BOS1901 Development Kit

1 Features

- Plug and play development kit to experience piezo haptic feedback
- Low-power BOS1901 integrated circuit, high voltage driver with digital interface
- Simple power interface for development via USB port
- Standard USB audio to prototype haptic effects in MATLAB®, Python®, Audacity® and many other softwares[1]
- Fully embeddable modular software driver
- Easy generation of high-voltage waveforms up to 190 Vpp
- Two breakable miniature PCBs with BOS1901 drivers
- Standard commercial piezo actuators included in the Kit:
  - Starter Set: TDK PowerHap™ 1204[2] lateral
  - Premium Set: TDK PowerHap™ 1204 lateral, 0904 lateral, 0909 square, Bimitech Python™ PUA3020-5H200 bending.

2 Description

The BOS1901-KIT is a Development Kit to help users who want to get familiarized with the BOS1901 Piezo Haptic Driver IC.

The USB powered kit appears as an USB Audio device for the computer, which allows the rapid generation of waveforms using existing audio software like Audacity® for haptic prototyping.

Each breakable miniature PCB gives access to all signals allowing the user to experiment with the BOS1901 using a development platform of his/her choice.

Standard commercial piezo actuators are provided as a starting point to begin experiencing with haptic feedback.

Table 1: Ordering information

PRODUCT	DESCRIPTION
BOS1901-KIT-B	Starter Set with One Actuator
BOS1901-KIT-A	Premium Set with Four Actuators

For details see section 2

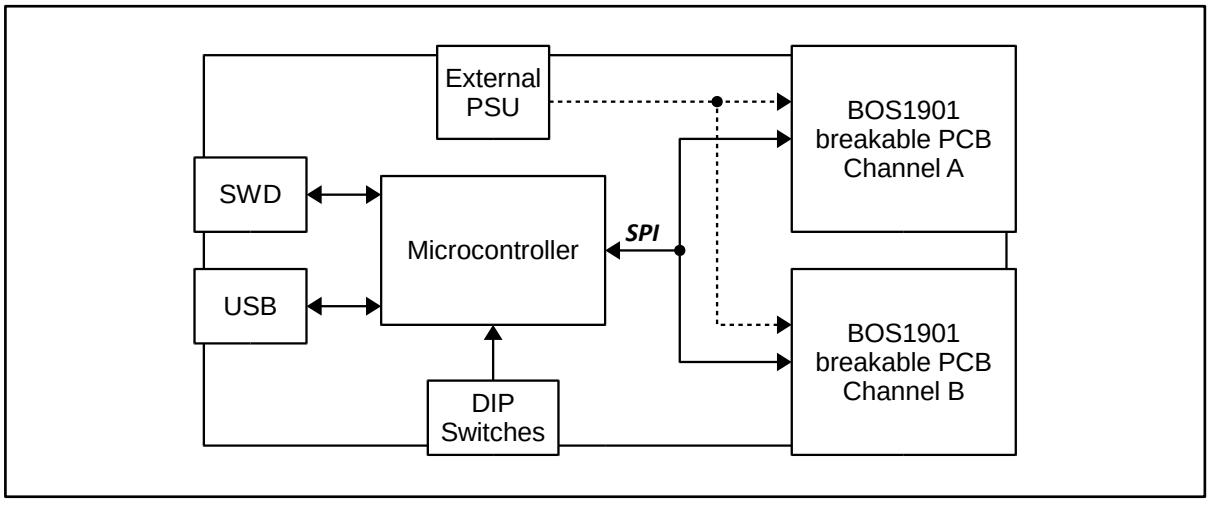


Figure 1: Simplified BOS1901-KIT diagram

[1] MATLAB® is registered trademark of The MathWorks, Inc.
Python® is a registered trademark of the PSF

[2] PowerHap™ is a trademark of TDK Corporation
Audacity® is a registered trademark of Dominic Mazzoni

3 Quick-Start guide

3.1 What's in the Box

The BOS1901-KIT is currently available in two distinct packages: *Premium Set* and *Starter Set*. The following tables show the content of each set.

Table 2: **Premium Set BOS1901-KIT-A** development kit content

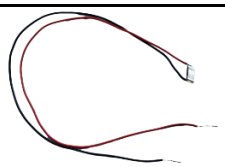
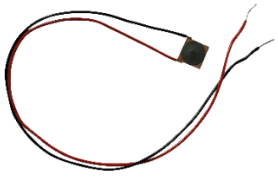
#	ITEM	DESCRIPTION	REFERENCE
1	Evaluation PCB	BOS1901 Evaluation PCB	
2	USB Cable	Cable to connect the evaluation PCB to a computer Stewart Connector part number SC-2AMK001F	
3	TDK Piezo Actuator	TDK Mini PowerHap™ 1204H018V060 Actuator Ordering : Z63000Z2910Z 1Z 39 Capacitance : 0.42 µF Dim : 12.0 x 4.0 x 1.8 mm	
4	TDK Piezo Actuator	TDK Mini PowerHap™ 0904H014V060 Actuator Ordering Z63000Z2910Z 1Z 41 Capacitance : 0.32 µF Dim : 9.0 x 3.75 x 1.4 mm	
5	TDK Piezo Actuator	TDK PowerHap™ 0909H011V060 Actuator Ordering: B54103H2020A001 (Z63000Z2910Z 1Z 2) Capacitance : 0.85 µF Dim : 9.0 x 9.0 x 0.55 mm	
6	Bimitech Piezo Actuator	Bimitech Python™ PUA3020-5H200 bender with Clamp with screws Capacitance : 71 nF Dim : 50 x 20 x 0.56 mm *Refer to section 4.2.3 for clamp assembly instructions.*	
7	Clamp	Clamp with screws for Bimitech piezo actuator	
8	Power Connector	Connector and cable for external power supply connection (refer to section 4.1.1) JST Sales America Inc. part numbers PHR-2 and ASPHSPH24K51	

Table 3: **Starter Set BOS1901-KIT-B** development kit content

#	ITEM	DESCRIPTION	REFERENCE
1	Evaluation PCB	BOS1901 Evaluation PCB	
2	USB Cable	Cable to connect the evaluation PCB to a computer Stewart Connector part number SC-2AMK001F	
3	TDK Piezo Actuator	TDK Mini PowerHap™ 1204H018V060 Actuator Ordering : Z63000Z2910Z 1Z 39 Capacitance : 0.42 µF Dim : 12.0 x 4.0 x 1.8 mm	

