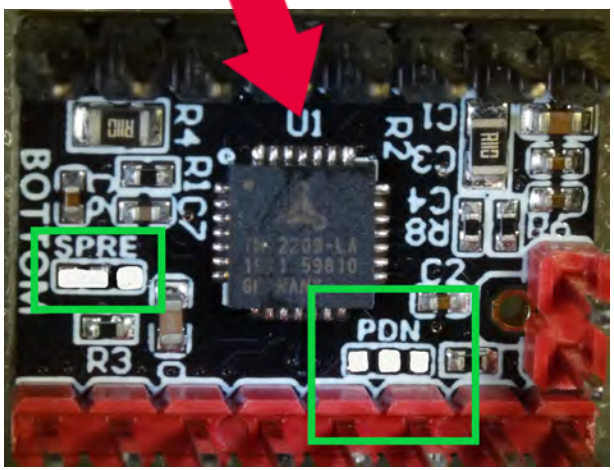
MOST BIQU TMC2209 V1.2 driver boards, when purchased for UART mode, will have the correct PDN pads already soldered together, located on the bottom of the driver board.

NOTE: 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.

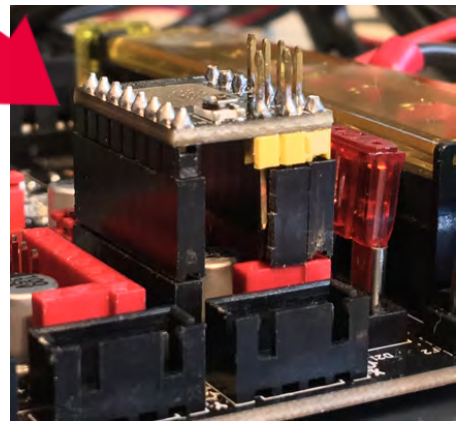
NOTE: Use the potentiometer (POT) on the top of the board to adjust your Vref, as shown in RED; OR use the "Vref Test point" location on the top of the driver board, as shown in BLUE . See the appendix for instructions on how to set the Vref on a driver board



Note: To switch to Standalone, none of the PDN pads should be bridged. The picture below shows Standalone Mode with SpreadCycle.

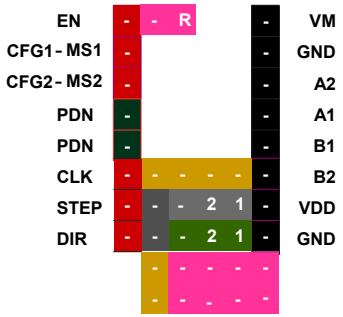


Note: When the stall-guard function is not used, the stall-guard pin of the TMC2209 must be removed (desoldered) or use long pin header risers so that the"R" pin does not connect to the SKR PRO V1.1 board

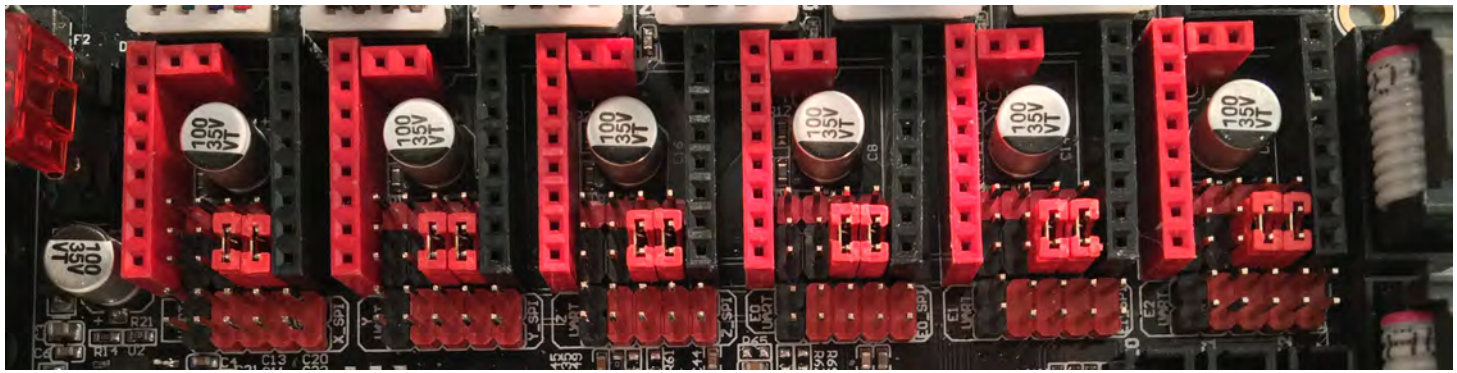


Stand Alone Mode - SpreadCycle

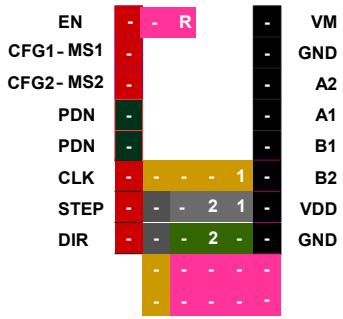
Stand Alone Mode - SpreadCycle



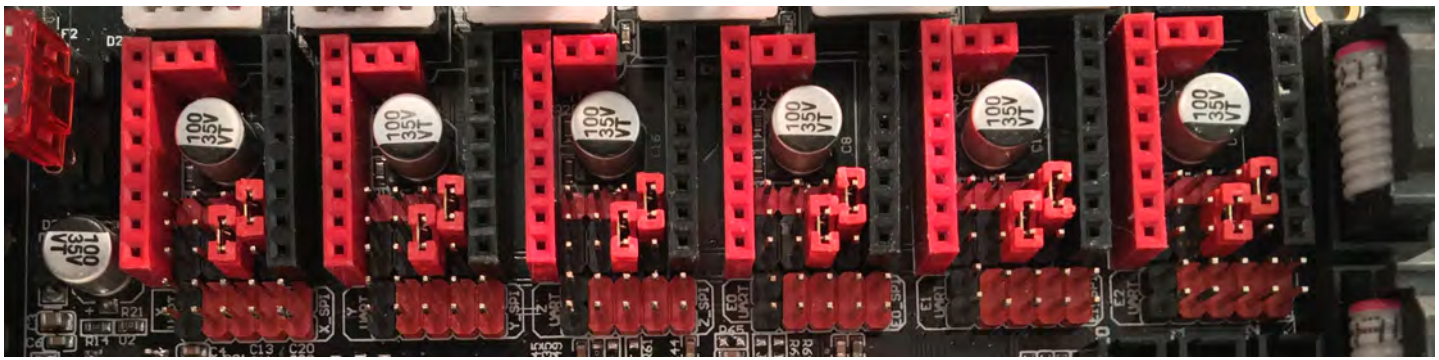
1/8
Interpolation: 1/256
SpreadCycle



Stand Alone Mode - SpreadCycle



1/32
Interpolation: 1/256
SpreadCycle



Stand Alone Mode - SpreadCycle

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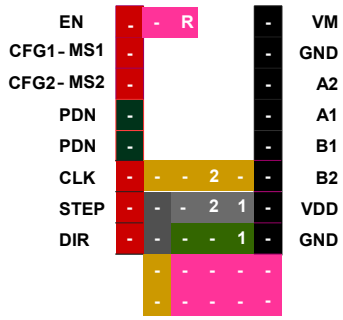
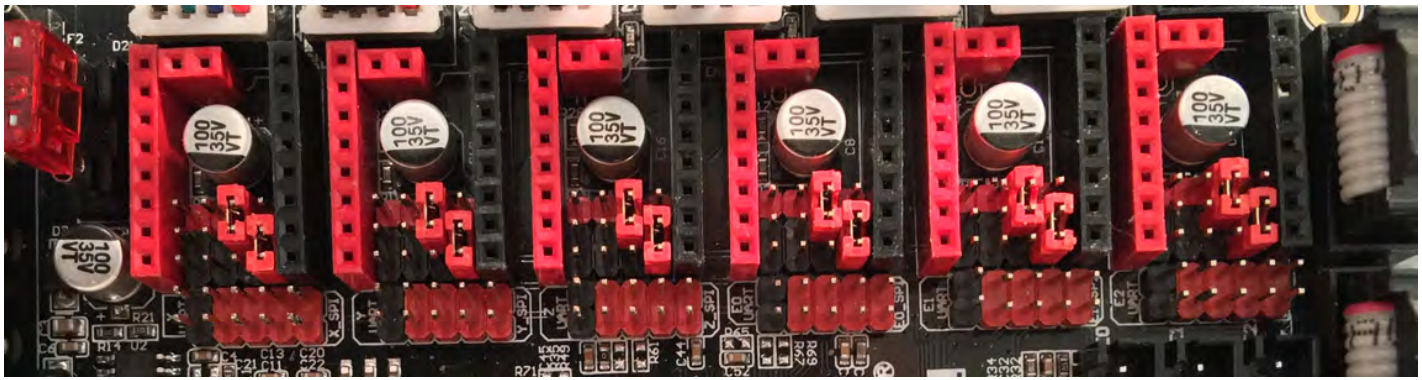
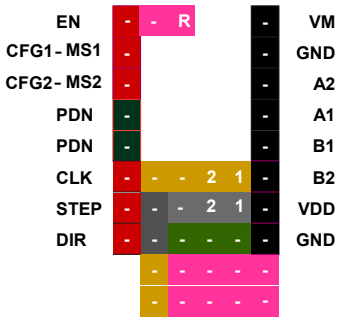


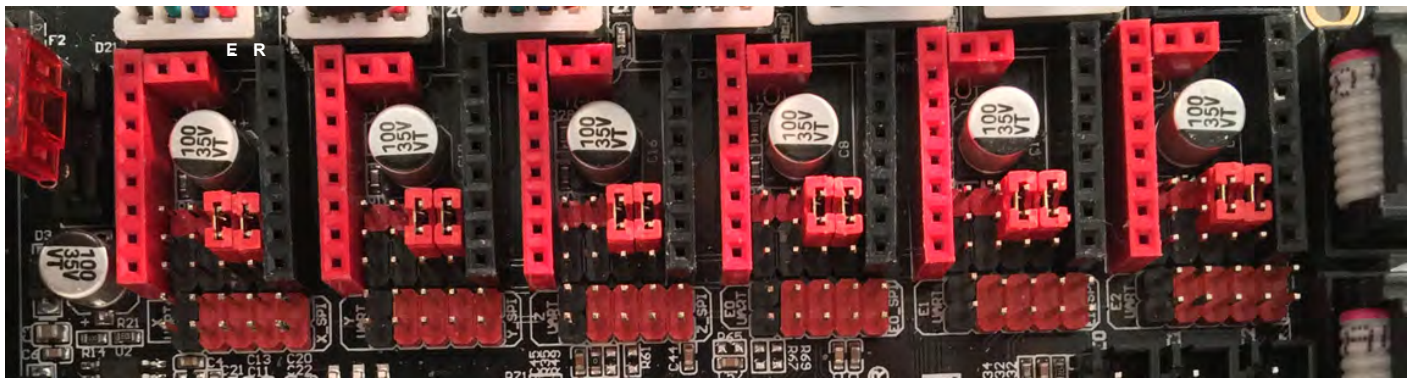
1/64
Interpolation: 1/256
SpreadCycle



Stand Alone Mode - SpreadCycle



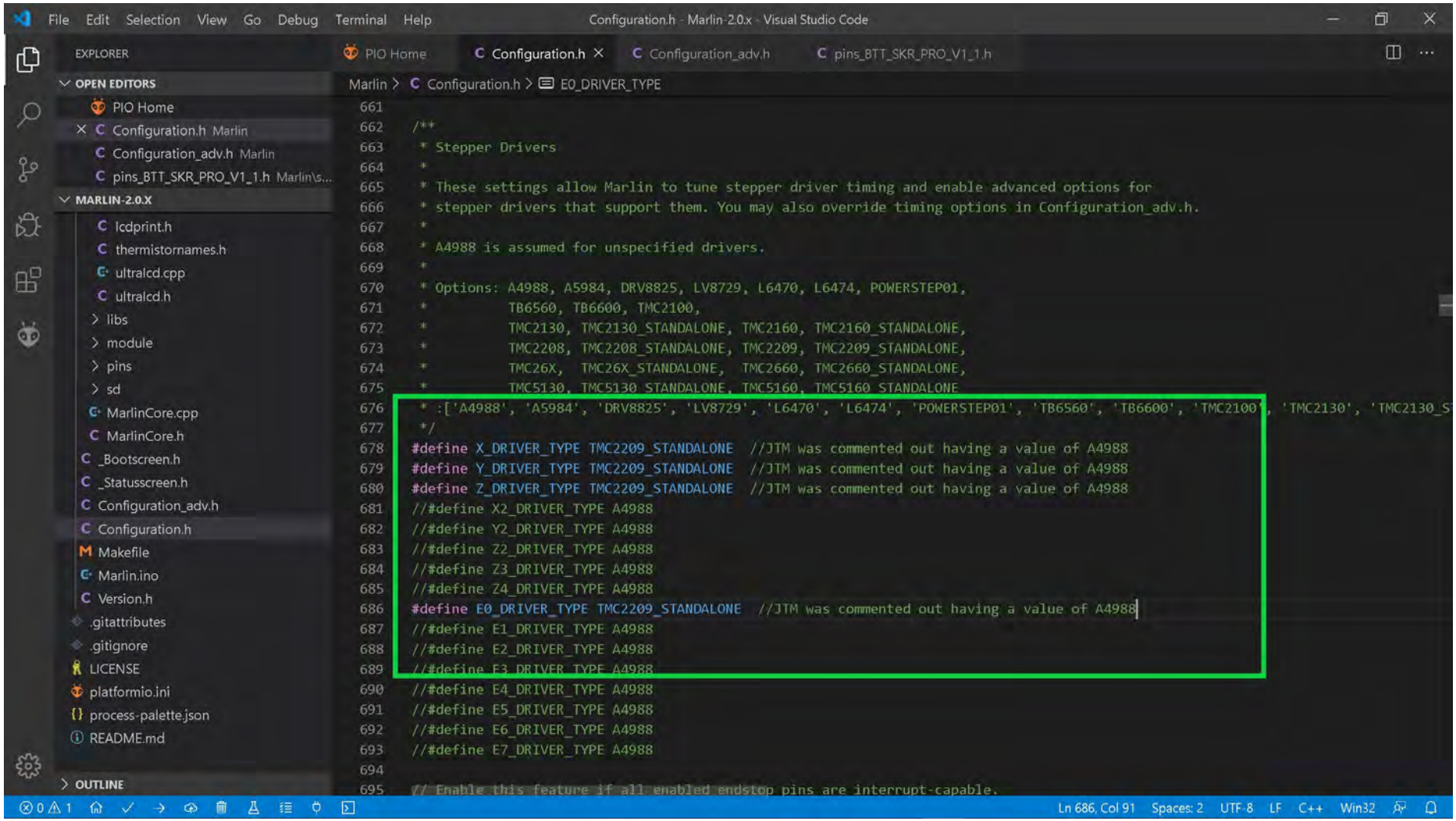
1/16
Interpolation: 1/256
SpreadCycle



The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand Alone Mode for SpreadCycle

NOTE: Go to Appendix C 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 ("//").



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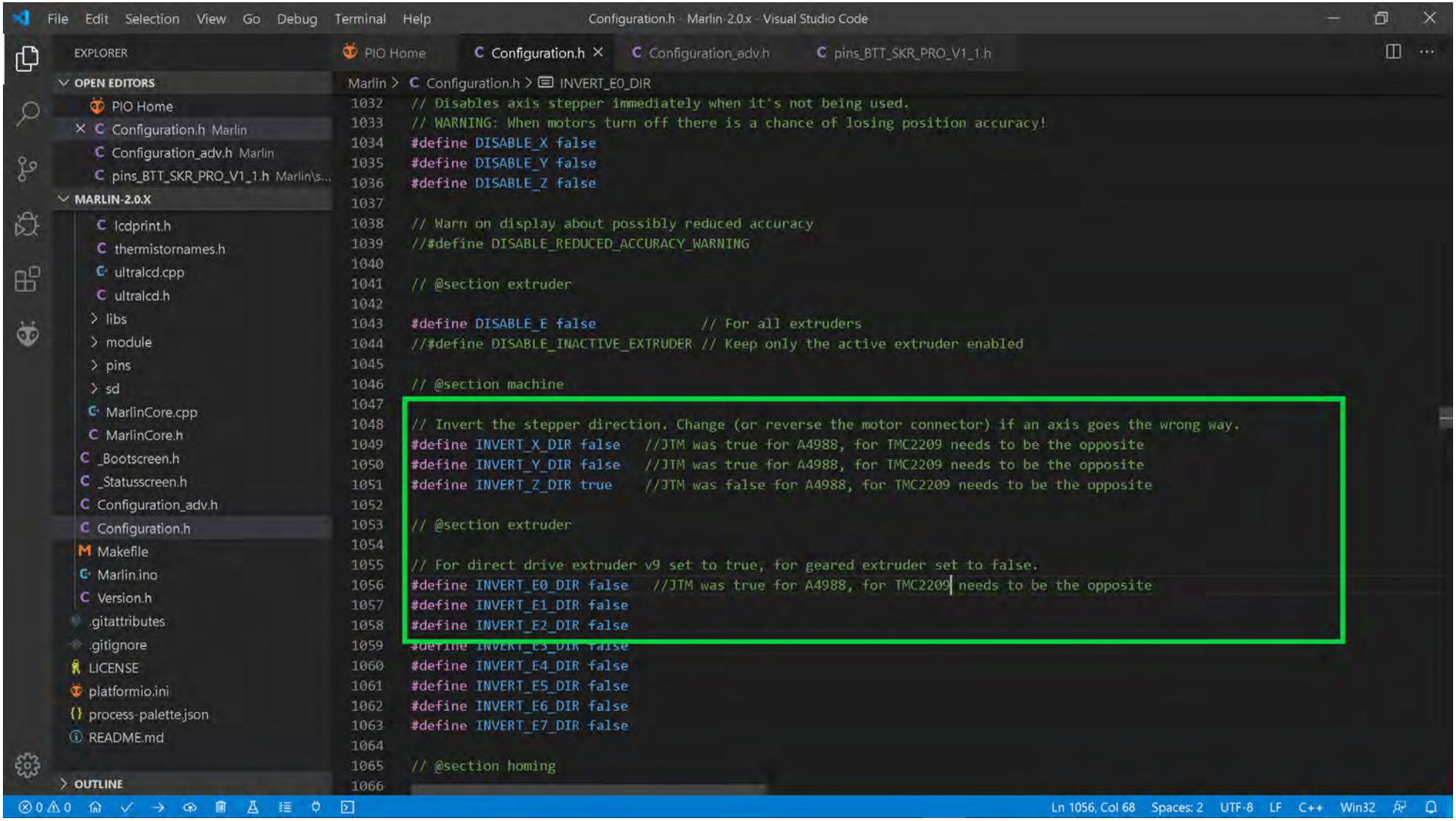

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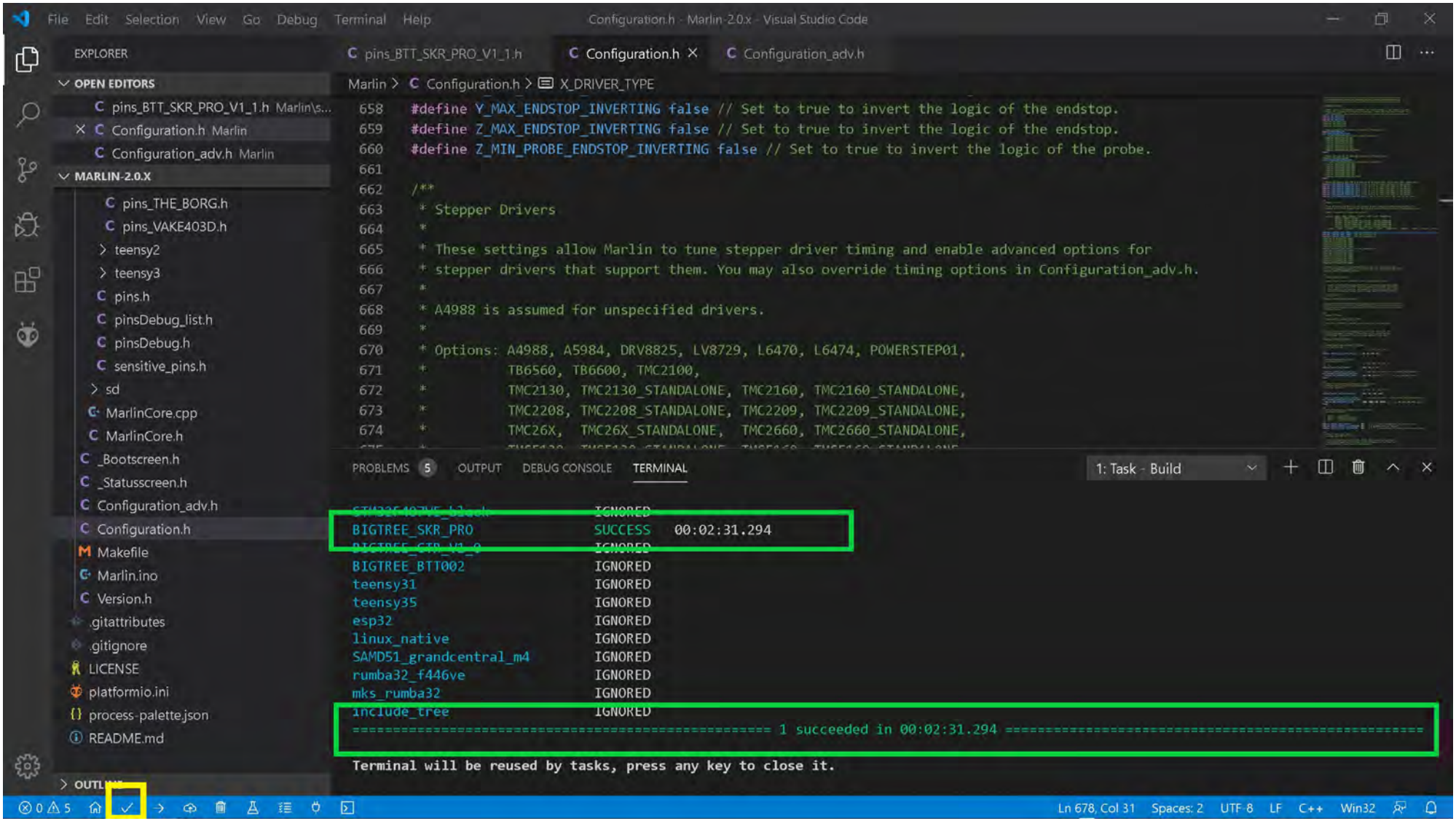

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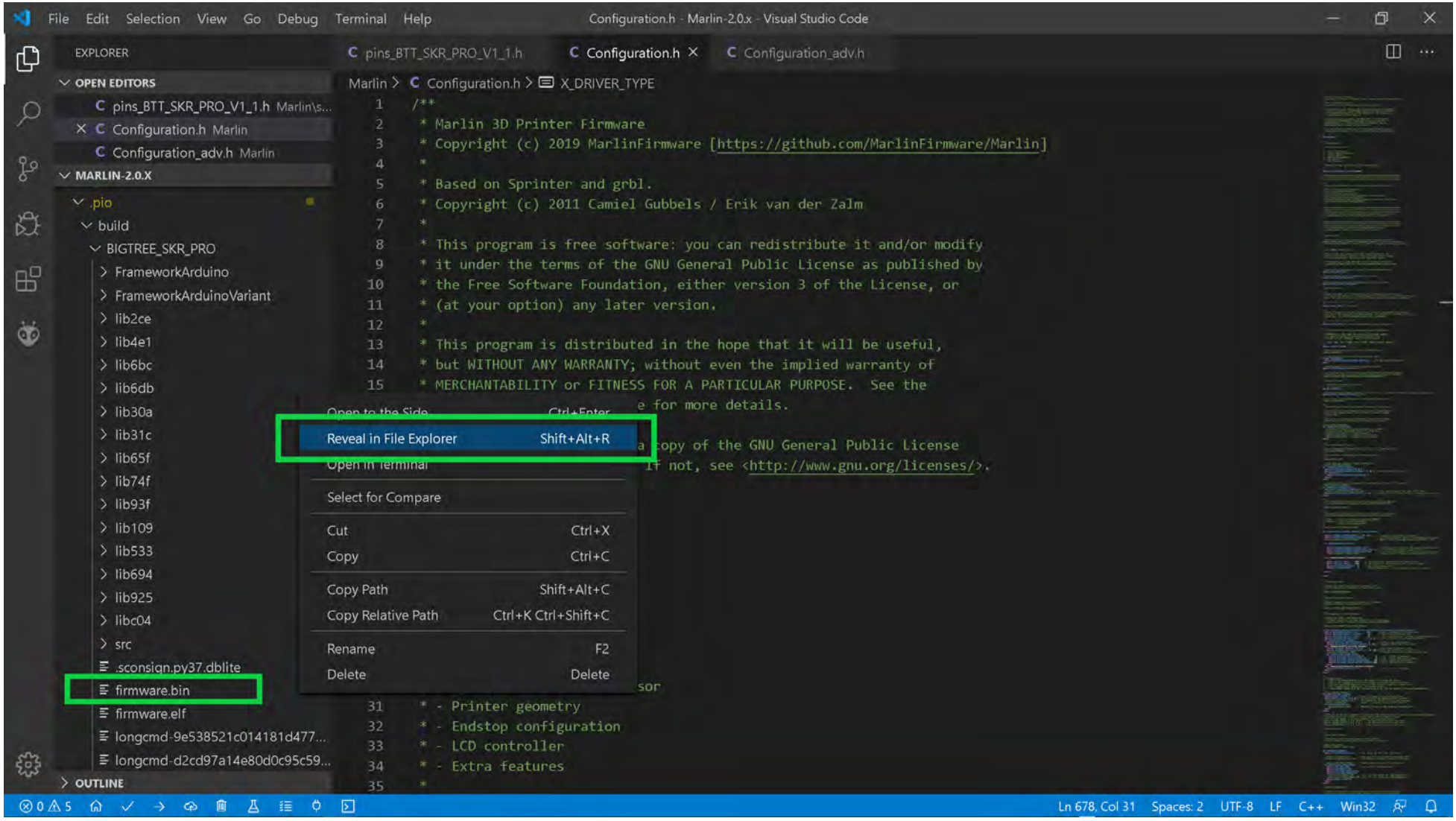

