Tactronik™ Evaluation Kit

User Manual

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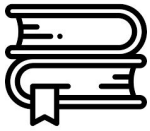
1. Introduction

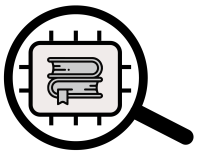
Welcome to the world of HD haptics. The evaluation board will allow you to explore, create and test new ways of interaction by using haptic stimulation effects. Actronika continues to develop an entire value chain in order to deliver the highest-end haptics to our clients.

What are the key ingredients of HD haptics?



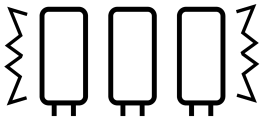
HD Haptic Effects Library

Our library is based on over 30 years of research in the haptic domaine, including fields like vibrotactile feedback, neuroscience and tribology (the study of interacting surfaces). It gives full access to an exclusive collection of HD haptic effects that are all available on the Tactronik™ module. It can easily be upgraded with a new effect based on your project's needs.



Electronic Driver

The electronic driver is easy to integrate and delivers a reliable performance. It can control up to 200 actuators independently. The 32-bit ARM Cortex™ M4f CPU on board along with UART, SPI, PDM and I^2C communication protocols provide more than enough computing power and integration flexibility in an extremely small package.

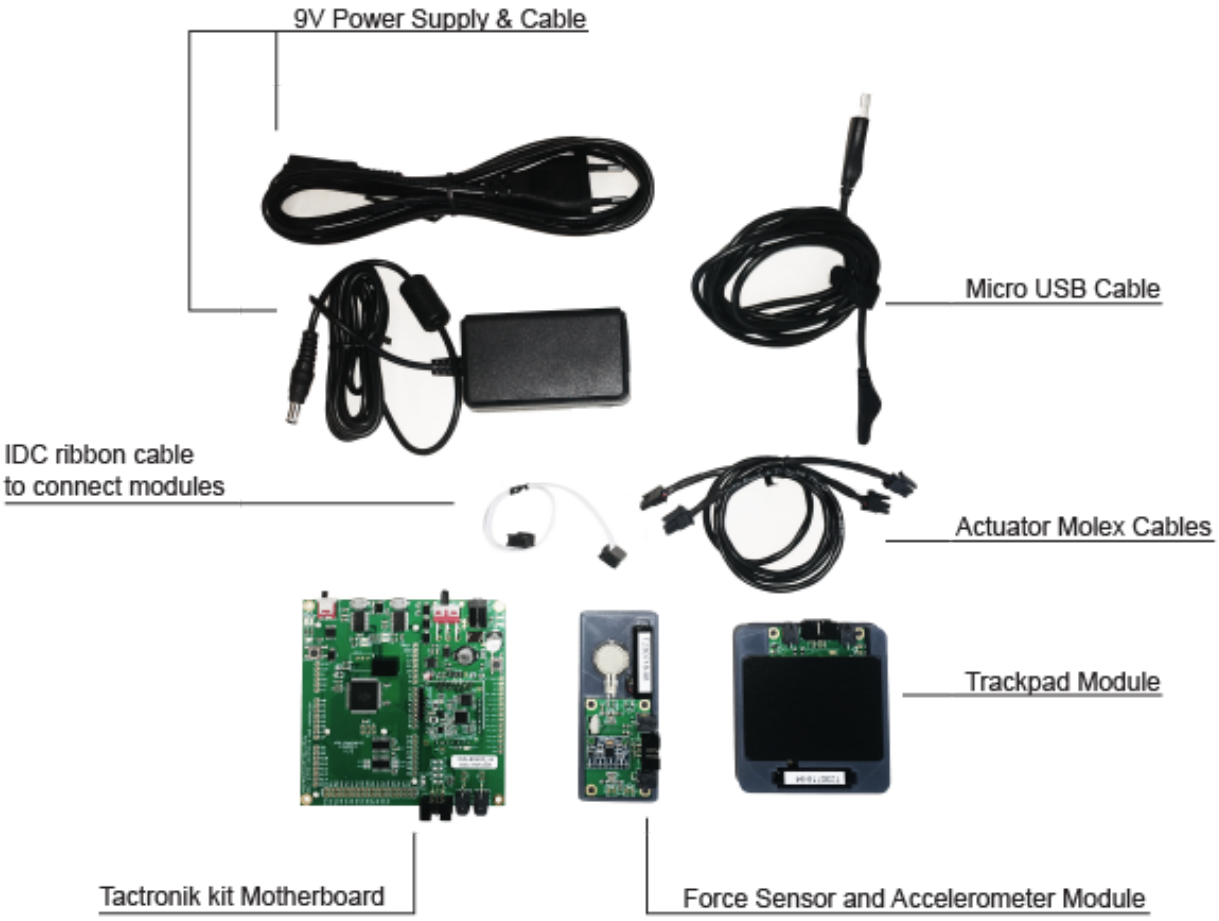


Actuators

This actuator has been specifically designed for haptic effects. Its most important parameter is its large bandwidth, allowing you to produce highly complex effects. It has been optimized and packaged in a small volume which provides the best volume-to-power ratio delivered on the market.

2. Inside the Box

What will you find inside the Evaluation kit box ?



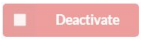
3. Quick Start (Evaluation Mode)

Once you have opened the box, simply follow these steps (detailed instructions to follow):

1. Download our Tactronik™ desktop application file (version 0.18.0) from: http://dev.actronika.com/resources.html.
2. Install the application on your PC (Windows or Linux OS).
3. Connect the Evaluation kit motherboard to your PC using a USB cable.
4. Connect the power supply (DC 12V) to the motherboard.
5. Launch the application.
6. Choose a serial communication port from the header of the application. (See image below.)

7. Choose a haptic effect to be activated.
8. Choose a preset.
9. Connect a corresponding sensor module that works with the selected effect.
10. Click the Activate button  and play with it!