3.2 PCB Overview

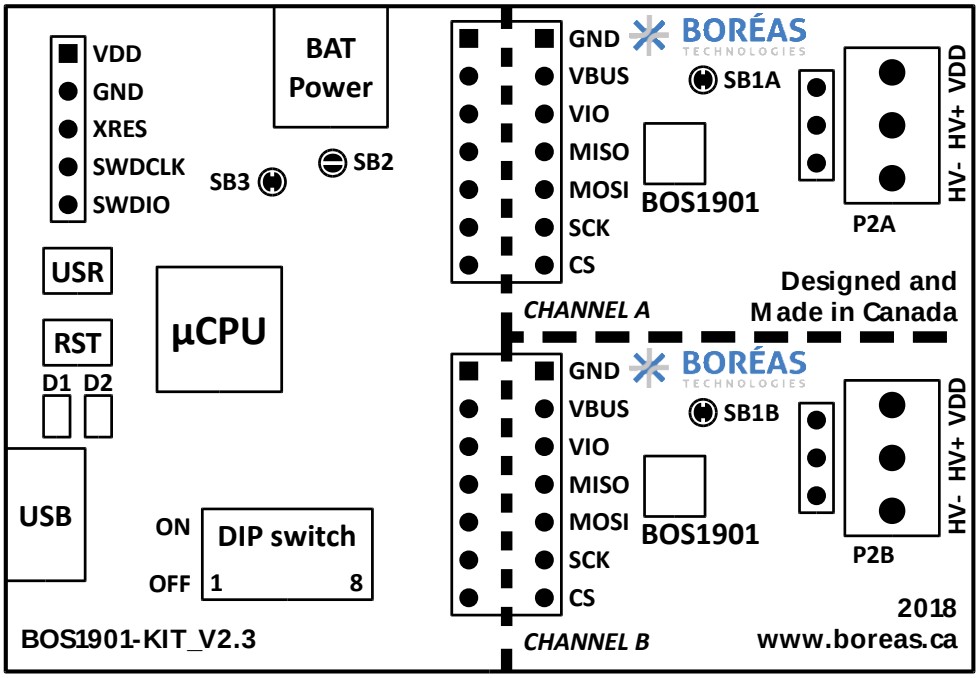


Figure 2: BOS1901-KIT Evaluation PCB overview

3.3 Quick-Start Procedure

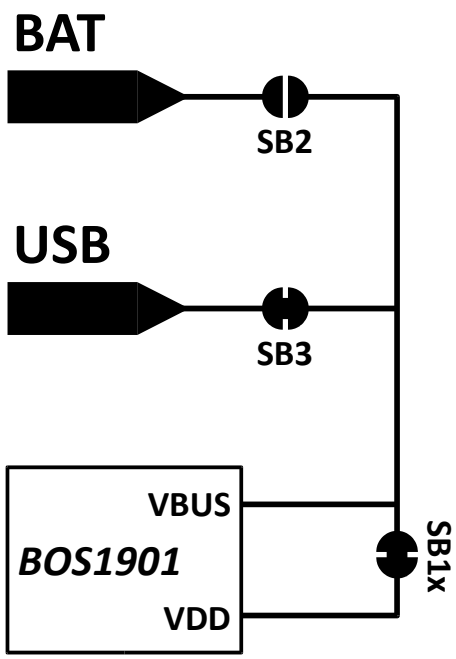
1. Refer to sections 4.1 for jumper options and 4.2 for switch settings to ensure the evaluation PCB is in the intended settings.
2. Connect the selected actuator to channel A on P2A connector (refer to sections 4.2 and 4.4). We recommend securing the actuator on a flat surface using electrical insulation tape to avoid touching exposed connections and improve the feedback sensation.
3. Connect the evaluation PCB to a computer using the included USB cable, then wait for LED D1 (green) to light up and LED D2 (red) to turn and stay off, after the firmware identification sequence (see section 6.1).
4. Push the sensor with a finger to feel the feedback. Enhance the feedback experience by changing DIP switch settings (refer to section 4.2). With switches 5, 6 and 7 all set to OFF the "click" might be too subtle. Turn all switches 5, 6 and 7 to ON and then push the piezo again; the feeling should be clearer. Try various settings for switches 5 to 7 and see how it affects the feedback.
5. Plug the piezo into channel B and set SW3 to ON and SW4 to ON. Gradually apply pressure on the piezo, 3 events can be felt: 1 click, then a stronger click, and then a buzz. If it is difficult to distinguish all 3 events, set SW7 OFF to decrease the sensitivity.
6. Using the Audacity® software (refer to section 5.2), select a waveform to play on the actuator.

4 Hardware

4.1 Jumper Options

The BOS1901-KIT is provided by default with jumpers SB2, SB3 and SB1X set to operate from USB power, UPI mode off.

Table 4: Jumper options

Function	Shorts	HW
USB Power UPI OFF (default)	SB2 SB3 SB1x	
USB Power UPI ON*	SB2 SB3 SB1x	
BAT Power UPI OFF	SB2 SB3 SB1x	
BAT Power UPI ON*	SB2 SB3 SB1x	

* Refer to section 4.1.2 for more details and limitations.

4.1.1 Using BAT Power (external power supply connection)

From default state:

1. Remove power to the evaluation PCB by unplugging the USB cable.
2. Cut junction of SB3 jumper. Verify it is well-disconnected using a multimeter.
3. Put a solder joint on SB2. Verify the new connection using a multimeter.
4. Optional, solder a capacitor on C19 if additional decoupling is required on VBUS node.
5. Plug the USB cable to the evaluation PCB for power and communication to the microcontroller section.
6. Apply an external DC source ranging from 3 V to 5 V on connector P5 using the provided power connector (item # 8 in Table 2: Premium Set (BOS1901-KIT-A) development kit content).
7. Push and release "RST" button (S2), then wait for green LED to light up and for red LED to turn and stay off, after the firmware identification sequence (see section 6.1).

Note: the "USR" button (S1) has reserved usage on the current firmware.

4.1.2 Using UPI Feature

WARNING - With UPI enabled, the energy recovery feature of the BOS1901 will accumulate energy on C1A/C1B capacitor, causing VDD voltage to increase. The user should make sure that VDD voltage never exceeds the 5.5 V limit otherwise it may permanently damage the BOS1901. For instance, due to its larger capacitance, it is not recommended to use the PowerHap™ 0909H011V060 actuator with 5 V supply and UPI feature ON. When using this feature with piezo devices other than those provided in the kit, make sure to size C1A/C1B accordingly. Please refer to BOS1901 datasheet section 6.2.10 for more details.

From default state:

1. Remove power to the evaluation PCB by unplugging the USB cable.
2. Remove solder joint on one or both SB1X, depending on the choice of UPI configuration. Verify the disconnection using a multimeter.
3. Plug the USB cable to the evaluation PCB, wait for green LED to light up and for red LED to turn and stay off, after the firmware identification sequence (see section 6.1).

4.2 Piezo Actuators

One TDK actuator is provided with the BOS1901-KIT ***Starter Set*** and four with the ***Premium Set***, one from Bimitech and the others from TDK.

4.2.1 Bimitech Actuator

Bimitech PUA3020-5H200 piezo actuator specifications:

Type	Bender
Polarity	Red wire on "HV+" terminal Black wire on "HV-" terminal
Range	-90 V to +160 V, use with switch SW1 at "ON" position (refer to section 4.3)

4.2.2 TDK Actuator

TDK PowerHap™ 0909H011V060 piezo actuator specifications:

Type	Cymbal design
Polarity	Red wire on "HV+" terminal Black wire on "HV-" terminal
Range	Unipolar -10 V to +60 V, use with switch SW1 at "OFF" position (refer to section 4.3)

TDK Mini PowerHap™ 1204H018V060 specifications:

Type	Cymbal design
Polarity	Red wire on "HV+" terminal Black wire on "HV-" terminal
Range	Unipolar -10 V to +60 V, use with switch SW1 at "OFF" position (refer to section 4.3)

TDK Mini PowerHap™ 0904H014V060 specifications:

Type	Cymbal design
Polarity	Red wire on "HV+" terminal Black wire on "HV-" terminal
Range	Unipolar -10 V to +60 V, use with switch SW1 at "OFF" position (refer to section 4.3)

It is of utmost importance to not use the TDK PowerHap™ actuators in Full-scale mode as it can get damaged unless the waveform is properly designed to limit the output voltage between -10 V and +60 V. Example waveforms are provided on Boréas website (www.boreas.ca/bos1901-kit).

Refer to section 4.4.2 for a special output configuration, in which two actuators can be connected on a single BOS1901 circuit:

- "Load 1" with red wire connected to "HV+" and black wire on "VDD"
- "Load 2" with red wire connected to "HV-" and black wire on "VDD"
- Use of Unipolar mode with output voltage limited to +60 V (SW1 set to OFF)
- Toggle SW2 to single ended mode (ON)

4.2.3 Bimitech Actuator Clamp Assembly

The Bimitech actuator must be assembled using the provided clamp to be operated properly. There are two possible configurations, shown in the figures below. Use both screws to tighten the clamp part of the assembly. The screws feature thread locker, therefore they need not be tightened too much, only make sure the actuator is held in place.

The configuration on the left (button configuration) allows to emulate a button using the development kit sensing feature. It features a mechanical hard-stop to prevent too much displacement to be applied to the actuator. Apply a small force on the center of the actuator to feel the BOS1901 detecting the force and then issue a feedback. Pulling upward the tip of the actuator will create a similar result. For better sensing detection, change *sensitivity release threshold* values to 3 in the *BOS1901-KIT Controller* software, *Sensing Config* tab (See BOS1901-KIT Development Kit GUI Controller User Manual for details).

The configuration on the right (vibrator configuration) is used to produce strong vibrations. Use Audacity™ to play haptic waveforms (see section 5) on the actuator and feel the vibration. For maximum feeling, hold the clamp in your hand while the actuator is vibrating. It is also possible to attach a small weight at the tip of the actuator to enhance the vibration at a given frequency (please contact Bimitech for more information).

Figure 3 Bimitech actuator clamp assembly – button configuration (left) and vibrator configuration (right)

4.3 DIP Switch Settings

The evaluation PCB is provided by default with S3 DIP Switch set to Unipolar operation with only Channel A enabled. It is recommended to toggle these switches only while not playing waveforms.

Table 5: S3 DIP switch settings

DEFAULT	SWITCH	OFF	ON
OFF	SW1	Unipolar (-10 V/+60 V)	Full-scale (-95 V/+95 V)
OFF	SW2	Differential out config*	Single ended config*
OFF	SW3	Only channel A ON	Both channels ON
OFF	SW4	Press-release feedback on channel B	Multipress feedback on channel B
OFF	SW5	100 Hz feedback	180 Hz feedback
OFF	SW6	75 % amplitude feedback	100 % amplitude feedback
OFF	SW7	Low sensitivity feedback	High sensitivity feedback
OFF	SW8	Not used	Not used

* Refer to section 4.4 for more details on output configurations

SW1 The ranges listed for SW1 settings are for full amplitude input signal, for example -1 to +1 when using Audacity® software (refer to section 5.2). When using Bimitech PUA3020-5H200 bending piezo actuator, set SW1 to ON. When using a TDK PowerHap™ piezo actuator, set SW1 to OFF.

