# Table of Contents

# 1. Updating the Mini Lab firmware.

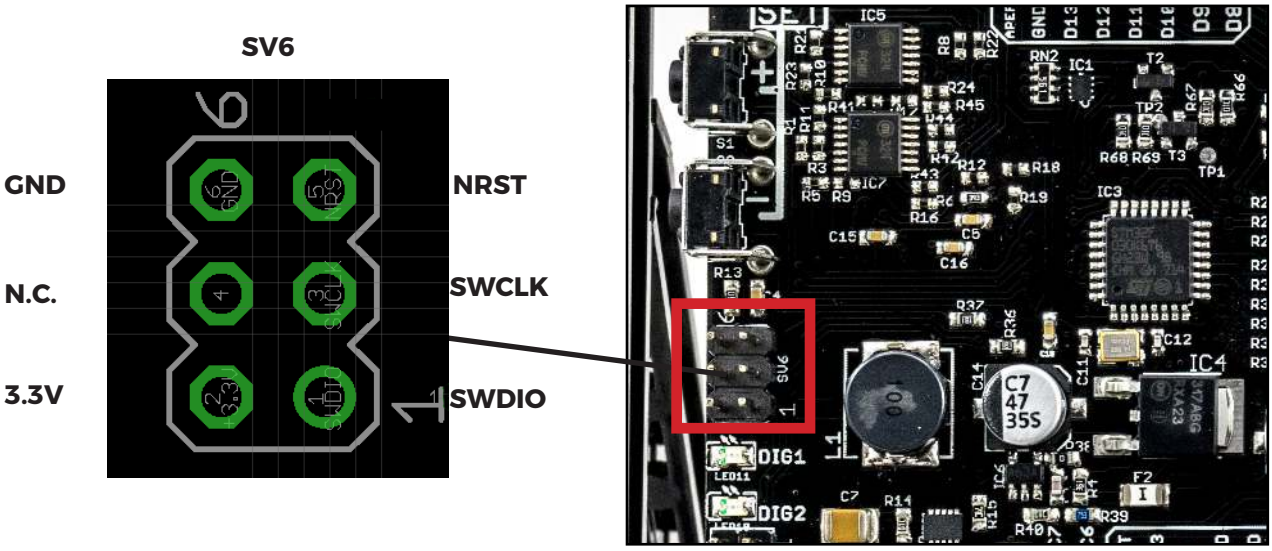
## 1.1. When is it required?

Normally you will not need to update the firmware to the Lab Board in the Mini Lab. But in case a bug has sneaked in, or a new feature is introduced, it might be handy to be able to upgrade the firmware.

## 1.2. The MCU, STM32F030K6T.

The micro controller is an ARM Cortex M0, 32 bit, running at 48 MHz, with 32 kB flash program memory and with 4 kB RAM.

## 1.3. The In-Circuit-Serial-Programming (ICSP) connector.




1. Programming connector.

# 2. Using the ST-LINK/V2 in-circuit debugger/programmer

## 2.1. The ST-LINK/V2

First you need to have an ST-LINK/V2 programmer. It is available many places, compatible ones can be bought inexpensively from Totem's webshop, www.totemmaker.net , or on Ebay and AliExpress to mention some.

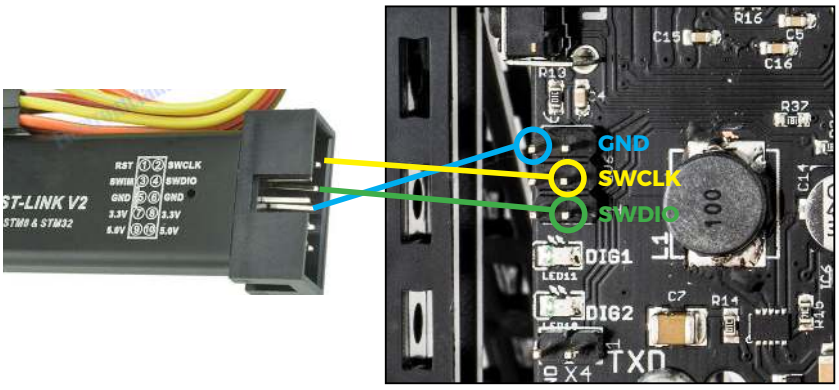

2. ST-LINK/V2 programmer

# 3. Connecting the ST-LINK/V2 to the LabBoard

## 3.1. 3 wires required.

The 3 signals you need to program the LabBoard is:

GND (Connect this first, it's good practise), SWCLK and SWDIO.




3. Connecting the SV6 connector to the ST-LINK/V2

You are now ready to program the new firmware, but you must have the required software utilities on your computer. The next section will show you how.

OBS ! You must have the Mini Lab connected, so that the L abBoard have power! We are not supplying the power via the ST-LINK, but from the TotemDuino and it's power supply.

# 4. How to get the Firmware from Totem?

The Firmware is obtainable from www.totemmaer.net/wiki/

When you are on the WIKI section in totemmaker.net, you will navigate yourself to the Mini Lab section, and there you will find a download link to get the latest release of our firmware. The firmware binary file will have a name like this: Labboard_1.5.bin. It will contain a version number.

# 5. Windows OS with the ST-LINK Utilty software.

## 5.1. Where to download it.

The software you need to program new firmware into the Lab Board is called STSW-LINK004, and is made by STMicroelectronics. From their website www.st.com you can find the STSW-LINK004 software.

http://www.st.com/content/st_com/en/products/development-tools/software-development-tools/stm32-software-development-tools/stm32-programmers/stsw-link004.html

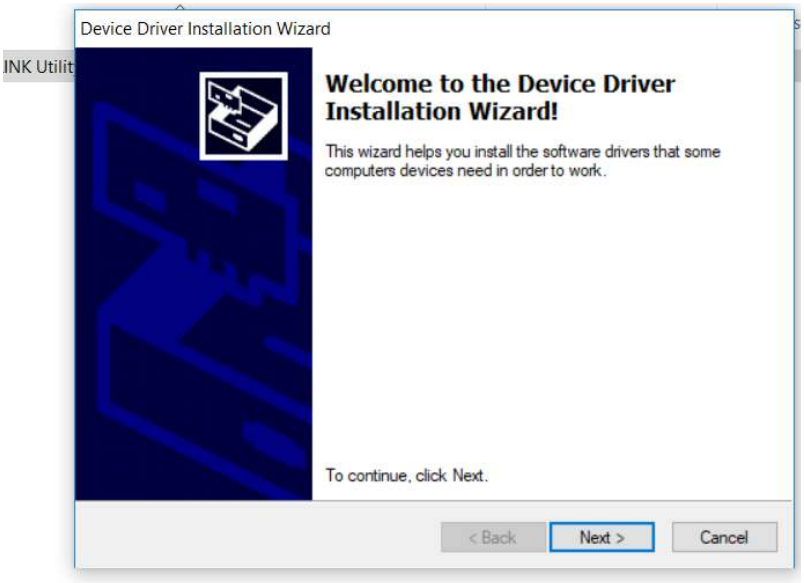
There is a snag to downloading this utility, you have to register to st.com with some personal information, like an email address etc. But that's expected I suppose.