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The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in Stand Alone Mode for SpreadCycle

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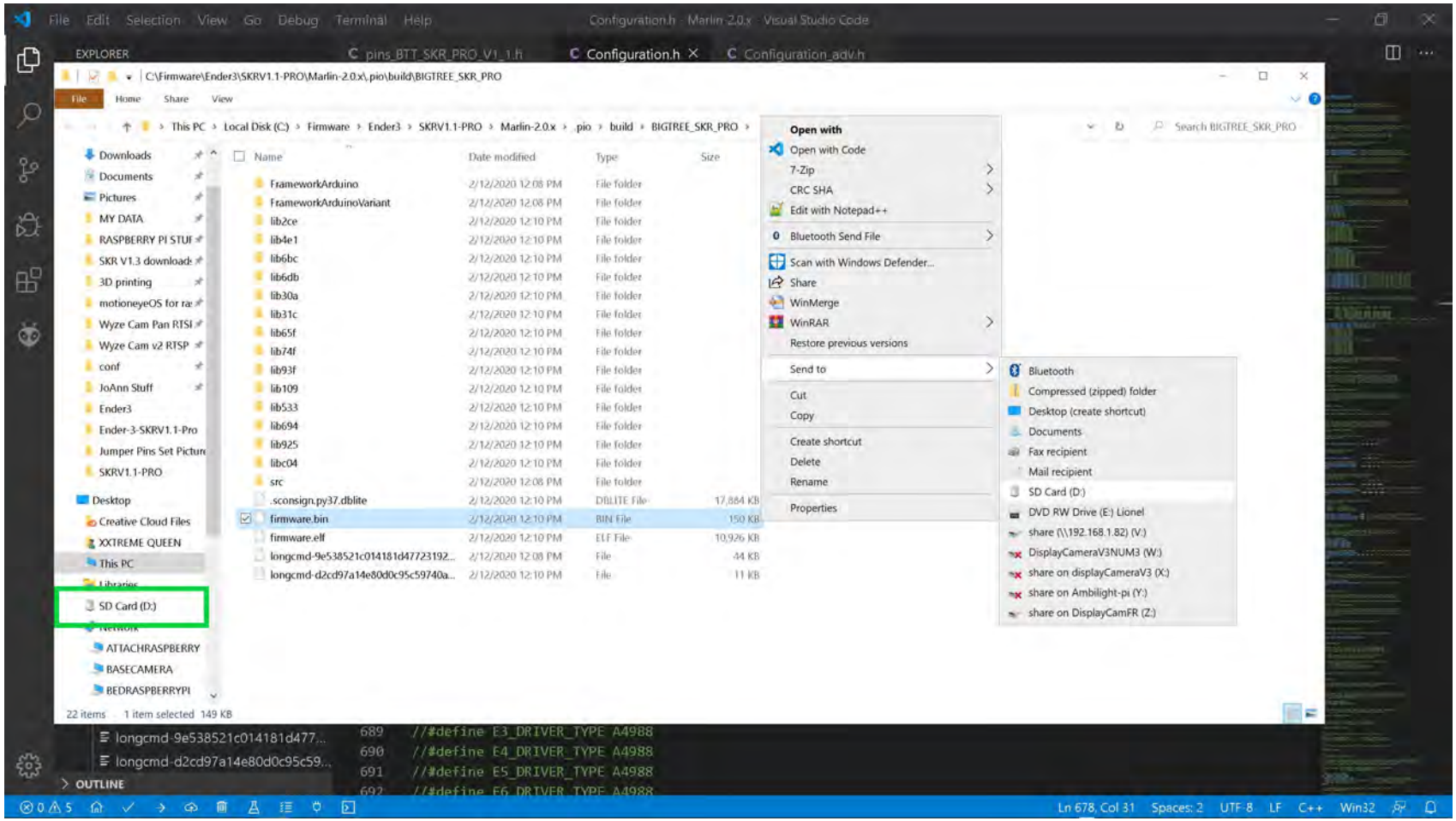
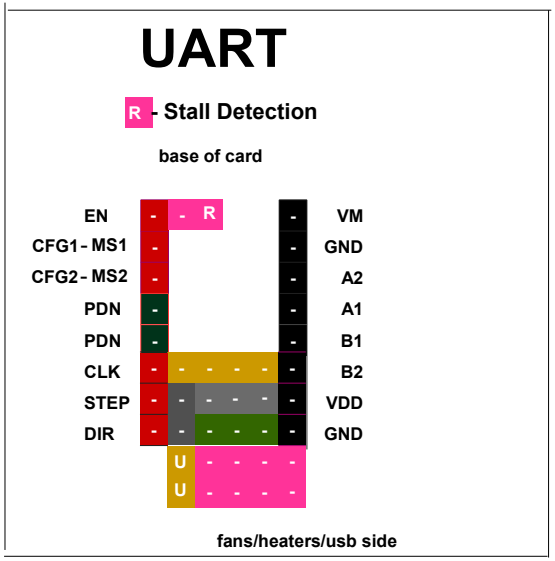


- Right click on the SD card reader, as seen in the GREEN box above, and select "Eject" from the context menu. Take the micro-SD card out of the adapter and place it into the micro-SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR"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

BIQU TMC2209 V1.2

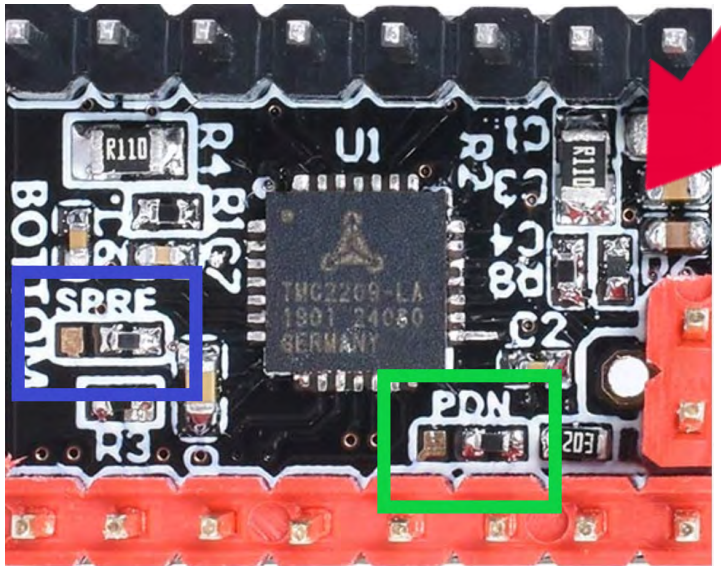
UART Mode



Driver Chip	Steps are set inside of your Firmware
TMC2209 UART mode Maximum subdivision 256 5.5V - 28V DC 2.8A	$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$
Driving current calculation formula	$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$

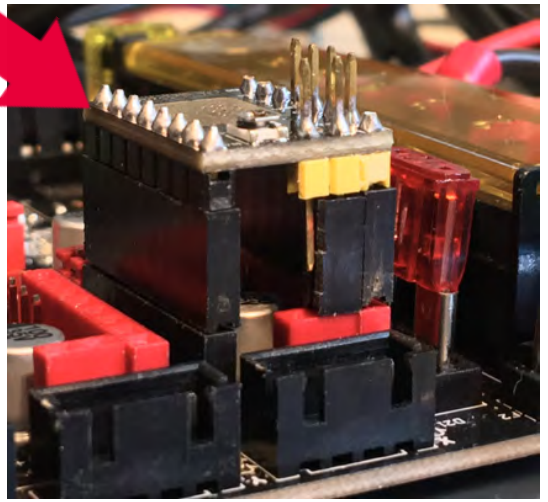
Note: To ensure your TMC2209 is in UART mode, look on the bottom of the driver board for the PDN pads. Two of the three pads should be bridged together. If a bridge exists then the device is in UART Mode, as seen in the GREEN box.

The BLUE box shows the device has StealthChop .



Note: When the stall-guard function is not used, the stall-guard pin 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.



Note: You can use 50% to 90% of the calculated Irms (Imax/1.414) when tuning ("X_CURRENT", "Y_CURRENT", etc.) the stepper motor driver in the firmware.

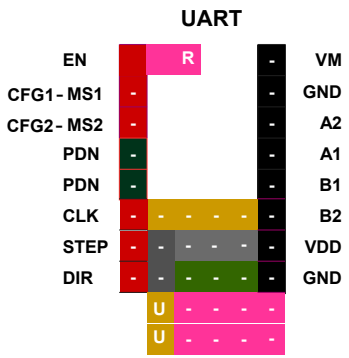
NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

BIQU TMC2209 V1.2

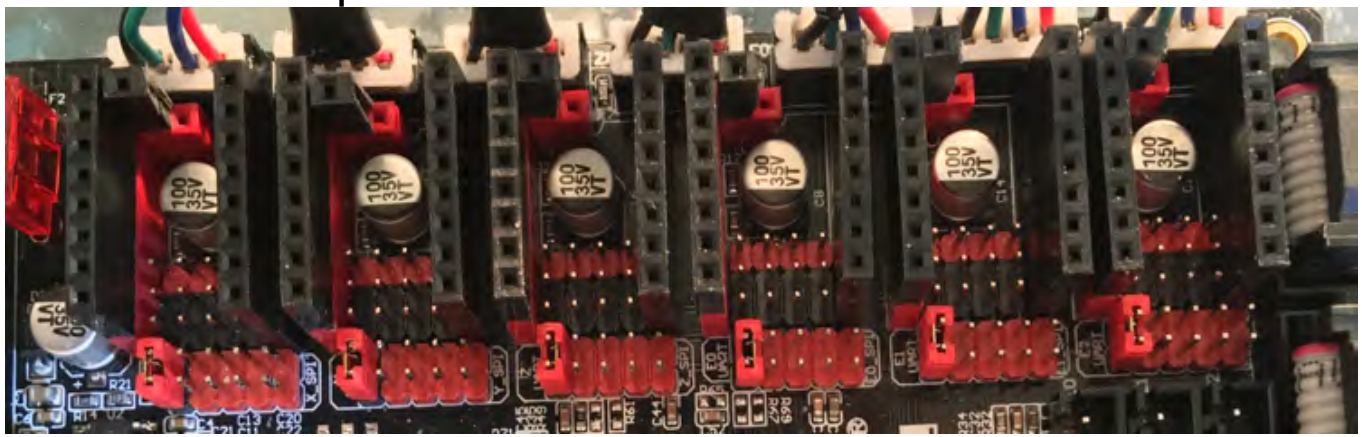
UART Mode

UART

R - Stall Detection



Note: Set Jumper "U" for UART MODE!!

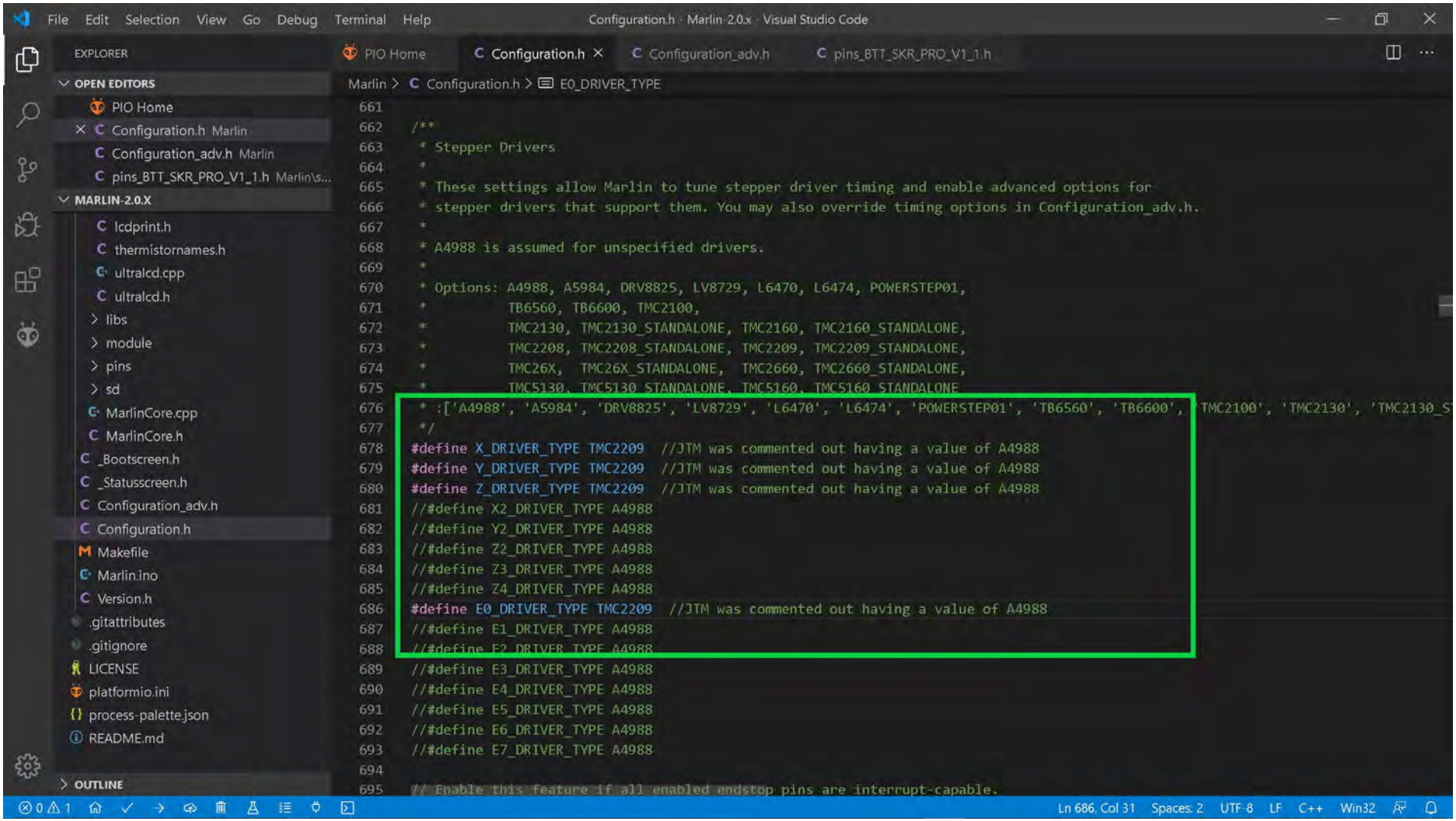


NOTICE!: pin labels are relative to driver chip carrier board, not Controller. Double check compatibility before use. Numbered pairs denote required jumpers.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

NOTE: Go to Appendix C 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 ("//").



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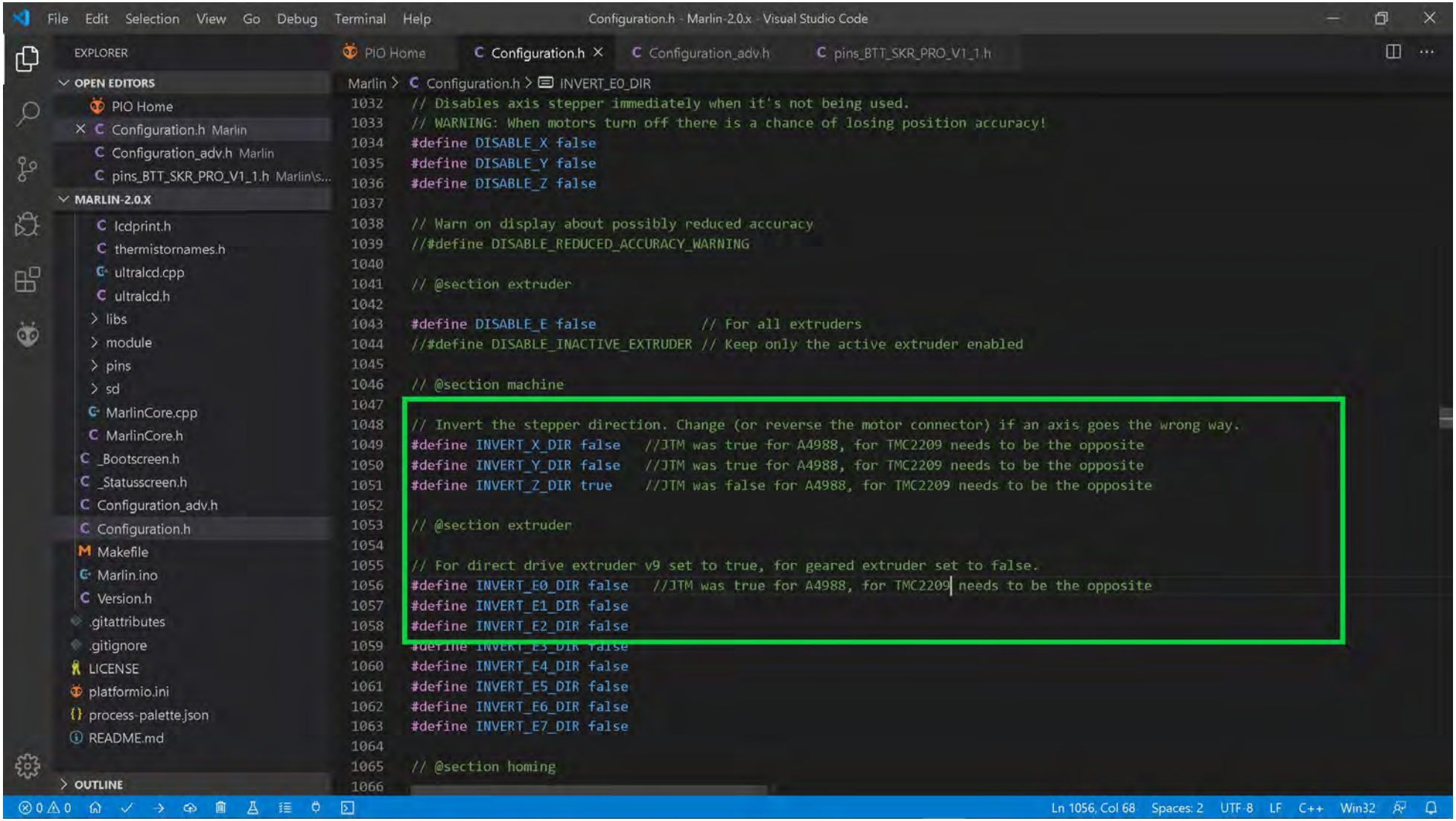
The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

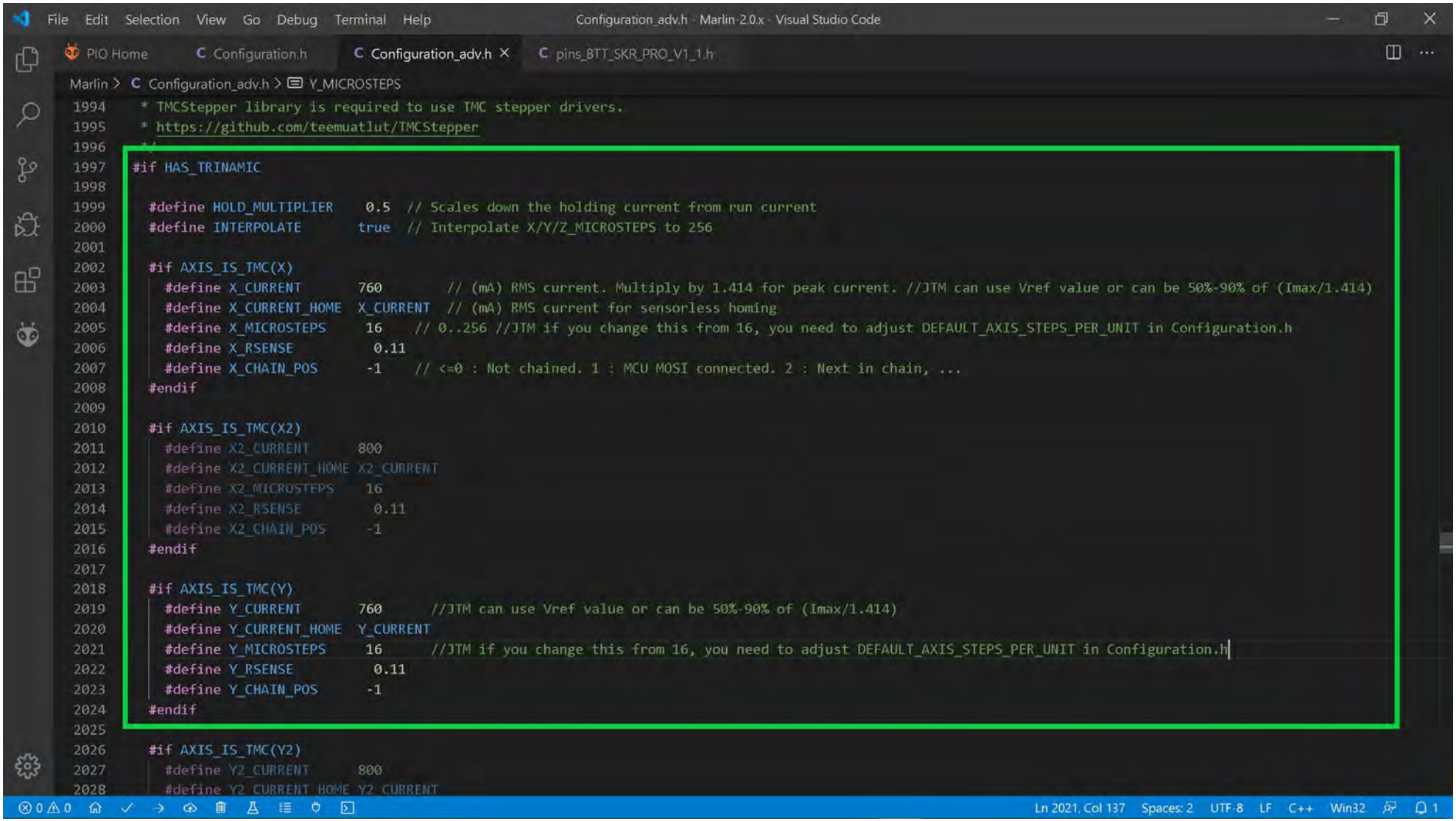
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC2209 drivers, I must invert the stepper motor direction because the TMC2209 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC2209 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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

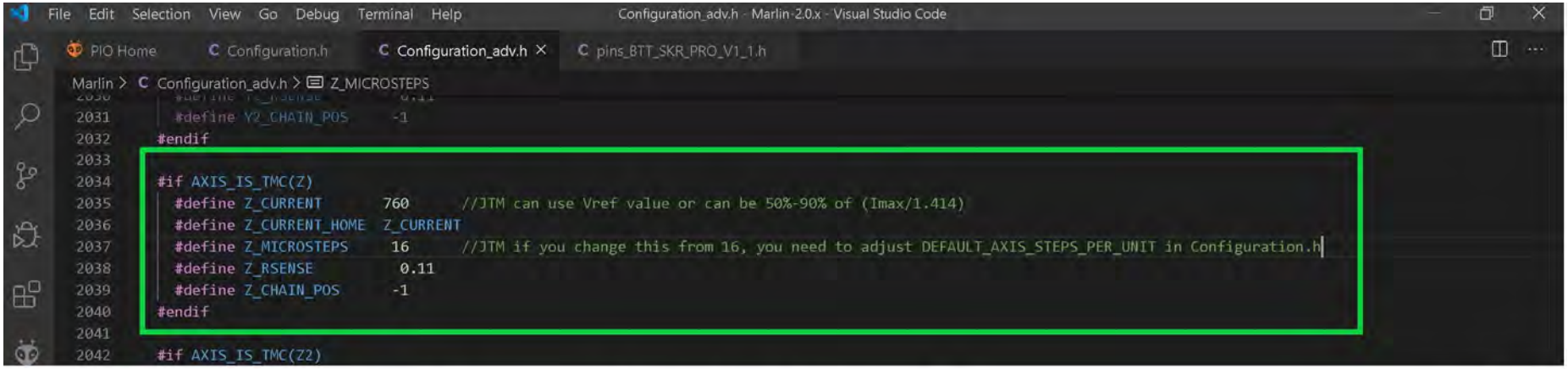
- next you want to set your Vref in the Marlin firmware for each axis that has the TMC2130 driver, as seen in the GREEN box below. I changed the "X_CURRENT" to be the calculated Vref for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated Vref for my Y-Axis, which is 760mV on the Ender 3.