More precisely, this switch sets the maximum and minimum values allowable for the selected range. It does not affect the gain and offset conversion between the input signal and the output voltage. If the requested voltage is out the range, the firmware will clip the signal to the limits of the range. Therefore, a single conversion equation is used for the same voltage in both ranges. The relation between the input signal value and the output voltage is:

$$Signal = \frac{Voltage}{95\ V}$$

Thus signals of +1, -1 and 0 correspond to 95 V, -95 V and 0 V respectively. To generate a 60 V output, the signal amplitude should be 60 V/95 V = 0.631.

SW2 Refer to section 4.4 for configuration details. Sensing is not possible in single-ended configuration.

SW3 SW3 determines how many channels are active. Set SW3 to OFF to activate only channel A. Set SW3 to ON to activate both channels. When a channel is activated it can sense pressure and give feedback, and it can play waveforms.

SW4 When both channels are active (SW3 is ON), set SW4 to OFF to have both channels feedback a single click. Setting SW4 to ON will maintain channel A to feedback single clicks but channel B will give three feedback response levels depending on the exerted pressure. A low-level

pressure triggers a single light click, medium pressure triggers a stronger click, and a high pressure triggers a longer feedback.

SW5 SW5 sets the frequency of the feedback response when the actuator is pressed and released.

SW6 SW6 sets the amplitude level of the feedback response. Setting SW6 to ON will provide a stronger response than setting it to OFF. SW6 has an effect only in press-release mode.

SW7 SW7 sets the sensitivity level for feedback. Setting SW7 to ON will require less pressure to trigger the feedback.

SW8 SW8 is not used in the current firmware. It could be used in firmware created by the user.

Setting SW5, SW6 and SW7 to ON will maximize the feedback response.

4.4 Output Configuration Options

With the two-terminal differential output, two outputs configurations are possible to drive a piezo.

4.4.1 Differential Output Configuration

The typical output configuration is the differential output, refer to Figure 4. The piezo-element is driven with one terminal connected to "HV+" and the other connected to "HV-". This configuration can achieve a differential output voltage of 190 Vpp in Full-scale mode.

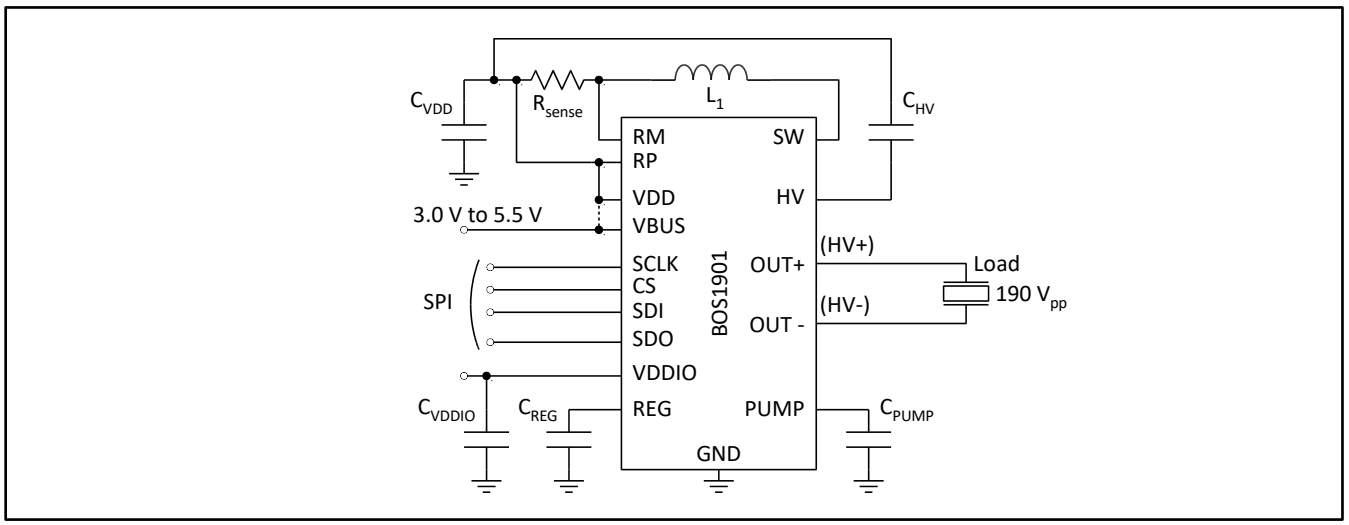


Figure 4: Two-terminal differential output configuration

4.4.2 Single-Ended Output Configuration

The single ended output configuration allows to drive up to two different piezo elements, see Figure 5. A piezo element is driven with one terminal connected to "HV+" or "HV-" and the other connected to "VDD". This configuration can achieve a single ended output voltage of 95 V. Only one piezo element can be driven at a time based on signal polarity.

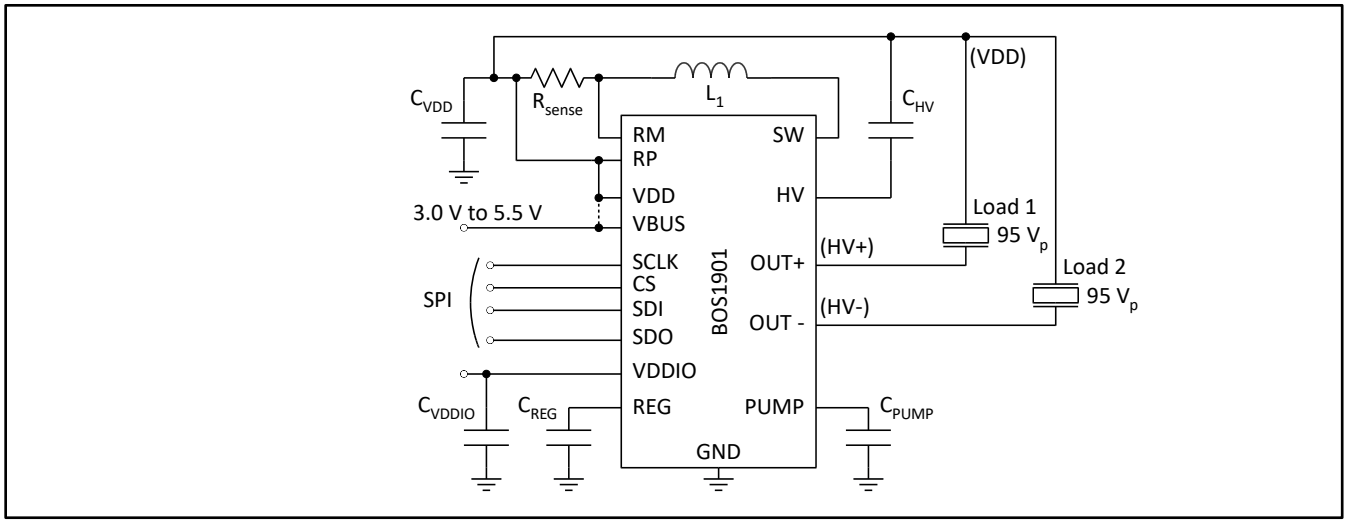


Figure 5: Two-terminal single-ended output configuration

4.5 Breakable Units

The use of the breakable units with custom-made firmware is done at the user's own risk of causing damage beyond repair to the BOS1901 circuit. Boréas Technologies will not be held responsible.

Each channel is on a breakable PCB unit that can be used alone with a user-preferred development platform. The available signals are:

- GND 0 V reference
- VDD Main power supply for the BOS1901 (from 3 V to 5 V)
- VIO Digital IO power supply (set to SPI signals voltage level, between 1.8 V and 5 V)
- MISO SPI Master In/Slave Out signal
- MOSI SPI Master Out/Slave In signal
- SCK SPI Clock signal
- CS SPI Chip Select signal (active low)

Refer to BOS1901 datasheet for a complete description on how to use and program the circuit.

5 Software

5.1 Software Installation Procedure

Please follow the Audacity® installation procedure. The software is free of use and can be found at: https://www.audacityteam.org/download/.

Refer to https://www.audacityteam.org/about/license/ for the terms of GNU General Public License (GPL) for Audacity® use.

