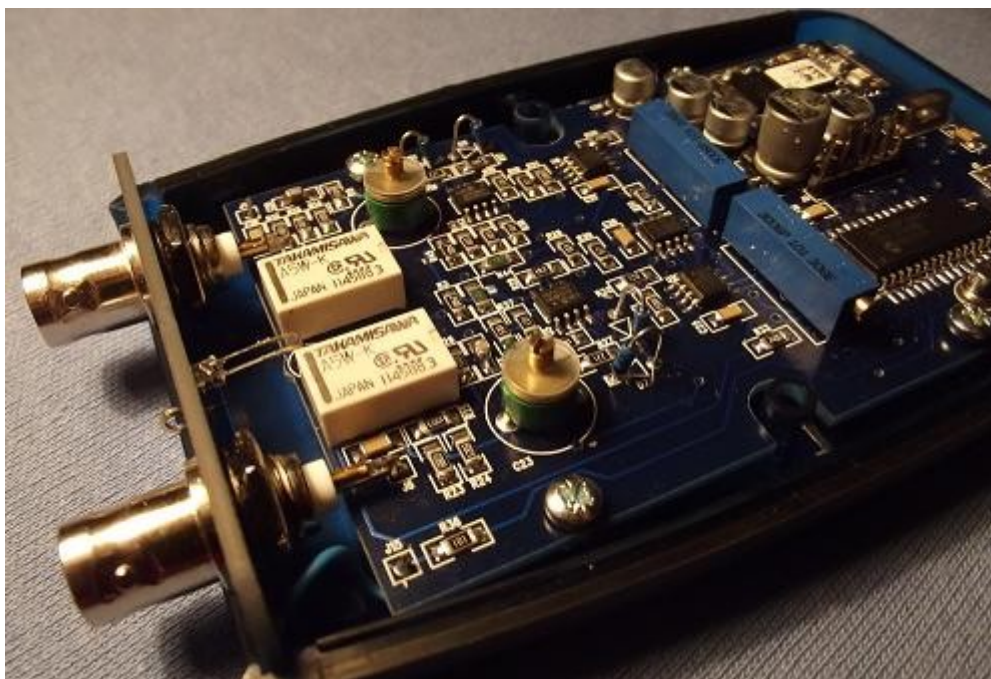# BlueDSO assembly manual

Thank you for purchasing the BlueDSO oscilloscope kit.

This document leads you through the process of assembling the device, making it possible for people with less experience in assembling. You'll need some basic assembling and soldering practice and circumspection though and you really have to stick to this manual. Polarities of the components should really be taken into consideration.

You'll need the following tools and materials for assembling:
- small, min. 18-20W, thin-tipped soldering-iron
- soldering-iron purifier sponge
- max. 0.5mm thin solder used in electronics
- disassembly ply
- plastic adhesive tape
- mechanican tweezers
- small pinchers
- small, slim and cross-shaped screw-driver
- small pliers or wrench for BNC connectors
- magnifying glass in case of need

The assembly of the device can be done in 2-3 hours. The lesser your experience are, the more time can be neccessary. The device mostly consists modern, surface-mount (SMD) chips, many of these components are only obtainable in this form factor. Assembling them could seem like a challenge, but it won't cause any problem while sticking to this guide. Always take care of working clean and precisely.

Boxing out

The purchased package contains the following:
- Printed BlueDSO circuit sheet
- BlueDSO front panel
- Case, which contains the tiny electrical components and screws for final assembly
- Measuring strings
- USB cable
- CD disk, containing the data sheets of each of the components, users' manuals and the software neccessary for using the device

Components

All the ICs in the package are needed for the assembly. Be cautious while outboxing, as the tiny components can be jumbled easily. Some of the SMD IC-s (ceramic condensators) does not have any notation on them, the type of such components are only indicated on their package; you should only get them out of the package when they will be soldered. Only pick one component at a time and assemble it right away.