Here is a description from STMicrolelectronics dowloading page:

> STM32 ST-LINK Utility (STSW-LINK004) is a full-featured software interface for programming STM32 microcontrollers.
> It provides an easy-to-use and efficient environment for reading, writing and verifying a memory device.
> The tool offers a wide range of features to program STM32 internal memories (Flash, RAM, OTP and others), external memories, to verify the programming content (checksum, verify during and after programming, compare with file) and to automate STM32 programming.
> STM32 ST-LINK Utility is delivered as a graphical user interface (GUI) with a command line interface (CLI).

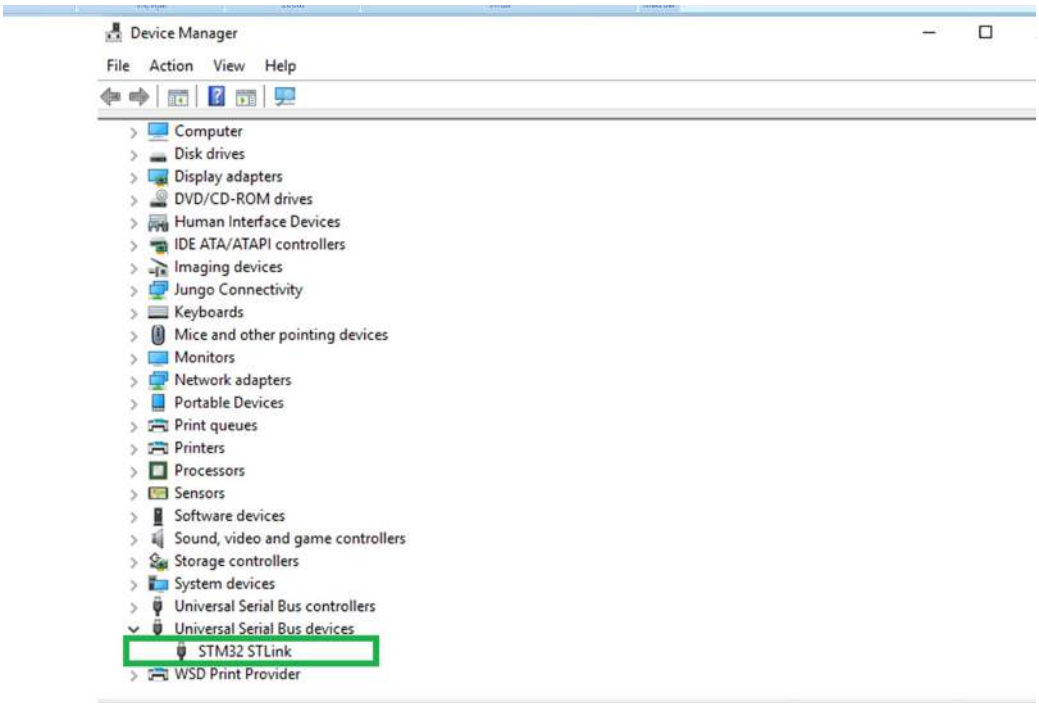
## 5.2. Installing the driver.

Next step is to install the driver:



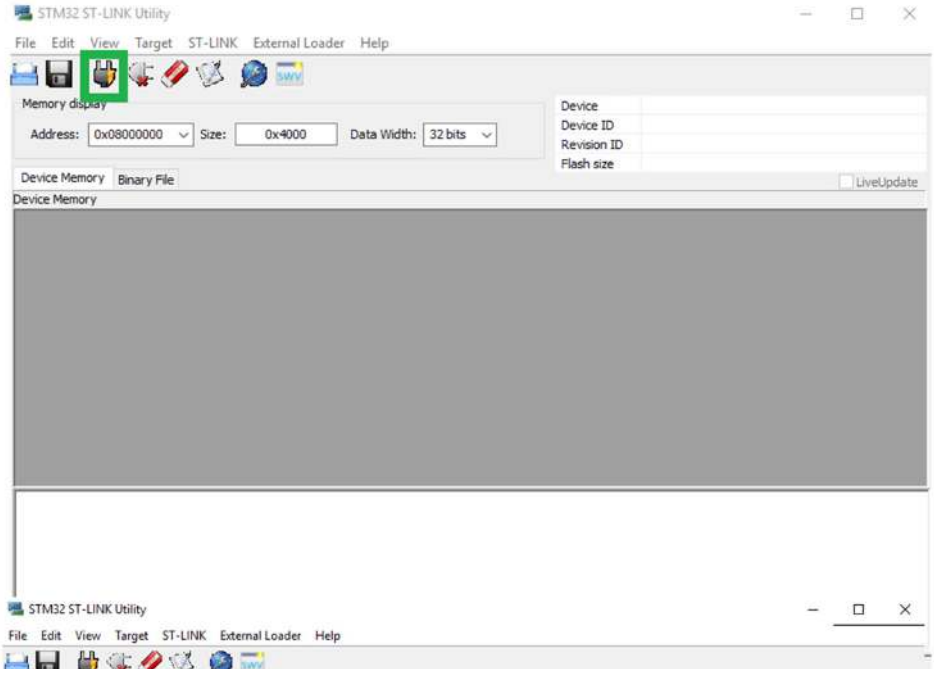

After you have installed the STSW-LINK004 software on your computer, you can start the STM32 ST-LINK Utility.

The USB driver will be installed when you put your ST-LINK/V2 into a USB port in your PC. You can check that it is installed be checking the “Device Manager” in the Control Panel in Windows.