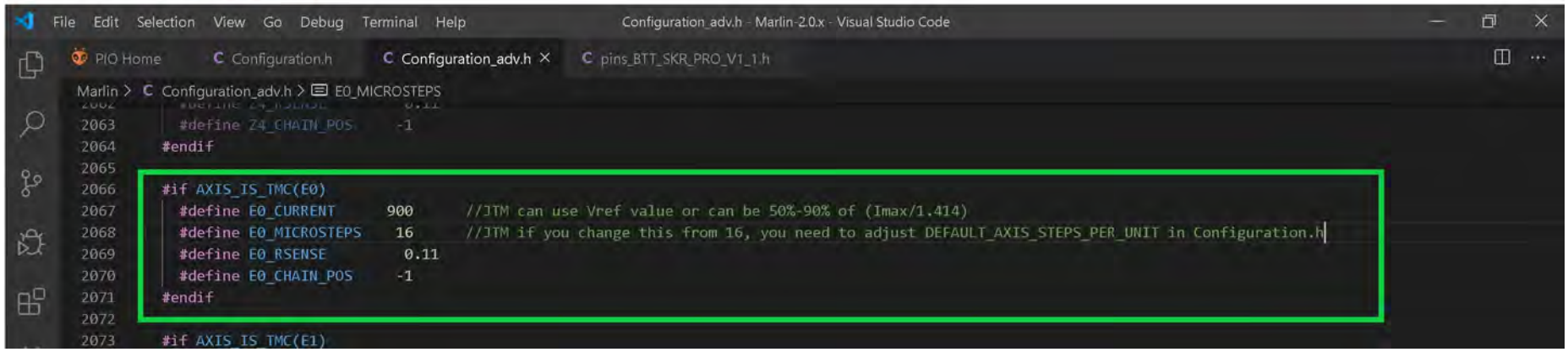


- Go to the next page.

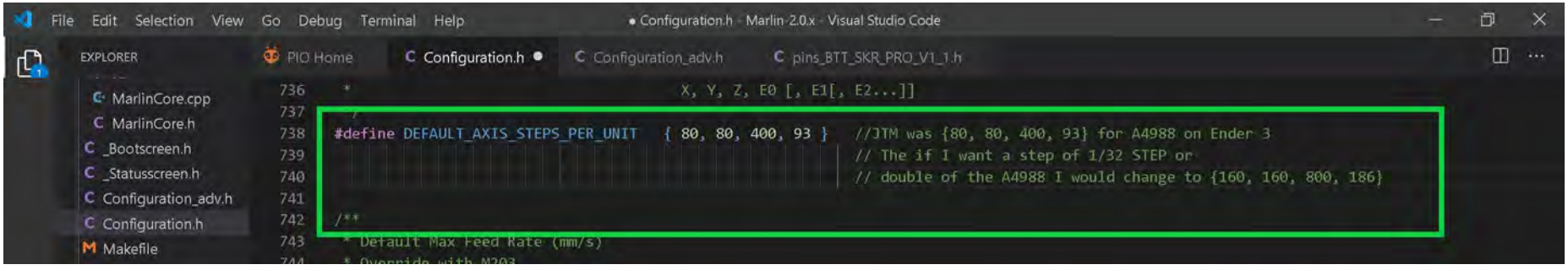
The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Now, I am setting the Vref for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated Vref for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated Vref for my Extruder, which is 900mV on the Ender 3.





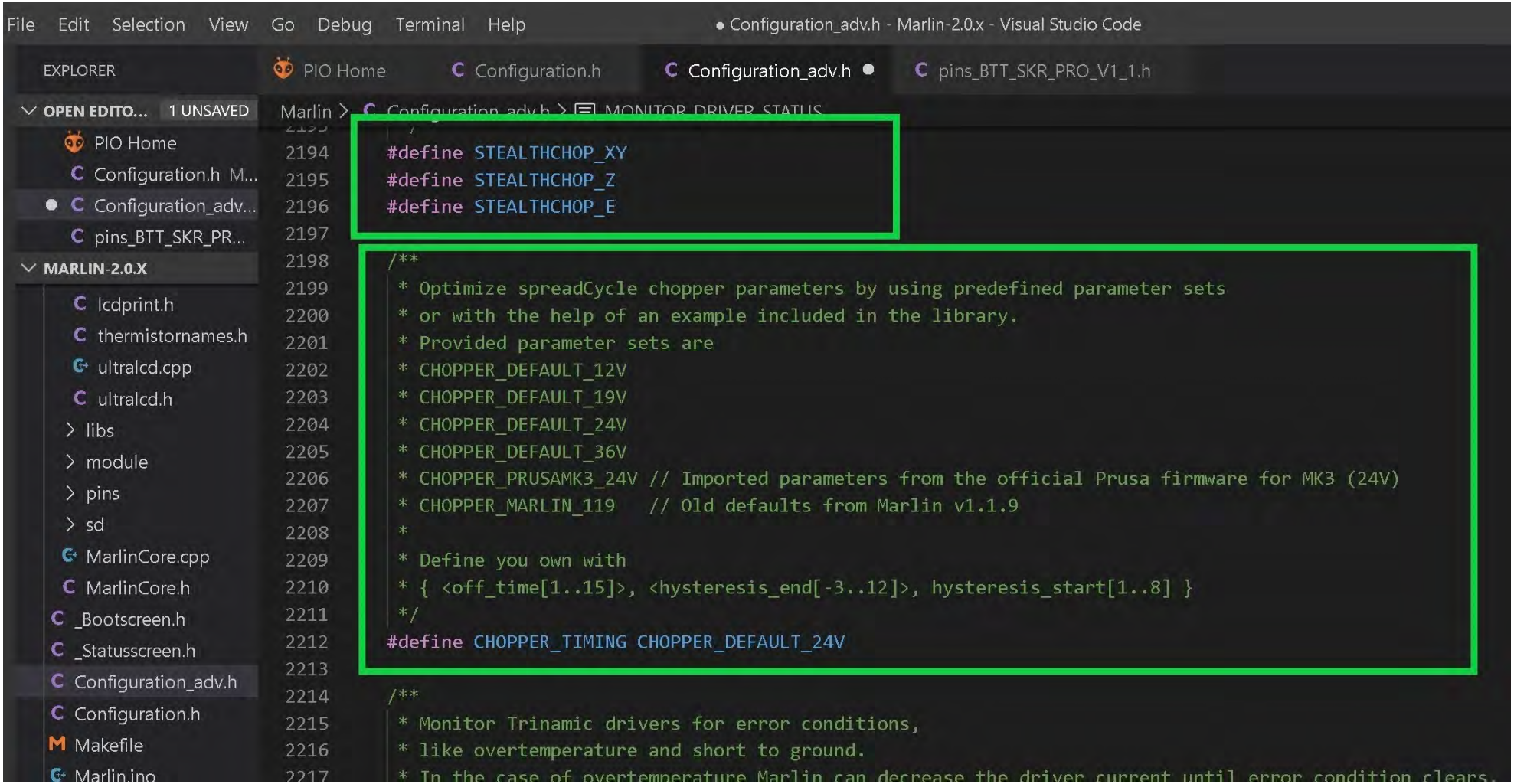
- If you changed the "MICROSTEPS" for any of the axes then you will need to update "DEFAULT_AXIS_STEPS_PER_UNIT" to reflect your changes



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

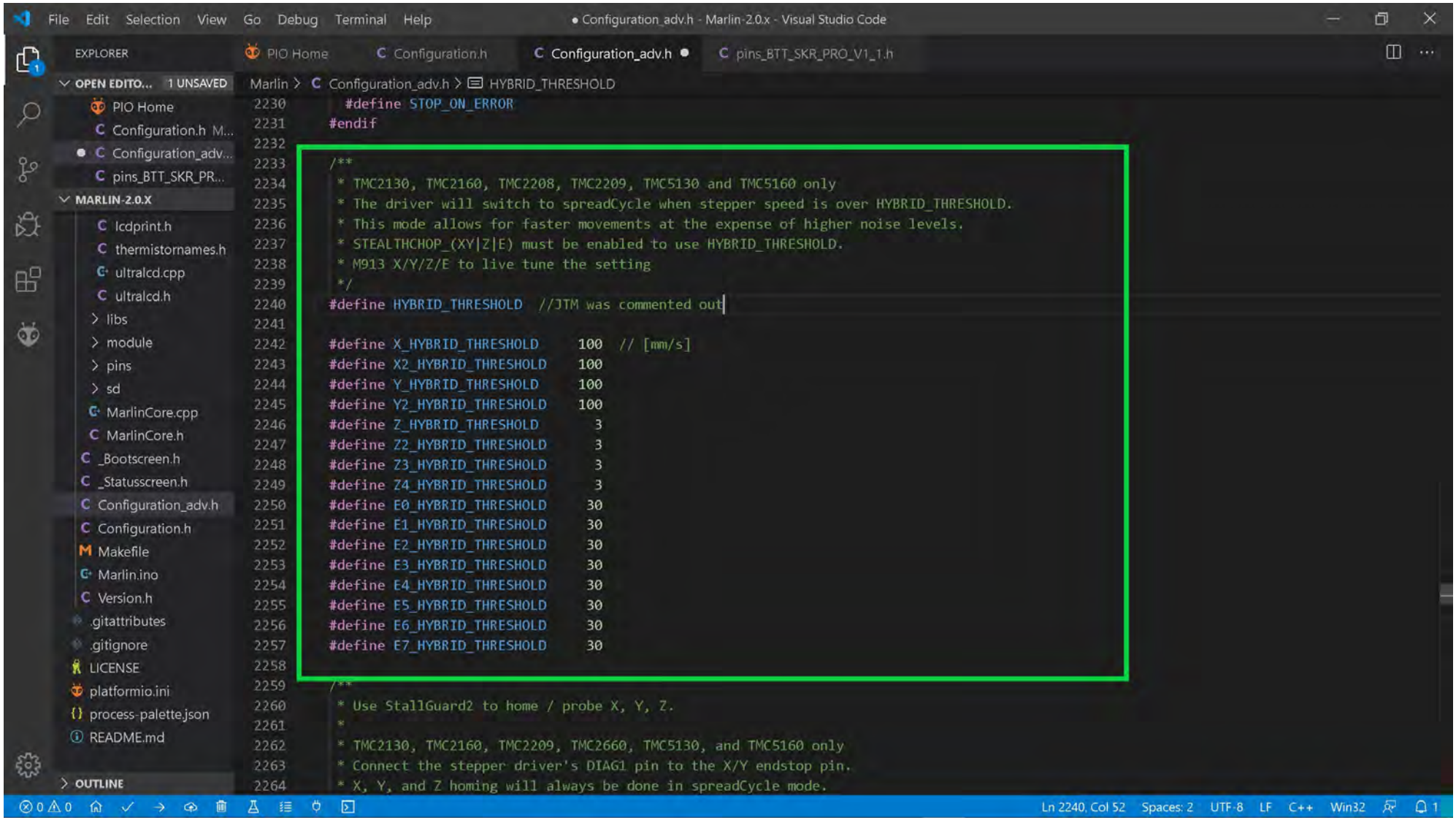
- By default stealthChop in enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.



- 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_THERSHOLD" 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.



- 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.
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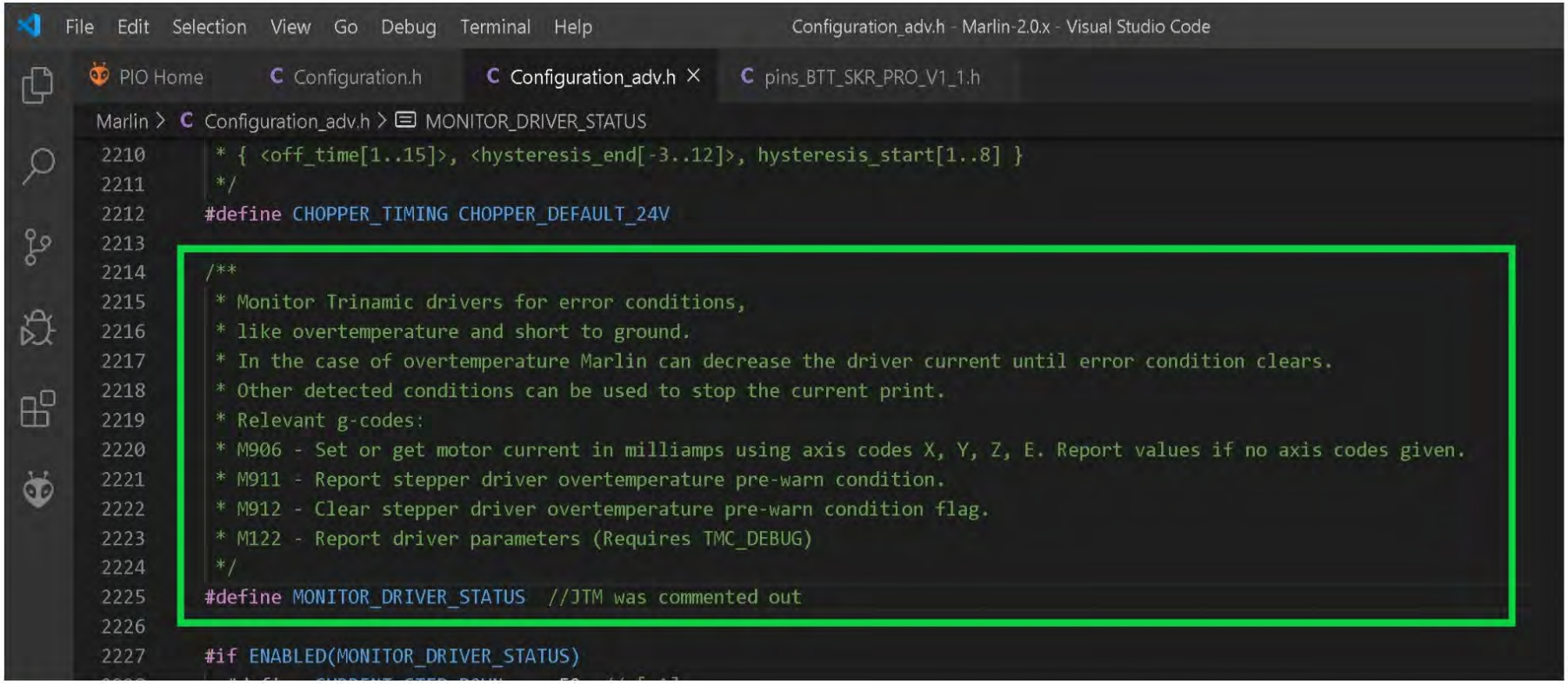
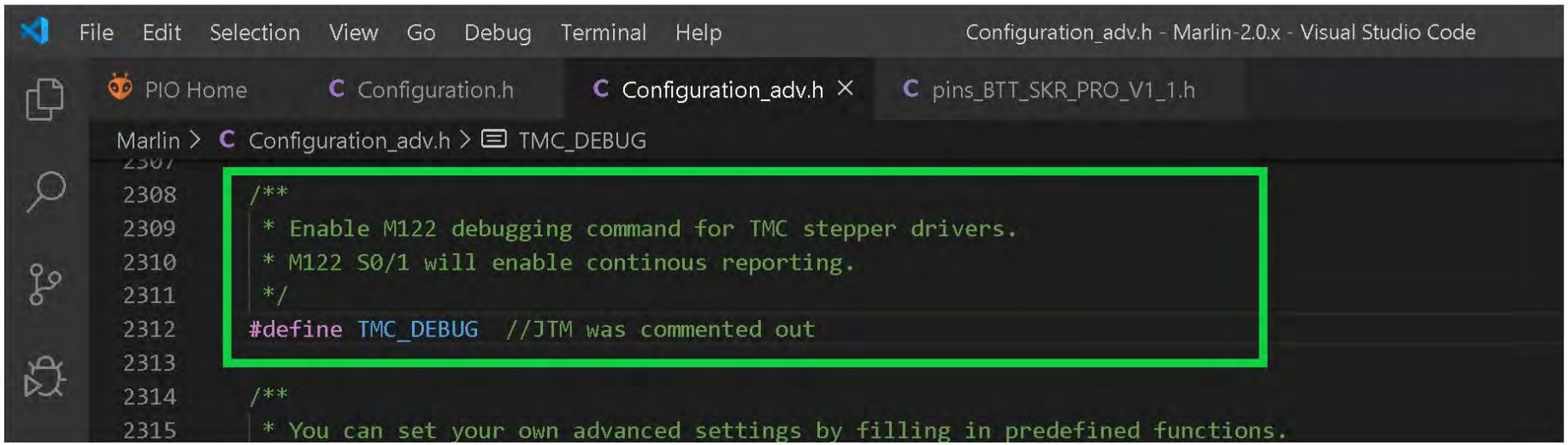
The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

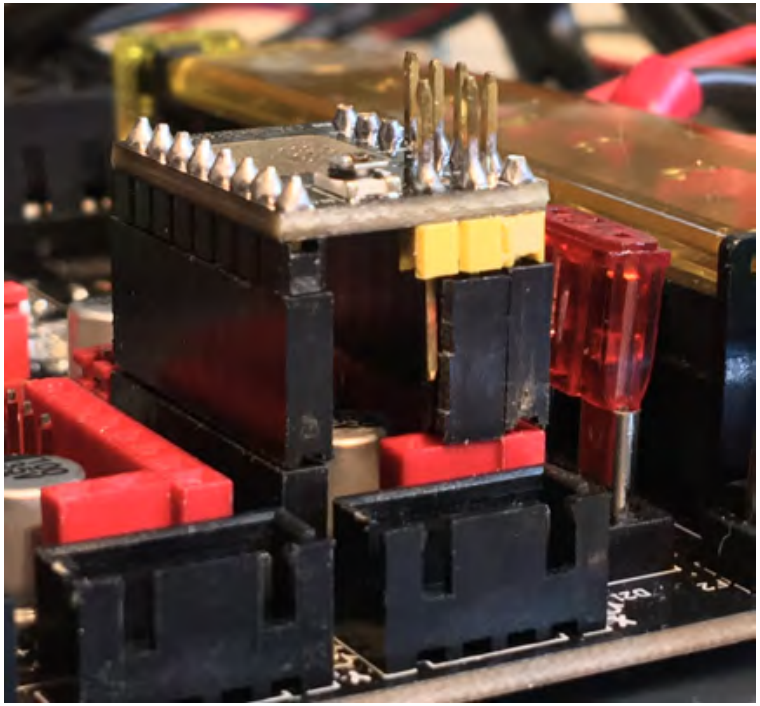




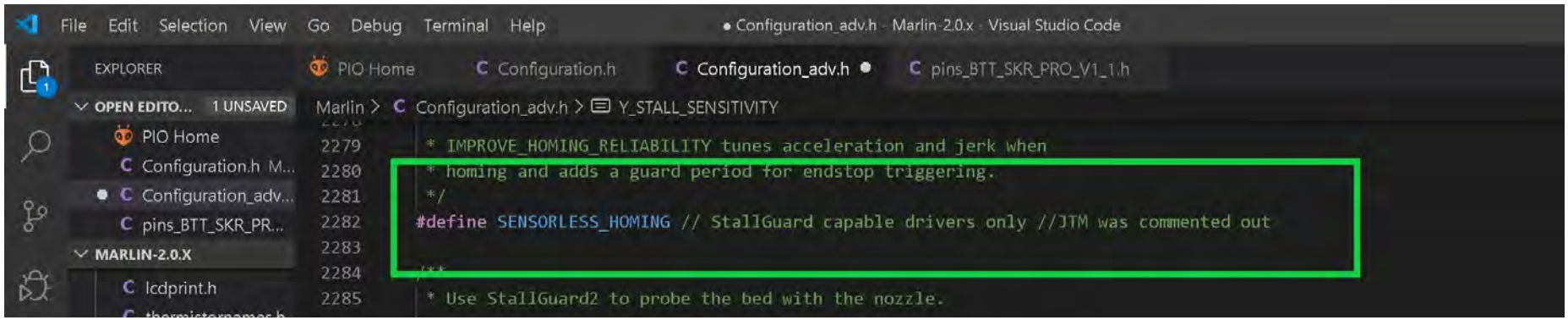
- Go to the next page.

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.



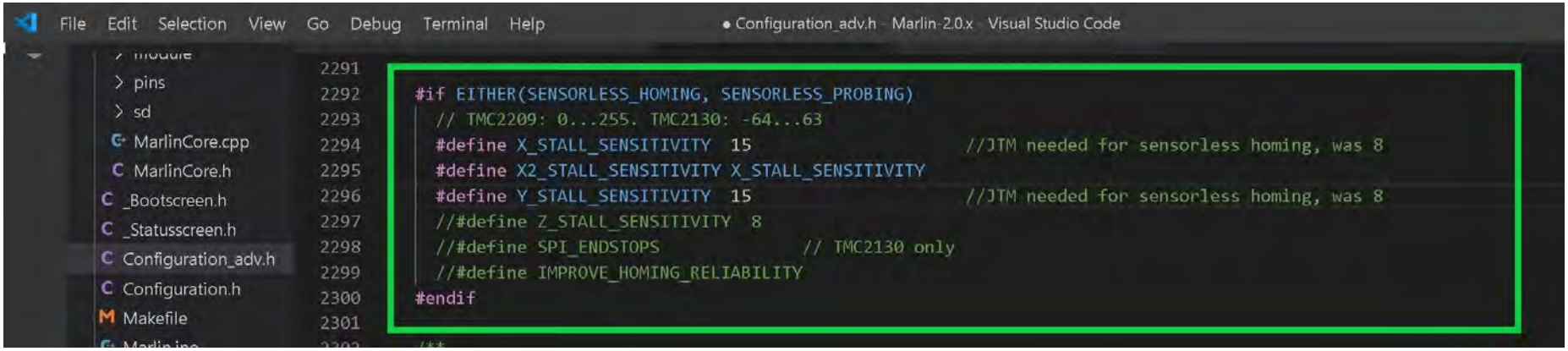
- sensor-less homing is commented out by default. So I remove the two leading "//" to un-comment "SENSORLESS_HOMING"



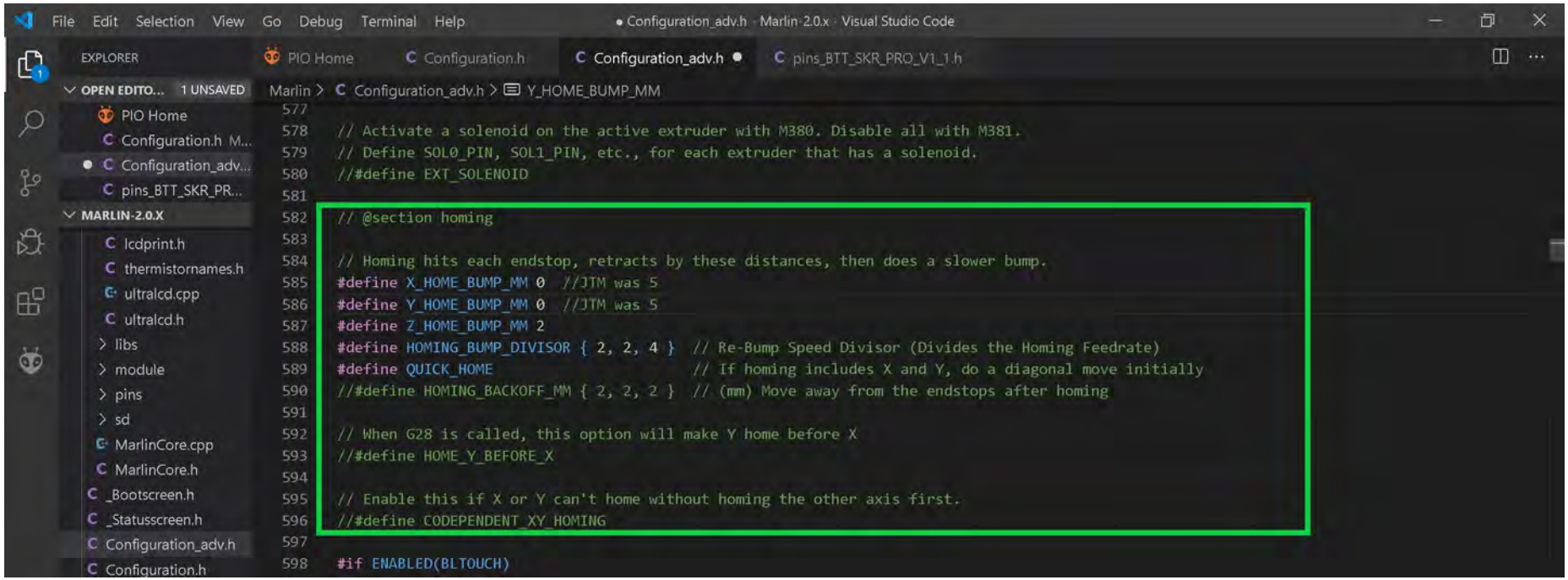
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Next we set a "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".