The SMD resistors usually identified by numbers. An SMD resistor has a 3 or 4-digit caption on it. These numbers indicate the value of resistance in Ohm.
The last digit tells us how many 0-s should be written after the precieding 2 or 3 digits. Eg. if it's 120, then it's a resistor of 12 Ohm. If it's 1003, than it's a 100000 Ohm or 100 kOhm resistor.

Tantalum electrolyte condensators have similar captioning convention than resistors. In this case, the values are given in pF. E.g. if the caption is 106, then it's a 100000000 pF = 1000 nF = 10 uF condensator. Mind that these condensators are polarity-dependent. On one side of the component there is a signature (a line or such obvious mark) indicates the positive (+) polarity.

Aluminium electrolyte condensators have different signatures. In this case, the values are given in uF. Mind that these condensators are polarity-dependent. On one side of the component there is a signature (a line or such obvious mark) indicates the negative (-) polarity.


The ceramic condensators usually have no signatures on them, thus you have to be cautious not to mix them. Ceramic condensators are polarity independent.

The SMD inductivities notations are widely varying by vendor. These are also polarity independent chips. Their form factor is similar to tantalic electrolyte condensators, but they don't have any notation of polarity on them.

SMD transistors. These are made in multiple form factors. All of the transistors used in BlueDSO devices are SOT23 (shaped). On the chip, you can read a code which identifies it's type. E.g. the 1F code means a BC841B NPN transistor. These codes can be read in the compnents' data sheets.

This is a list of components in the device:

Name	Signature	Pcs. neccessary / device	ID	Value
CONDENSATORS				
aluminium electrolyte 6,3V, 10x10mm		1	C15	1000uF
ceramic SMD 1206		12	C2, C9, C10, C12, C14, C18, C19, C21, C22, C25, C26, C29	100nF 50V
tantalic electrolyte 6,3V, „B"		3	C1, C5, C27	100uF
aluminium electrolyte 6,3V, 6x5mm		4	C13, C16, C28, C30	100uF
tantalic electrolyte 6,3V, „A"		1	C6	10uF
ceramic SMD 1206	(red)	2	C3, C4	15pF
ceramic SMD 1206	(green)	1	C11	1uF
ceramic SMD 1206	(blue)	2	C7, C8	22pF
trimmer capacitor		2	C17, C23	5-10pF
ceramic SMD 1206	(black)	2	C20, C24	68pF
ceramic SMD 1206	(brown)	1	C31	470pF
CONNECTORS				
USB mini connector, 5 pt. SMD		1	J2	USB mini, 5
Callibational connector		1	gold testpoint	
Connectors to the front panel		2	J11, J12	BNC
Relay				
Relay		2	K3, K4	RLY-A5WK
Inductivity				
Inductivity SMD 1210	R12	1	L1	0,12uH
RESISTANCES				
Resistance SMD 1206		2	R1, R4	1,2k
Resistance SMD 1206		7	R6, R14, R15, R21, R25, R26, R31	100k
Resistance SMD 1206		1	R36	100R
Resistance SMD 1206		12	R8, R9, R10, R11, R18, R22, R28, R29, R37, R38, R42, R43	10k
Resistance SMD 1206		2	R13, R24	120k
Resistance SMD 1206		2	R44, R7	120R
Resistance SMD 1206		4	R19, R20, R30, R32	12R
Resistance SMD 1206		1	R5	1M
Resistance SMD 1206		2	R17, R46	1R
Resistance SMD 1206		4	R16, R27, R34, R39	220R
Resistance SMD 1206		4	R3, R33, R35, R45	240R
Resistance SMD 1206		2	R12, R23	680k
Trimmer potentiometer		2	R40, R41	100R