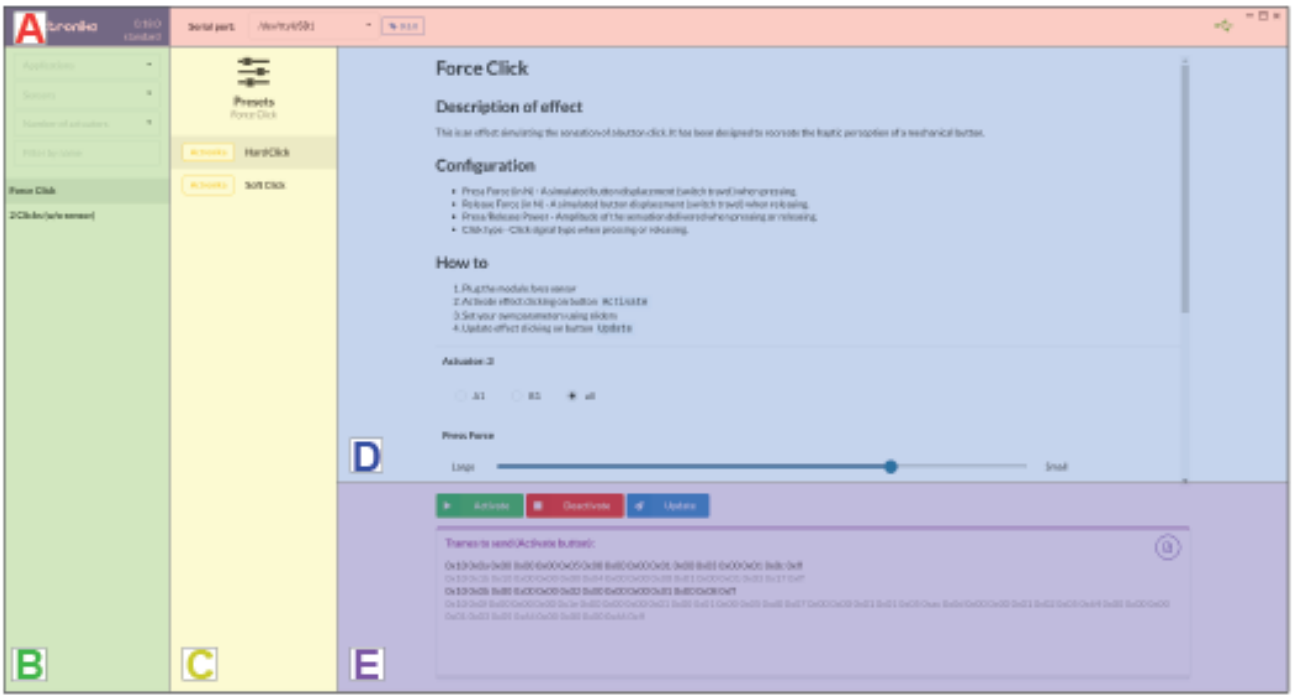
Tips !

- You can deactivate the effect at any time by pressing the Deactivate button  .
- At any time you can modify the effect by changing parameters and clicking the Update button  .
- To make sure that the USB communication has been established properly, verify that the USB icon in the upper right corner is **green**. 

4. Application Interface

4.1. Application Interface: Section Guide

Download our Tactronik™ desktop application file (version 0.18.0) from: http://dev.actronika.com/resources.html.
Once installed and launched, it will appear on your screen *as shown below*. This section of the user manual will explain to you how to use it and what features it provides.



4.1.1. Application Interface: Section Explanations

A. Header

a. **Serial port** - the name of the serial port connected to the evaluation board.
b. **USB connection icon** - an indicator of a connection state between the evaluation board and a PC; connected (**green**) / disconnected (**red**)

B. Library Column

a. **Filters** - a set of words which allow you to find the best matching effects. Filter selection criteria:
   i. **Application**
   ii. **Sensors**
   iii. **Number of actuators**
   iv. **Filter by name**

b. **Library of Effects** - a list of available effects on the Tactronik™ platform

C. **Presets Column** - a suggested combination of parameters. Each preset has one of two possible tags:

i. **“Actronika” tag** - when a preset was set by us

ii. **“User” tag** - when a preset is saved by the client

D. **Effect Zone**

a. **Effect description**

b. **Configuration**

c. **Parameters** - a set of parameters available to control the specific haptic effects. These parameters change depending on the chosen effect.

Tips !

- Every time you change a default or preset parameter, you must click the Upload button to be able to experience it.

E. **API Zone**

a. **Activate button** - activates communication between the Tactronik™ module and the end module.

b. **Deactivate button** - deactivates communication between the Tactronik™ module and the end module.

c. **Update button** - updates parameters of the current activated effect.

d. **API frame generator**

e. **API documentation button** - when pressed, this provides easy access to the API documentation.

Tips !

- When you move the mouse cursor over the specific line in the API frame generator, a comment will appear to indicate what information it provides to the Tactronik™ module.

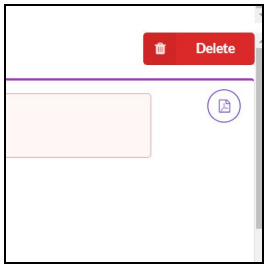
4.2. How To: Save or delete a haptic effect with a new user preset

The application will automatically suggest to save a new set of parameters under a new name every time a parameter of an already existing preset is modified. This way, once you tune the effect the way you like, it will not get lost. All you have to do is click on the icon and give it a name (*See left image below*).

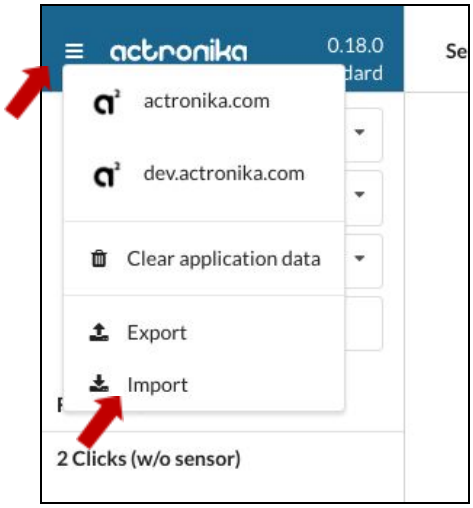
Whenever you want to delete a user-defined effect, just click the delete button in the API application interface zone (*See right image below*).

Name :

Delete :



4.3. How To: Import an effect database



You can import a database by clicking on the ***Menu*** button, then on ***Import***.

Tips !

- Be careful while importing new databases - if you don't wish for your current database to be erased to import a new database, see instruction 4.3.1. to learn about merging imported databases.

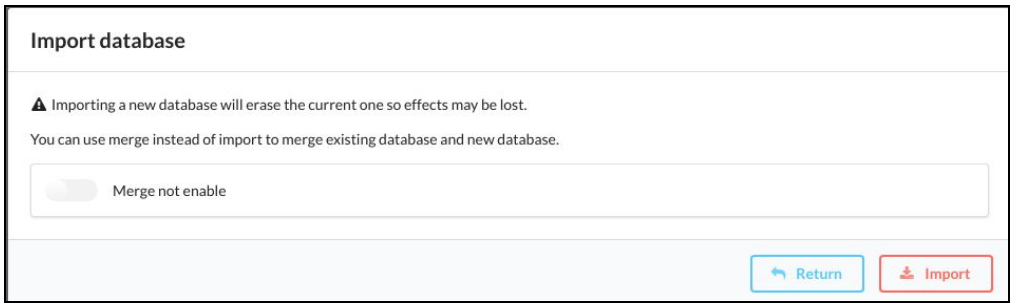
4.3.1. How To: Merge an imported effect database

There is also the option to import a new database without deleting the loaded database. This option will conserve the existing loaded database, and simply add the additional effects of the new database.

For example:

You have an old database with 2 effects (click and scroll), and 2 effects on a new database (click and heartbeat). When you use this option, you will now have a new database with 3 effects: click, scroll, and heartbeat.

To merge 2 databases, click on the ***Menu*** button, then on ***Import***.