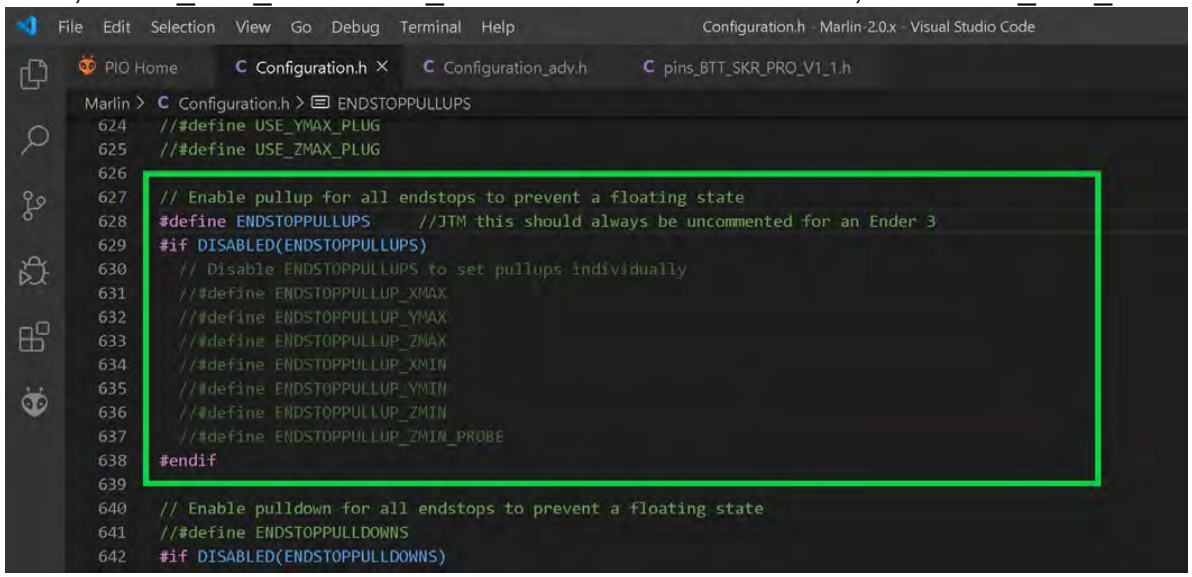
- We now have to set our home bump to 0 for each axis with sensor-less homing enabled. So I will set "X_HOME_BUMP_MM" to 0 and "Y_HOME_BUMP_MM" to 0. If you want sensor-less homing on Z axis then you will need to set "Z_HOME_BUMP_MM" to 0.

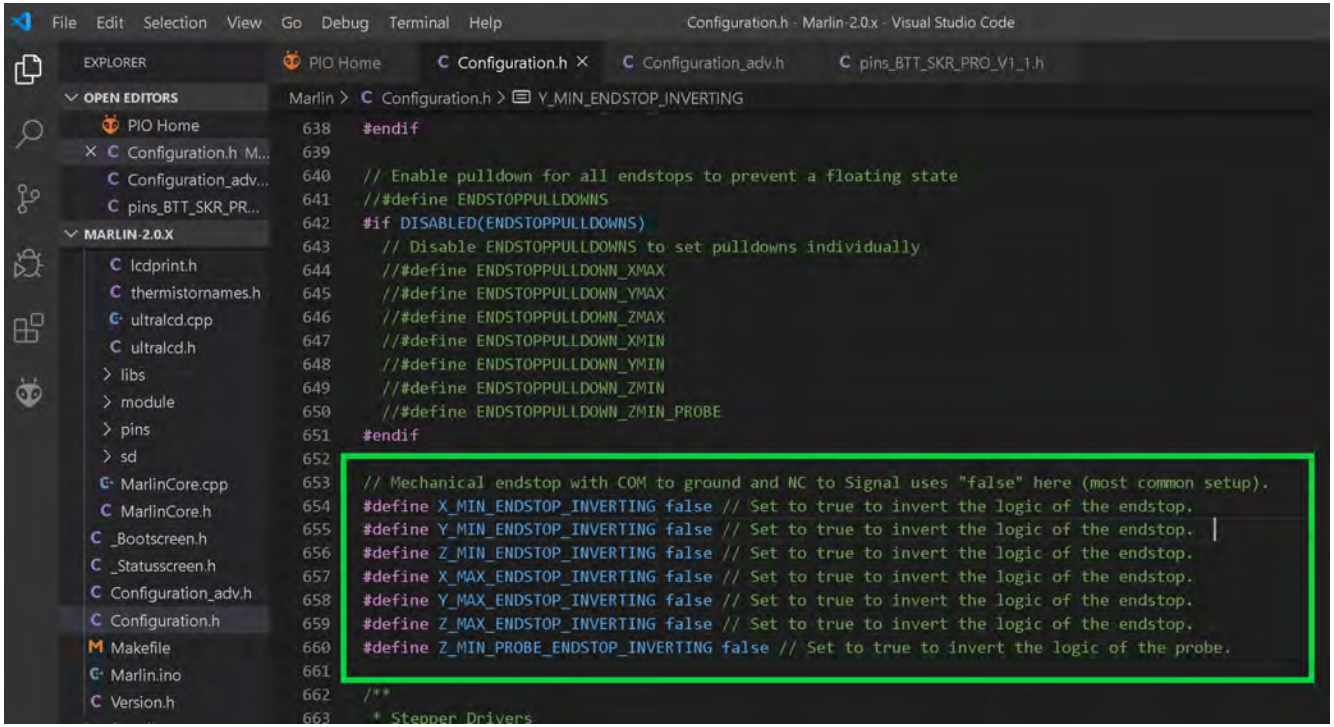


- Go to the next page.

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 and 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.

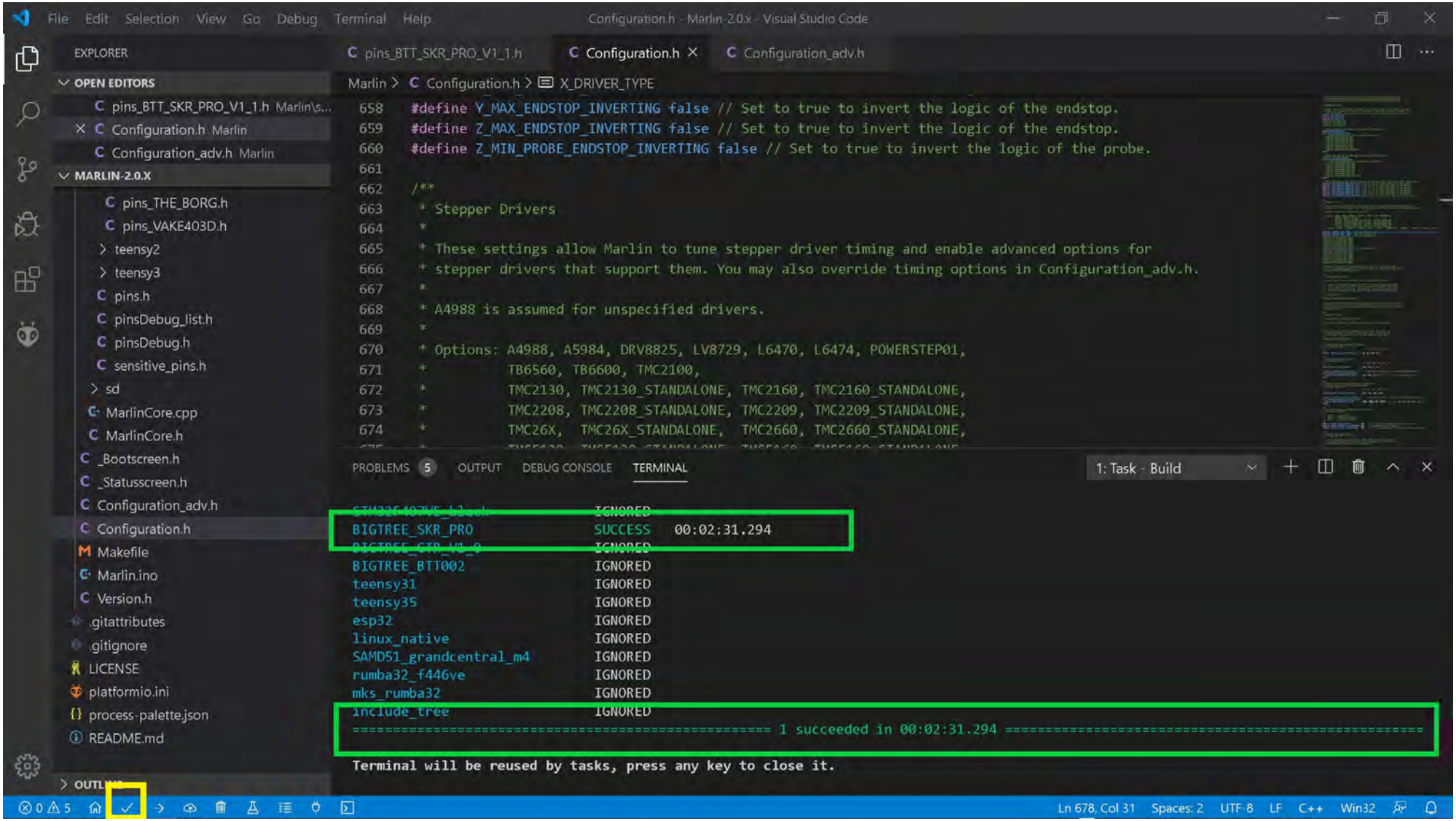




- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

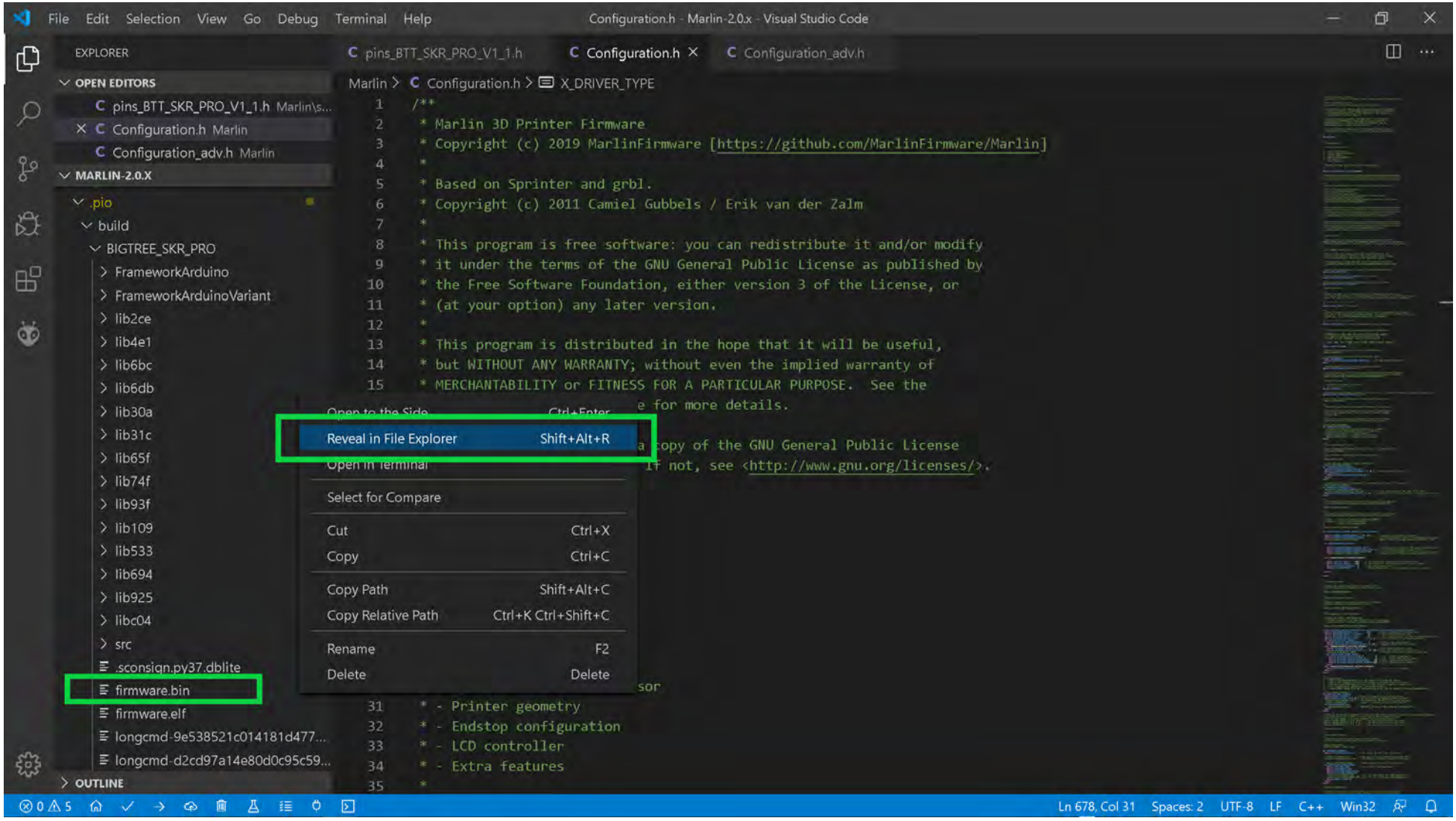
- The end of Marlin setup for BIQU TMC2209 drivers in UART mode . Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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.

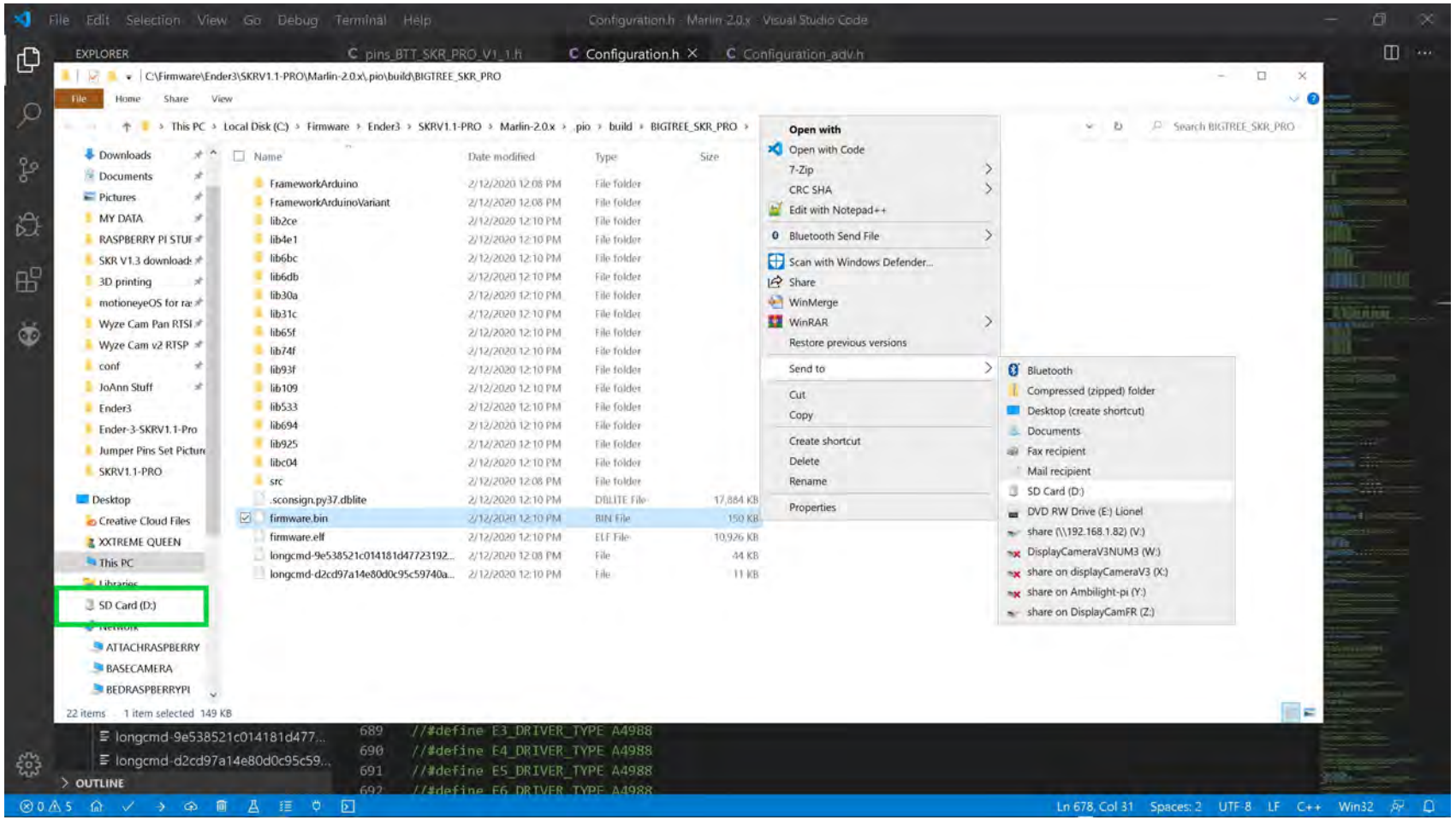


- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC2209 V1.2 Drivers in UART Mode

- Ensure your micro-SD card that 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.

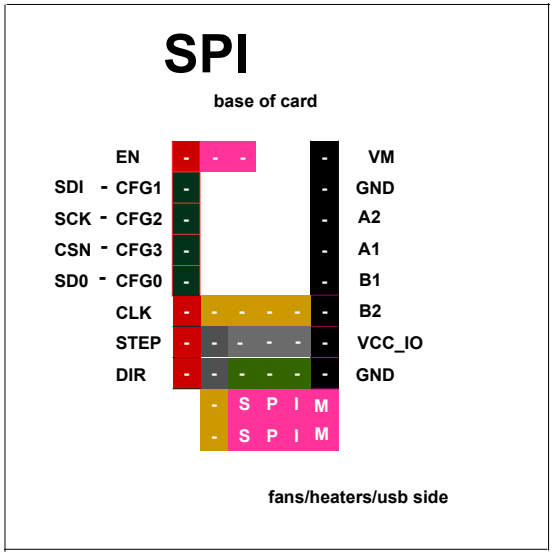
    - From the file explorer window right click on the "firmware.bin" file name and select "Send to" from the content menu. For my computer "D:" is my SD card reader. For your computer it may be a different drive letter. The "firmware.bin" file will be written to the SD card and renamed to "FIRMWARE.CUR".



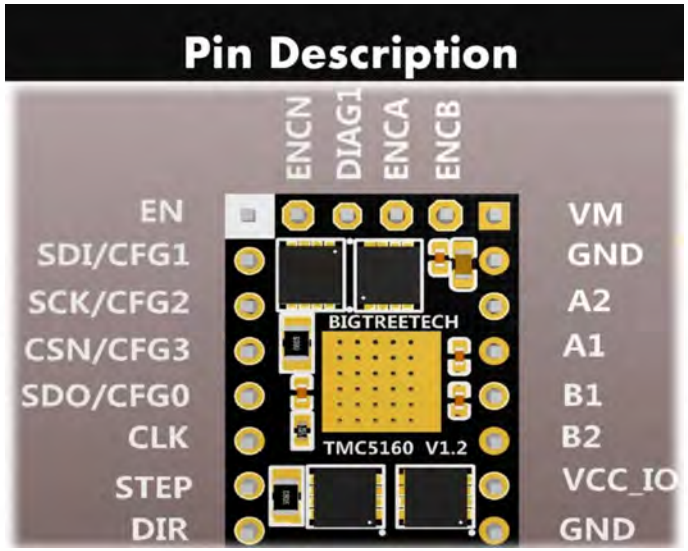
- Right click on the SD card reader, as seen in the GREEN box above, and select "Eject" from the context menu. Take the micro-SD card out of the adapter and place it into the micro-SD card reader of the SKR PRO V1.1 board. Turn on the power to the printer (i.e. the SKR PRO V1.1 board) and the "FIRMWARE.CUR"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

BIQU TMC5160 V1.2

SPI Mode

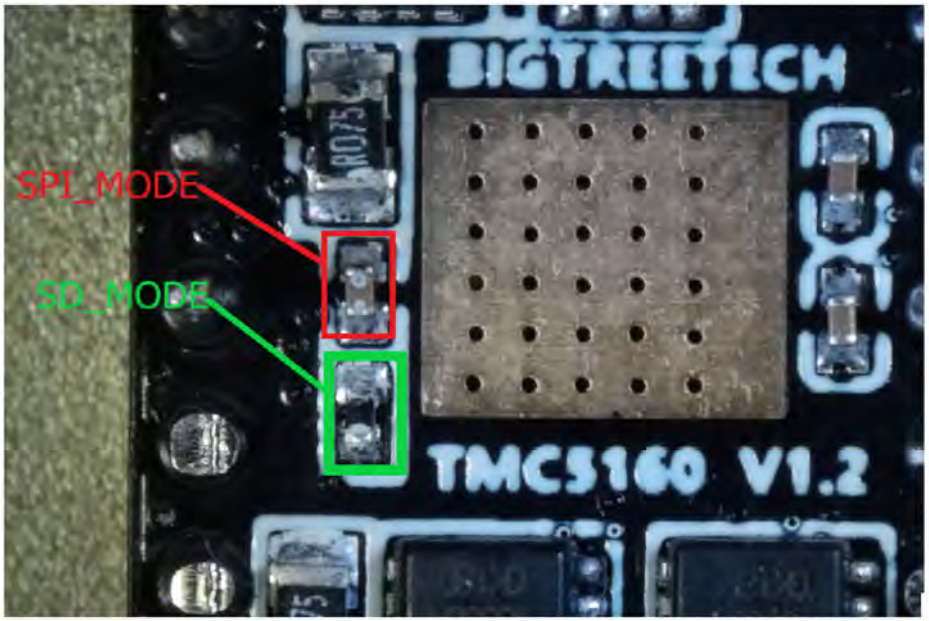


IMPORTANT: The default configuration for the TMC5160 is SPI MODE!!



NOTE: By default the TMC5160 is in SPI Mode, which means BOTH SPI_MODE and SD_MODE are jumpered to VCC_IO pin

Note: To place TMC5160 into UART Mode, you MUST desolder one end on both SPI_MODE and SD_MODE jumper and then solder that end to GND pin.



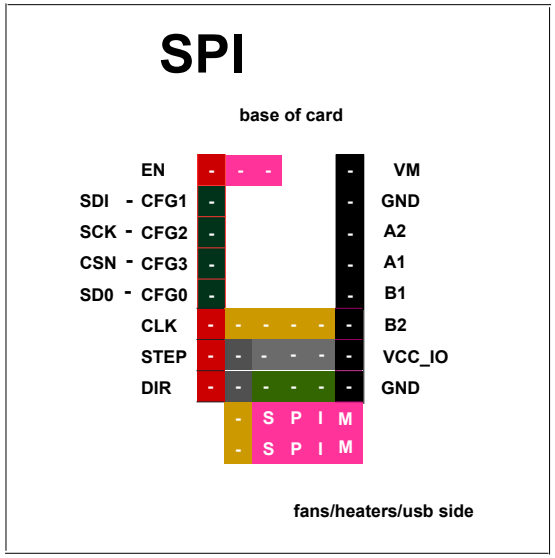
Note: To place TMC5160 into SPI and Motion Controller Mode, you must desolder one end of SD_MODE jumper and then solder that end to GND pin on the Driver Board.

NOTE: By default the TMC5160 is in SPI Mode, which means BOTH SPI_MODE and SD_MODE are jumpered to VCC_IO pin

Important: Marlin supports TMC5160 in SPI MODE ONLY

BIQU TMC5160 V1.2

SPI Mode



Driver Chip	Steps are set inside of your Firmware		
TMC5160 SPI Mode 10v - 35v DC 4.2A Maximum subdivision 256	SD_MODE	SPI_MODE	Mode
	GND	GND	UART enabled
	GND	VIO	SPI and Motion Controller enabled
	VIO	GND	Standalone
	VIO	VIO	SPI enabled

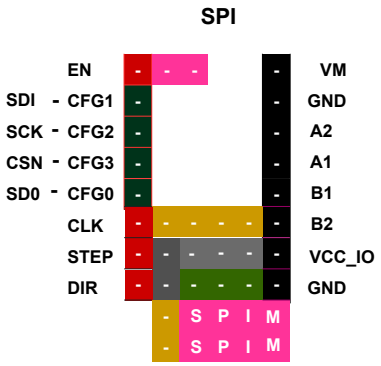
Driving current calculation formula

$$I_{MAX} = (((V_{ref} * 1.77) / 2.5) * \sqrt{2})$$

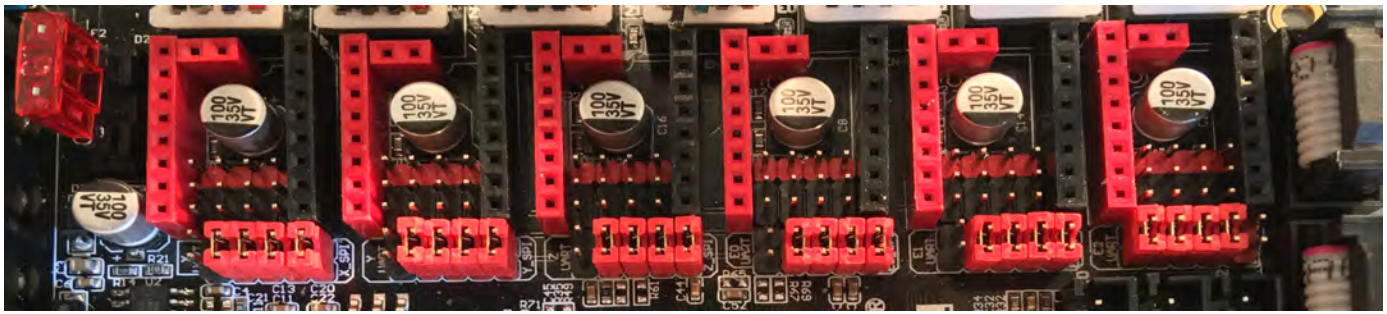
$$V_{ref} = (\frac{I_{MAX}}{\sqrt{2}} * 2.5) / 1.77$$

Note: The TMC5160 V1.2 by default comes in SPI mode, which means that SD_MODE and SPI_MODE are already jumpered to VIO (VCC_IO) on the driver board. The BIQU TMC5160 does NOT come with a POT or "Vref Test point" location because the Imax is set inside of the Firmware.