5.2 Software Operation

The evaluation PCB appears as a speaker to the computer. The following operation example is made using Audacity® software, but the use of any other software is also possible. Make sure the USB audio firmware is installed on the evaluation PCB, refer to section 6.1 for firmware installation/update procedure.

1. Connect the evaluation PCB with the USB cable, wait for green LED to light up and for red LED to turn and stay off, after the firmware identification sequence (see section 6.1).
2. Start Audacity®, then select "File/Open…" to load "Audacity project - BOS1901-KIT.aup" file available for download on Boréas website.
3. Select the appropriate Audio Host (see Figure 6):
   - For Windows: select "Windows Direct Sound"
   - For MAC OS X: select "Audio Core"
   - Fox Linux: select "ALSA"
4. Select "Cypress Digital Audio" as the Playback Device (see Figure 6).
5. Press play button to start the default 100 Hz sine waveform, which will play for 5 seconds.

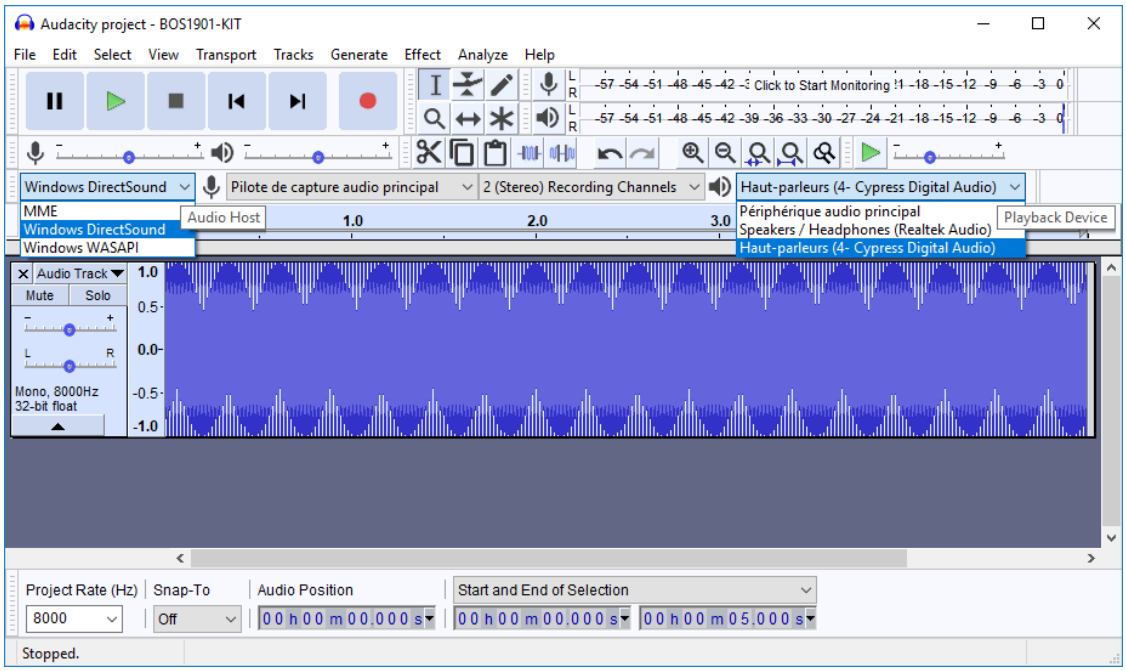


Figure 6: Audacity® software interface

6. The balance between channels A and B can be changed using the "L/R" dial in the "Audio Track" field, "L" corresponding to channel A, "R" to channel B. The gain can also be changed with "-/+" dial, but beware of positive gains that may cause output clipping.
7. To generate another kind of waveform, change its frequency or amplitude, go to the "Generate/Tone…" menu. For Square and Sawtooth, it is possible the software will calculate points based on an 8 kHz filter, therefore distorting the output waveform. To offset the waveform, an effect called "DC offset" may be applied, but it must be installed first. Instructions on how to install plugins are given on the Audacity® website.
8. Existing or generated .wav files can be played with Audacity®, loaded with the "File/Open…" dialog.
9. If starting a new project, make sure to use a Project Rate at 8 kHz (lower left corner field).
10. For other Audacity® features, please refer to the software help.

6 Firmware

6.1 Identifying the Firmware Revision Number

Since firmware revision 2.2, when powering up the development kit, both LEDs will show the firmware revision number and then the IC revision.

After the 10-second bootload window while both LEDs are on (see next section), the green and red LEDs flash to indicate the firmware revision number. For a firmware revision X.Y with major revision X and minor revision Y, the green LED will flash X times and then the red LED will flash Y times. This sequence is repeated for a beta revision.

Then both LEDs are lit a short while as some initialization is performed, and then ICs are identified. Green LED will flash to indicate channel A BOS1901 IC revision, and red LED will flash to indicate channel B BOS1901 IC revision. For each channel, the LEDs will flash 1, 2 or 3 times to indicate the IC for that channel is of revision A, B or C respectively.

6.2 Firmware Installation/Update Procedure

The BOS1901-KIT is provided out-of-the box with a firmware for use as an USB Audio device.

This firmware can be changed and/or updated using the USBBootloaderHost.exe application available on Boréas website. The procedure is the following:

1. Load the appropriate *.cyacd file using the "Load File" button.
2. Press and release the "RST" button on the evaluation PCB . When the "USB HID State" field reads "Connected", press on "Program" button. Note that the evaluation PCB will stay connected for only 10 seconds; the "Program" button must be pressed within that time. After this delay, red LED turns off, the firmware identification sequence occurs and then the evaluation PCB enters normal operation. If the "USB HID State" field does not read "Connected", press on "RST" button and try again.
3. Wait for installation/update to finish, the "Status Log" field will inform of a successful firmware installation.
4. Once the installation is complete, LEDs will go through the firmware identification sequence given in the previous section, and end with green LED on and red LED off. If red LED does not turn off, wait a couple of seconds then press and release "RST" again.

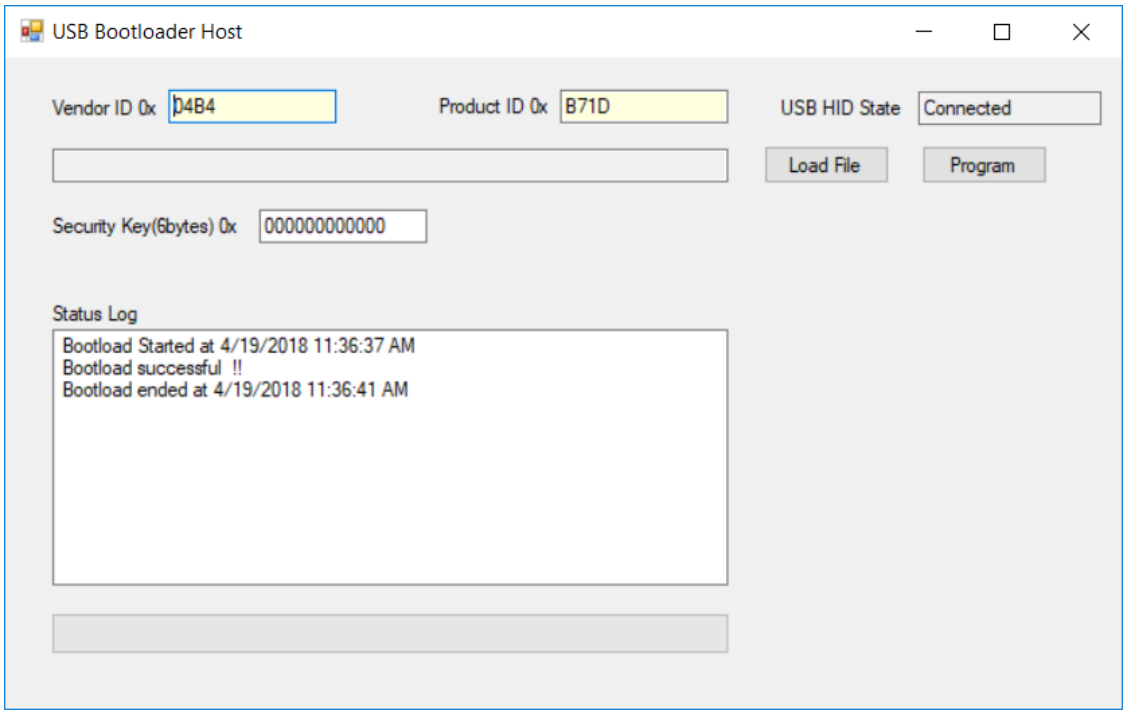


Figure 7: USBBootloaderHost.exe interface for firmware installation/update

6.3 Firmware Modification - Using PSoC® Creator™ [3]

Firmware modification by the user will not be supported by Boréas Technologies. It is done at the user's own risk of causing damage beyond repair to the BOS1901. This section only presents a starting point for any user who may want to modify the firmware. A careful read of the BOS1901 datasheet is strongly recommended before doing so.