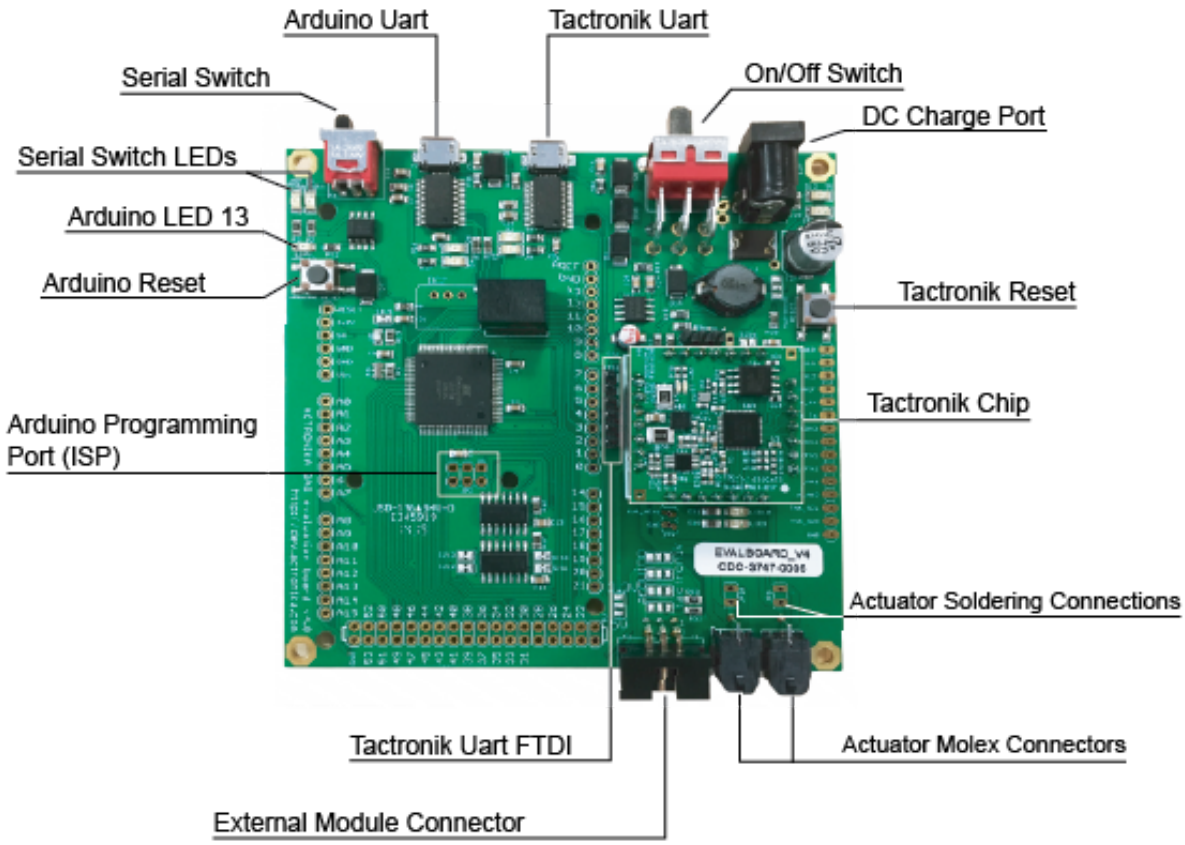


When you select ***Import***, you will see slider that toggles between ***Merge Enabled/Merge Not Enabled***. Select according to your needs.

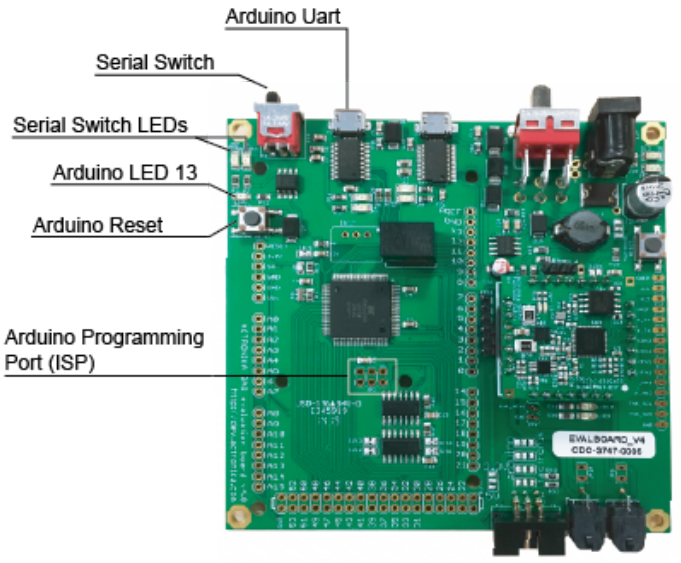
To finish the procedure, click again on ***Import*** or ***Merge***.

5. Evaluation Board

5.1. View of Tactronik™ Board



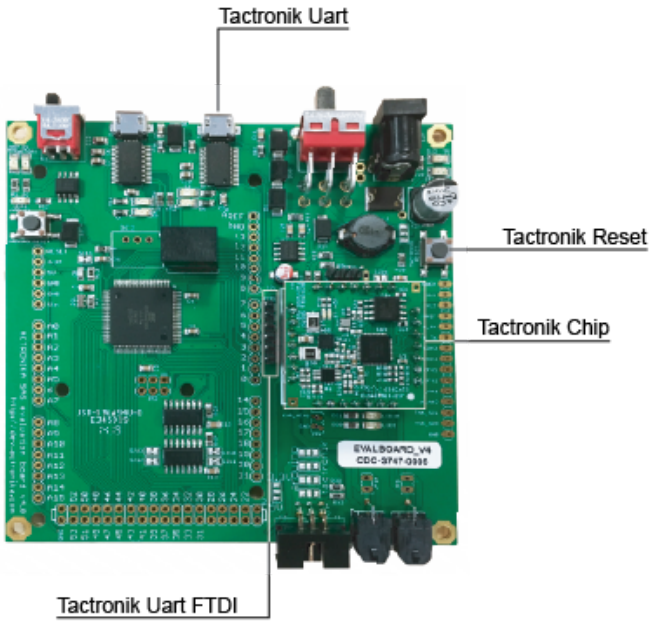
5.1.1. Arduino Section



The ISP Port can of the Arduino mega can be used to flash Arduino mega with the programmer.

Be careful: If you use this port to flash Arduino mega, you will erase the bootloader.

5.1.2. Tactronik™ Section



The Tactronik Uart FTDI is to be used with the serial switch in the middle position (see section 5.2.1.).