Note: You can use 50% to 90% of the calculated Irms (Imax/1.414) when tuning ("X_CURRENT", "Y_CURRENT", etc.) the stepper motor driver in the firmware.



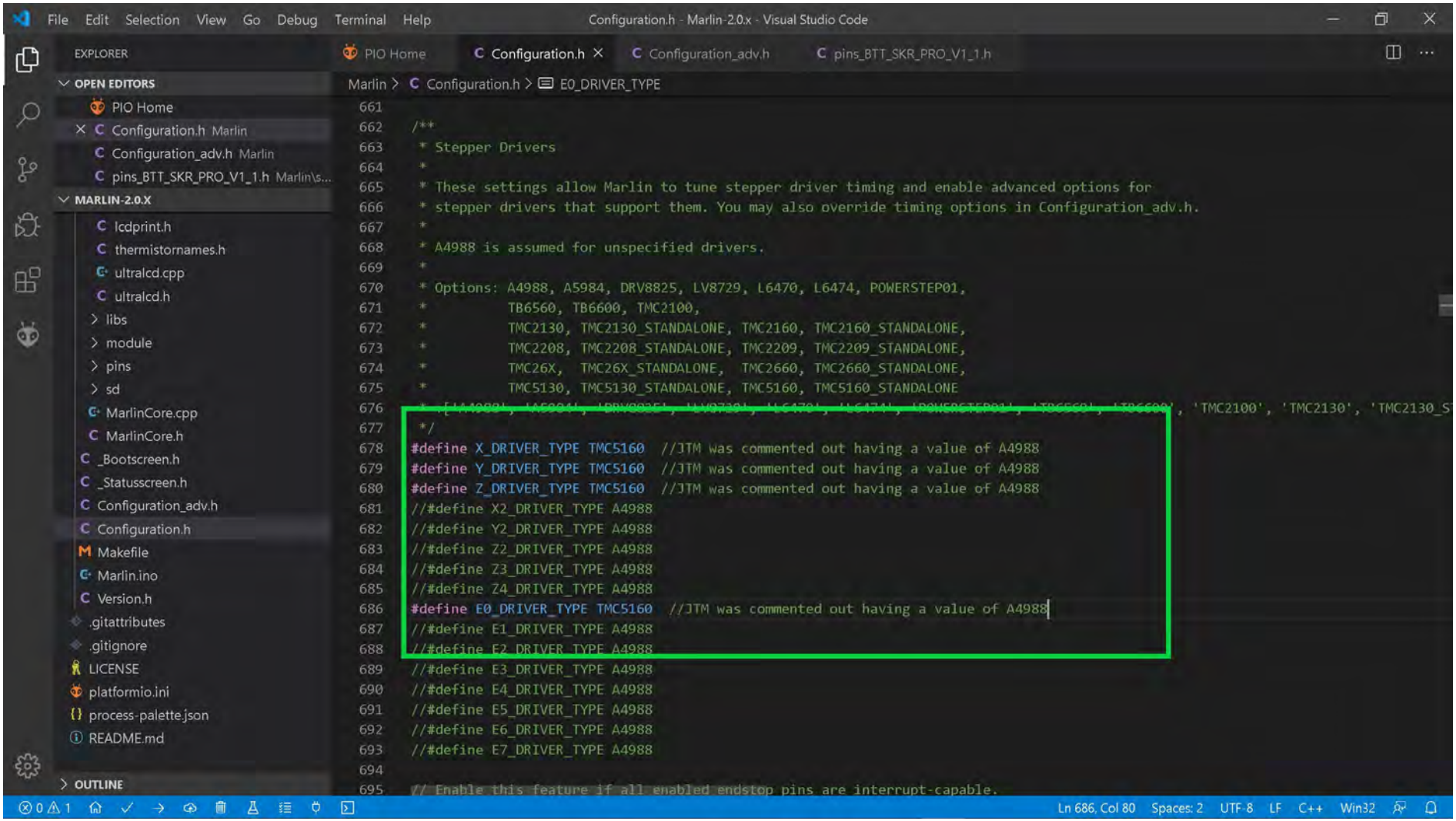
Note: Set JUMPERS "S","P","I","M" on the board!!



The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

NOTE: Go to Appendix C then come back here for the changes to Marlin for BIQU TMC5160 V1.2 stepper motor drivers in SPI mode.

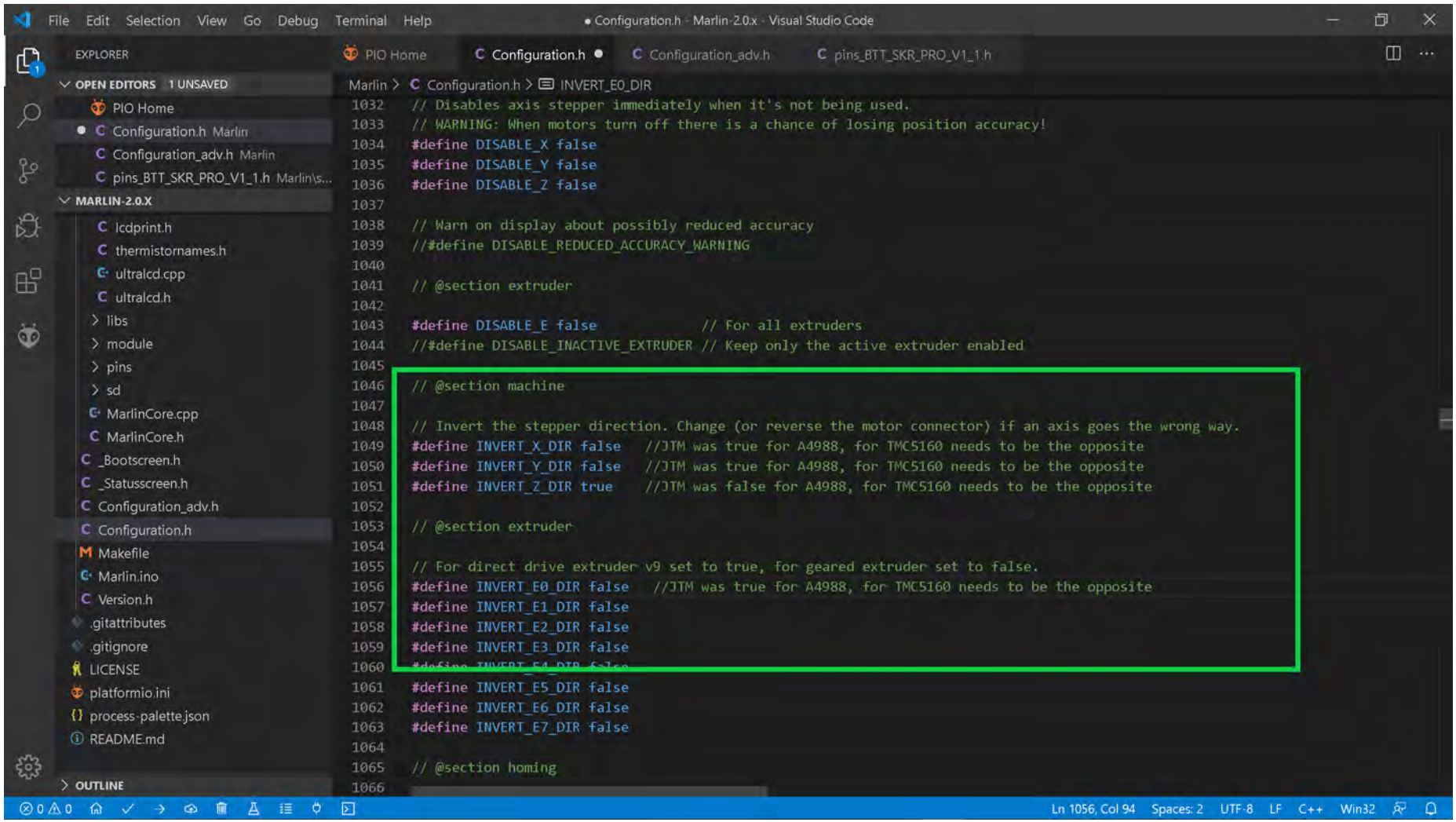
- Change the stepper motor drivers so that Marlin knows you are using TMC5160 drivers in SPI mode. Change one line for each axis and one for each extruder you will be using. See the picture below for an example of how to use TMC5160 drivers in SPI mode. When two "//" appear at the beginning of a line that means that line is commented out. To un-comment a line just remove the leading two forward slashes ("//").



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

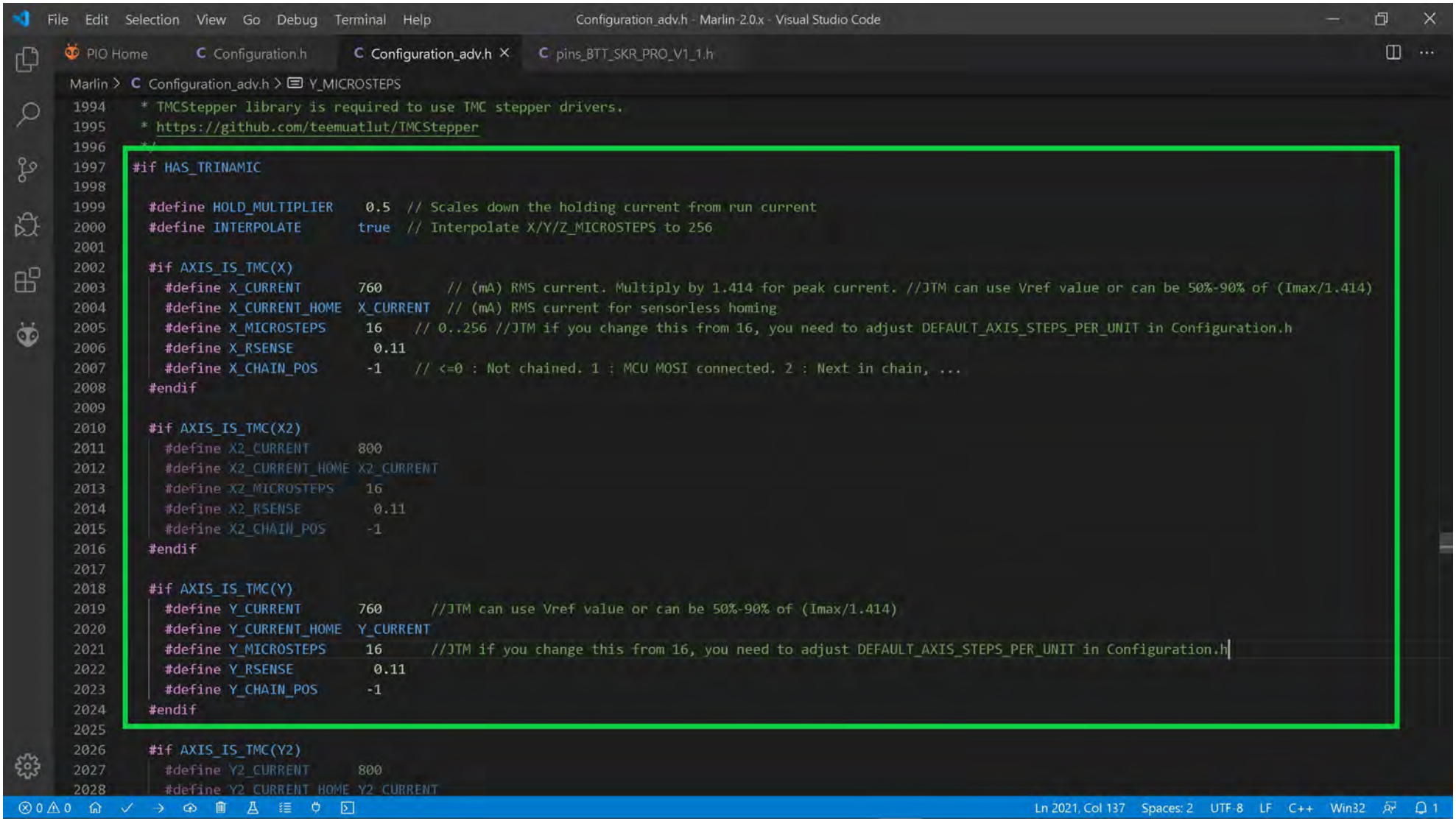
- Since the A4988 driver is what my Ender 3 used, but, now I want to use TMC5160 drivers, I must invert the stepper motor direction because the TMC5160 driver will turn the motors in the opposite direction than the A4988 driver's motor direction. So if the axis' setting you will be using the TMC5160 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



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

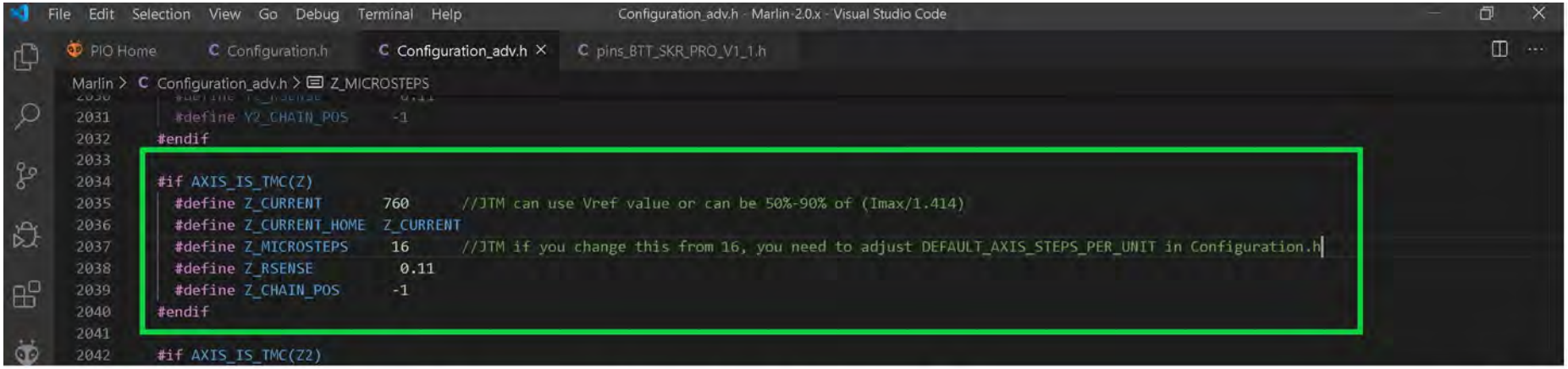
- next you want to set your Vref in the Marlin firmware for each axis that has the TMC2130 driver, as seen in the GREEN box below. I changed the "X_CURRENT" to be the calculated Vref for my X-Axis, which is 760mV for an Ender 3. I changed the "Y_CURRENT" to be the calculated Vref for my Y-Axis, which is 760mV on the Ender 3.

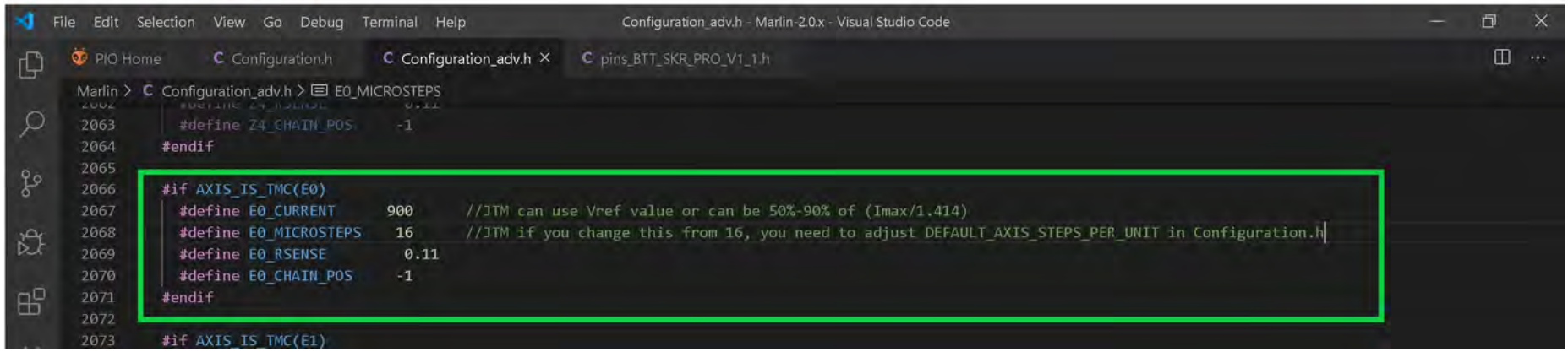


- Go to the next page.

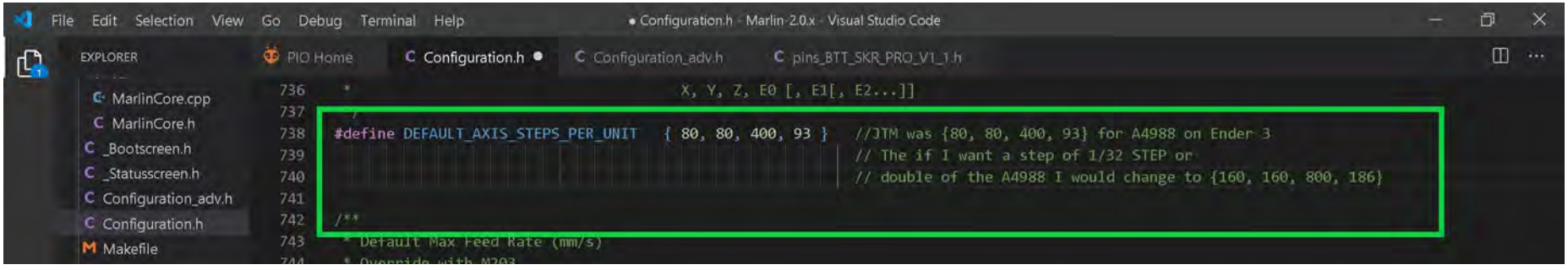
The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- Now, I am setting the Vref for Z-Axis and the extruder, as seen in the GREEN boxes below. I changed the "Z_CURRENT" to be the calculated Vref for my Z-Axis, which is 760mV for an Ender 3. I changed the "E0_CURRENT" to be the calculated Vref for my Extruder, which is 900mV on the Ender 3.





- 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



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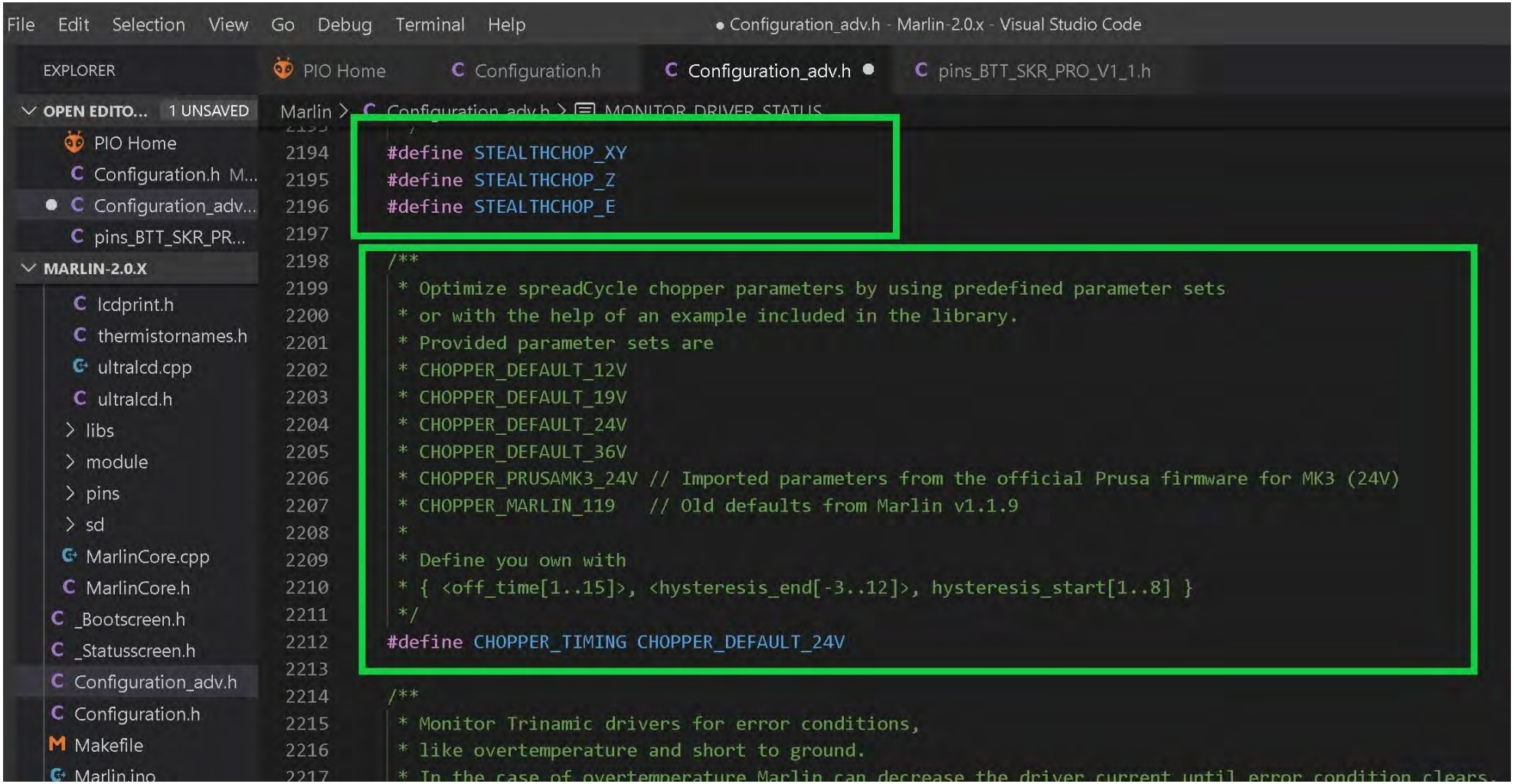
The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

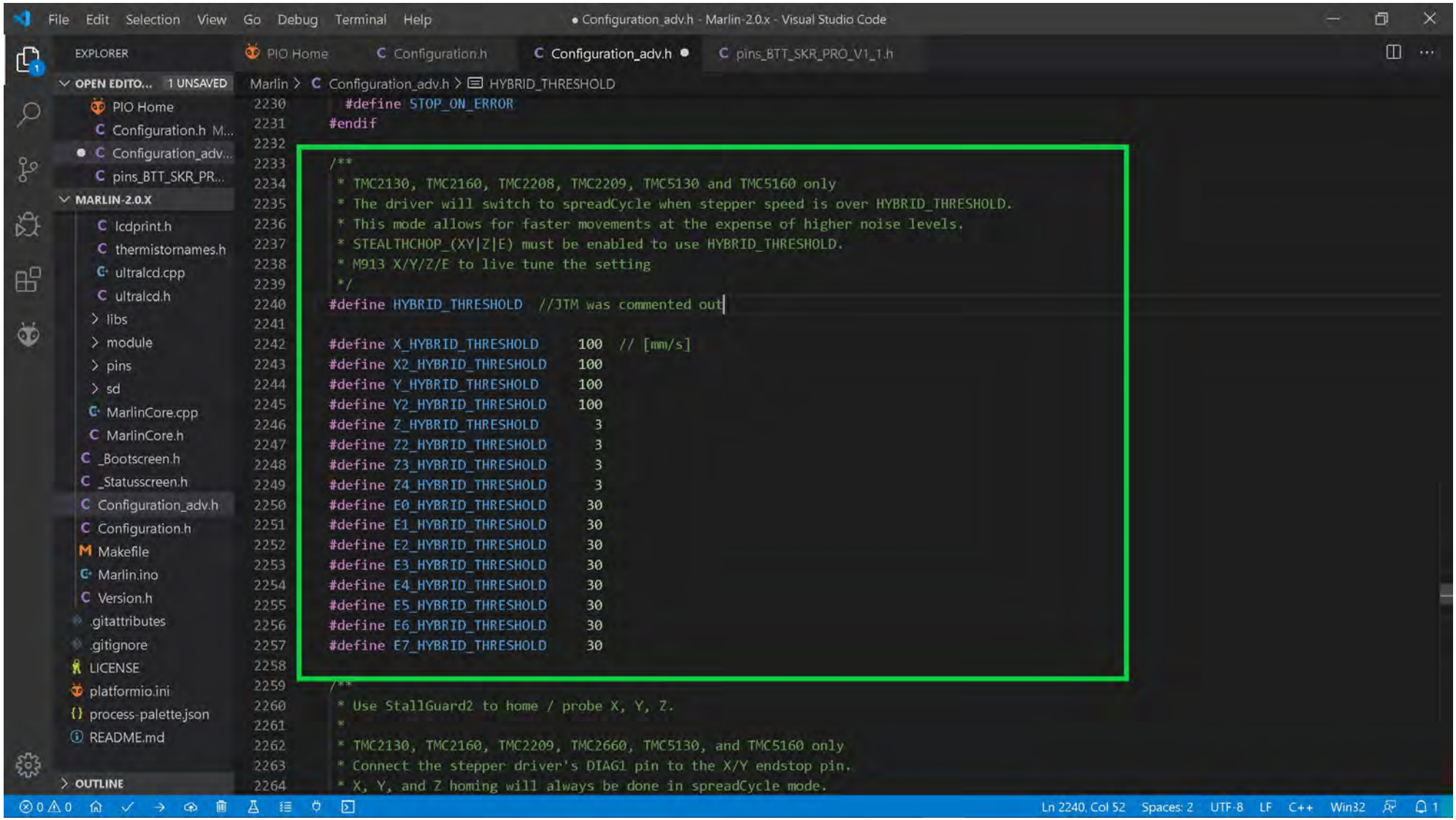
- By default stealthChop in enabled in the Marlin firmware. If you want spreadCycle ONLY then comment out the appropriate lines. I want stealthChop enabled so I want to make sure the the lines are not commented out {"STEALTHCHOP_XY", "STEALTHCHOP_Z" and "STEALTHCHOP_E"}. You also want to check to see if the proper "CHOPPER_TIMING" is set for your printer. An Ender 3 is a 24VDC printer, my "CHOPPER_TIMING" is correct.