The firmware source code is available for download on Boréas website. PSoC® Creator™ IDE is available for download at http://www.cypress.com/products/psoc-creator-integrated-design-environment-ide.

The procedure for first firmware compilation is:

1. Start PSoC® Creator™, then go to "File/Open/Project" and select the file "PSoCCreator.cywrk" (make sure to start with the latest project file).
2. In the "Workspace Explorer", right-click on "Project 'USBFS_Bootloader'" then choose "Build USBFS_Bootloader".
3. In the "Workspace Explorer", right-click on "Project 'BOS1901_Test'" then choose "Build BOS1901_Test".
4. The compiled firmware BOS1901_Test.cyacd will be in the folder:
   Project name\BOS9101_Test.cydsn\CortexM3\ARM_GCC_541\Debug\
5. Update the firmware using the procedure presented in section 6.2.

After any code modification, repeat steps 3 to 5 to test.

It is highly recommended to use a Cypress MiniProg3 (CY8KIT-002) when modifying the source code. This inexpensive kit allows to program the PSoC® microcontroller directly from PSoC® Creator™ through the SWD connector on the board. It also enables to enter debug mode and save valuable time in producing bug-free code.

Board resources can be used in modified code. DIP switch 8 is not used and can be programmed by the user. Other DIP switches, USR button, and LEDs can all be reprogrammed if the associated code is adjusted accordingly.

Unused PSoC® I/Os can be activated to expand user-specific application code; wires can be soldered on them if necessary. PSoC® internal components such as ADCs and EEPROM memory may also be used.

[3] PSoC® is a registered trademark of Cypress Semiconductor Corporation
PSoC® Creator™ is a trademark of Cypress Semiconductor Corporation

6.4 Adjusting Sensing Feedback Parameters via Firmware Modification

The BOS1901-KIT is provided out-of-the box with a firmware that allows sensing feedback to be experienced (see section 3.3). S3 DIP Switches SW4 to SW7 can be used to toggle the sensing feedback parameters between preset values (see section 4.3). Finer adjustment of the sensing feedback parameters is done by firmware modification or using the GUI available for download on our website, refer to section 7 for more details. The following sections explain how to change the settings of each DIP Switch state by modifying the firmware source code.

6.4.1 Sensing Feedback Amplitude

Do not put values higher than 1.0 for any of those variables or it will permanently damage the piezo. These variables only have an effect when in TDK mode (SW1 OFF).

1. In PSoC® Creator™, go to project "BOS1901_Test", then go to folder "Header Files" and open file "sensing_button_data.h".
2. Edit the #define variables values in section "Amplitude variables".
   - LOW_AMP_MULTIPLICATOR changes the high-low amplitude ratio.
   - HIGH_AMP_PRESS_FEEDBACK_TDK_CIRC changes the press feedback intensity.
     - When SW6 is ON, the feedback amplitude is set to HIGH_AMP_PRESS_FEEDBACK_TDK_CIRC.
     - When SW6 is OFF, the feedback amplitude is set to LOW_AMP_MULTIPLICATOR times HIGH_AMP_PRESS_FEEDBACK_TDK_CIRC.
   - HIGH_AMP_RELEASE_FEEDBACK_TDK_CIRC changes the release feedback intensity.
     - When SW6 is ON, the feedback amplitude is set to HIGH_AMP_RELEASE_FEEDBACK_TDK_CIRC.
     - When SW6 is OFF, the feedback amplitude is set to LOW_AMP_MULTIPLICATOR times HIGH_AMP_RELEASE_FEEDBACK_TDK_CIRC.
3. Save and build the project, and then upload the new firmware as explained in section 6.2 or using a MiniProg3.

6.4.2 Sensing Feedback Frequency

Do not put values higher than 300 for any of those variables or it will permanently damage the piezo.

1. In PSoC® Creator™, go to project "BOS1901_Test", then go to folder "Header Files" and open file "sensing_button_data.h".
2. Edit the #define variables values in section "Frequency variables".
   - SENSING_FEEDBACK_FREQ_DEFAULT_LOW changes the low feedback signal frequency (SW5 is OFF).
   - SENSING_FEEDBACK_FREQ_DEFAULT_HIGH changes the high feedback signal frequency (SW5 is ON).
3. Save and build the project, and then upload the new firmware as explained in section 6.2 or using a MiniProg3.

6.4.3 Sensing Threshold

These variables only have an effect when in TDK mode (SW1 OFF).

1. In PSoC® Creator™, go to project "BOS1901_Test", then go to folder "Header Files" and open file "sensing_button_data.h"
2. Edit the #define variables values in section "Threshold variables".
   - HS_TRESH_TDK_CIRC changes the high sensitivity threshold (SW7 is OFF).
   - LS_TRESH_TDK_CIRC changes the low sensitivity threshold (SW7 is ON).
3. Save and build the project, and then upload the new firmware as explained in section 6.2 or using a MiniProg3.

6.4.4 Response Type

1. In PSoC® Creator™, go to project "BOS1901_Test", then go to folder "Header Files" and open file "sensing_button_data.h"
2. Edit the #define variables values in section "Response type".
   - RESPONSE_TYPE_CLICK_PRD changes number of sine wave period on single click feedback (press-release feedback on both channels, low and medium pressure of multipress feedback on channel B).
   - RESPONSE_TYPE_LONG_PRD changes number of sine wave period on long feedback (high pressure of multipress feedback on channel B).
3. Save and build the project, and then upload the new firmware as explained in section 6.2 or using a MiniProg3.

Note: Since firmware v2.3, the “USR” button is used to return all parameters programmed using BOS1901-KIT Controller GUI software to their default value.

7 BOS1901-KIT Controller (GUI)

BOS1901-KIT Controller is a graphical user interface intended to ease evaluation of the BOS1901 IC using BOS1901-KIT development kit. Using this application, all functionalities specific to the BOS1901 IC and BOS1901-KIT are configurable, giving the user direct control over the behaviour of the driven piezoelectric actuator, without the need to modify the firmware source code. It is intended as a first step in evaluating the BOS1901 IC, before getting into system-specific SPI interfacing.

The GUI installer is available for download on Boréas website. Any advices on the installation procedure and on how to use it will be found in the BOS1901-KIT Controller (GUI) – User Guide also provided on the website.

