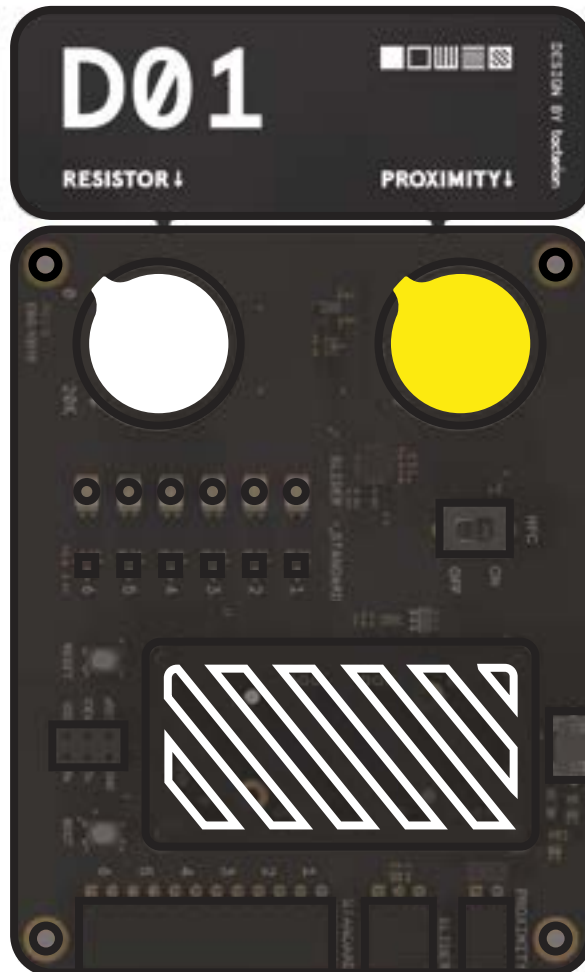




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Germany



USER MANUAL

pylon® flex development kit

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The plyon® flex development kit and its contents are engineering samples, meaning that the design of the product is not yet concluded and finally tested by tacterion. Engineering samples may be partially or fully functional and may differ from published product specifications.

The kits are intended solely for product and/or software developers for use in a research and development setting to facilitate feasibility evaluations, experimentation, or scientific analysis. The kits, nor its contents, have a direct function and are not a finished product.

The kit, nor its content, may be used for reliability testing in any finished product or for the purpose of manufacturing any finished product.
The kit is an engineering sample and has NOT been tested for FCC compliance.

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The kit, accessories, and packaging should be sorted for environmental-friendly recycling. Do not dispose of the device in the household waste!

According to the European Guideline 2012/19/EU, electric and electronic devices that are no longer usable must be collected separately and disposed of in an environmentally correct manner.

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tacterion GmbH reserves the right to change, amend, or update all available documents, including this user manual, at any time and without notice. Contact tacterion GmbH or go to <https://www.tacterion.com/shop/devkit> to obtain the latest documentation for this product.

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SKIP TO QUICK START GUIDE [**↗**](#)

1 GETTING STARTED

The pylon® flex development kit (dev kit) is designed to help you evaluate the capabilities of tacterion's flexible touch and force sensor technology, utilizing capacitive and resistive readout. Due to its versatility, the pylon® flex sensor modules can be used to make many curved surfaces touch and force sensitive.

Hybrid Readout (HFC)

Excellent Signal Integrity under Bending

Highly Customizable Layers

Small, Thin and Durable

Simple Electrical Interface



1.1 WARNING LABELS

To make risks clear, the following signal words and labels are used for safety notes.

ATTENTION: Failure to follow the information provided within these warnings may result in damage to the sensor or electronics, injuries, or property damage.

HINT: The user manual contains hints and tips, providing additional information about the technology, underlying principles, or other helpful pieces of information.