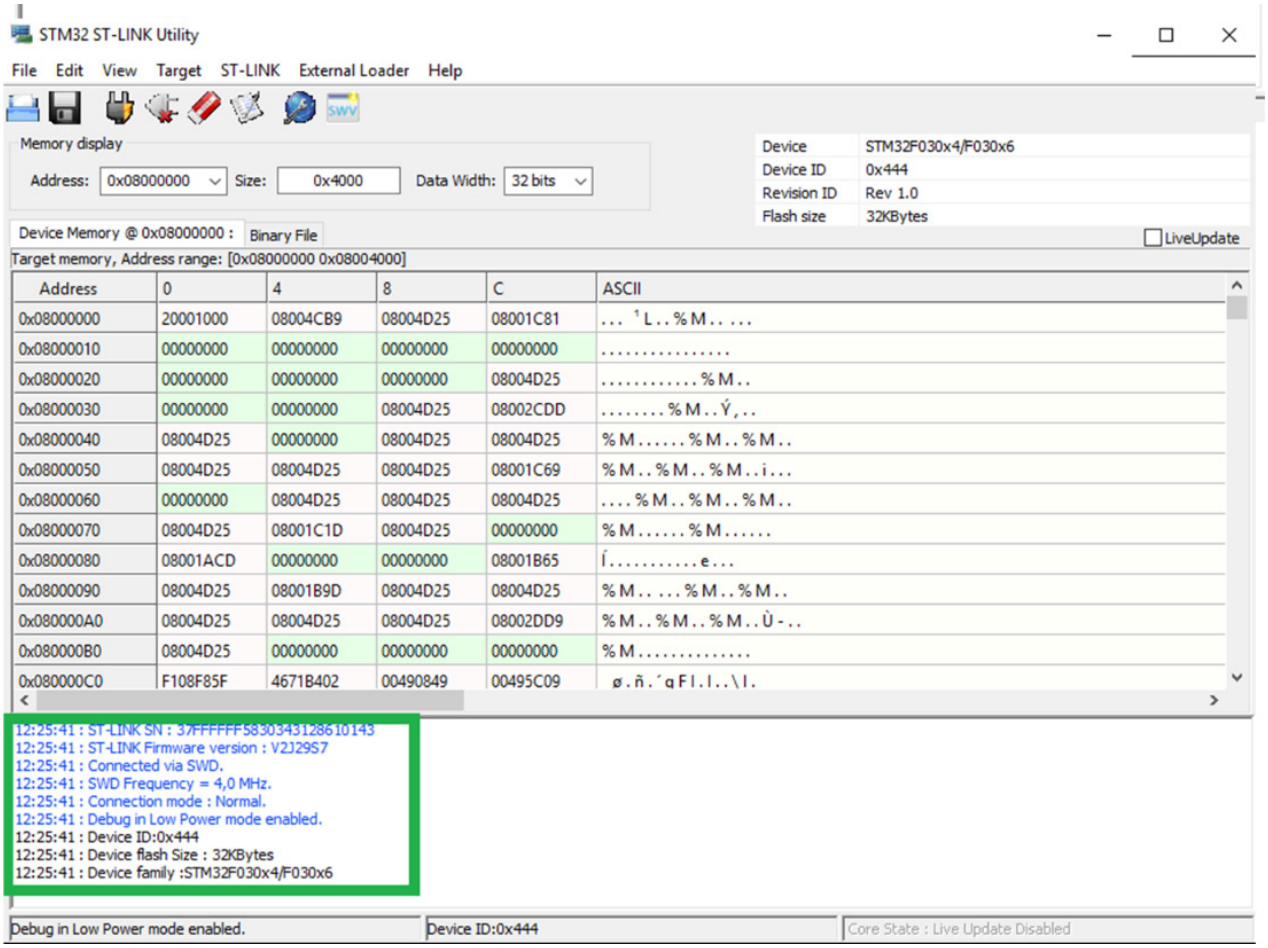



## 5.3. Starting the STM32 ST-LINK Utiity

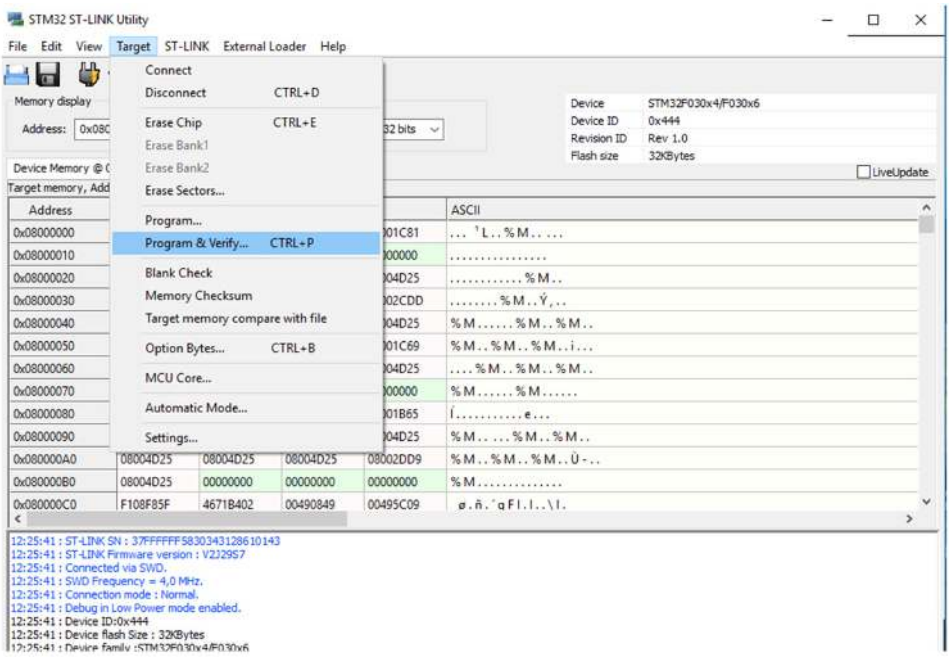
You can type “STM32” in the “Windows Start Menu” in the lower left corner, and see the ST-LINK Utility program, and click on it to start it. You will also see the STM32 ST-LINK Utility User Manual, a PDF file that gives you in depth reference to the software if you want to dig deeper.




Click on the “Connect” icon (marked green above) and you will see if you have a connection to the STM32 via the ST-LINK.