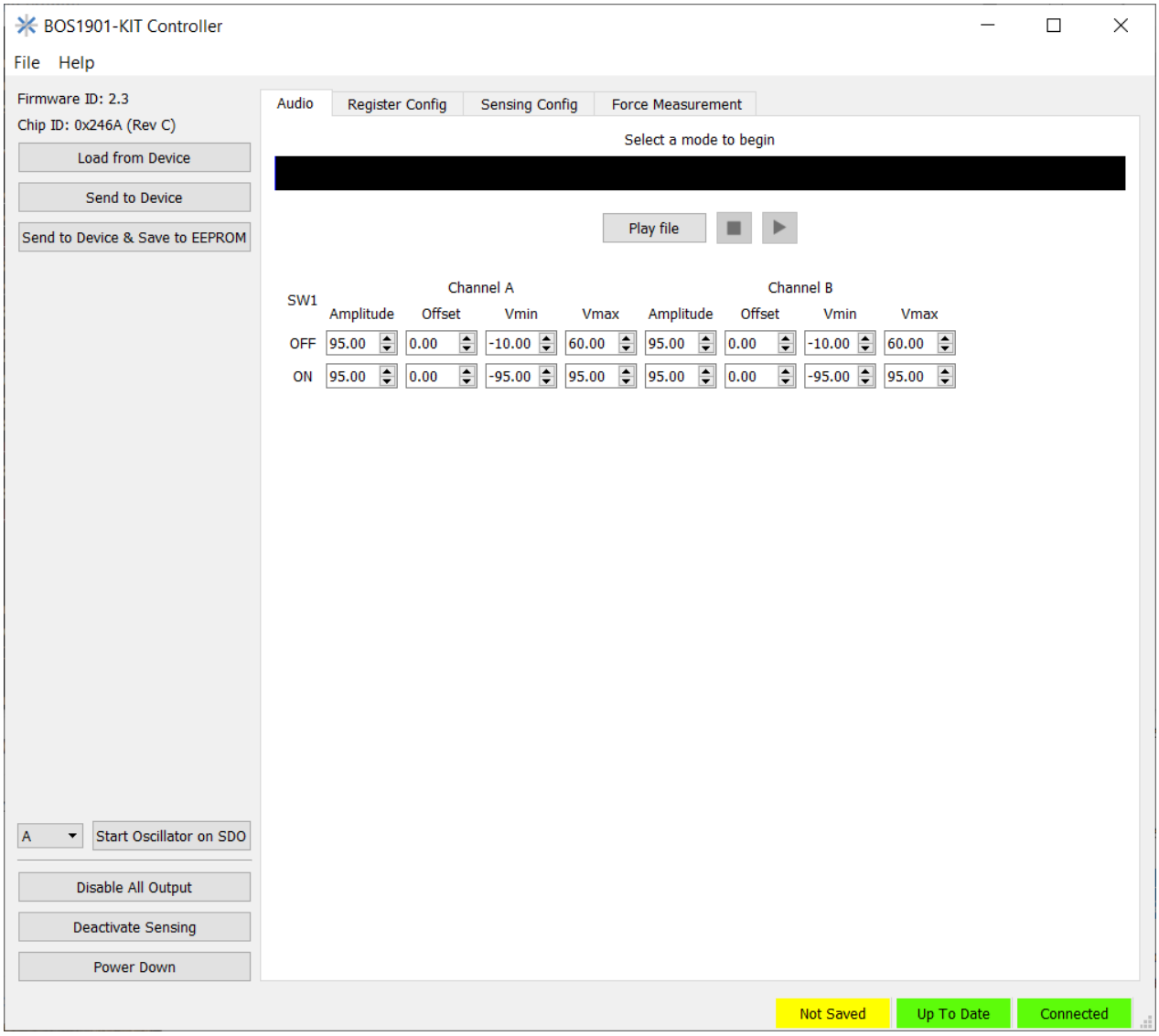


Figure 8: BOS1901-KIT Controller GUI – Main Window

8 Design Reference

8.1 Schematics

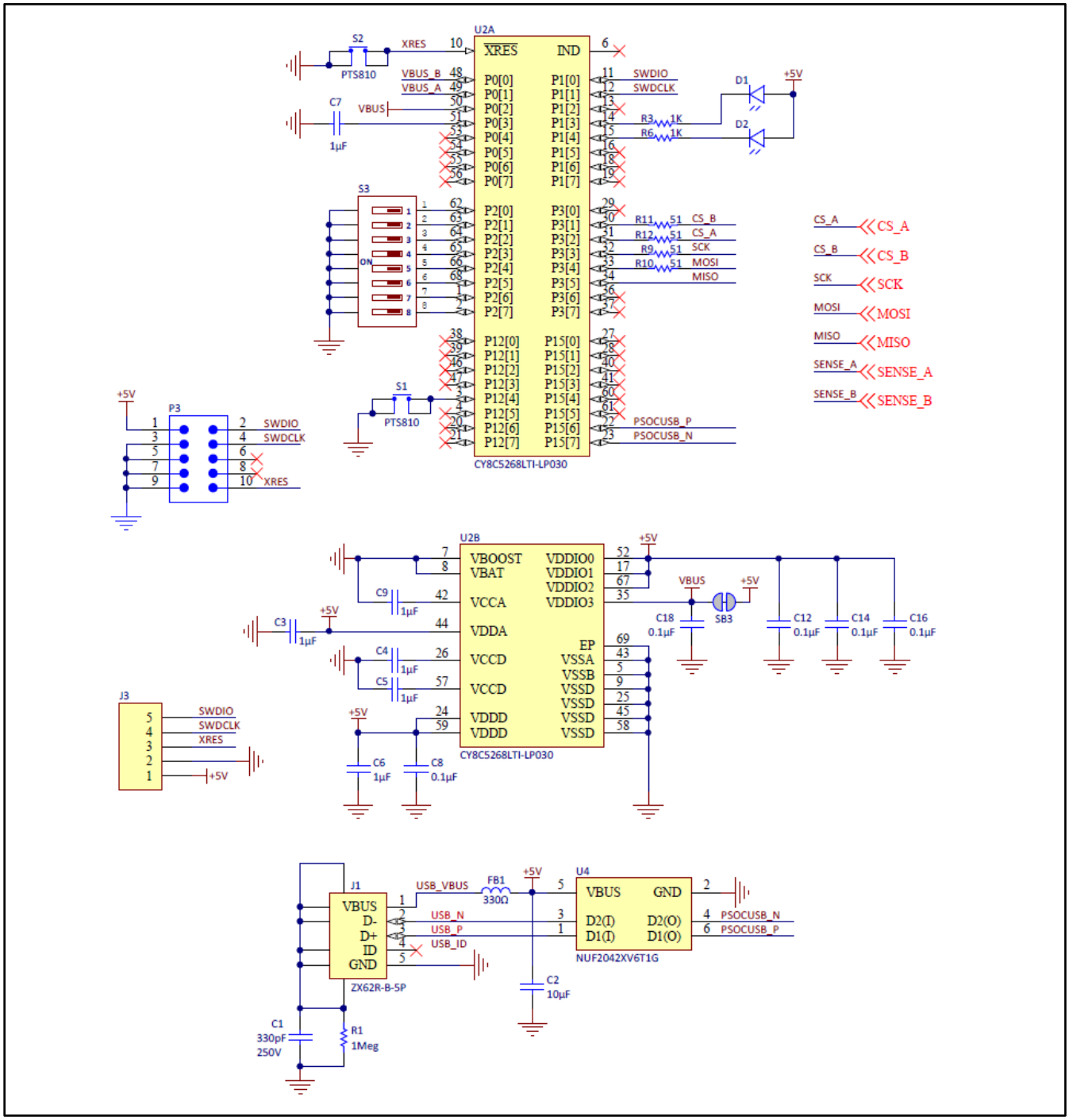


Figure 9: Schematic part 1 - USB and microcontroller

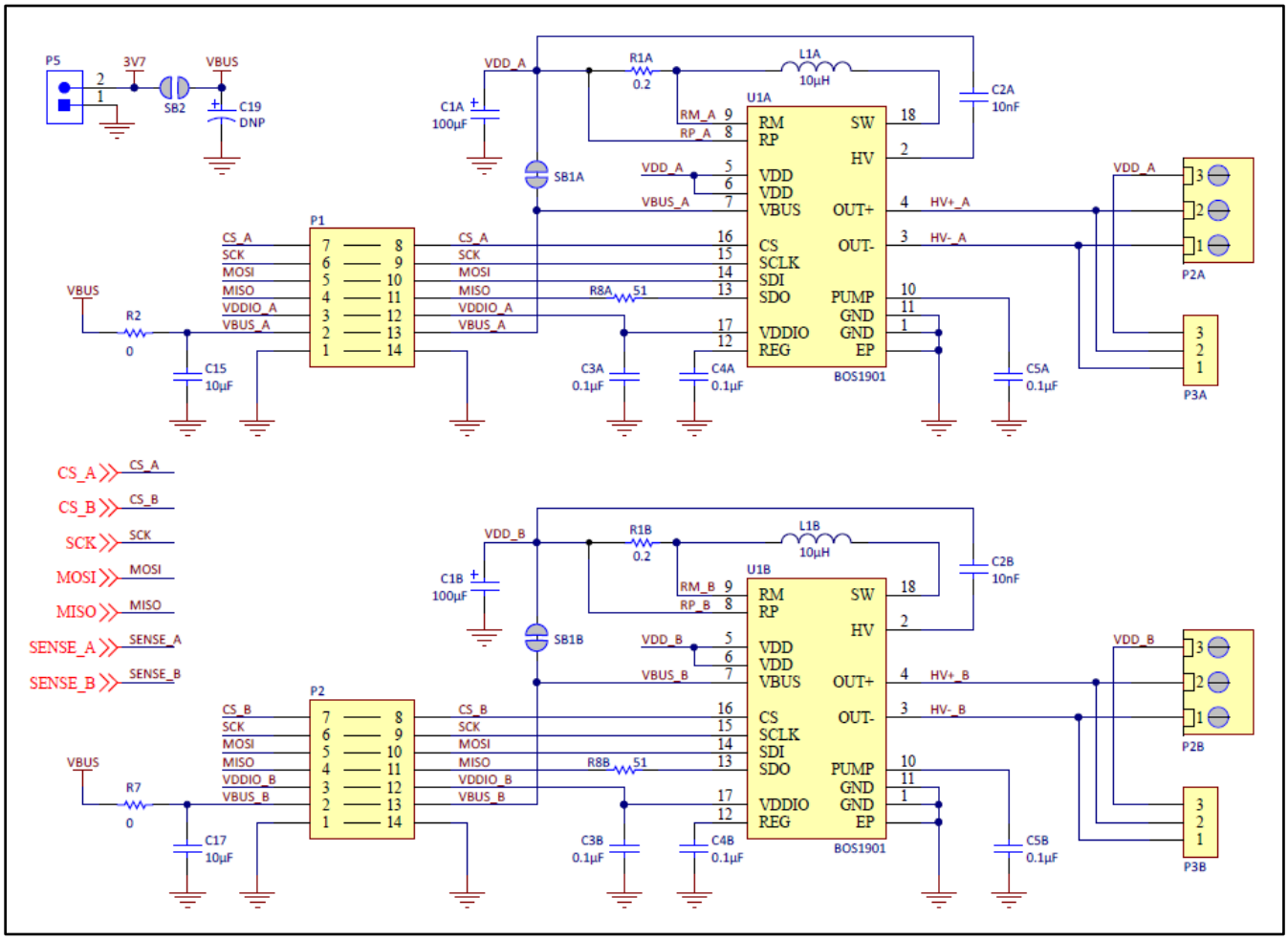


Figure 10: Schematic part 2 - BOS1901