1.2 TERMS & ABBREVIATIONS

dev kit/kit	Refers to the Standard pylon® flex Development Kit and all its content.
PET	Polyethylene terephthalate, thermoplastic polymer of the polyester family.
Product	Refers to the products based on the pylon® flex sensor technology, including the dev kit and all its contents.
Sensor module	Refers to a sensor with more than one sensitive area, e.g. the pylon® flex 4-taxel sensor module or the pylon® flex 4-taxel line array, which are part of the dev kit.
(single) sensor(s)	Refers to a sensor with a single sensing area. See taxel.
Taxel	Tactile pixel – refers to a single sensing area. The sensors offered by tacterion are either single-point sensors, e.g. PFL-10020, PFL-10021 and PFL-10033 or sensors with multiple sensing areas, e.g. PFL-10010 and PFL-10022. Each individual taxel or sensing area can determine when proximity, touch, or force are applied.
ZIF	Zero Insertion Force connector
HFC/hfc	hybrid force compensation - a combination of hardware and source code to reduce drift within the readout over time.
True Zero	pylon® sensors provide zero output under bending, unless a vertical force is applied, or a minimum radius undershot.

1.3 APPLICABLE DOCUMENTS

In addition to this user manual, the following documents apply and must be read and understood by the customer:

- Data sheet of pylon® flex standard sensors

The documents can be downloaded following the links below.

<https://www.tacterion.com/technology/data-sheet>

1.4 INTENDED USE

The content of the pylon® flex development kit is for the sole purpose of research and development, e.g. (i) evaluation of the general functionality of the materials, (ii) testing

the properties and performance of the sensors, the readout electronics, and the software supplied and (iii) examining potential use in/with products. The pylon® flex development kit and its content are excluded from the following EU directives based on the stated reference:

- EMC Directive 2014/30/EU, based on Article 2, 2. (e)
- RoHS 2 Directive 2011/65/EU, based on Article 2, 4. (j)

The contents may only be used within the scope of the technical data provided in this manual or the respective technical data sheet. Please refer to 1.3 Applicable documents and the Disclaimer for further details.

1.5 INAPPROPRIATE USE

The pylon® flex development kit and its content shall not be directly or indirectly assembled as a part or subassembly in any finished product.

The pylon® flex development kit and its content are not intended for consumer or household use.

The pylon® flex development kit and its content may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by users, in whole or in part, or used in any finished product or production. This may not apply to provided software released under a separate license. In this case, please refer to the respective license provided with the documentation.

Do not use the pylon® flex development kit or any of its content as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Do not use this product for applications other than its intended and authorized use. Before installing, handling, using, or servicing this product, the data sheet, user manual, and other application notes must be read and understood. Failure to comply with these instructions could result in property damage, serious injury, or death.

The pylon® flex development kit has not been tested for FCC compliance. For further details please refer to the Disclaimer.

1.6 PERSONNEL QUALIFICATION

Personnel working with the product must be sufficiently qualified to prevent serious injuries and property damage.

- Only qualified personnel may work with the components of the pylon® flex development kit
- The personnel must have read and understood the user manual and other relevant documentation provided with the pylon® flex development kit
- National safety regulations and general safety instructions must be observed