- 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_THERSHOLD" 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.



- 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.
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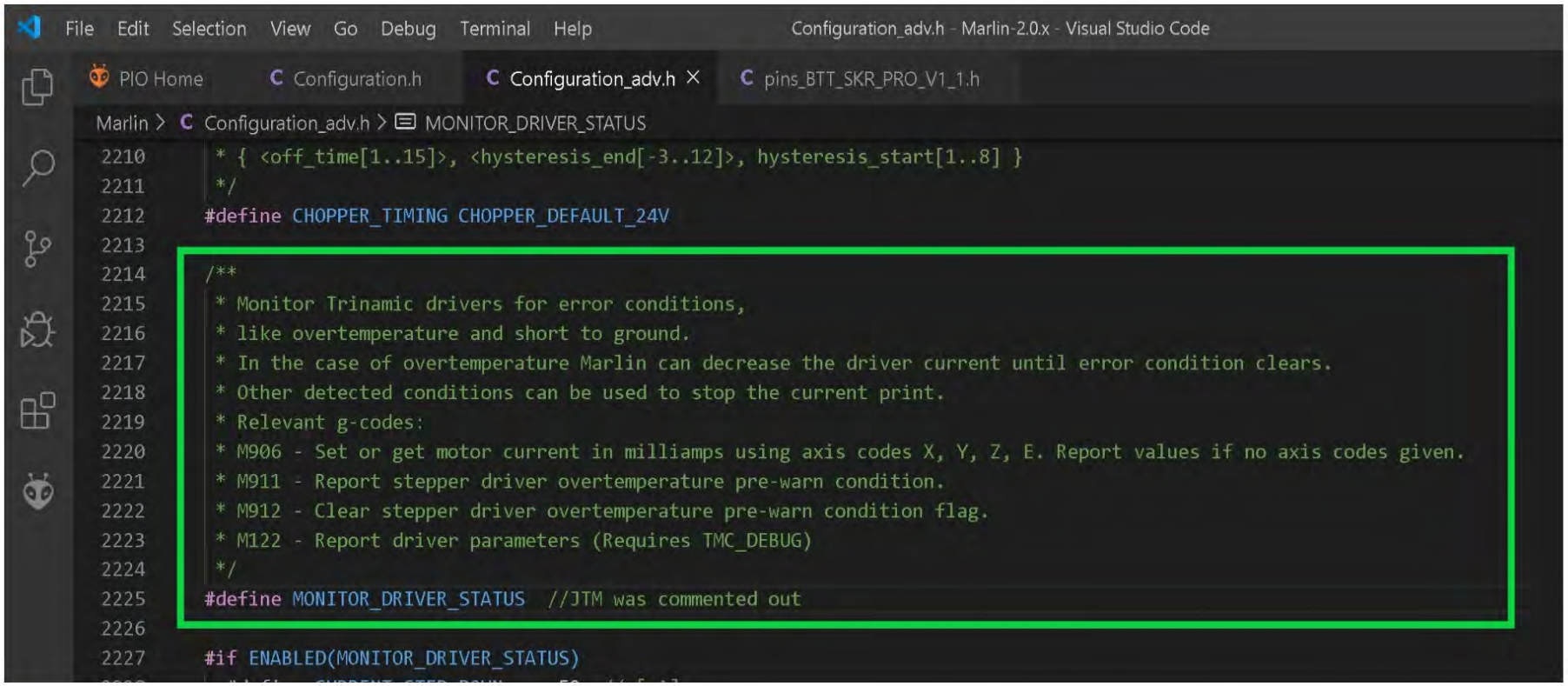
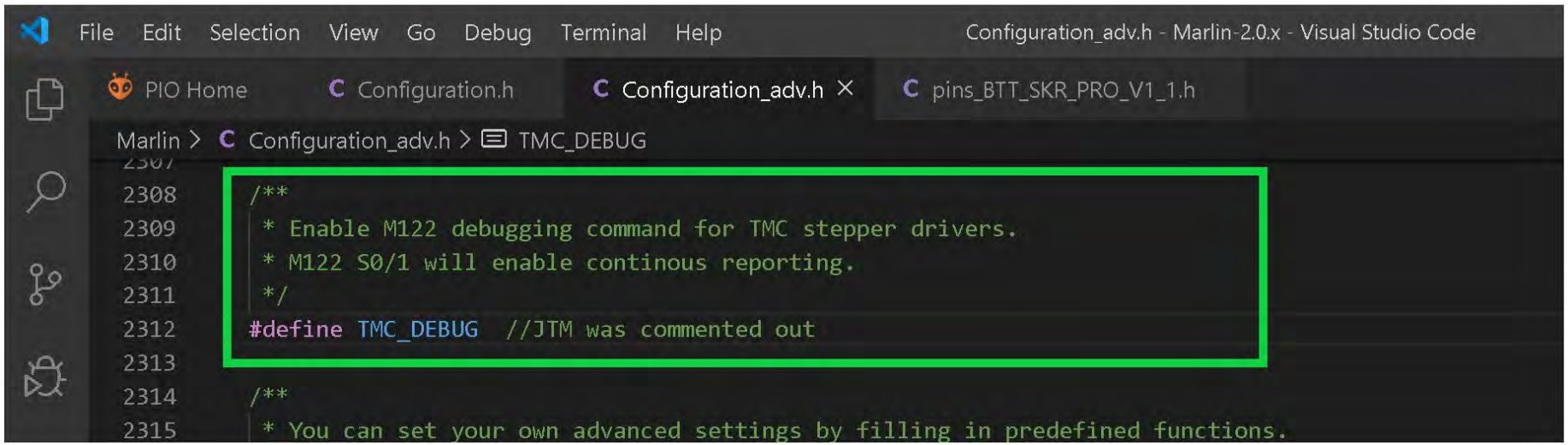
The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

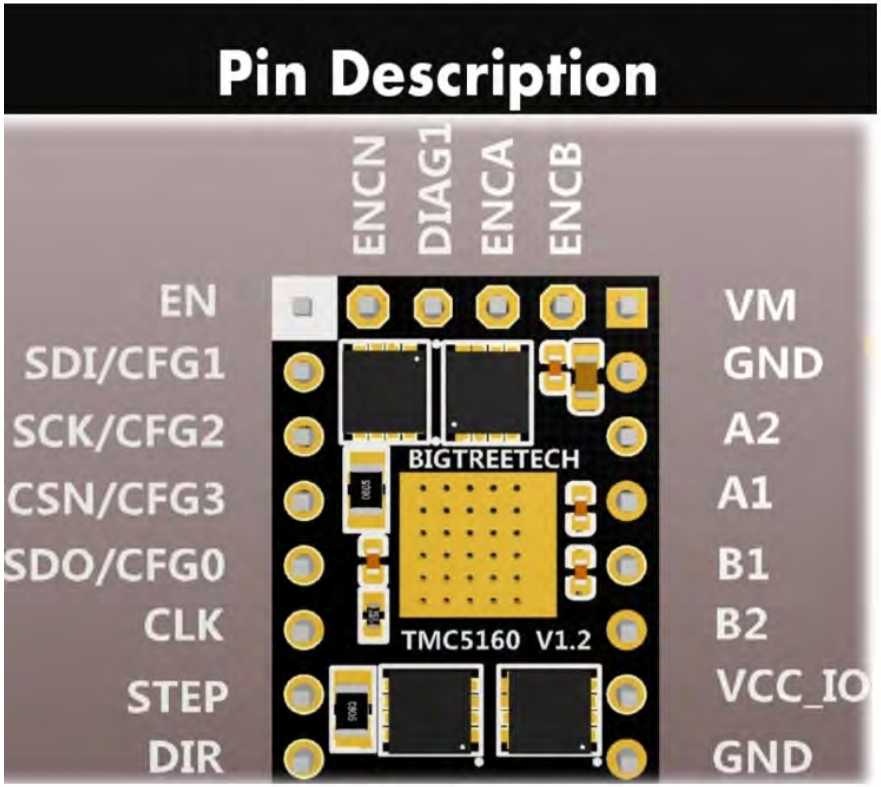


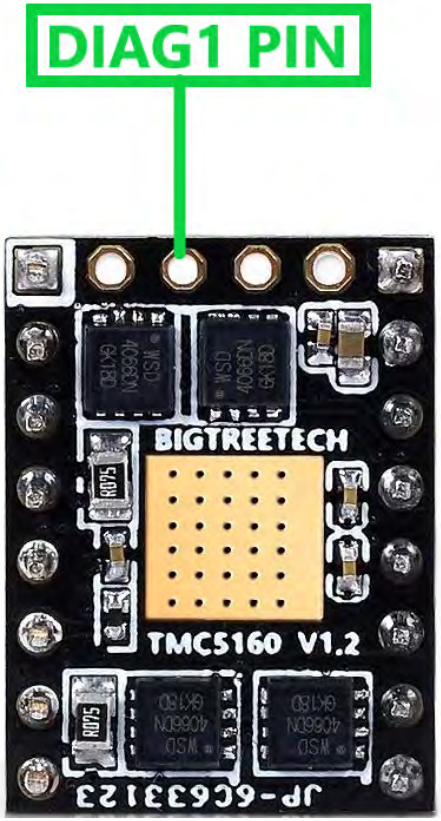


- Go to the next page.

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.



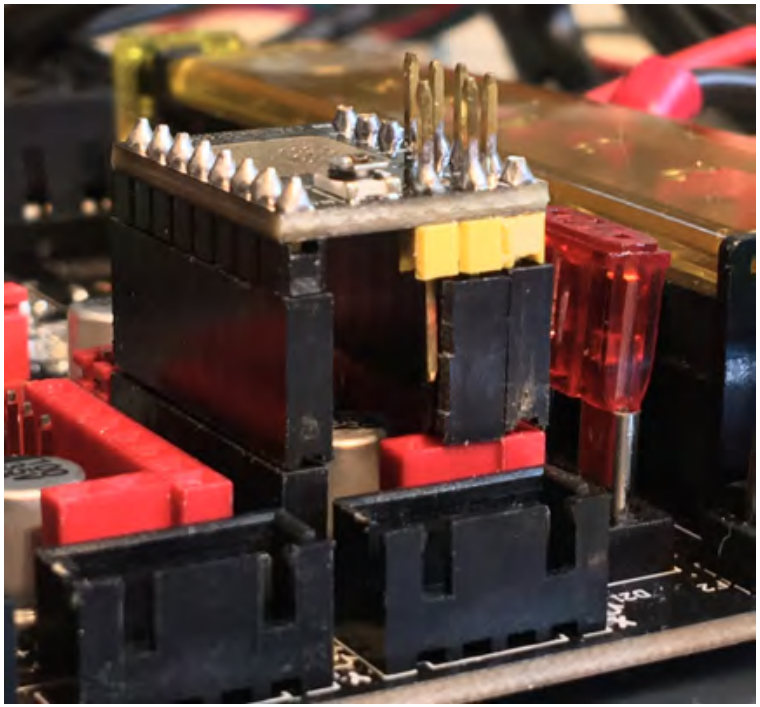


- The third pin position starting from the left on the top of the chip is where I need to solder in a header pin. I need it to face down so that when I plug in the TMC5160 into the SKR PRO V1.1 board the DIAG1 pin will be seated in the SKR PRO V1.1 board.

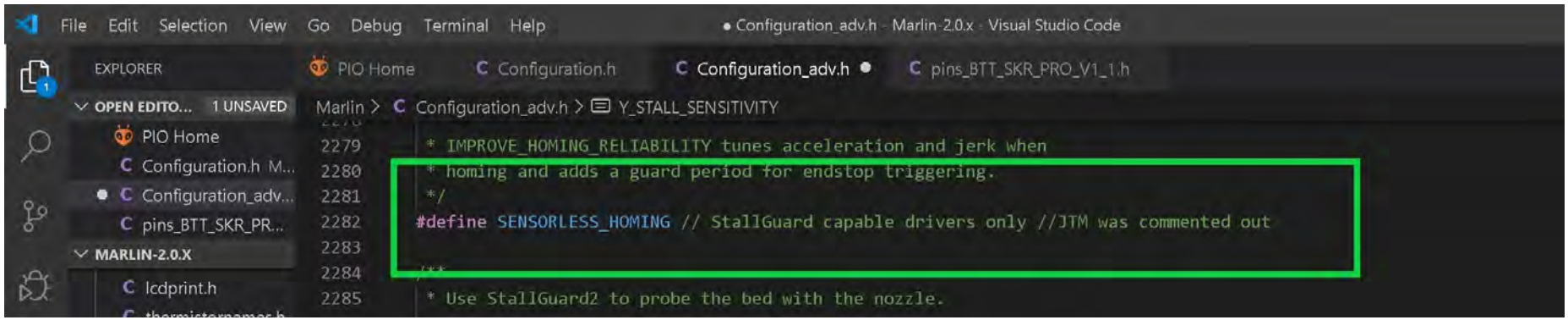
- Go to the next page.

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.



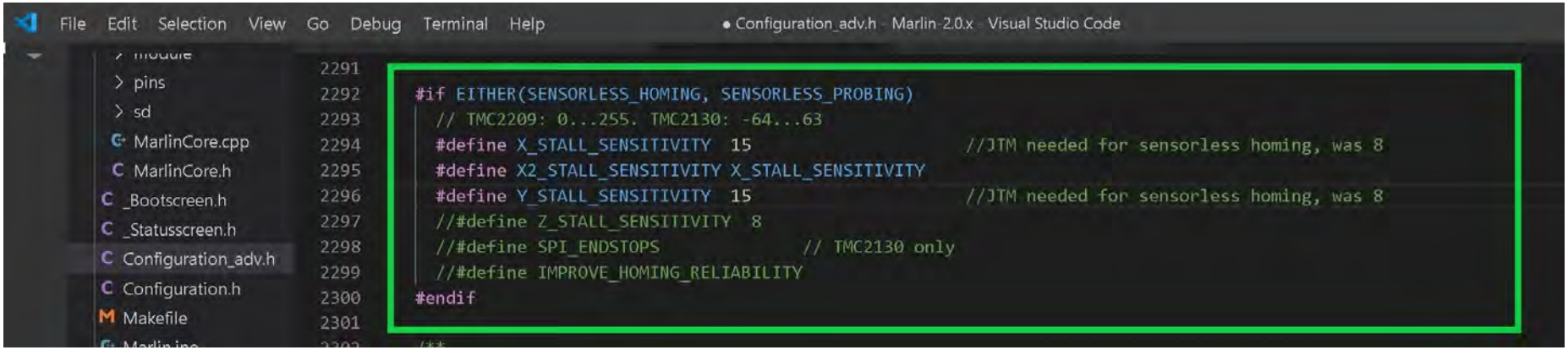
- Sensor-less homing is commented out by default. So I remove the two leading "//" to un-comment "SENSORLESS_HOMING"



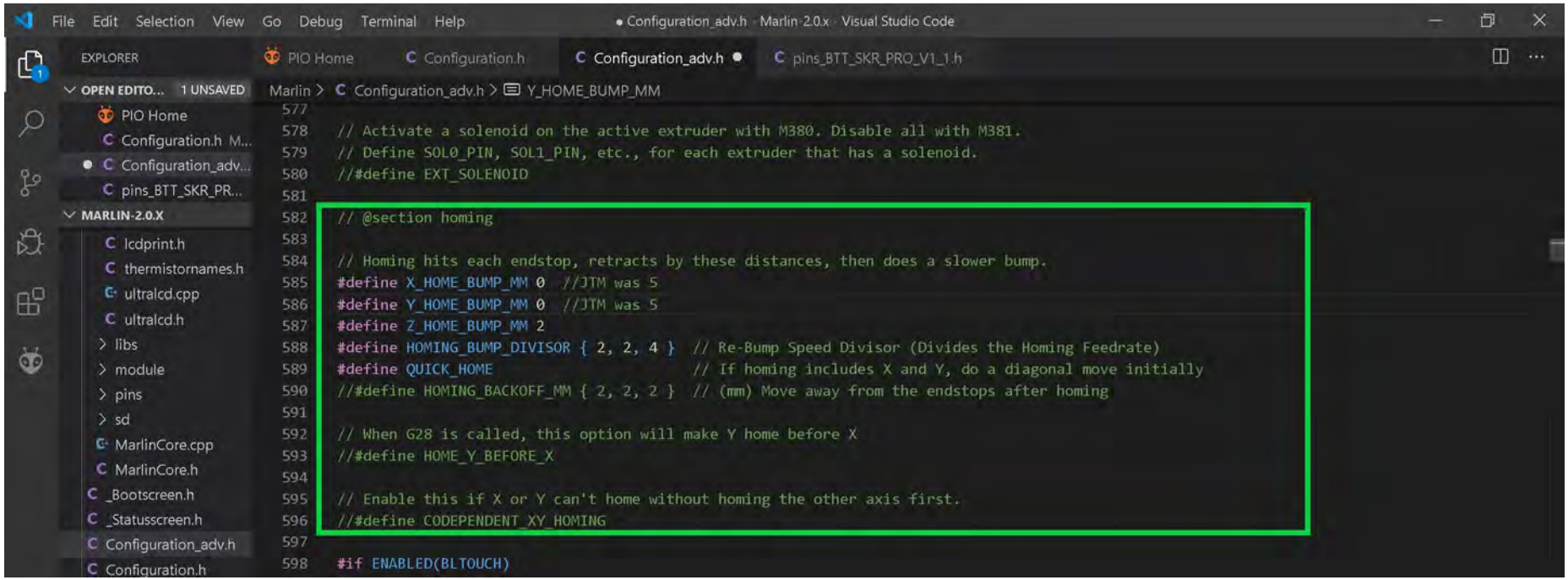
- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

- Next we set a "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".



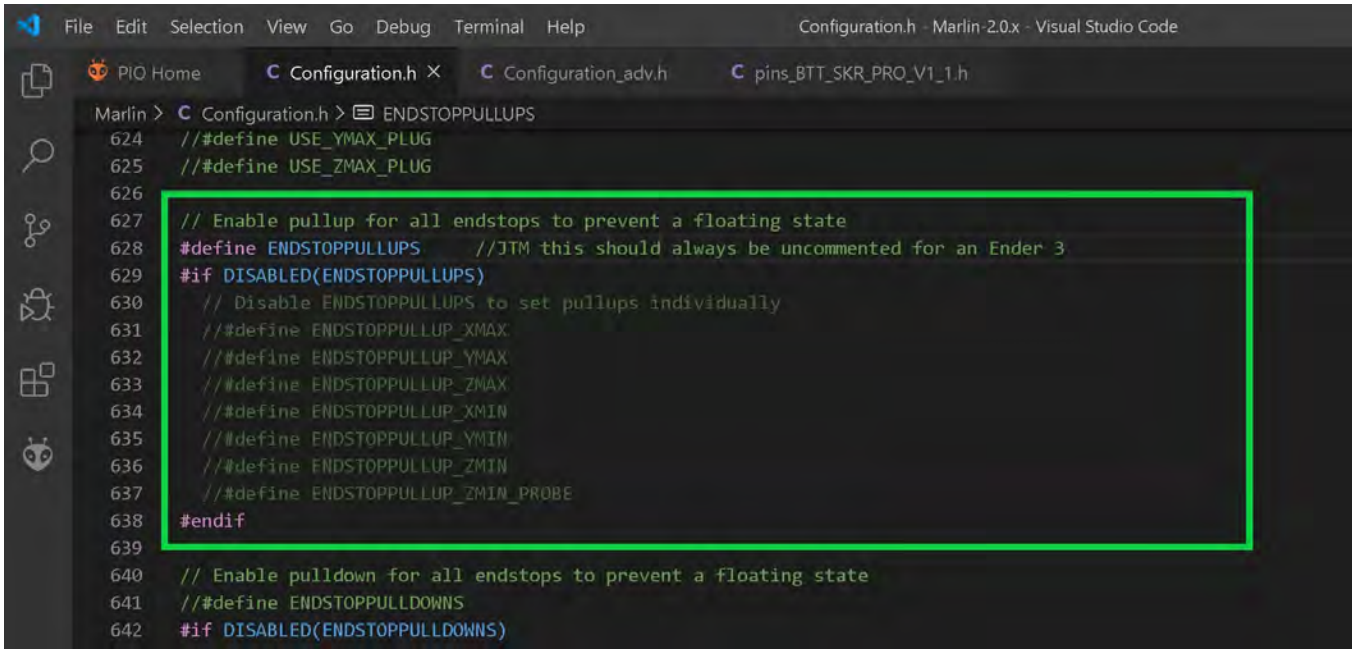
- We now have to set our home bump to 0 for each axis with sensor-less homing enabled. So I will set "X_HOME_BUMP_MM" to 0 and "Y_HOME_BUMP_MM" to 0. If you want sensor-less homing on Z axis then you will need to set "Z_HOME_BUMP_MM" to 0.



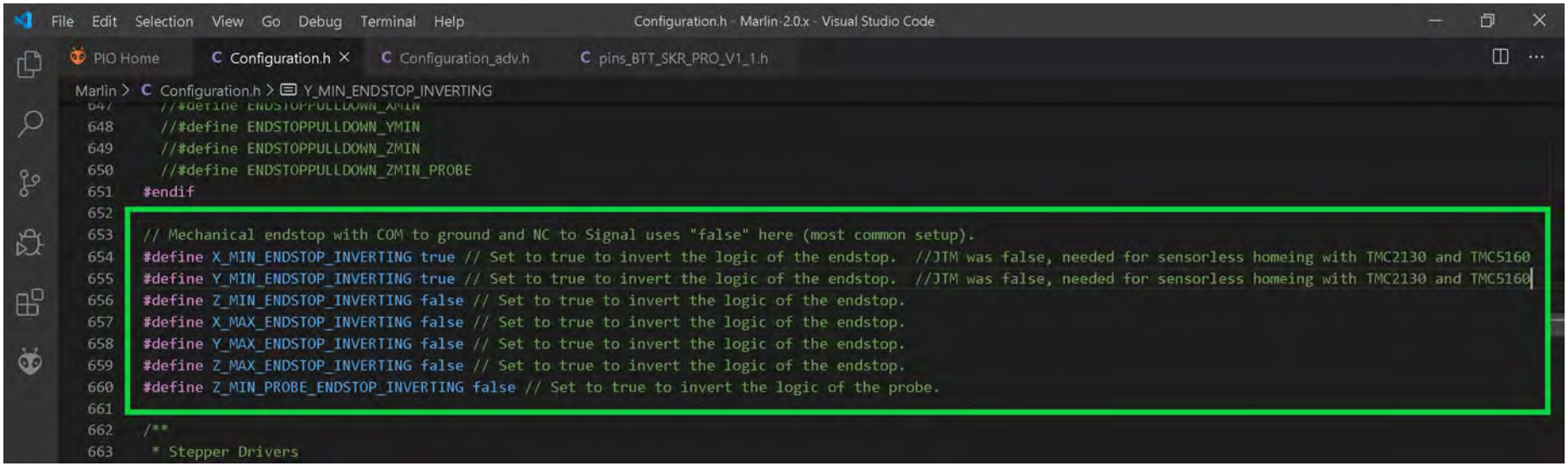
- Go to the next page.

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.