5.2. Configuration

5.2.1. Serial Switch

To configure the Evaluation Board according to your desired use case, there are three corresponding positions of the serial switch:

1. **Evaluation Board**

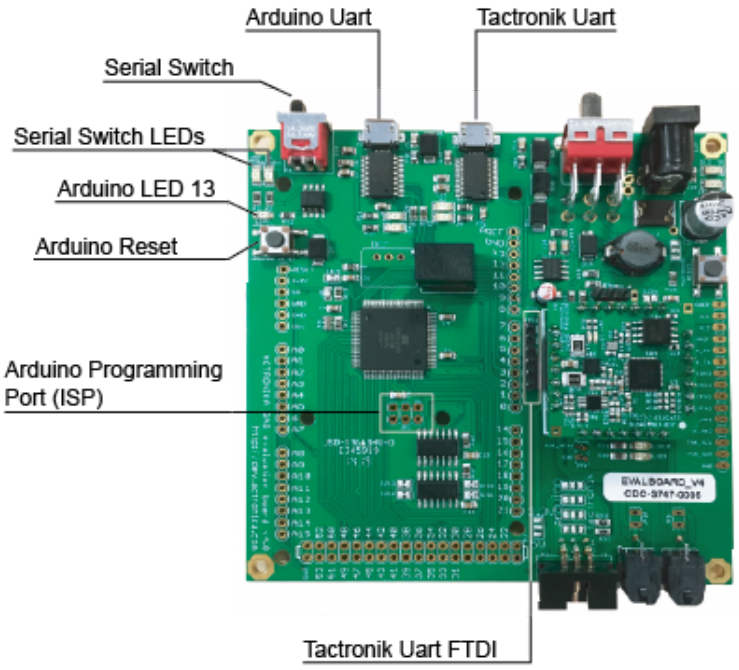
Use the integrated Arduino Mega flash with proxy and the Tactronik™ Application Interface demo kit.
LEFT Serial Switch position - Connect Tactronik™ to Arduino, (via the LEFT USB port).

2. **Development Board**

Use the integrated Arduino and Arduino Shield (display and keypad, or touchscreen).
RIGHT Serial Switch position - Connect Tactronik™ to the PC, (connected to FTDI via the RIGHT USB port) and have direct access. In this mode, you can connect directly by using the FTDI pins.

3. **Demo Board** (*Advanced option*)

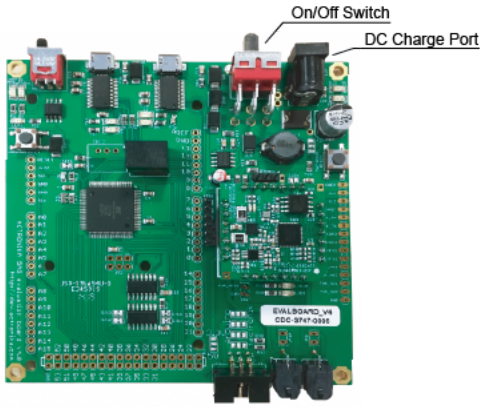
Use the integrated Arduino Mega, connected to Tactronik™.
MIDDLE Serial Switch position - without using the micro USB port, connect to FTDI pins for direct access.



Tips !

- The two Serial Switch LEDs indicate which of the three modes is enabled.
  - If LED **'ARD'** (left) is on, Tactronik™ Is connected to Arduino via the left USB port.
  - If LED **'PC'** (right) is on, Tactronik™ Is connected to the FTDI via the right USB port, which connects Tactronik™ directly to the PC.
  - If all LEDs are off, Tactronik™ Is disconnected.

5.3. Power Supply

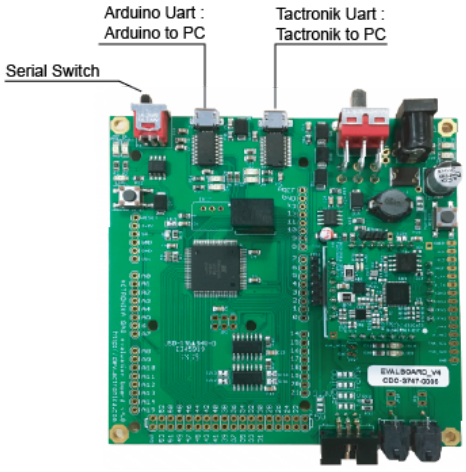


To power the board, connect the 12V power supply plug to the 2.1mm connector.

The large switch on the right-hand side of the motherboard is the On/Off power switch.

5.4. Connection

5.4.1. Micro USB Connections

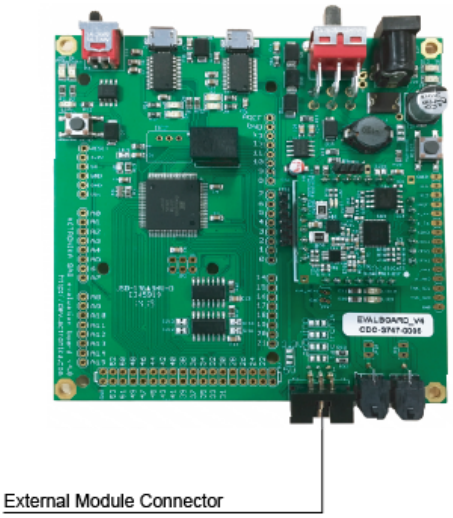


There are two micro USB connections:

- The connector on the **left** is to connect Arduino mega to the PC, using the serial switch in the **left** position.

- The connector on the **right** is to connect Tactronik™ to the PC, using the serial switch in the **right** position.

5.4.2. External Sensor Modules



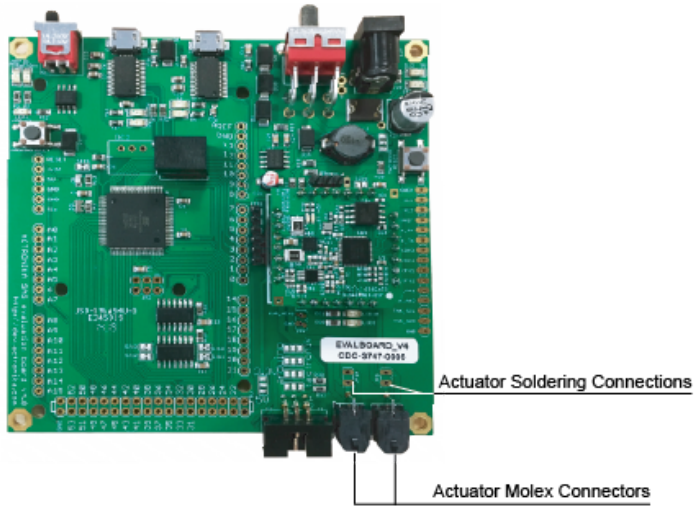
This is the plug to connect the external sensor modules.

You can connect Actronika's provided external modules, or your own - the use is flexible. You can use this connector to connect to your own sensor if you set your program on Arduino.

This connector has :

- 2 ADC
- 1^2C
- Power Supply (GND and 3.3V)

5.4.3. Actuators

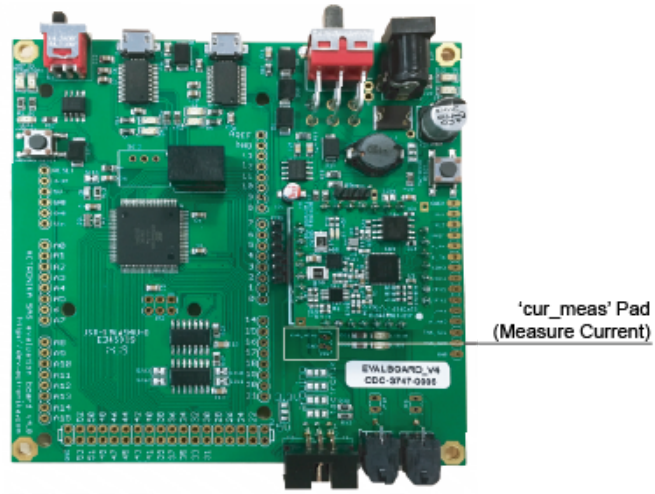


To connect the actuators to the Evaluation Kit, you can use:

1. Molex connectors
2. Soldering connections. If you choose to solder, insert the cables in from the front of the board and complete the soldering on the back of the board.