Semiconductors				
Microcontroller SO28		1	U1	DSPIC33FJ16 GS502
Programmable amplifier SO8		2	U9, U10	MCP6S91
Operational amplifier, 10MHz, SO8		2	U5, U13	MCP6292
Voltage converter, SOT23	CA	1	U12	TCM828
Operational amplifier, 1MHz, SO8		1	U11	MCP6002
USB protocol converter SO16		1	U2	MCP2200
Bluetooth module		1	U3	BTM-112
Memory SO8		1	U4	23X64
Voltage regulator SO8		1	U6	TC1107
Voltage regulator SOT23	CP	1	U7	MCP1700-2,5V
Reset circuit SOT23	PJ	1	U8	MCP130-2,7V
NPN transistor SOT23	1F	2	Q3,Q4	BC 847
Diode		4	D1, D2, D7, D8	BAT42
Diode		2	D3, D4	TMBYV10-60
LED		1	D5	narancs
Quartz crystal				
Quartz crystal		1	Y1	8MHz
Quartz crystal		1	Y2	12MHz
Quartz spacer		2		

Prepare for assembly

Soldering the chips will be done with the help of the component list and the assembly circuit sheet. Mind that all components get to the right place and orientation, especially for polarized chips. Both sides of the BlueDSO printed-circuit will have components on them. It's subservient to start with the lowest parts on both sides, and assemble the higher chips only after that, thus the taller ones don't traverse the assembly of smaller components. This method makes the job much easier. For safety, you need a desk, where you can place and rotate the printed-circuit comfortable. Secure and precise soldering can only be made in a clean environment, so you have to prepare a wet soldering-iron purifier sponge for cleaning the soldering-iron as neccessary (preferably often). Prepare the pliers and the solder.

SMD resitors, ceramic condensators and ceramic inductivities
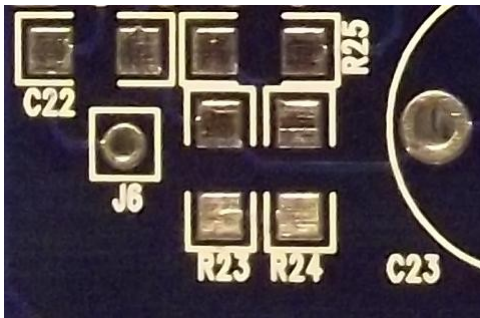
Assembly of an R23 resistor. The R23 resistor has a resistance of 680kOhm, it's signature can be 684 or 6803 as described earlier. Find the place of the component on the circuit's printed sheet. You can see the footprint of the component with the soldering points. Always keep the tip of the soldering-iron clean for successful soldering. Put some solder on the tip with operational temperature and clean it on the sponge. Note that you should always work with a clean tip. Apply some solder onto a soldering point in the footprint. Then, put the R23 resistor onto the footprint with a pair of pliers. Keep the component on the footprint by lightly pushing it down with the pliers and melt the solder underneath. You have just soldered one of the component's outlets, and it should now be stable. You may need to adjust the position of the component before soldering it's second outlet; you should just melt the solder stabilizing the component before moving it and push it to the correct position with the pliers. You should never strain SMD components without melting the solder as it impairs the printed circuit. After assembling the R23 resistor, keep on assembling the rest of the resistors and ceramic capacitors. As ceramic capacitors are lack of any notations, you should be thoughtful on assembling all the components to the right place.

SOT23 components

Assembling these components is very similar to assembling resistors. Solder one of the soldering points, then stabilize the component. When it's position is correct, then you may solder the remaining outlets. You should pay attention to place the components to the right place and with right orientation, which unambiguously defined by the footprints. When the solder of two outlets converge, use the disassembly wire to remove the unneccessary solder.

SMD tantal electrolyte capacitors

For example, the component C6 is a tantal electrolyte capacitor. This kind of component is polarity dependent, it's positive side is marked. You should mind assembling with the right polarity. The orientation of these components is marked by a corner chamfer both on the circuit sheet and the circuit itself. The sign on the footprint and the component should match. The process is the same at all other points as described above.

SMD diodes

The catode (negative side) is denoted similarly then through-hole components. You should mind that the signs should match while assembling.