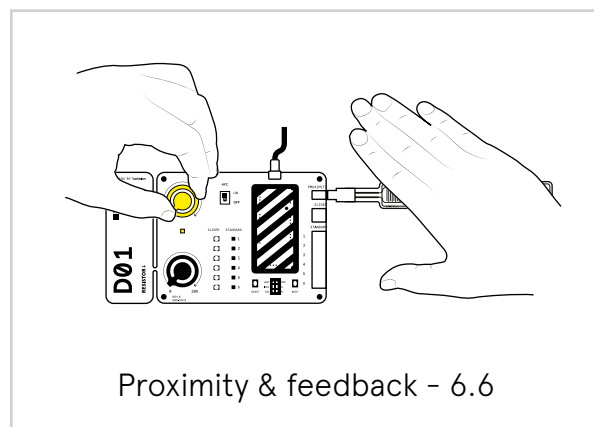
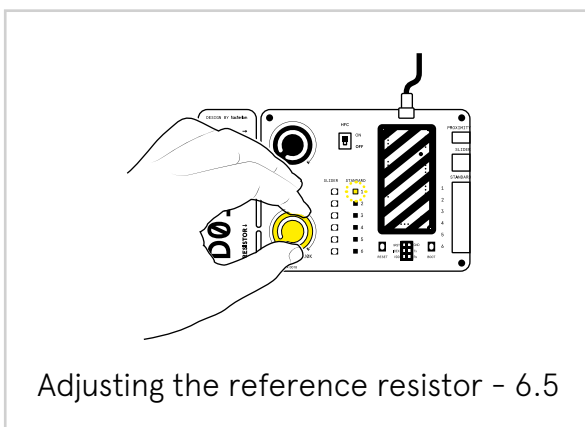
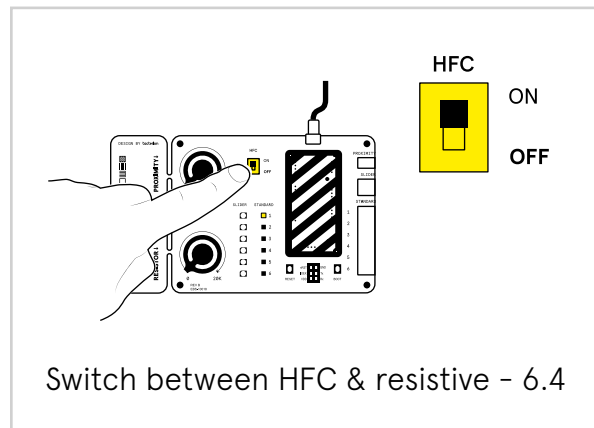
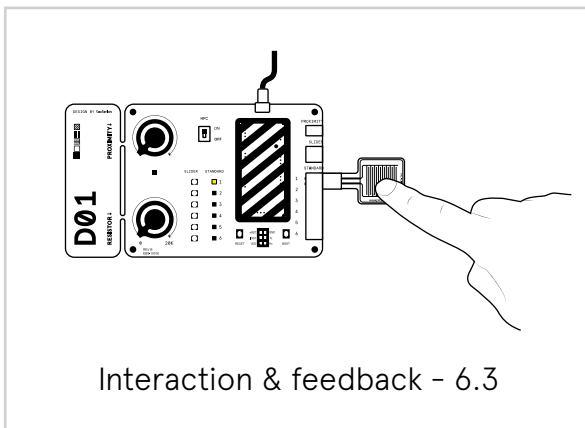
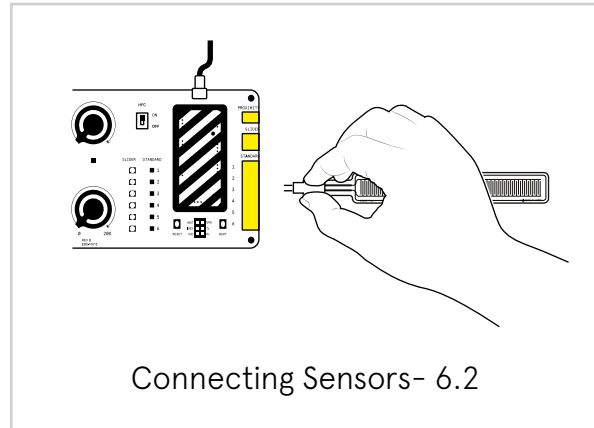
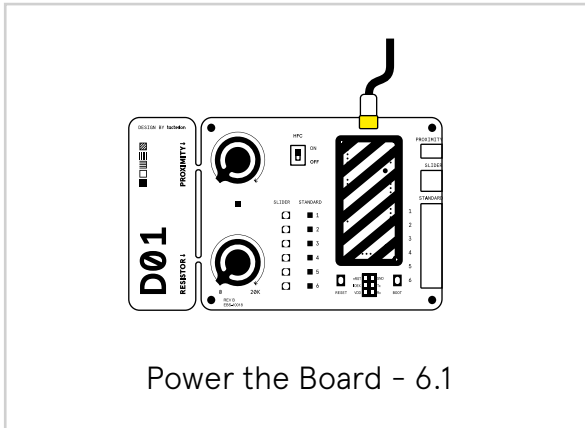
2 WARRANTY

If the pylon® flex development kit is used as intended (see chapter 1.4), the warranty is valid for 12 months from the ex-works delivery date.