8.2 PCB Layout

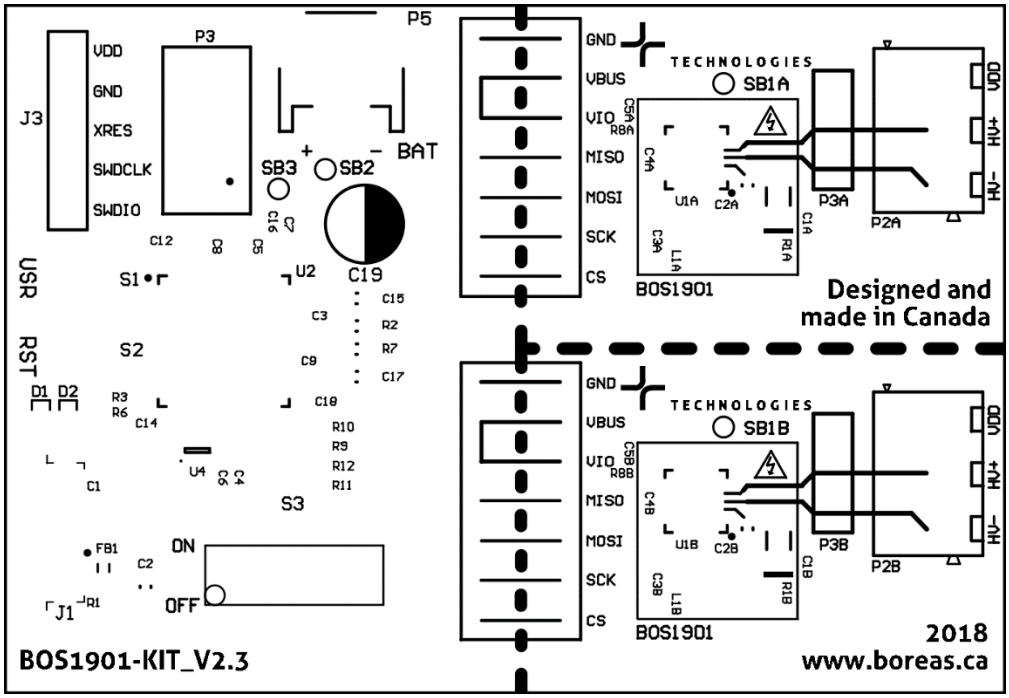


Figure 11: Layout view - Top Overlay (not to scale)

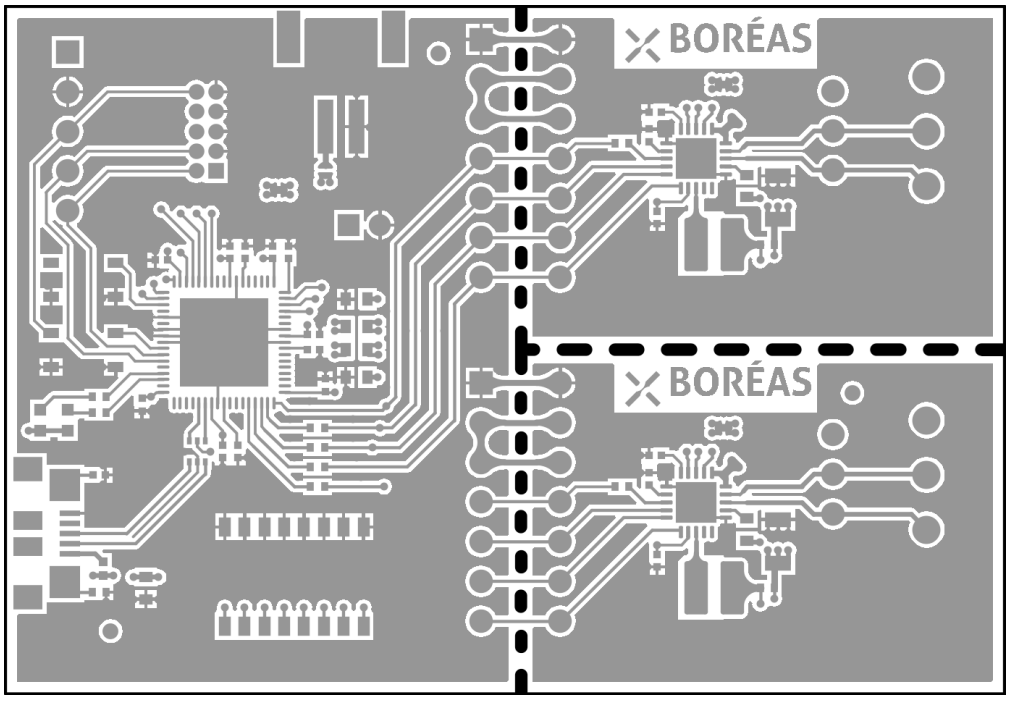


Figure 12: Layout view - Top Layer (not to scale)

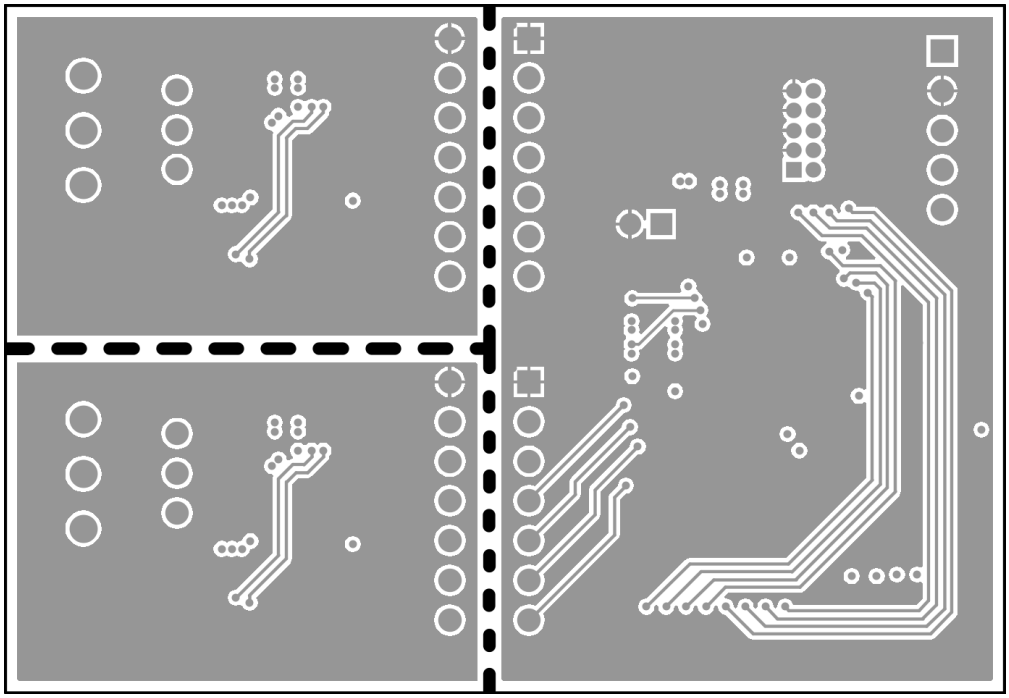


Figure 13: Layout view - Bottom Layer (mirrored, not to scale)