SMD integrated circuits for BlueTooth and USB
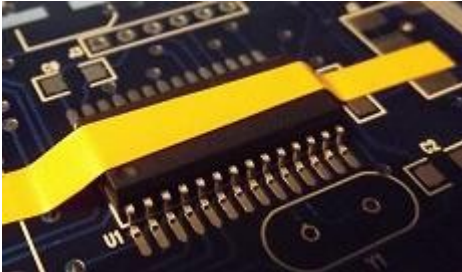
ICs used in the BlueDSO device have a pin distance of 1.25 mm (50 MIL or 0.05 inches). This is half of the formerly used DIP form-factor ICs' pin distance. Assembling these can also be done without special tools, though the precise placement of these may raise some difficulties. Again, you should regard that the footprint and the IC should match. Cut some adhesive tape, which is about the width of the integrated circuit's body (without it's pins) and few centimeters longer than the IC to be assembled. Stick it to the component such that the tape hang on both ends. Put the IC to it's place and stabilize it with the adhesive tape, while keeping the right orientation in mind. All outlets should be on the footprint as much as possible. After stabilization, check the preciseness of the location and correct it if neccessary. Now, solder one pin in one of the corners, and take care of keeping the component still. Check the location of the component again. You can adjust it while melting the soldering point if it became inaccurate. If the placement is OK, solder the very opposite pin. If the position is still right, solder all the remaining pins one by one. Unneccessary solder can be removed with a de-soldering ply. Pay attention not to overheat the component. After successful assembling, remove the adhesive tape. It's very important to stick to the height-order of the components and start with the lower ones, otherwise the higher components whould make positioning with the adhesive tape more difficult.

Note: as denoted on the circuit sheet, many of the BlueTooth module's pins are unused; these pins are not have to be soldered.

SMD aluminium electrolyte capacitors.

For example, the component C16 is a SMD aluminium electrolyte capacitor. This component is also polarity-dependent. The polarity denotion, similar to the through-hole aluminium electrolyte capacitors, is a strip on the negative side. Moreover, it's positive side is denoted by a corner chamfer. This needs to be in the same orientation on the component and the position plot. The process is the same at all other points as described above.

Other through-hole components

Put the components to the printed circuit, while paying attention to the orientation denotions as described in the assembly plot and solder two opposite pins. The through-hole diodes' outlets should be bent to the length neccessary. The long outlets should be cut off after successful soldering. As for LEDs, the shorter outlet should match the denoted side. The outlet of the LEDs on the front panel should be bent in right angle. You should put the printed circuit into the device's case, fasten it with two screws put the LED into the mortice on the front panel to determine and mark the bending point accurately. After that, get the printed circuit out of the case and solder the LED to it's final position after bending it's outlets.

Assembling the front panel

Solder the connector denoted as "CAL" onto the front panel and cut the unneccessary part of it's outlet. Assemble the BNC connectors. The screws of these connectors should be tightened by a wrench or pliers of sufficient size. Place the front panel into the device's case and fasten it with two screws. The front-side LED should fit it's mortice. Bend two spikes in right angle and connect the midpoints of the BNC connectors to the BlueDSO printed circuit. A row of 4 spikes is provided in the package. Get the panel out of the case again, bend the other two spikes for the size neccessary and connect the back-side of the front panel to the BlueDSO printed circuit's proper points (denoted as J15-J17 and J14-J16). Thus, the electrical assembly of the device is finished. Put the printed circuit into it's final position and fasten it with 4 screws. Before closing the case, some calibrational settings have to be done.

Setting the USB adaptor

All further settings has to be done on the working BlueDSO device. The electric current supply can be given on USB by a computer or an external, at least 500mA USB DC adaptor. The USB DC adaptor is not part of the package. Connecting it to a computer makes other power suppliance unneccesary.
Install the "MCP2200ConfigUtility" software from the BlueDSO CD. Connect the device to the computer with the USB cable. Install the driver of the MCP2200 USB unit by following it's instructions. The drivers neccessary can be found on the BlueDSO CD or can be downloaded from the Microchip website (www.microchip.com). Start the "MCP2200ConfigUtility" software. Set the communicational parameters (BaudRate: 115200 bps, RTS/CTS disabled, USBCFG enabled). You may write the name of the device into the "Product" field. After setting everything up, clicking on "Configure" finalizes these settings. After that, disconnect the device from the computer.