5.5. Debugging

5.5.1. Measure Current

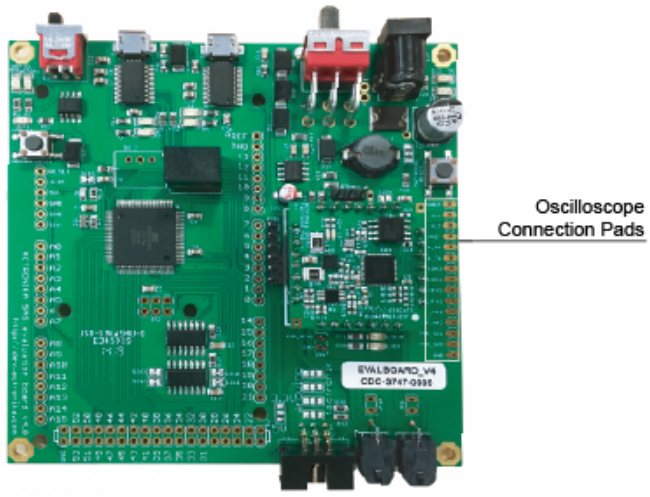


You can measure the consumption of the actuators.

To do this, measure the voltage of the 'cur_meas' Pad and use the following formula:

$$I = V_{out} / 2$$

5.5.2. Signal Debugging



These pads allow the user to connect the oscilloscope to many signals. These signals are Tactronik™ signals only.

5.6. Studied Enough? Go Ahead and Start.

5.6.1. Connect Tactronik™ to PC with/without Sensor Module

To connect **WITHOUT** a sensor module:

1. Set serial switch mode to connect the Tactronik™ to the PC (Right position).
2. Connect the Tactronik™ to the PC using the right micro USB connection.
3. Use the desktop Application Interface (version 0.18.0) that you have downloaded from http://dev.actronika.com/resources.html.
4. Launch the effect without the sensor module.

To connect **WITH** a sensor module:

1. Set serial switch mode to connect Arduino to PC (Left position).
2. Connect the Arduino to the PC using the left micro USB connection.
3. Flash *proxy* application on Arduino.
4. Launch the desktop Application Interface (version 0.18.0).
5. Connect your chosen sensor module to the Evaluation kit.
6. Load and play the effects. To do this, use the desktop Application Interface.

5.6.2. Connect Using your Own Application

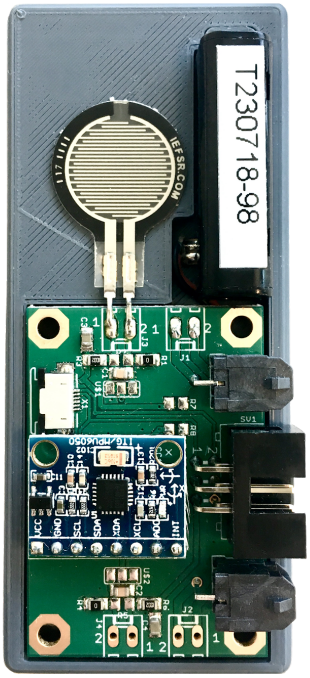
1. Set serial switch mode to connect Arduino to PC (Left position).
2. Connect the Arduino to the PC using the left micro USB connection.
3. Flash your own application on Arduino.
4. Connect your chosen sensor module to the Evaluation kit.
5. Use Arduino to control the TactronikTM. To do this, use our APIs and read some Arduino examples on our GitHub.

Have fun!

6. External Sensor Modules

In the Evaluation mode, three modules are provided so that you can discover and understand the haptic effects that are associated with our sensors: A Force Sensor module and a Trackpad module. They are to be connected to the motherboard via the module connector (detailed in section 5.4.2.).

6.1. Force Sensor Module



Composition

The Force Sensor module consists of:

- Frame
- One actuator
- Connectors (2 Molex, 1 IDC)
- Control Card
- Force Sensor

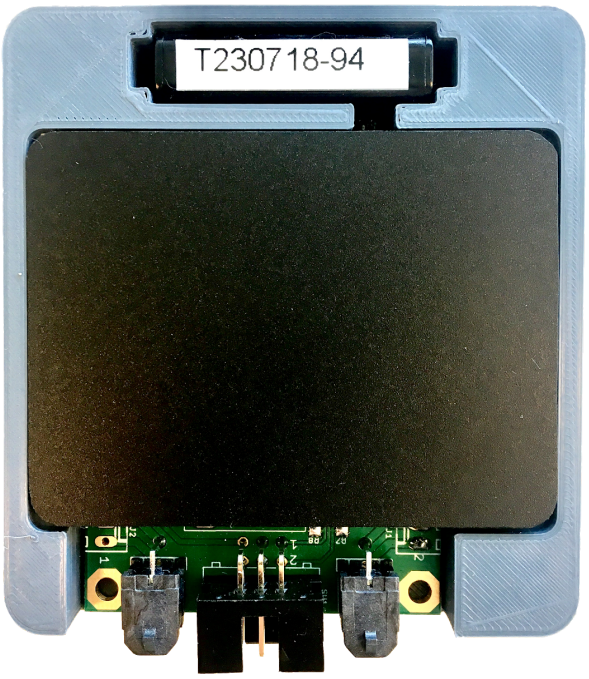
The module must be connected to the motherboard with IDC ribbon cable and two Molex Cables.

Use

Once you implement the desired effect through Actronika's software application, the module can be used.

- **Force Click**: Hold the module so that your thumb is on top of the force sensor (circular section). Press down in order to feel the effect.
- **Double Force Click**: Same procedure as Force Click. When you feel the first click, apply more force to feel a second click effect. When you release the pressure, you will feel again the two clicks release.

6.2. Trackpad Module



Composition

The Trackpad module consists of:

- Frame
- One actuator
- Connectors (2 Molex, 1 IDC)
- Control Card
- Touch surface

The module must be connected to the motherboard with IDC ribbon cable and two Molex Cables.

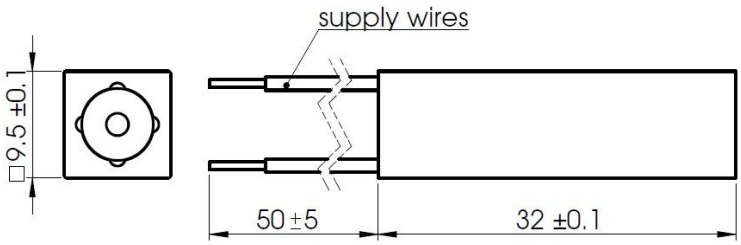
Use

Once you implement the desired effect through Actronika's software application, the module can be used.

- **Generic Texture (X-axis)**: Slide your finger from left to right and vice versa to feel the effect.
- **Scroll (Y-axis):** Slide your finger from top to bottom and vice versa to feel the effect.