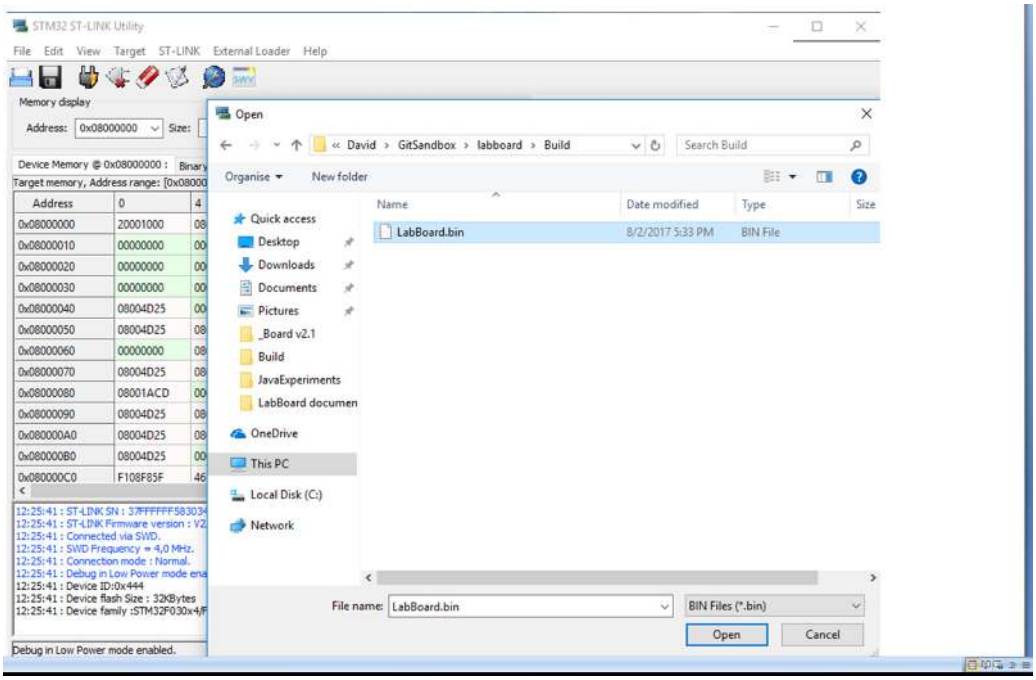

If the programming succeeded, you will see the screen as above. The utility has read the memory of the MCU, and are ready to go.



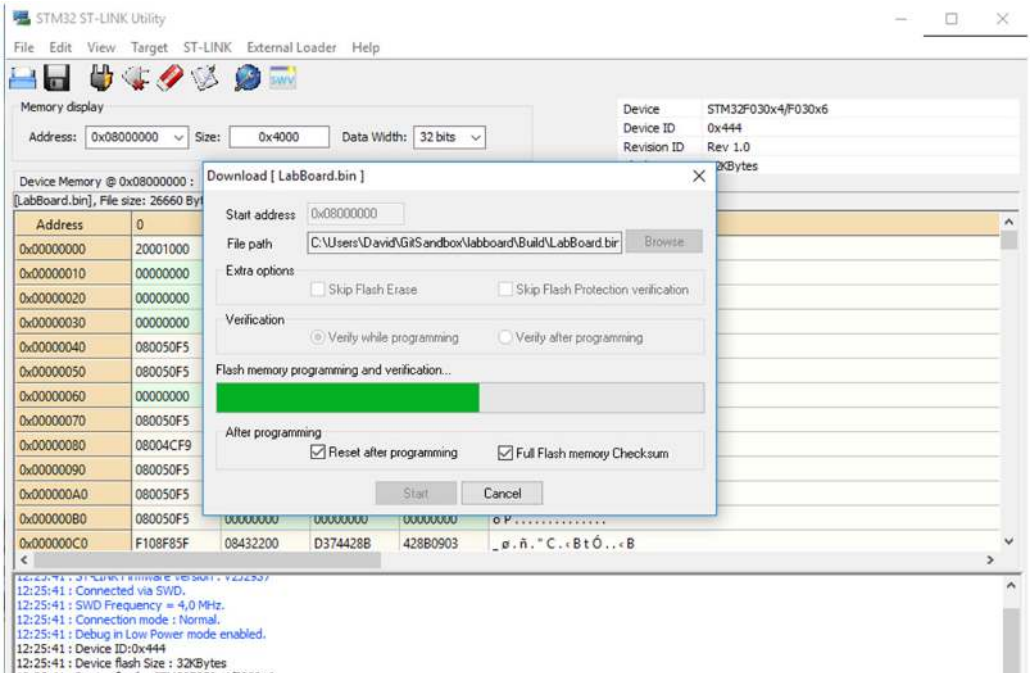

To start programming, select **<Target>** and then **<Program & Verify....>**

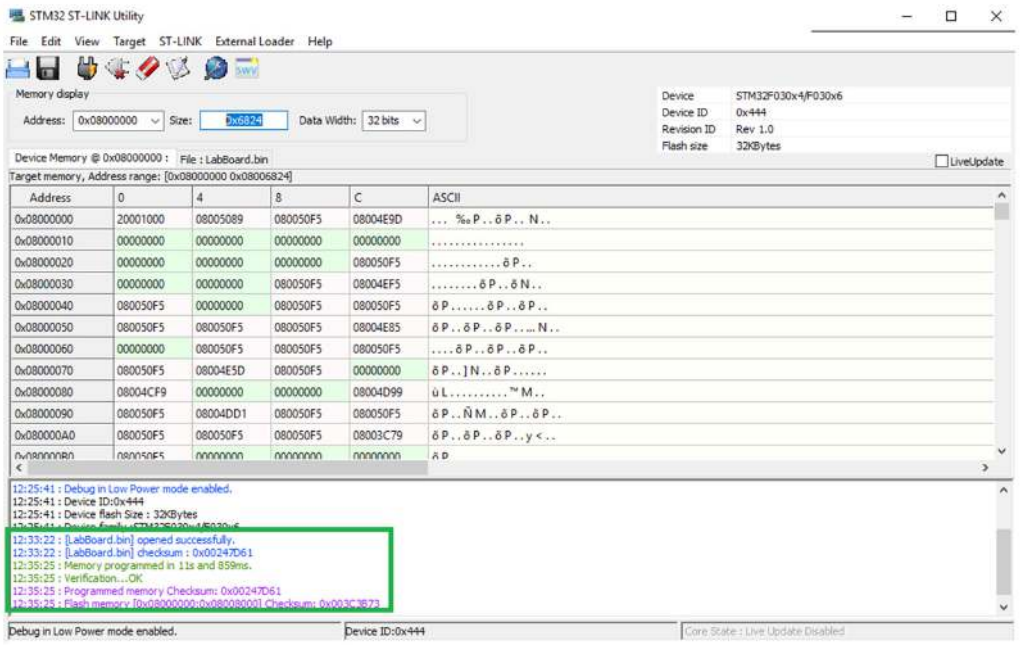
You should have already have downloaded the new firmware binary file from the www.totemmaker.net WIKI section. See **chapter 4 How to get the Firmware from Totem?**

Browse to the folder you downloaded the *.BIN file to, and select it in the dialog window like you see in the screen shot below:




And when programming the firmware, you will see this screen:





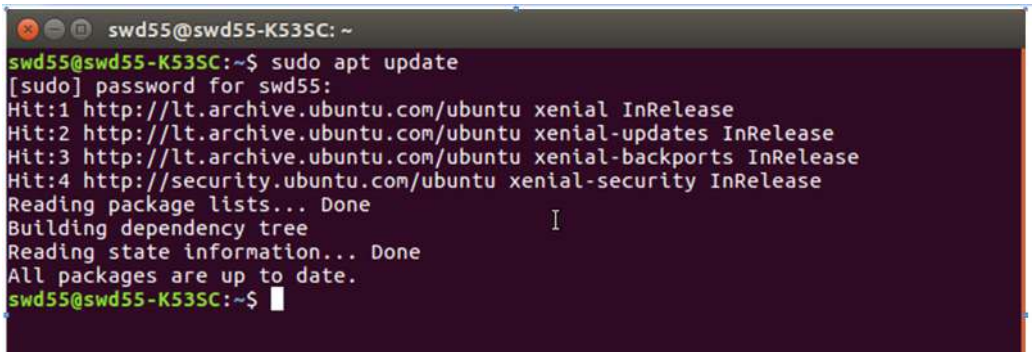

When a successful programming is done, you will get the message **“Verification... OK”**, and you will know that you have updated the firmware. Now, you will need to restart the LabBoard/MiniLab by switching off and on the power, then check that it starts up normally with the new firmware.. Then you should re-calibrate the LabBoard, because some parameters may have been lost during programming. These parameters store e.g. the zero-points in the voltage metering, so that a higher accuracy is obtained. You can check the calibration section in the last chapter of this document.

# 6. Lab Board firmware update on Linux (debian / Ubuntu)

## 6.1. Update your Linux system.

In this section we will show you how to use a Linux system to update the firmware in the Lab Board. We will show it in a debian Ubuntu system, so it might be a bit different in other systems. We assume that users of Linux have a good knowledge of their system, so this chapter is a bit more technical in it’s form than the Windows section.

So first you should check for updates for your system, using the **sudo apt upgrade** command.

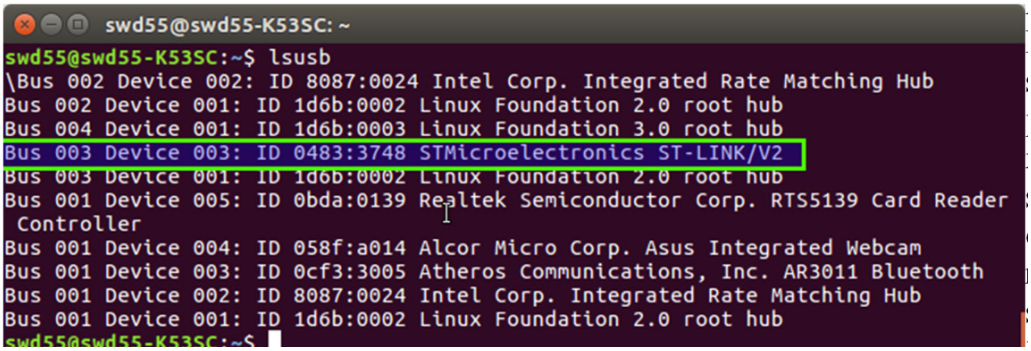



If there are updates for your system, use the **sudo apt upgrade** command.

6.2. Check if the ST-LINK/V2 has been detected by the OS.

Type **lsusb**

If OS can see ST-LINK/V2 programmer, you can start download the needed software.

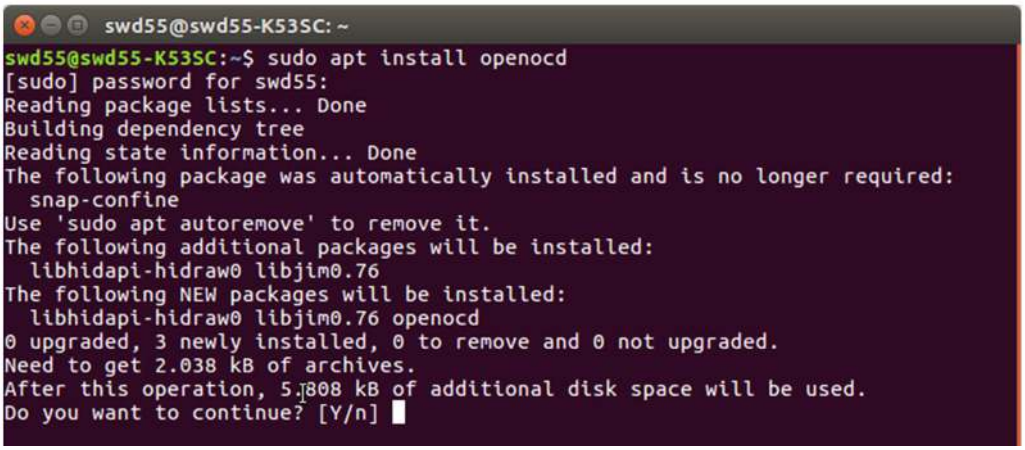



You can install st texane flashing tool, but this tool should be build from source (for debian Ubuntu users) and it works only as a flasher.

There is a slightly easier way to install needed software, installing from already existing debian repository.

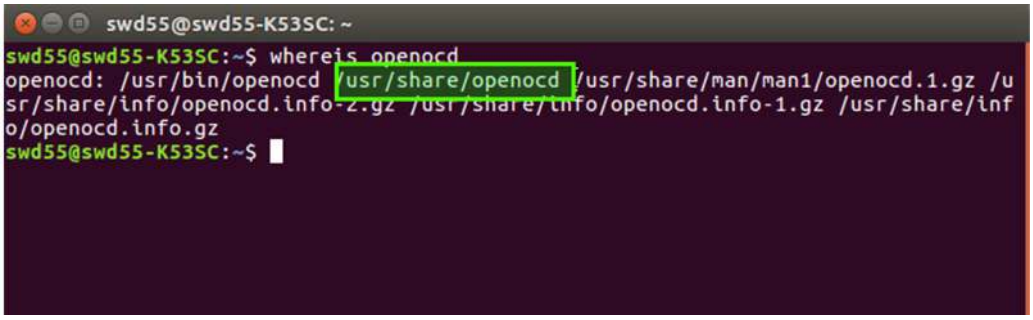
Firstly we need openOCD software:

## sudo apt install openocd



Check where openOCD located, as path may differ, it is necessary to check path:

**whereis openocd**



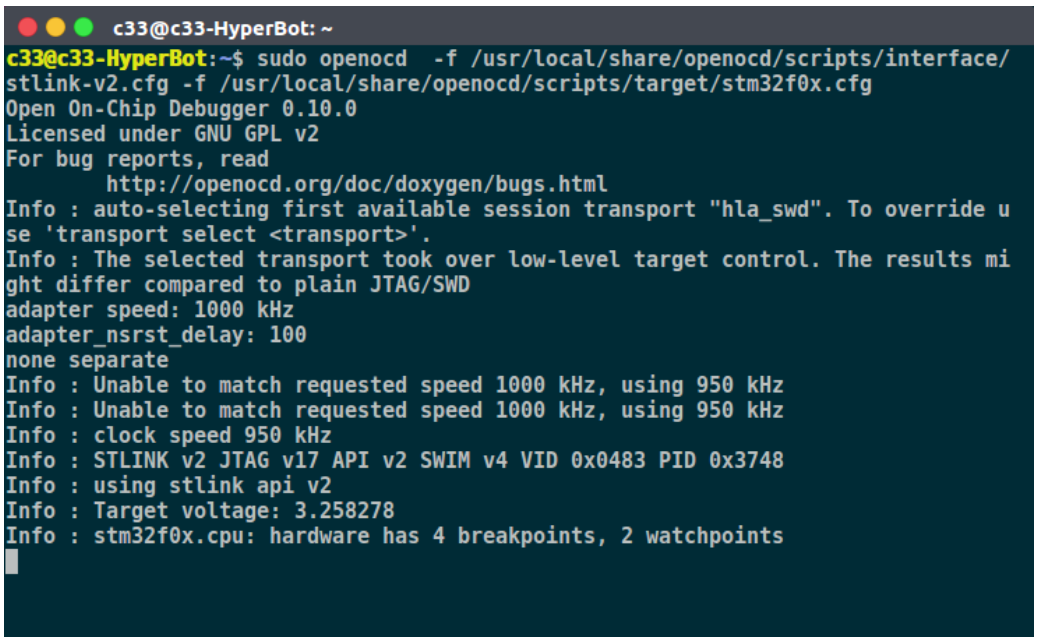

6.3. Connect ST-LINK/V2 to PCs USB port and connect wires to the programming connector SV6 on the LabBoard.

Refer to chapter 3 “Connecting the ST-LINK/V2 to the LabBoard”. Here you will find instructions for how to connect the 3 wires from the ST-LINK/V2 to the LabBoard.

6.4. Try to connect to the target.

Type:

**sudo openocd -f /usr/share/openocd/scripts/interface/stlink-v2.cfg -f /usr/share/openocd/scripts/target/stm32f0x.cfg**




Optionally you may not need full path:

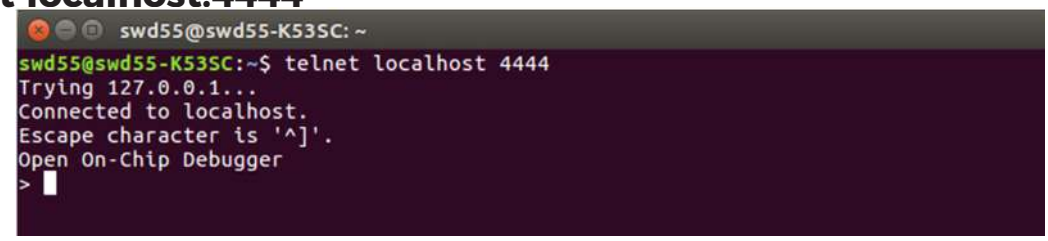
**sudo openocd -f interface/stlink-v2.cfg -f target/stm32f0x.cfg**

## 6.5. Programming the ST-LINK.

Next step is to send commands to do the actual “flashing” of the firmware. To do that you’ll need “**telnet**” which is a default app for many operating systems.

Type:

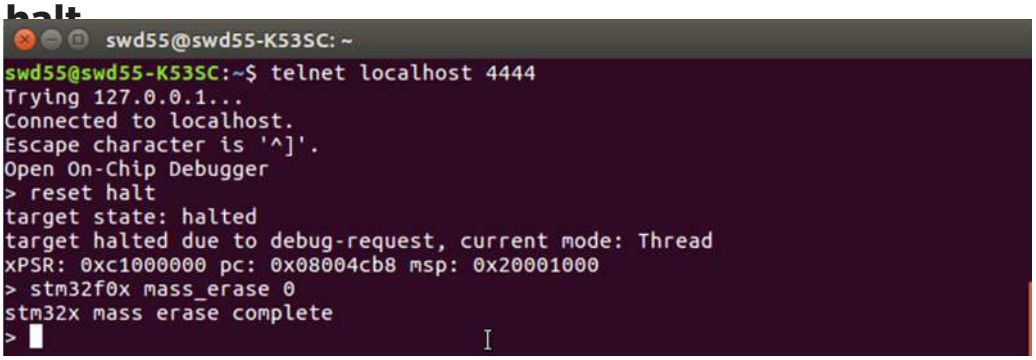
**telnet localhost:4444**




Now you can send commands for device debugging, memory reading and etc.

First of all, halt device:

**reset halt**




Now MCU is stopped.

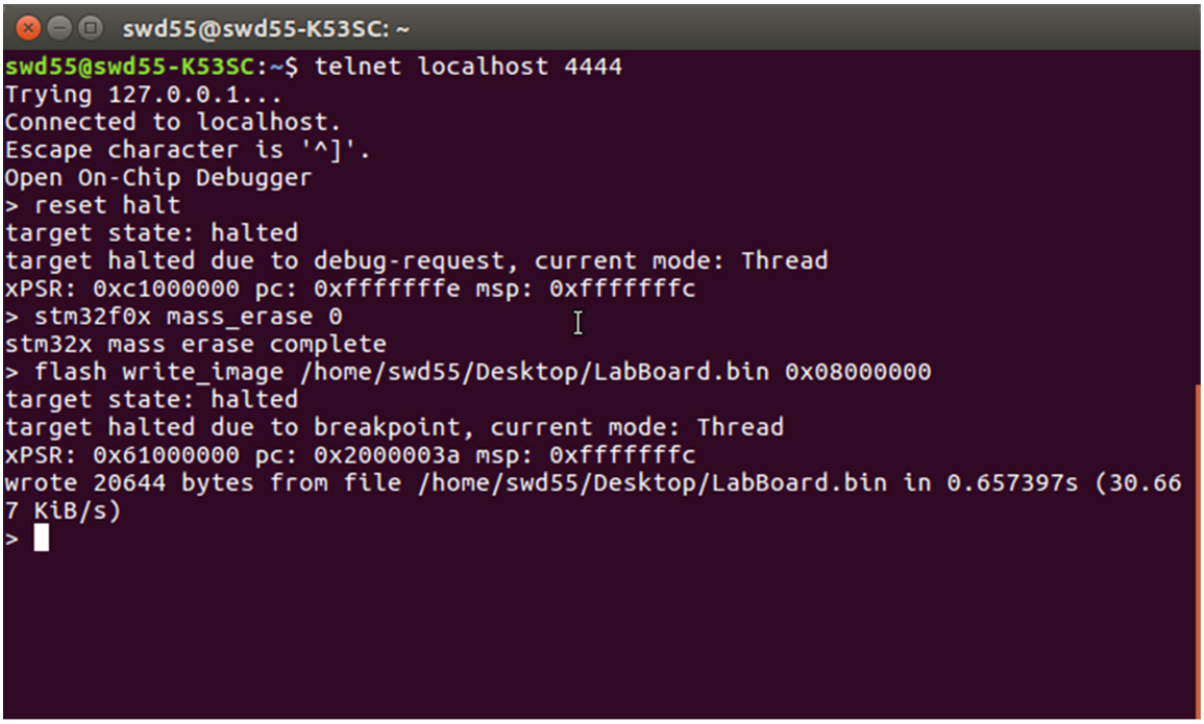
Before writing new firmware, delete the old one in the Lab Board:

**stm32f0x mass_erase 0** (see above screen shot)

Now you can flash new firmware.