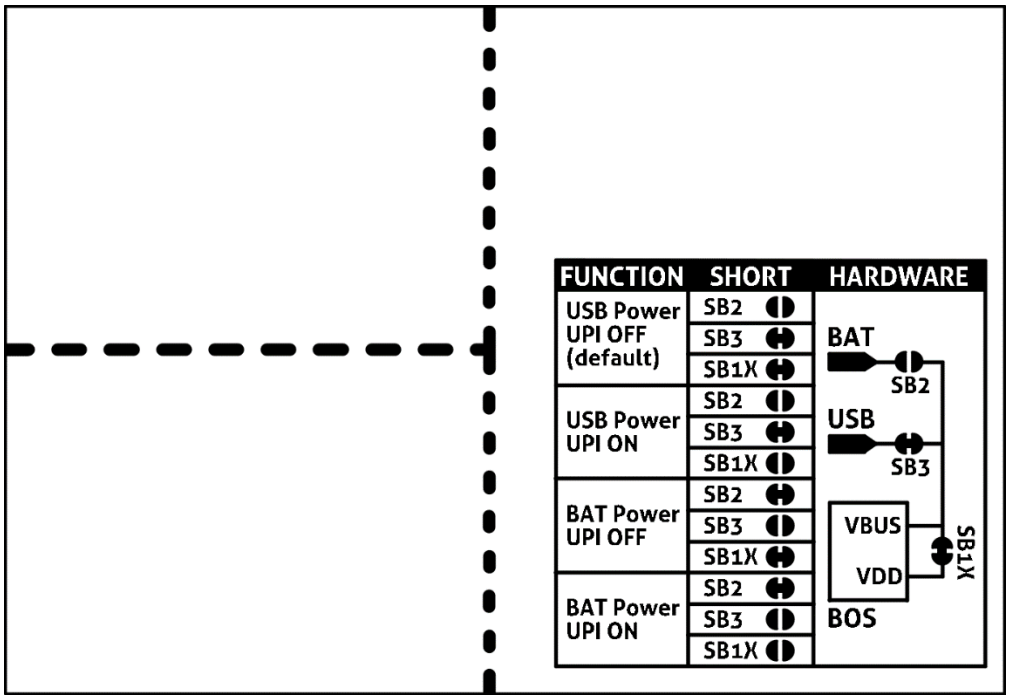


Figure 14: Layout view - Bottom Overlay (mirrored, not to scale)

8.3 Bill of Materials

The following is a list of the components that populate the evaluation PCB. Due to availability, some components with equivalent performance/characteristics may be installed on the actual evaluation PCB. If the exact part number is not available, the components can be replaced by ones with equivalent package and specifications.

Table 6: Bill of Materials

DESIGNATOR	QTY	VALUE	DESCRIPTION	MANUFACTURER	PART NUMBER
C1	1	330 pF	CAP CER 330PF 250V C0G/NP0 0402	KEMET	C0402C331JAGACAUTO
C1A, C1B	2	100 µF	CAP TANT POLY 100UF 6.3V 1206	Vishay / Polytech	T55A107M6R3C0045
C2, C15, C17	3	10 µF	CAP CER 10UF 10V X5R 0603	Taiyo Yuden	LMK107BJ106MALTD
C2A, C2B	2	10 nF	CAP CER 10000PF 200V X7R 0603	KEMET	C0603X103K2RECAUTO
C3, C4, C5, C6, C7, C9	6	1 µF	CAP CER 1UF 10V X6S 0402	TDK	CGB2A1X6S1A105M033BC
C3A, C3B, C4A, C4B, C5A, C5B, C8, C12, C14, C16, C18	11	0.1 µF	CAP CER 0.1UF 25V X5R 0402	Samsung Electro-Mechanics	CL05A104KA5NNNC
C19*	1	33 µF	CAP ALUM 33UF 20% 10V RADIAL	Nichicon	UMA1A330MDD
D1	1	-	LED YLW/GREEN DIFFUSED 1608 SMD	ROHM	SML-D12M1WT86
D2	1	-	LED RED DIFFUSED 1608 SMD	ROHM	SML-D12U1WT86
FB1	1	-	FERRITE BEAD 330 OHM 0402 1LN	Murata Electronics	BLM15PX331SN1D
J1	1	-	CONN RCPT USB MICRO B SMD R/A	Hirose Connector	ZX62R-B-5P(30)
J3	1	-	CONN HEADER .100" SNGL STR 5POS	Sullins	PRPC005SAAN-RC
L1A, L1B	2	10 µH	FIXED IND 10UH 1.2A 322 MOHM SMD	Wurth Electronics	74438336100
P2A, P2B	2	-	TERMINAL BLOCK 3.5MM 3POS PCB	On Shore Technology Inc.	OSTTE030104
P3A, P3B	2	-	CONN HEADER FEMALE 3POS .1" GOLD	Sullins	PPPC031LFBN-RC
P3*	1	-	CONN HEADER 10POS DUAL .05" T/H	Samtec Inc.	FTSH-105-01-L-D-K
P5	1	-	CONN HEADER PH SIDE 2POS 2MM SMD	JST Sales America Inc.	S2B-PH-SM4-TB(LF)(SN)
R1	1	1 MΩ	RES SMD 1M OHM 1% 1/16W 0402	Yageo	RC0402FR-071ML
R1A, R1B	2	0.2 Ω	RES 0.2 OHM 1% 1/8W 0402	TE Connectivity	RLP73N1ER20FTDF
R2, R7	2	0 Ω	RES SMD 0 OHM JUMPER 1/10W 0603	Panasonic	ERJ-3GEY0R00V
R3, R6	2	1 kΩ	RES SMD 1K OHM 1% 1/16W 0402	Yageo	RT0402FRE071KL
R8A, R8B, R9, R10, R11, R12	6	51 Ω	RES SMD 51 OHM 1% 1/10W 0402	Panasonic Industrial Devices	ERJ-2RKF51R0X
S1, S2	2	-	SWITCH TACTILE SPST-NO 0.05A 16V	C&K	PTS810SJM250SMTRLFS
S3	1	-	SWITCH SLIDE 8 DIP SPST 25MA 24V	Grayhill Inc.	97C08SRT
U1A, U1B	2	-	Piezo Haptic Driver	Boréas Technologies	BOS1901-4
U2	1	-	IC MCU 32BIT 256KB FLASH 68QFN	Cypress Semiconductor	CY8C5268LTI-LP030
U4	1	-	FILTER RC(PI) 22 OHM/42PF SMD	ON Semiconductor	NUF2042XV6T1G

* These components are not populated on the PCB, the proposed part numbers are for reference only.

9 FAQ and Troubleshooting

Please refer to Boréas website for FAQ and Troubleshooting information, which will be maintained throughout the BOS1901-KIT lifecycle. It will also contain application note documents that will be helpful for the user writing his/her own code to operate the BOS1901.

10 Notice and Warning

Danger High Voltage!

Electric shock possible when connecting board to live wire. Board should be handled with care by a professional. For safety, use of isolated test equipment with overvoltage and/or overcurrent protection is highly recommended.

This product uses semiconductors that can be damaged by electrostatic discharge (ESD). When handling, care must be taken so that the devices are not damaged. Damage due to inappropriate handling is not covered by the warranty.

The following precautions must be taken:

- Do not open the protective conductive packaging until you have read the following and are at an approved anti-static workstation.
- Use a conductive wrist strap attached to a good earth ground.
- If working on a prototyping board, use a soldering iron or station that is marked as ESD-safe.
- Always disconnect the microcontroller from the prototyping board when it is being worked on.
- Always discharge yourself by touching a grounded bare metal surface or approved anti-static mat before picking up an ESD - sensitive electronic component.
- Use an approved anti-static mat to cover your work surface.

Oscilloscope measurements:

Both HV+ and HV- are active outputs. When measuring these signals using an oscilloscope, use a separate probe on each output. Never connect the ground of a probe to one of these outputs. Doing so might damage the BOS1901-KIT and/or your oscilloscope. For more information, please consult the *Probing BOS1901 with an Oscilloscope* application note available for download on Boréas website.

11 Ordering Information

Table 7: Ordering information

	ORDERABLE DEVICE	PACKAGE	PACKING FORMAT	STANDARD QUANTITY	ACTUATORS	ROHS COMPLIANT
1	BOS1901-KIT-A (Premium Set)	PCB 64x48mm (35x24)	Box (6x6x1)"	1/box 2 Channels 4 Actuators	TDK PowerHap™ 1204 Lateral TDK PowerHap™ 0904 Lateral TDK PowerHap™ 0909 Square Bimitech PUA3020-5H200	Yes
2	BOS1901-KIT-B (Starter Set)	PCB 64x48mm (35x24)	Box (4x2x1)"	1/box 2 Channels 1 Actuator	TDK PowerHap™ 1204 Lateral	Yes

12 Document History

ISSUE	DATE	Document Number	CHANGES
5	January 2021	BT001DDK01.01	Premium Set BOS1901-KIT-A content updated. Updated Terms and Conditions.
4	September 2019	BOS1901CDK01.03	Updated BOS1901-KIT Starter Set contents. Oscilloscope measurement warning.