7. Actuator Characteristics

7.1. Technical Characteristics & Figures



Performance Characteristics	
Resonant Frequency	65 Hz (±10%)
Bandwidth	10 Hz to 7 kHz[1]
Acceleration peak-to-peak[2]	4 g
Consumption RMS[2]	40 mA

Actuator Characteristics	
Dimensions	9.5 x 9.5 x 32 ± 0,1 mm
Total Mass	8,2 ± 0,1 gr
Moving Mass	4,5 ± 0,1 gr
Resistance	4,7 Ω
Inductance	120 µH
Thermal Resistance	30,7 °C/W
Max. Instant Power	5 W
Max. Continuous Power	2 W
Max. Operating voltage	12 Vpp

[1] 98% of the haptic bandwidth and most of the audio bandwidth

[2] At the resonant frequency, a test load of 100 g and an operating voltage RMS of 0,71 V

7.2. Performance Graphs

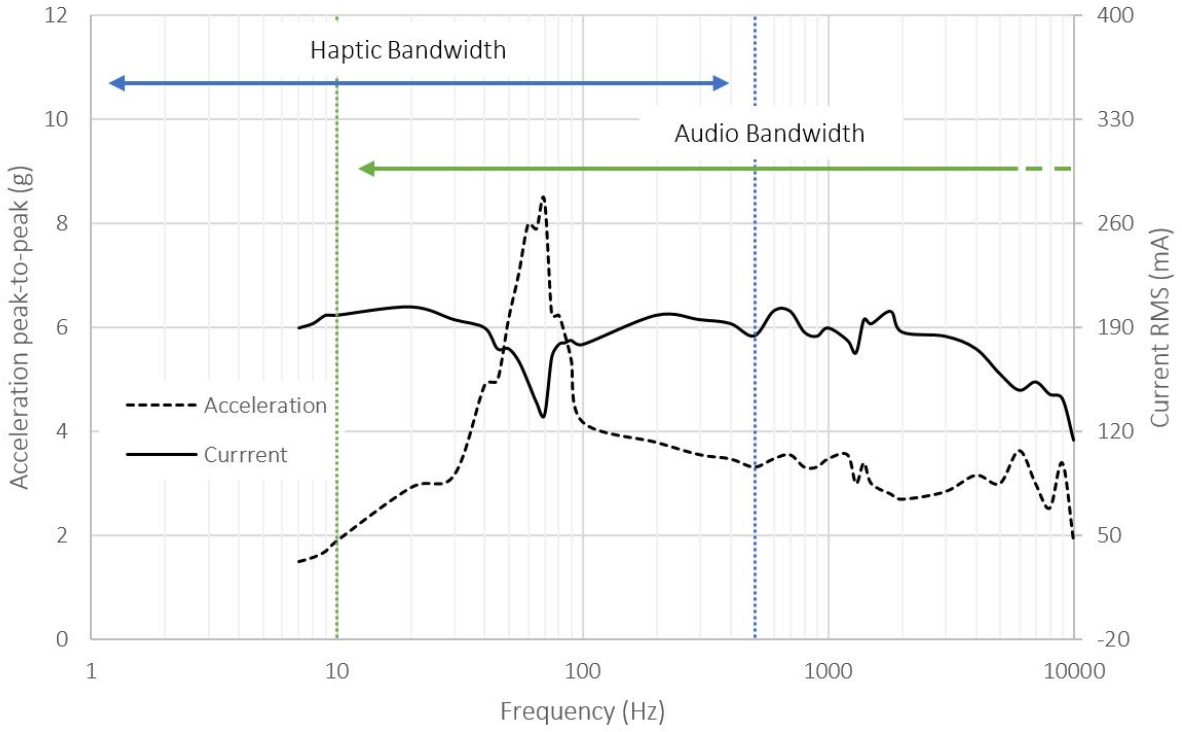


Figure. HFBA9532 Bandwidth, 5 Vpp sinus command

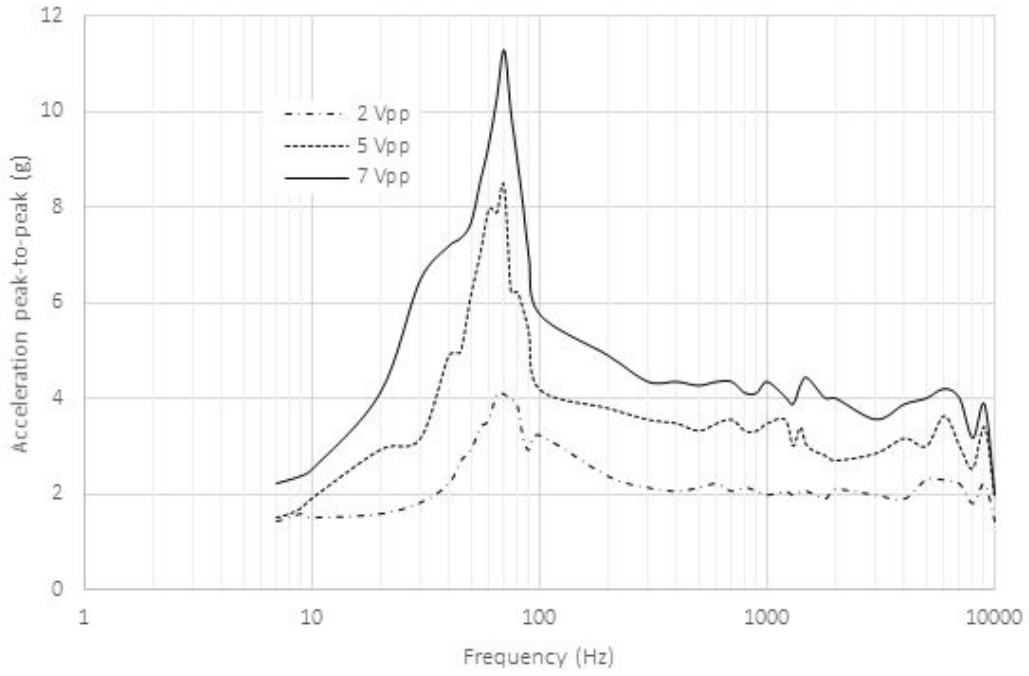


Figure. HFBA9532 Bandwidth for various amplitude command

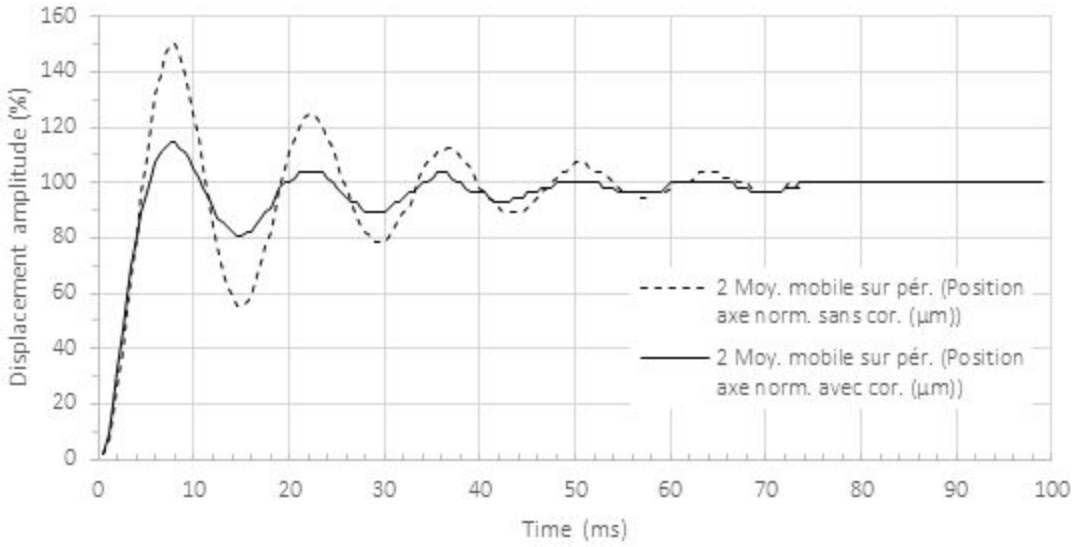
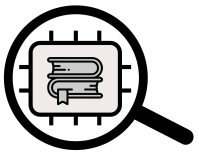