Firmware flashing:

**flash write_image /home/swd55/Desktop/LabBoard.bin 0x08000000**




The filename “LabBoard.bin” may vary, according to versions etc. When you download it, you will see what version it has, we just use this “LabBoard.bin” as a placeholder name. It may look like this: **flash write_image <PATH>/Labboard_1.5.bin 0x08000000**

Reset device :

**reset**

Now you should re-calibrate the LabBoard, because some parameters may have been lost during programming. These parameters store e.g. the zero-points in the voltage metering, so that a higher accuracy is obtained. You can check the calibration section in the last chapter of this document.

# 7. Upgrading Mini Lab firmware using ST-LINK/V2 programmer on macOS

This document guides through steps required to upgrade firmware in the Mini Lab, usinga macOs PC. Upgrading firmware can lead to better performance and functionality bug fixes. See chapter : **4. How to get the Firmware from Totem?**

When you have downloaded the latest version of the firmware, you can continue with the steps below:

Before starting, make sure that you meet all necessary requirements:

## 7.1. Requirements:

- **macOS v 10.10 or higher**
- **SWD compatible programmer (ST-LINK/V2)**
- **Jumper cables to connect programmer to Mini Lab**

SWIO, SWCLK and GND signals will be used for flashing. If you're using different programmer from the one used in this example, refer to that programmer documentation for correct pinout. For the flashing software, we'll be using stlink application. The recommended way of getting it is using homebrew package manager. Refer to homebrew installation instruction on how to install it on your computer.

## 7.2. Updating procedure

1. Prepare software. After installing homebrew, stlink can be installed from Terminal.app, by writing command shown below:

**brew install stlink**

7.3. Connect the ST-LINK/V2 to the Lab Board's programming port..

Refering to pinout schematics below, connect all three needed pins using jumper cables: You can also read chapter 3 in this document : "Connecting the ST-LINK/V2 to the LabBoard" that explains in more detail.

7.4. Verify the connection.

Power on minilab and plug in programmer into your computer. Successful connection and installation of stlink can be verified by issuing this command in your Terminal.app:

## st-flash reset

If programmer was able to establish connection to the LabBoard, information about the chip should be printed: Flash the updated firmware. Using command below, flash the updated firmware package into minilab:

```
regina:~ karolistarasauskas$ st-flash reset
st-flash 1.4.0
2018-01-11T13:48:13 INFO src/common.c: Loading device parameters....
2018-01-11T13:48:13 INFO src/common.c: Device connected is: F0 small device, id 0x10006444
2018-01-11T13:48:13 INFO src/common.c: SRAM size: 0x1000 bytes (4 KiB), Flash: 0x8000 bytes
(32 KiB) in pages of 1024 bytes
regina:~ karolistarasauskas$
```

## st-flash write <file.bin> 0x08000000

<file.bin> should point to the exact file path in your computer. The recommended way of doing this is to drag the file into the terminal window, and the path will be filled automatically, only the finishing address number needs to be input. The actual filename of the binary firmware file may be more like: **Labboard_1.5.bin**

```
regina:knob karolistarasauskas$ st-flash write /Users/karolistarasauskas/Desktop/update.hex.
txt 0x08000000
st-flash 1.4.0
2018-01-11T13:56:33 INFO src/common.c: Loading device parameters....
2018-01-11T13:56:33 INFO src/common.c: Device connected is: F0 small device, id 0x10006444
2018-01-11T13:56:33 INFO src/common.c: SRAM size: 0x1000 bytes (4 KiB), Flash: 0x8000 bytes
(32 KiB) in pages of 1024 bytes
2018-01-11T13:56:33 INFO src/common.c: Attempting to write 3166 (0xc5e) bytes to stm32 addre
ss: 134217728 (0x8000000)
Flash page at addr: 0x08000c00 erased
2018-01-11T13:56:33 INFO src/common.c: Finished erasing 4 pages of 1024 (0x400) bytes
2018-01-11T13:56:33 INFO src/common.c: Starting Flash write for VL/F0/F3/F1_XL core id
2018-01-11T13:56:33 INFO src/flash_loader.c: Successfully loaded flash loader in sram
  4/4 pages written
2018-01-11T13:56:33 INFO src/common.c: Starting verification of write complete
2018-01-11T13:56:33 INFO src/common.c: Flash written and verified! jolly good!
regina:knob karolistarasauskas$
```

That's it, firmware has been updated. Now your Mini Lab should be reset by cycling it's power back on.

Then you should re-calibrate the LabBoard, because some parameters may have been lost during programming. These parameters store e.g. the zero-points in the voltage metering, so that a higher accuracy is obtained. You can check the calibration section in the next chapter of this document.

# 8. Calibration of the voltage measurement inputs.

## 8.1. Why is calibration needed?

The device voltmeter circuit can be affected by the environment. After some time the device may loose a little accuracy. Normally the voltmeter inputs are floating within a small range. If the floating measurements is out of range, you can very simply re-calibrate the voltage inputs. Also if you uploaded new firmware, you should calil-brate again.

## 8.2. How to find out if your Min Lab needs calibration?

1.To check if you need calibration, connect 50/5/0.5 V channels to ground(GND) with some short patching cables, and read voltage measurement values.