Installing the BlueDSO software

Install the BlueDSO software as described in the User's Manual.
Connect the device with a USB cable. At the first time, wait until the computer sets up the communication port assigned to the device. After this, open the BlueDSO software. Select the communication port assigned to the device and click "Connect". If you don't know the port number, the "Search BlueDSO" option, which can be found on the "Tool" panel, can find and connect to the device automatically. If the connection was successful, the conection status indicator turns green. The front-side LED's single blinking indicates that the connection is made via USB.

Offset setting

Offset setting means the calibration of the analogue amplifier. At this point, the "Zero level calibration missing" message should be disregarded. Connect the 1:1 div measuring string onto the CH1 input connector and short-circuit the black and the red measuring tweezers. Set the voltage range of both CH1 and CH2 to 1V/div, the trigger source to Line and click "Start" for data capturing. Adjust the trimmer potentiometer on the CH1 side to match the middle line of the displayed grid. Then, do the same for CH2. After that, set the range to 100mV/div and refine the setting with the trimmer potentiometers. After this, stop data capturing and remove the strings from the inputs.

Zero level calibration

Click on the "Zero level calibration" button to set the channels' zero level. After doing so, the "Zero level calibration missing" message disappears. This should be done on every computer, with which you want to use the device.

Frequency compensation