Figure. Response time of HBFA9532 for a half-stroke maximum command

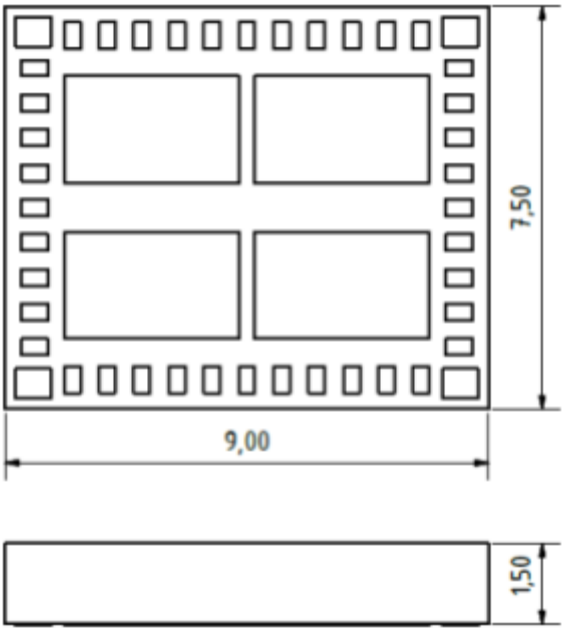
8. Tactronik™ Module



The Tactronik™ LGA module is a miniaturized all-in-one development system, measuring 7.5 x 9 x 1.5 mm. It allows seamless integration of HD haptic effects in our clients' products. Tactronik™ enabled devices provide users with unique, highly realistic haptic renderings.

8.1. Mechanical Dimensions

Dimensional drawing of a 9 x 7.5 x 1.5 mm, 48-Pad LGA Package



9. Troubleshooting

1. **Problem**: I have installed a new version of the TactronikTM Application Interface but the library is missing some haptic effects.
2. **Problem**: I want to remove all presets previously saved in the application.

Proposed solution: Clear application data. (***Menu, Clear application data***).

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4. TERM AND TERMINATION
   - 4.1. This TEA shall commence on the Effective Date and continue until terminated as provided below or until the end of the Evaluation Period.
   - 4.2. Either Party may terminate this TEA and/or the Evaluation Period immediately and without any liability upon written notice to the other Party.
   - 4.3. Upon any such termination or expiration, Licensee shall immediately cease all use of the Evaluation Products. Sections 5, 9, 11 and 15 through 35 shall survive any termination or expiration of this TEA.
5. CONFIDENTIAL INFORMATION

5.1. Licensee agrees that the Evaluation Products, Actronika product plans, Actronika price quotations, all code, inventions, know-how, business, technical and financial information and any related benchmarking results, technology, idea, algorithm or information it obtains regarding the Evaluation Products constitute the confidential property of Actronika ("Confidential Information").

5.2. Licensee will hold in confidence and not use or disclose any Confidential Information except as expressly permitted in this TEA.

5.3. Licensee shall only disclose Confidential Information to its personnel who have a need to know such information and are bound to protect such information under a signed agreement with confidentiality provisions no less restrictive than those contained herein.

5.4. Licensee shall only use Confidential Information for the purpose of conducting the technical evaluation contemplated in this TEA.

5.5. Licensee's non-disclosure obligation shall not apply to information which Licensee can document: (i) is or has become public knowledge through no fault of Licensee; or (ii) is required to be disclosed pursuant to a regulation, law or court order (but only to the minimum extent required to comply with such regulation or order and with advance notice to Actronika).

5.6. Licensee acknowledges that disclosure of Confidential Information would cause substantial harm to Actronika that could not be remedied by the payment of damages alone, and therefore that upon any such disclosure by Licensee, Actronika shall be entitled to seek appropriate equitable relief. Licensee will return all Confidential Information to Actronika upon termination or expiration of this TEA and, if requested by Actronika at any later time, certify to such return in writing.

6. DISCLAIMERS

6.1. The Evaluation Products are provided "as is" and to the extent permitted by applicable law, both Parties hereby disclaim all warranties, express, implied, statutory or otherwise, regarding the Evaluation Products, including without limitation, any implied warranties of merchantability and fitness for a particular purpose, non-infringement, or arising from a course of dealing or usage of trade.

6.2. Licensee acknowledges that the Evaluation Products are not intended for production or commercial use, only for evaluation and testing purposes.

6.3. Licensee acknowledges that the Evaluation Products may not work properly or in accordance with their documentation.

6.4. Actronika does not warrant that Licensee's use of the Evaluation Products will be uninterrupted or error-free or that any security mechanisms implemented by the Evaluation Products will not have inherent limitations.

7. LIMITATION OF REMEDIES AND DAMAGES

7.1. NEITHER PARTY SHALL BE LIABLE FOR ANY LOSS OF USE, LOST DATA, FAILURE OF SECURITY MECHANISMS, INTERRUPTION OF BUSINESS, OR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND (INCLUDING LOST PROFITS), REGARDLESS OF THE FORM OF ACTION, WHETHER IN CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE, EVEN IF INFORMED OF THE POSSIBILITY OF SUCH DAMAGES IN ADVANCE. THIS SECTION SHALL NOT APPLY TO LICENSEE WITH RESPECT TO ANY CLAIM ARISING UNDER THE SECTIONS TITLED "LICENSEE OBLIGATIONS", "RESTRICTIONS" OR "CONFIDENTIAL INFORMATION".

7.2. NOTWITHSTANDING ANY OTHER PROVISION OF THIS TEA, ACTRONIKA'S ENTIRE LIABILITY TO LICENSEE UNDER THIS AGREEMENT SHALL NOT EXCEED THE PRICE OF THE EVALUATION PRODUCTS.

7.3. The Parties agree that the limitations specified in this section will survive and apply even if any limited remedy specified in this TEA is found to have failed of its essential purpose.

8. MISCELLANEOUS

8.1. This TEA does not create any agency, joint venture or partnership relationship between the Parties.

8.2. No rights or licenses whatsoever, either express or implied, are granted hereunder by one Party to the other Party as to any patents or patent applications, copyrights, trademarks, trade secrets, or other intellectual property now or hereafter acquired, developed, or controlled.