### Abnormal conditions:

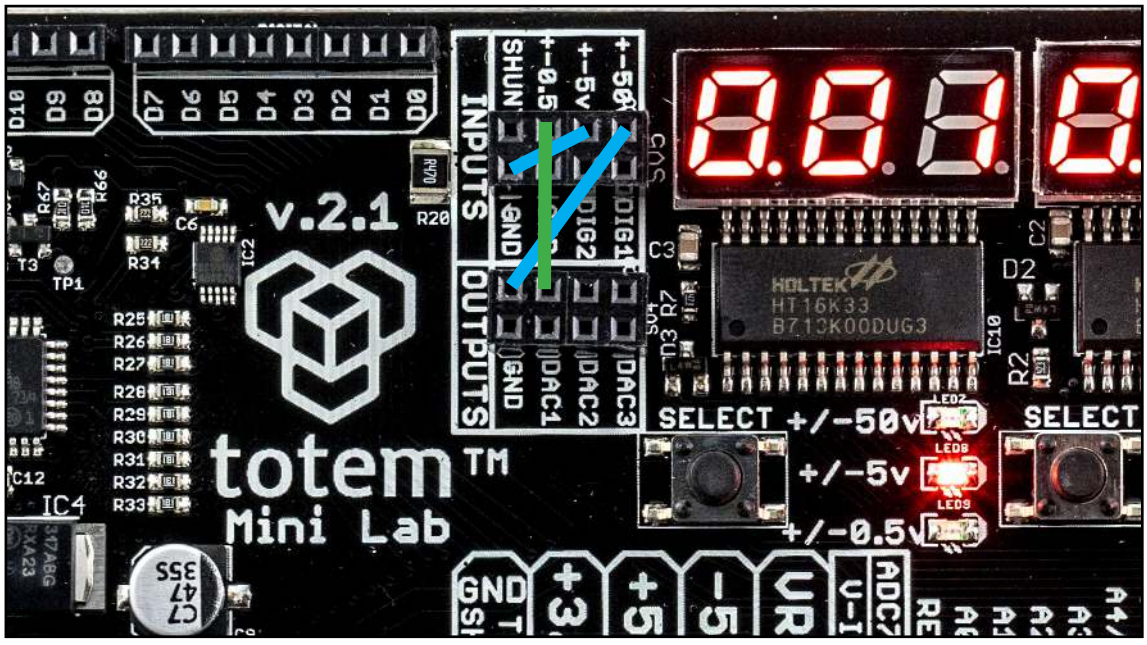
+/-50V channel value floats more than 0.2V when connected to ground(GND).

+/-5V channel value floats more than 0.1V when connected to ground(GND).

+/-0.5V channel value floats more than “005” (0.005V->5mV) when connected to ground(GND).

**Note**: 0.5 V channel is very sensitive and when floating (when nothing is connected) it may show values more than 5mV.  It picks up statics etc.

If you found any of above conditions, then calibration could be needed.




5. How to connect voltmeter inputs for calibration.

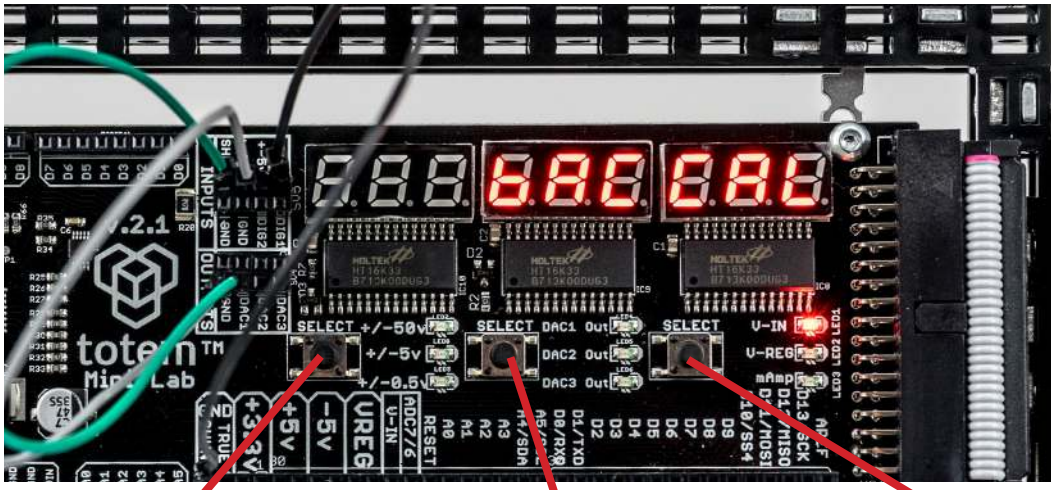
## 8.3. Connect your voltage inputs for calibration.

The above picture shows how to connect the Lab Board for calibration. You simply take 3 short patching cables, and connect the +/-50v and the +/-5v to a GND header. You will normally find the closest GND headers. In figure 6, these patching cables are shown in blue color. The +/- 0.5v input should be connected to the DAC 1 output.

It is illustrated in the figure 6 as the green patching cable. The +/-0.5v input will use also a +0.5v output from the DAC 1, so it gets a 2-point calibration. This gives it an even better calibration than using only GND, as the 2 other inputs use.

## 8.4. Calibration procedure:

You may wait for 2-3 minutes until the circuit's temperatures stabilizes.

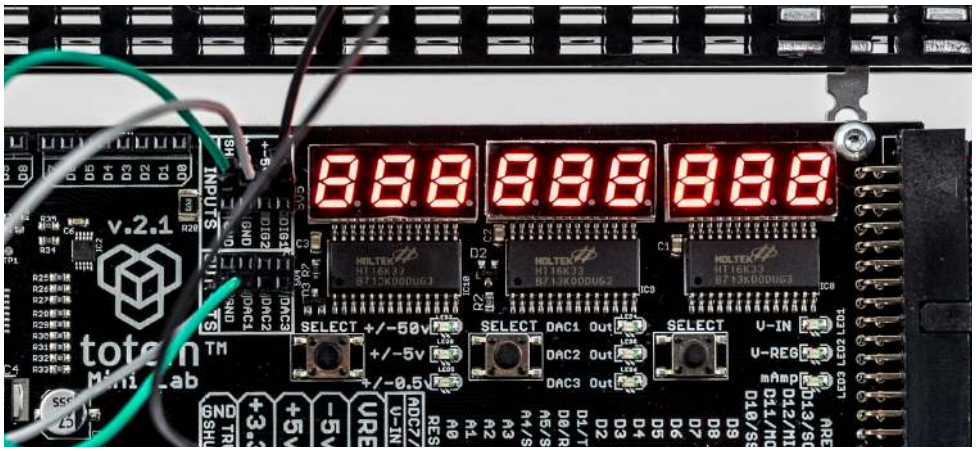



6. To start the calibration routine, press the SELECT voltage display button for more than 5 seconds.

7. "bAC" means "back", and simply escapes the calibration routine. Nothing is done or stored if you escape with this SELECT button.

8. Pressing the SELECT button to the right, under the "CAL" display, will start the calibration.

So, pressing the rightmost SELECT button will start calibration. For a moment "888888888" will appear on the display when the device calibrates. After that, the device will restart itself.




Calibration is then done. Now you can then check if the floating values are better.