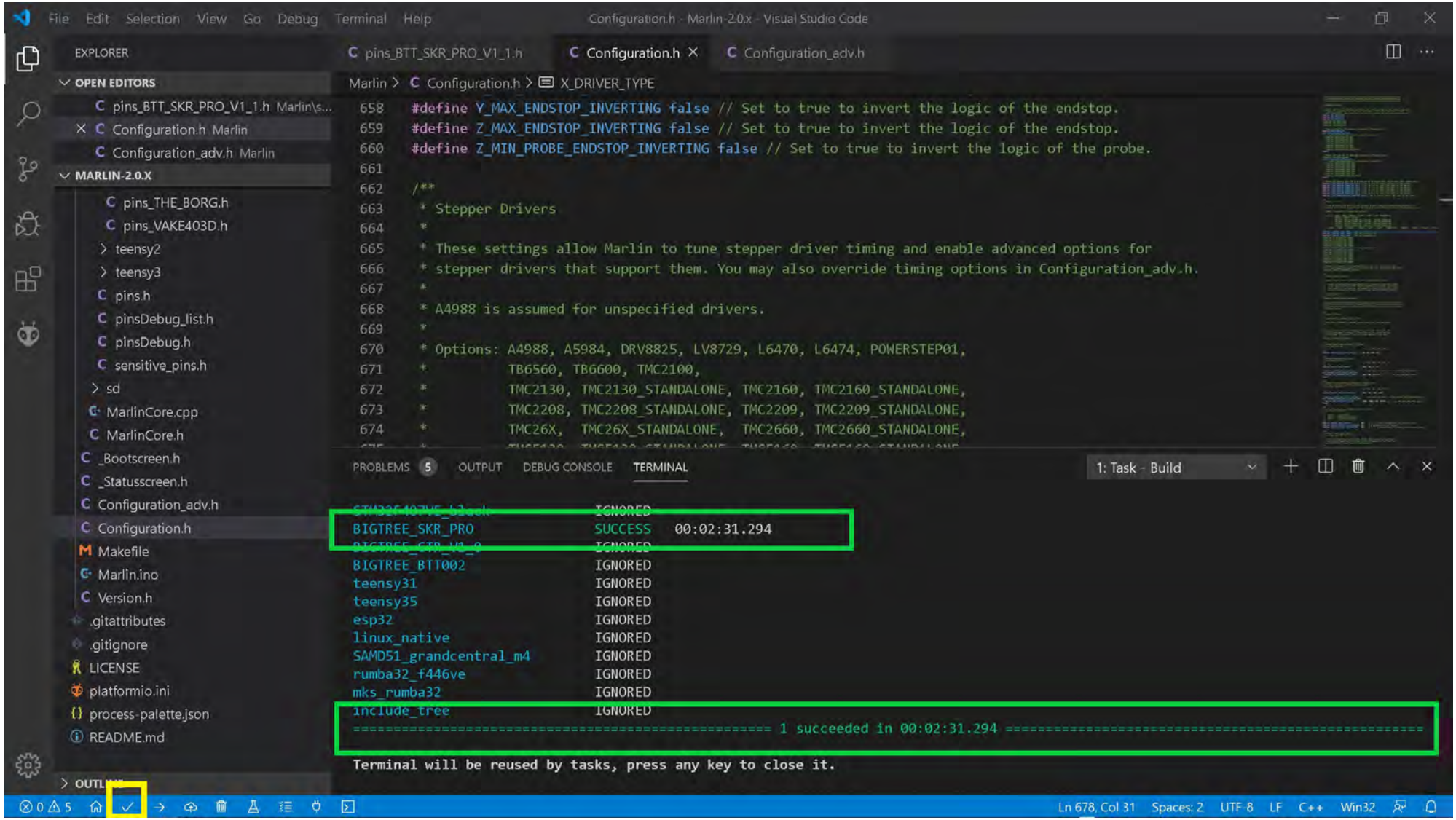
- Next to allow sensor-less homing to work we need to change our end stop logic. Therefore I set "X_MIN_ENDSTOP_INVERTING" to true and "Y_MIN_ENSTOP_INVERTING" to true. If you want sensor-less homing on the Z axis, you will need to set "Z_MIN_ENDSTOP_INVERTING" to true. But since I do not want sensor-less homing on the Z axis I will leave "Z_MIN_ENDSTOP_INVERTING" set to false.



- Go to the next page.

The (latest release of) Marlin Setup for BIQU TMC5160 V1.2 Drivers in SPI Mode

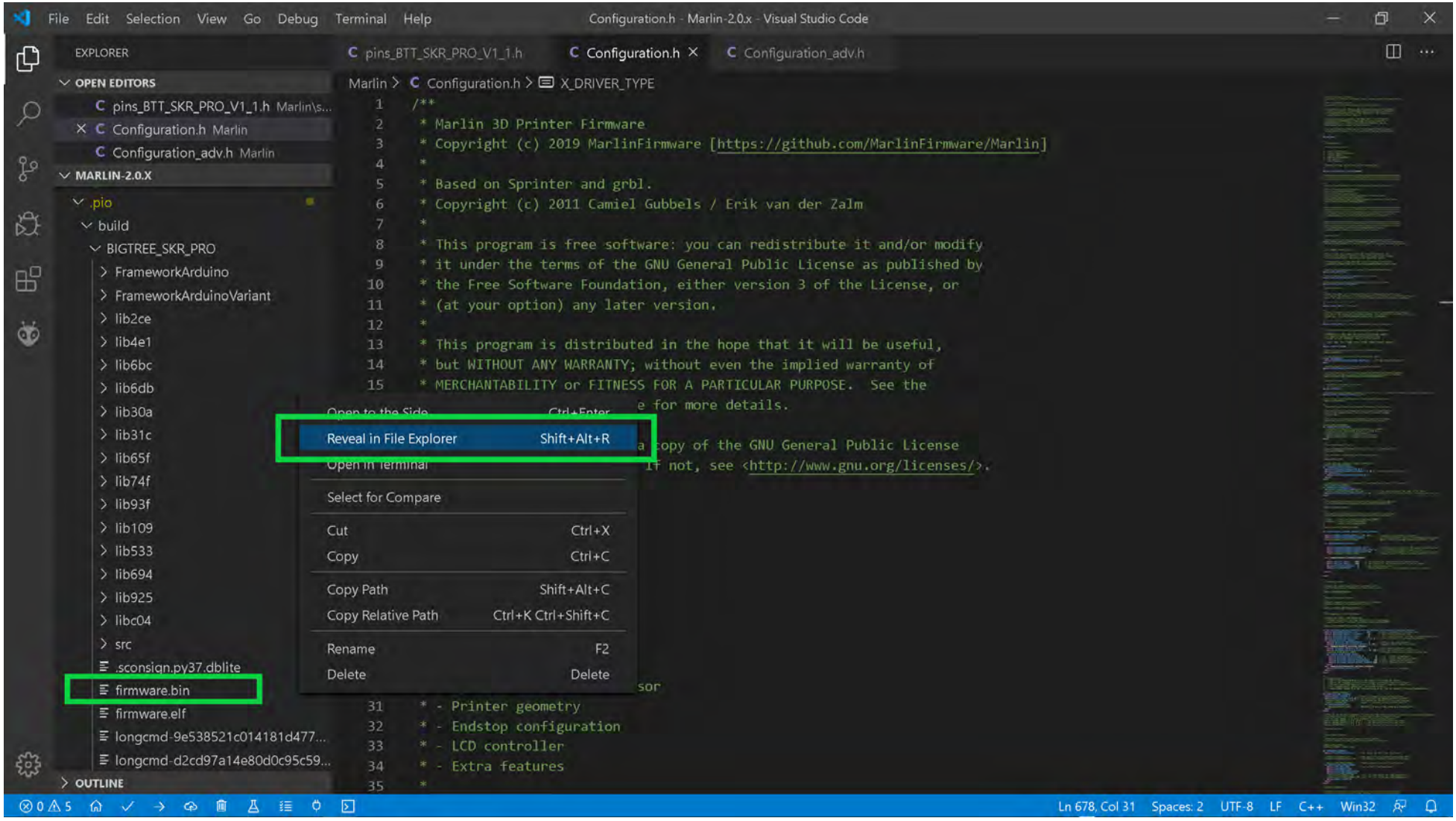
- The end of Marlin setup for BIQU TMC5160 drivers in SPI mode . Now, compile your code by clicking on the check mark, as seen in the **YELLOW** box below. Once the firmware has compiled successfully you will see the following messages, as shown in the **GREEN** boxes below.



- 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

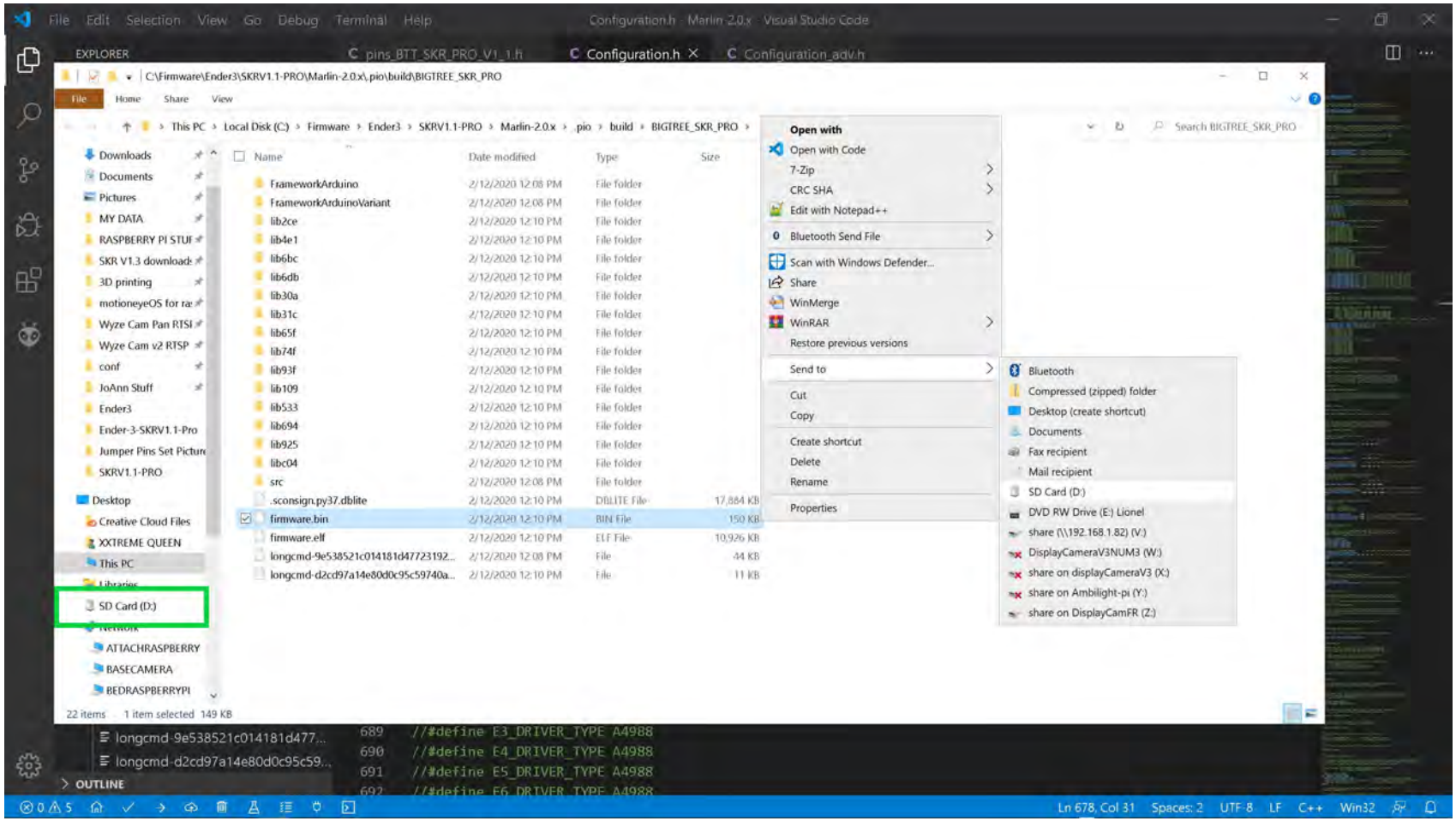
- the firmware.bin file can be found by using the left side of the VS code window and going to folder Marlin-2.0.X/.pio/build/ BIGTREE_SKR_PRO/ and right clicking on the "firmware.bin" file name to bring up the content menu. Select "Reveal in File Explorer" to have your Window's machine open a file explorer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

How to adjust the Vref 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 Drivers[2]

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 "Vref 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 (Imax) 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 Vref) which corresponds with the current you want to set. Use a ceramic screw driver to adjust the POT. A ceramic screw driver is non conductive 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.

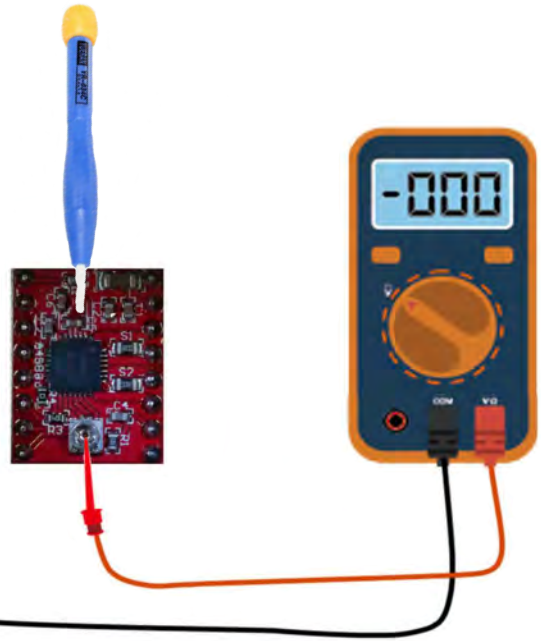
Note: **See the next page for a diagram of the setup.**

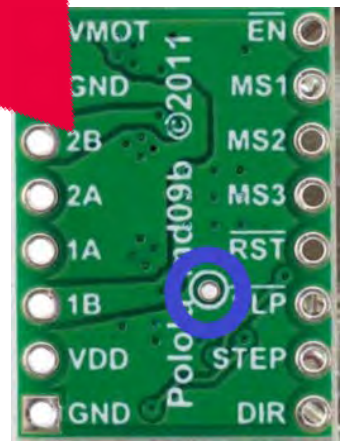
[1] from https://github.com/superjamie/lazyweb/wiki/3D-Printing-Stepper-Motors-and-Drivers and
[2] from https://github.com/superjamie/lazyweb/wiki/3D-Printing-Stepper-Motors-and-Drivers#how-to-tune-stepper-drivers

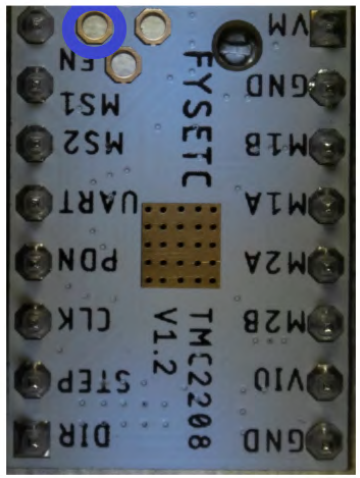
How to adjust the Vref on a Stepper Motor Driver board using the Potentiometer[1,2]

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 Vref (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.**

Note: Some stepper motor driver boards have a "Vref Test point" location, shown in BLUE. Check the bottom or the top of your board for a location.







[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

APPENDIX B

For the TMC drivers what's the difference between Stand alone Mode and ("UART" or "SPI ") mode?

All the TMC driver chips **EXCEPT TMC5160** 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 Vref For Stepper Motor Divers

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 Vref formula (found on the first page of each different stepper motor driver section of this document) and do the Vref calculation.

Remember this Vref calculation is just a suggested starting point. If your stepper motors are running too hot you will need to adjust the Vref downward. If your stepper motors are skipping steps when printing then you will need to adjust your Vref upwards. Our goal is to find a low enough Vref where our stepper motors are cool enough with out the printer missing any steps. For this example I will use the TMC2208 stepper motor drivers.

1. **So, TMC2208 Vref formula is Vref=((Imax/1.414)*2.5)/1.77 OR Vref=(("Rated Current"/1.414)*2.5)/1.77.**
2. **I take each of my Axis' "Rated Current" and plug it into that equation to get X-Axis Vref is equal to (((0.84/1.414)*2.5)/1.77)=0.8391 volts.**
3. **Now, take 90% of that for a starting point Vref value of ((0.8391*0.90)=0.75519) 0.755 volts or 755mV or X-Axis Vref = 0.755V. Since X,Y and Z stepper motors have the same "Rated Current" we now have the Vref for X, Y and Z stepper motor drivers. Their value is 0.755 volts.**
4. **For E (extruder) Vref the equation is (((1.0/1.414)*2.5/1.77))=0.9988 volts. Now, take 90% of that for a starting point Vref value of ((0.9988*0.90)=0.8990) 0.900 volts or 900mV. We now have the Vref for E (extruder stepper motor driver) which is 0.900 volts.**
5. **We use the our multimeter and turn the POT on the top of the stepper motor driver until we see the wanted Vref voltage displayed.**

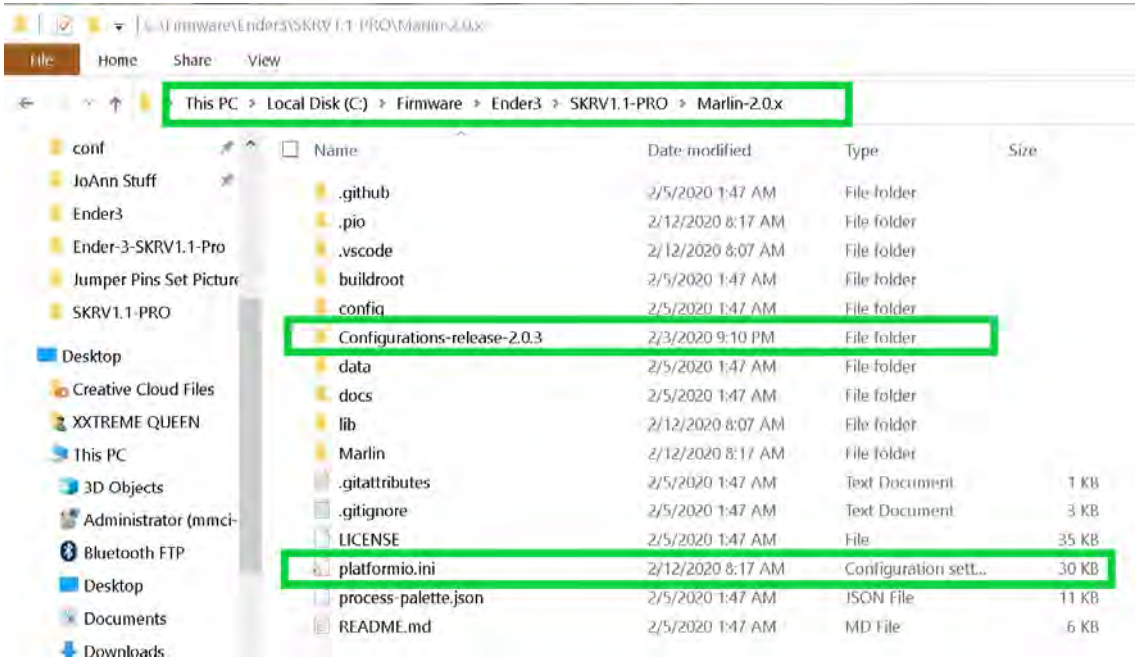
APPENDIX C

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

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 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



APPENDIX C

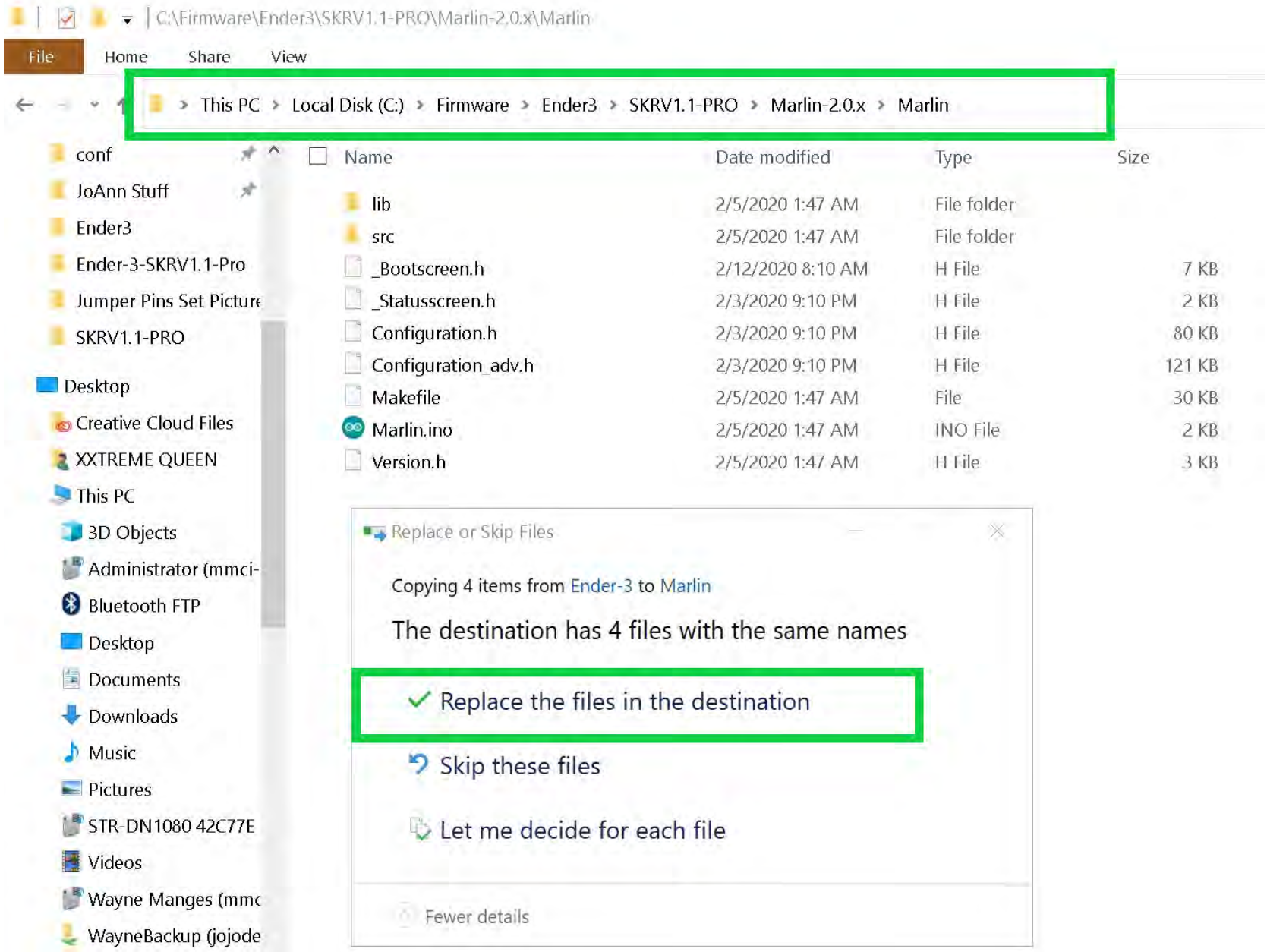
The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

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.

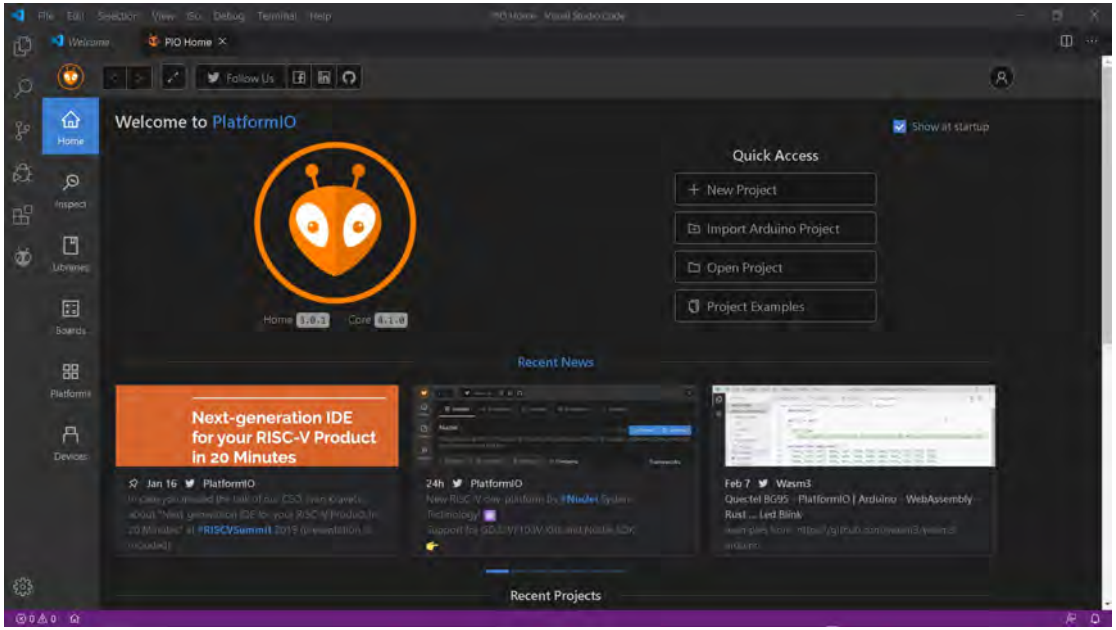
The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- Copy TO THIS directory so the above files reside in the same directory as Configuation.h and Configuration_adv.h. When prompted allow the overwrite of the files!