Frequency compensation is the high-frequency compensation of the device's amplifiers and input gain stage. Connect the 1:1 div measuring string to the input CH1. Connect the red measuring tweezers onto the "CAL" connector on the front panel. Set the range of CH1 to 2V/div, the time base to 25 us/div and the trigger source to CH1. In the BlueDSO software, set the calibrational wave's frequency to 10kHz and turn it on by clicking the "CAL" button. Then, you will see a square wave sequence. Use the CH1-side trimmer condensator to set frequency compensation. Repeat this process for CH2.
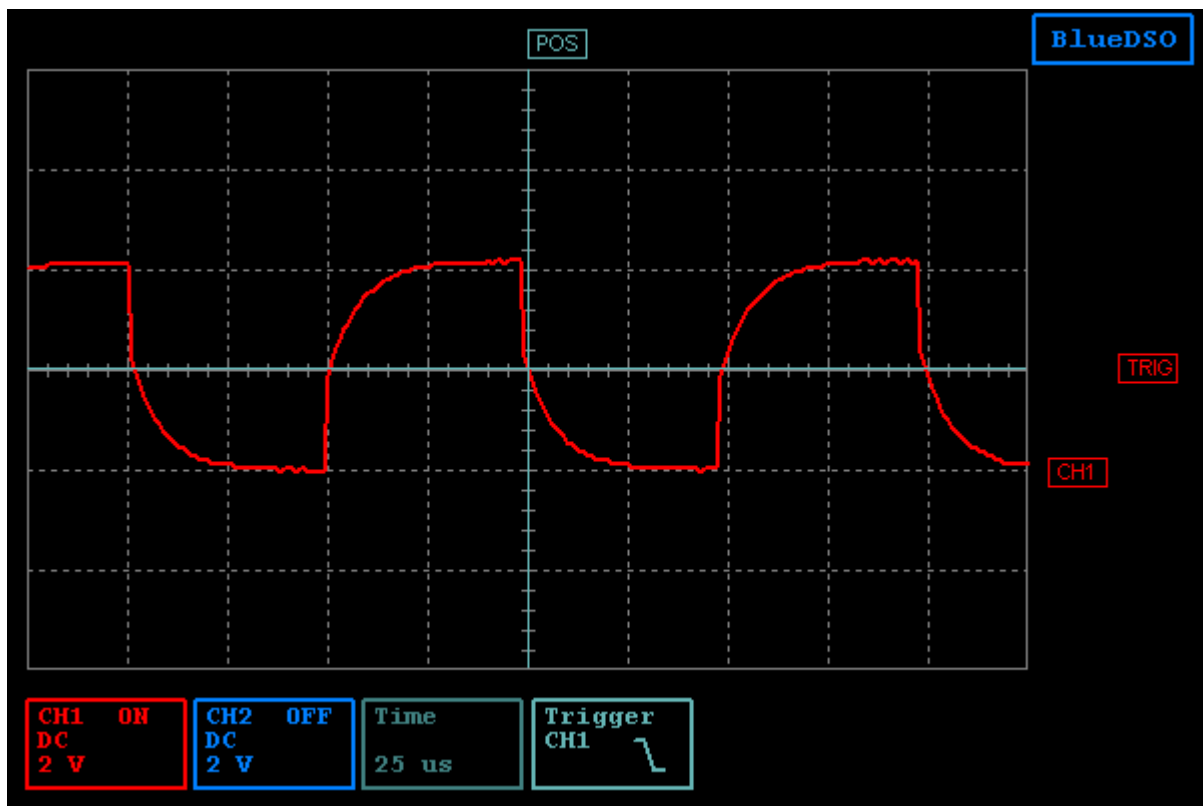
Undercompensated gain stage
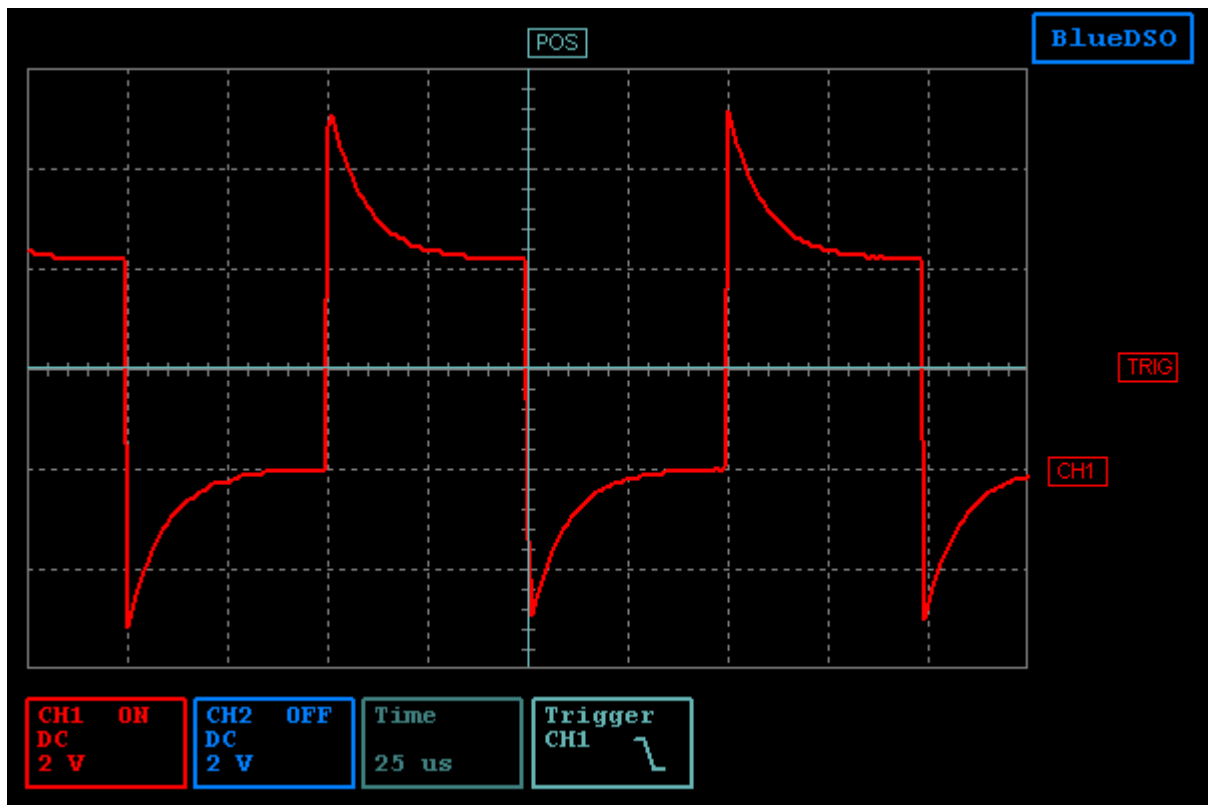
Overcompensated gain stage
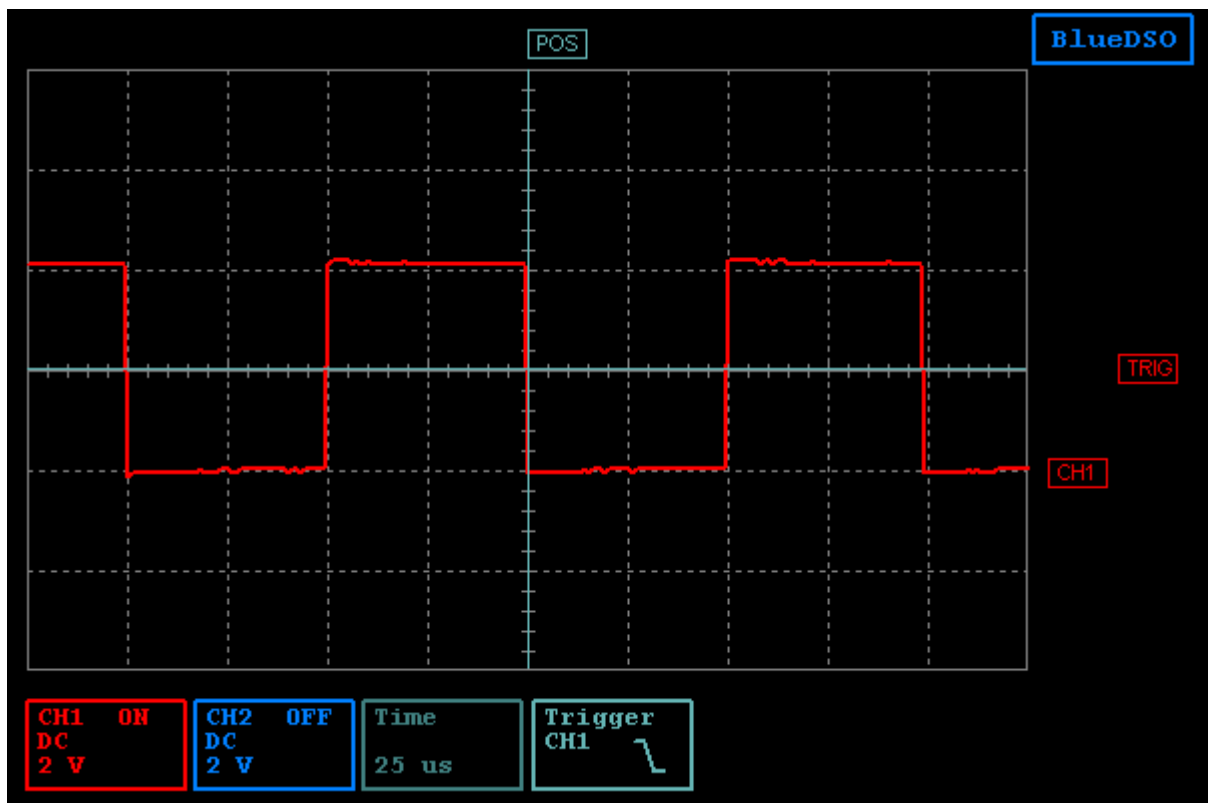
Correctly compensated gain stage

The assembly and calibration of the device is done. The device is ready to use after closing it's case.