8.3. This TEA may be executed in two or more identical counterparts (including facsimile and other electronically transmitted copies), each of which shall be deemed to be an original and all of which taken together shall be deemed to constitute the agreement when a duly authorized representative of each Party has signed the counterpart.

8.4. All notices, requests and other communications under this TEA shall be deemed to have been duly given on the third day after mailing of the notice, postpaid, to the Party entitled to such notice at the address set forth below.Any notice to be given under or in connection with this TEA shall be made in writing, by registered letter, and sent to the following address: If to Actronika: Actronika - 68, Boulevard de Courcelles - 75017 Paris - France; If to the Licensee: _____

8.5. Neither Party may assign this TEA without the other Party's prior written consent, and any assignment in violation of this TEA shall be void. This TEA shall benefit and be binding upon the Parties to this TEA and their respective successors and permitted assigns.

8.6. Wherever possible, each provision of this TEA shall be interpreted in such manner as to be effective and valid under applicable law, but if any provision of this TEA shall be prohibited by or invalid under applicable law, such provision shall be deemed modified to the extent necessary to make it enforceable under applicable law. If any such provision is not enforceable as set forth in the preceding sentence, the unenforceability of such provision

shall not affect the other provisions of this TEA, but this TEA shall be construed as if such unenforceable provision had never been contained herein.

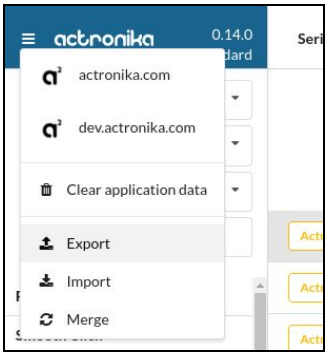
8.7. This TEA including the annexes, exhibits and attachments hereto (if applicable) sets forth the entire understanding and agreement between the Parties with respect to the subject matter hereof, and supersedes any prior oral or written agreements, and all contemporaneous oral communications. All additions or modifications to this TEA must be made in writing and must be signed by the Parties. Any failure to enforce a provision of this TEA shall not constitute a waiver thereof or of any other provision.

8.8. THIS TEA SHALL BE GOVERNED BY THE LAWS OF FRANCE, WITHOUT REFERENCE TO CONFLICT OF LAWS PRINCIPLES. THE EXCLUSIVE VENUE FOR ANY DISPUTE SHALL BE IN PARIS, FRANCE. ALL DISPUTES BETWEEN THE PARTIES IN CONNECTION WITH OR ARISING OUT OF THE EXISTENCE, VALIDITY, CONSTRUCTION, PERFORMANCE AND TERMINATION OF THIS TEA (OR ANY TERMS THEREOF), WHICH THE PARTIES ARE UNABLE TO RESOLVE BETWEEN THEMSELVES AMICABLY, SHALL BE FINALLY SETTLED BY THE COMPETENT COURTS OF PARIS, FRANCE.

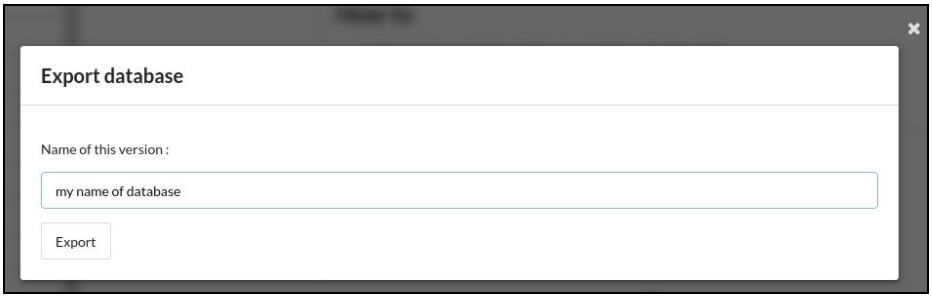
11. Annexe and Advanced Information

12.1. How to export an effect database

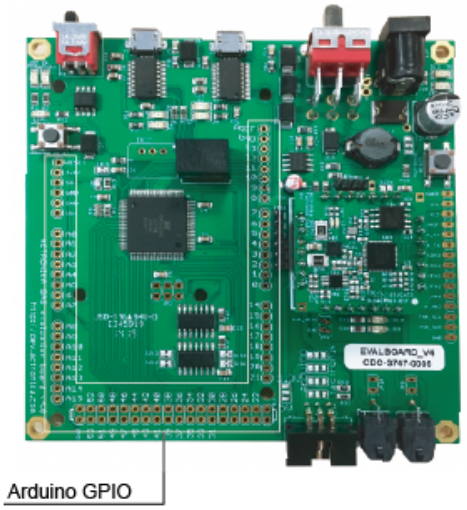
We learned in section 4.3 that we can import and merge imported databases. It is also possible to export an effect database.
To do so, export your database by clicking on the ***Menu*** button and on ***Export***.



Then, give a name to your database, click on ***Export*** and save your new database file (json format).



12.2. GPIO (General Purpose Input-Output) Details



This is the Arduino GPIO (General purpose input-output) as an Arduino mega board.

The below listed GPIO are reserved for communication purposes between ATmega and Tactronik:

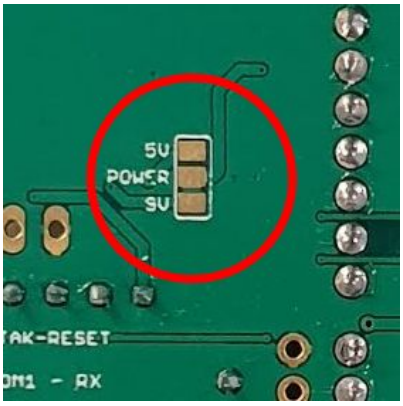
AVR Port	Arduino pin	Function	Used by
PE7	/	/	Tactronik Reset
PE0	0	RX	FTDI to PC
PE1	1	TX	FTDI to PC
PA0	22	/	Tactronik
PA1	23	/	Tactronik
PD0	21	SCL	Sensor connector
PD1	20	SDA	Sensor connector
PF0	A0	Analog 0	Sensor connector
PF1	A1	Analog 1	Sensor connector
PA2	24	/	Tactronik
PA3	25	/	Tactronik
PD3	18	TX1	Tactronik API
PD2	19	RX1	Tactronik API
PB2	51	MOSI	Tactronik
PB3	50	MISO	Tactronik

12.3. Power Supply Jumper

On the bottom of the board, there is a jumper to switch the set voltage of the regulator.

By default, the regulator is configured to generate 9V for actuators.

You can change the jumper by cutting wire and short-circuiting another to have a 5V configuration.



12. Revision History

Date	Ver.	Ref.	Description	Author	Approved by
16/06/2017	1.0	TAEKUM0001	Document creation	Rafal Pijewski	Rafal Pijewski
03/07/2018	3.0	TAEKUM0001	Update for version 3.0 of Evaluation Kit	Jérémy Cheynet	Rafal Pijewski
26/04/2019	4.0	TAEKUM0001	Update for version 4.0 of Evaluation Kit	Claire Richards	Rafal Pijewski