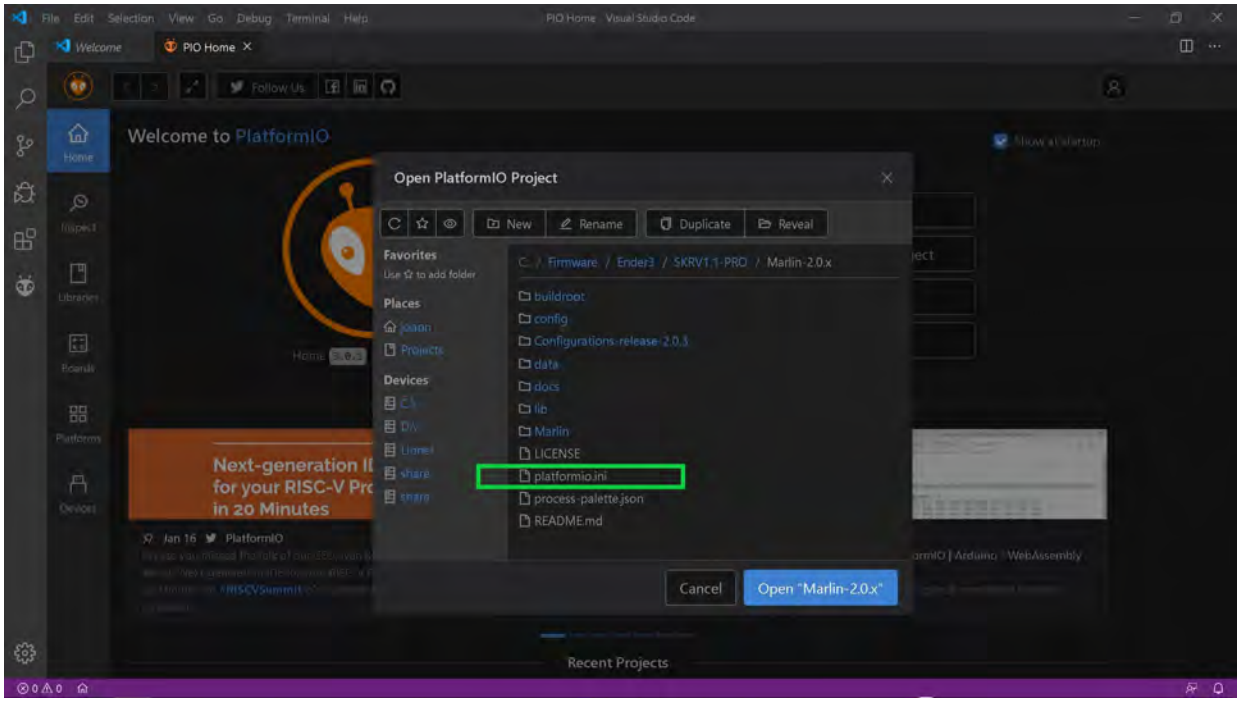


The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- Open VS code (see picture below) and then select "Open Project".

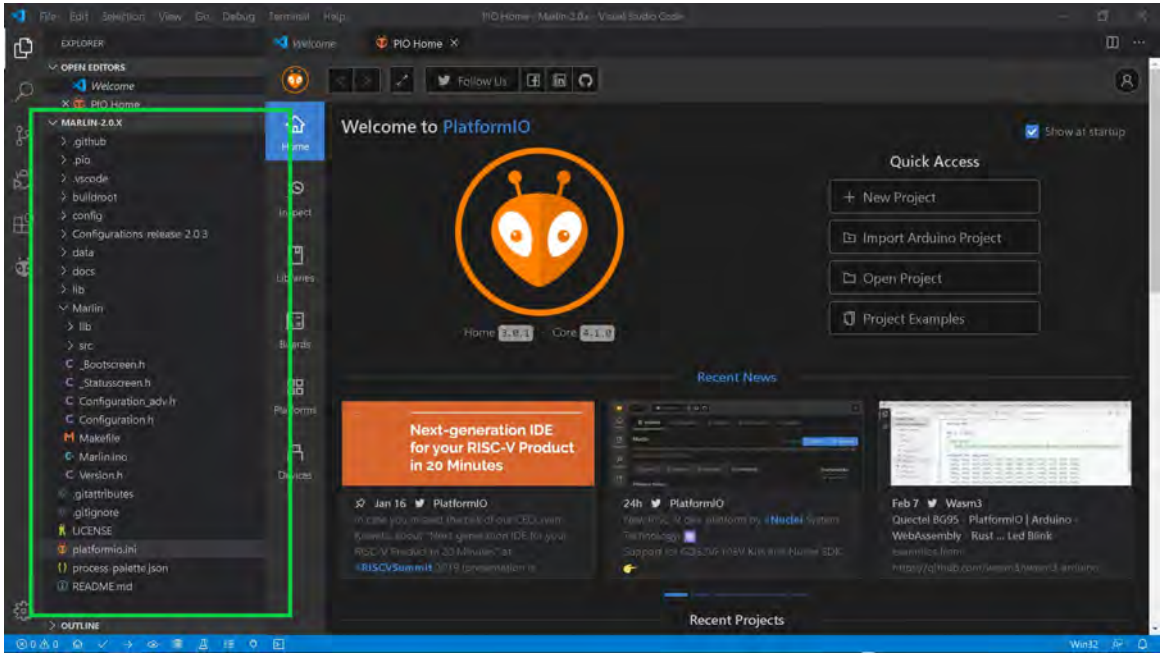


- Goto the directory where the platformio.ini file resides and open that folder (see picture below)

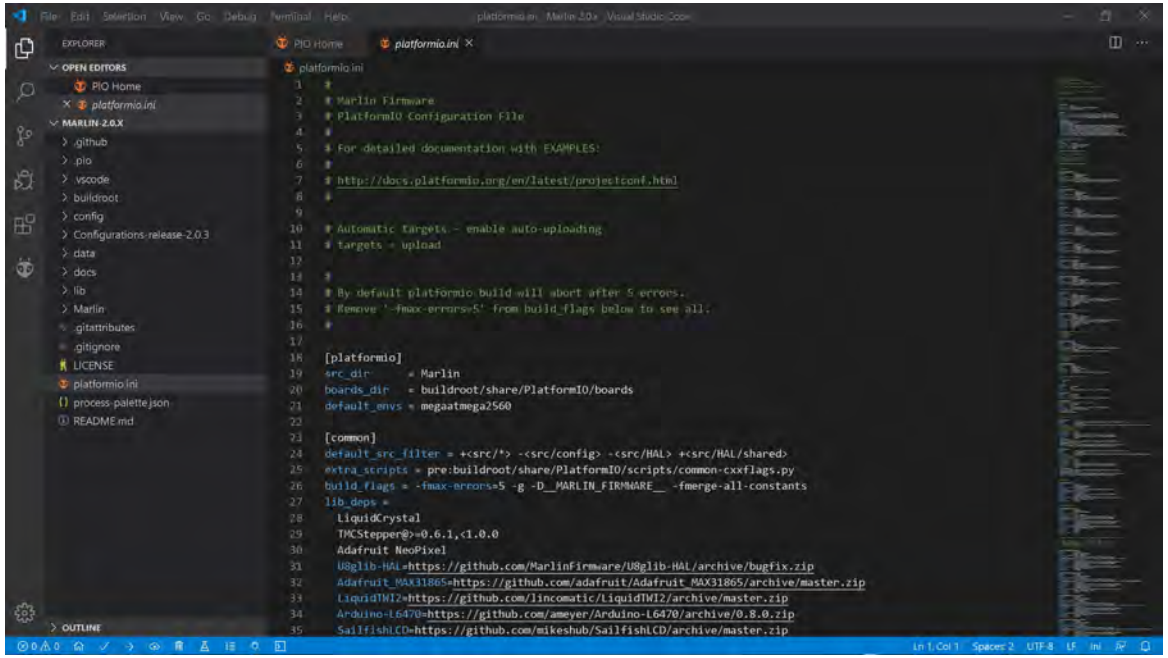


The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- 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.

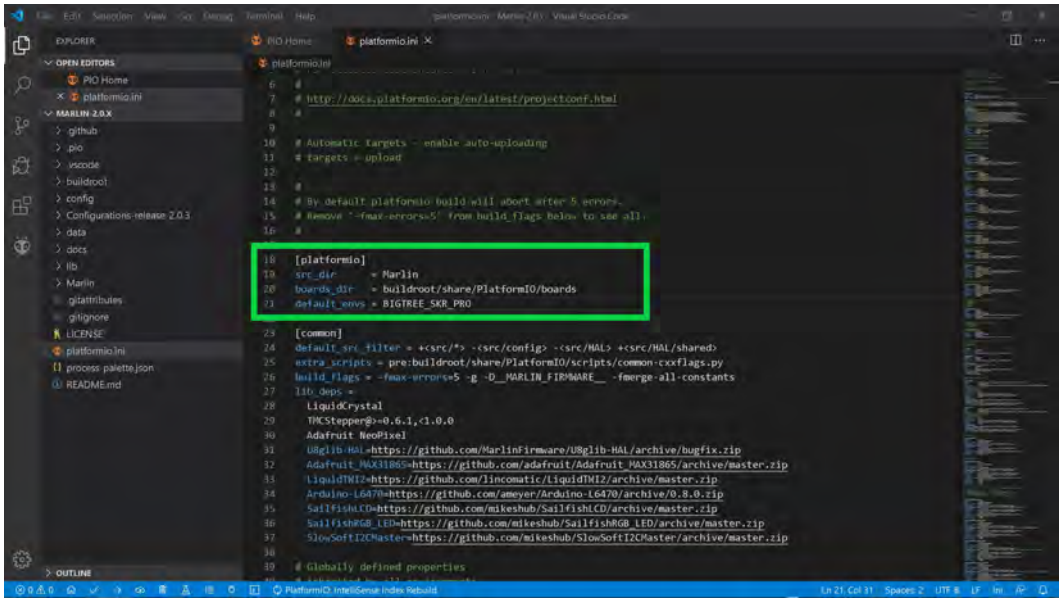


- What you will see when "platformio.ini" is opened up in the VS code editor window

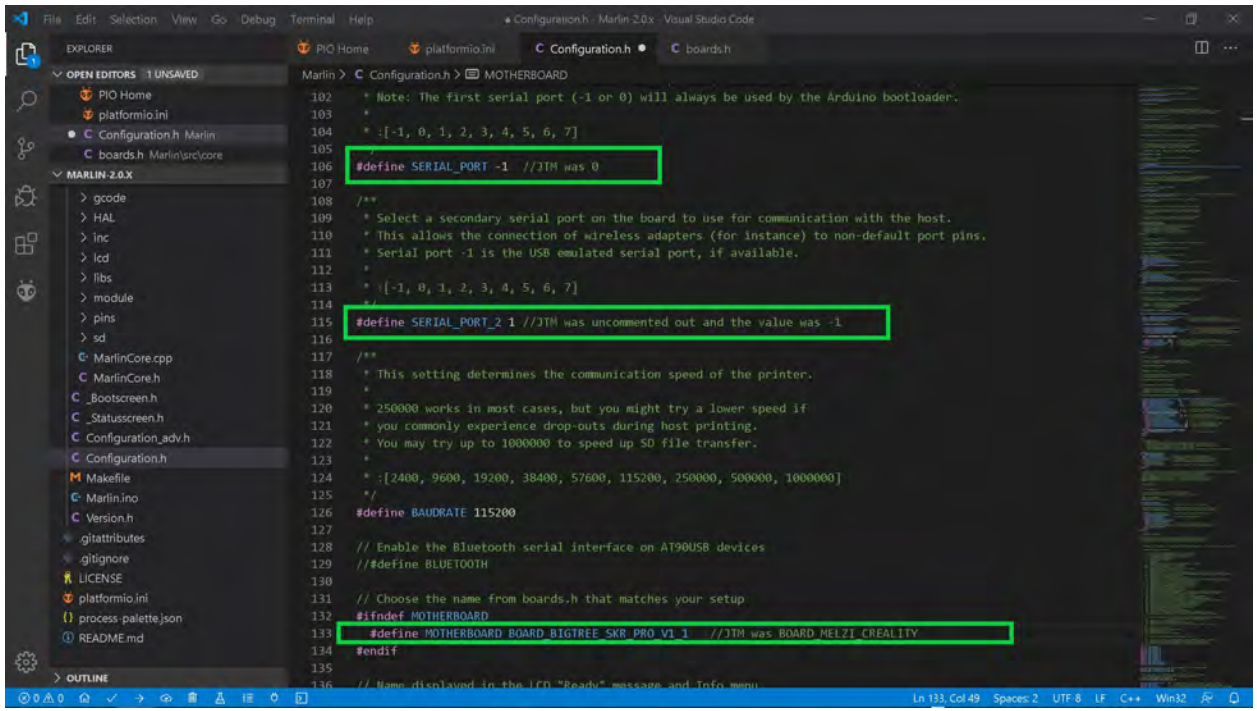


The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

- Edit the "default_envs = megaatmega2560" line and make "default_envs = BIGTREE_SKR_PRO", as shown below in GREEN



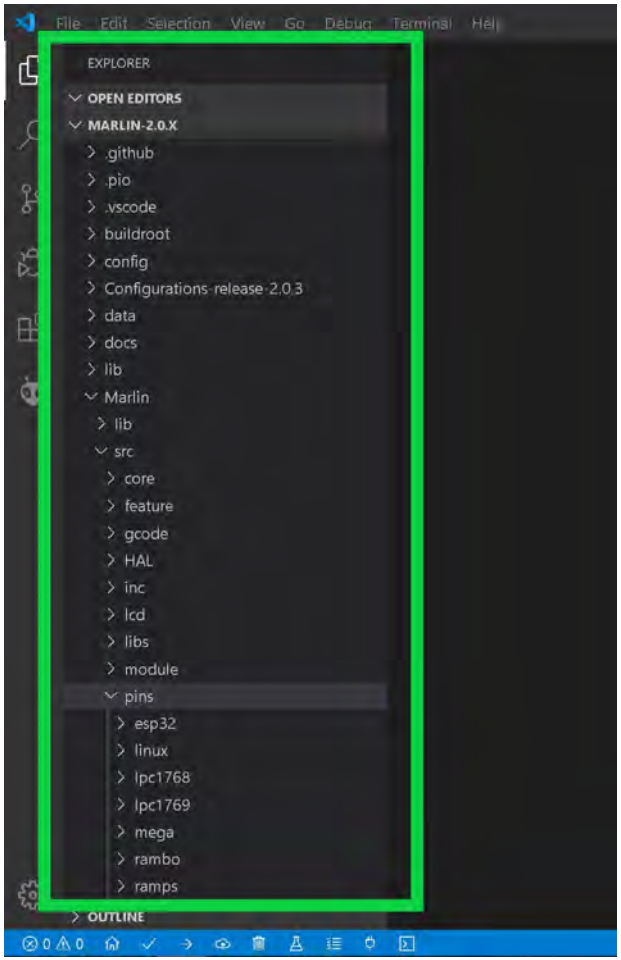
- Go to the Configuration.h file and change the following three items, as seen in the 3 GREEN boxes below.

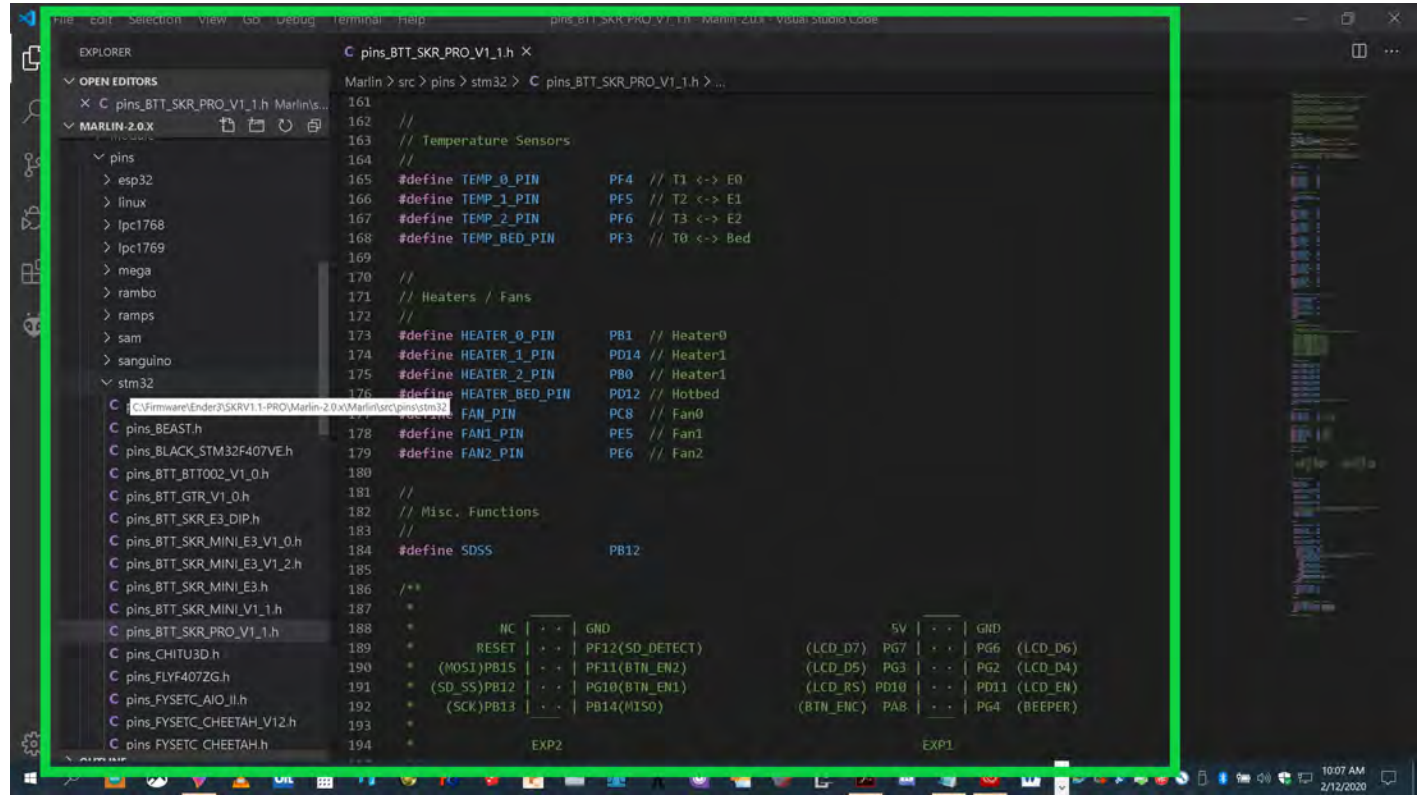


APPENDIX C

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 "pins_BTT_SKR_PRO_V1_1.h" file by double clicking on it.

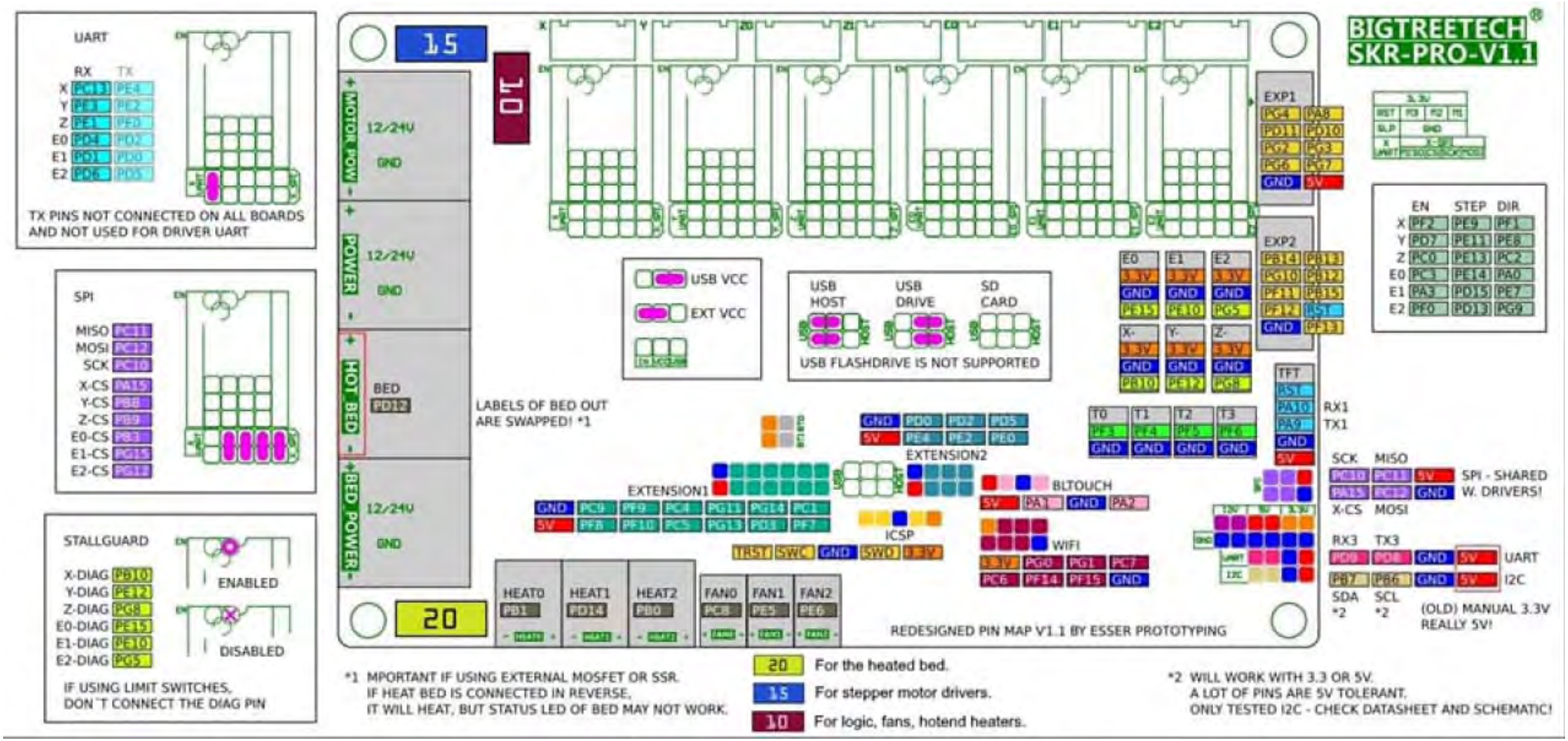




APPENDIX C

The (Latest Release of) Marlin Setup That Is Common To ALL Stepper Motor Drivers

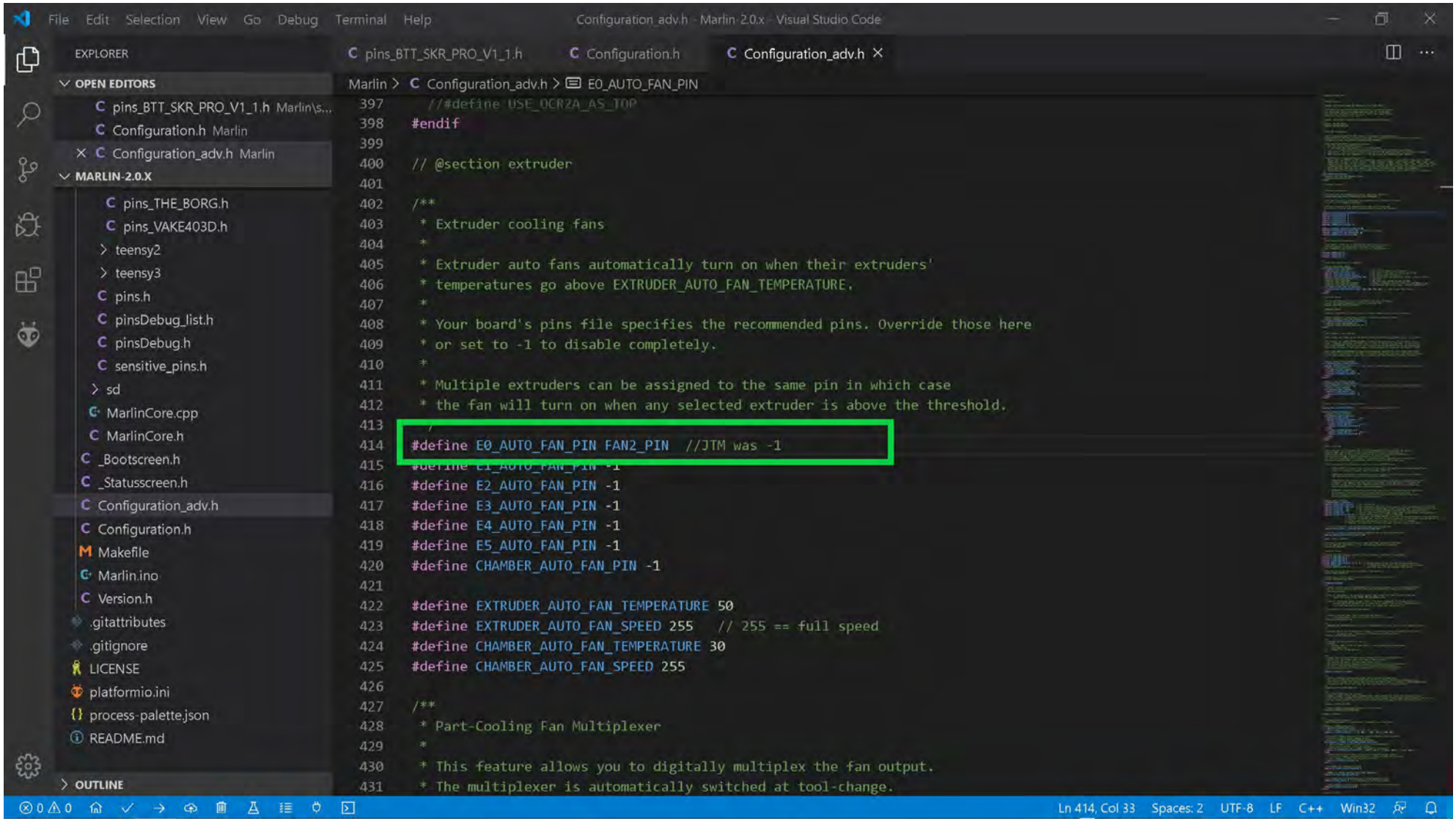
- We want to set the fan on the hot end to automatically turn on when the hot end starts to get hot. In the pins_BTT_SKR_PRO_V1_1.h file you will find all the pins that are defined for the board. They should all conform to the SKR PRO V1.1 Pin diagram shown below.



- 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" we see FAN2 port is defined as PE6. So you can choose to copy "PE6" or "FAN2_PIN".

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



- 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.