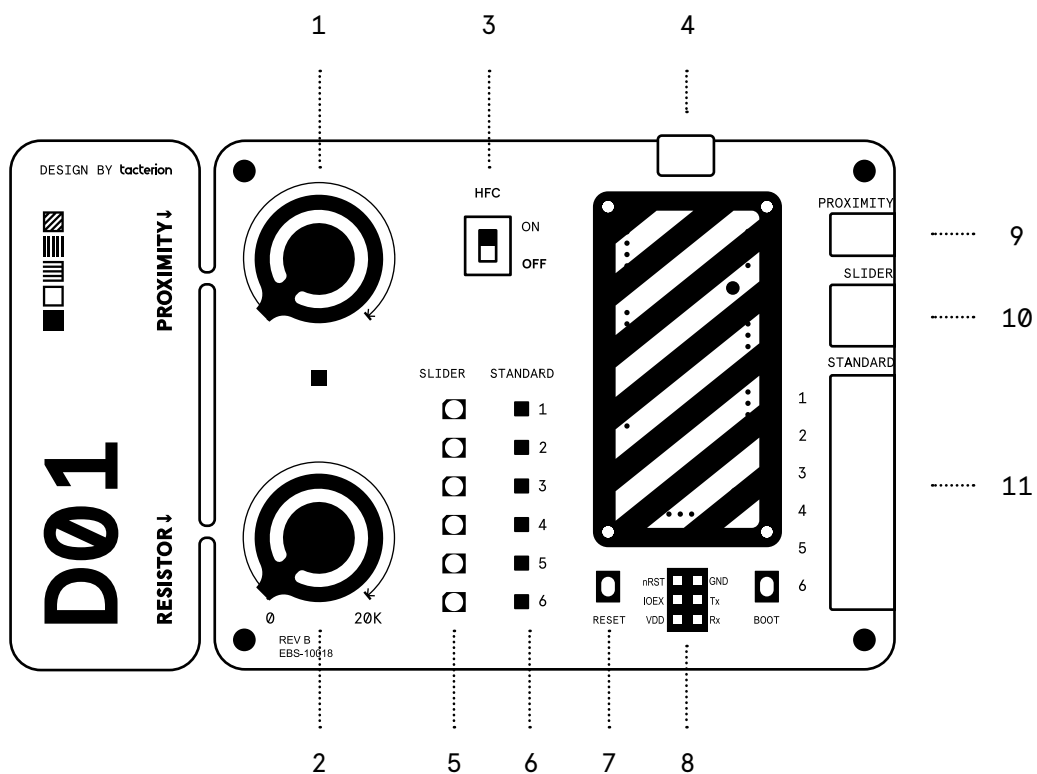
3 PACKAGE CONTENTS

01x	plyon flex® Stripe
02x	plyon flex® Medium
02x	plyon flex® Square
01x	plyon flex® Array with ZIF Connector
01x	plyon flex® Slider
01x	Core Unit
01x	D-01 PCB
01x	Micro-USB cable
15x	Jumper Wires

4 QUICK START GUIDE



5 FIND YOUR WAY AROUND THE BOARD



- 1 Proximity Potentiometer and feedback LED
- 2 Reference Resistor Potentiometer
- 3 HFC/Resistive Switch
- 4 USB Micro
- 5 Slider feedback LEDs
- 6 Single taxel feedback LEDs
- 7 Reset
- 8 Pin header connector
- 9 Proximity channel
- 10 Slider channel
- 11 Standard - single taxel channels

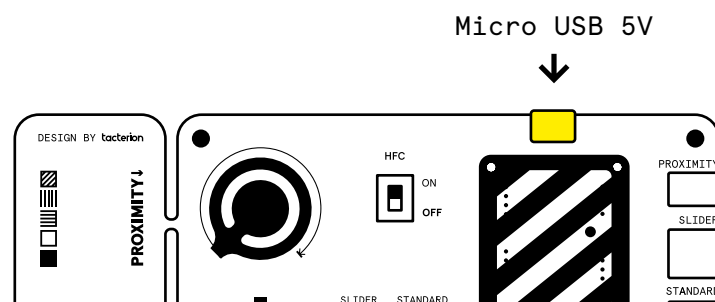
6 STANDALONE

The „standalone“ mode of the plyn® flex development kit allows direct onboard interaction without having to connect additional hardware or installation of readout software. Its strength lies in intuitive and quick learning of how the sensors function and what affects sensor performance and characteristics most. For detailed signal analysis or even table top prototype mockup setups please visit the respective chapters „data stream“ or „prototype“.

6.1 Power the Board

The D-01 PCB can either be supplied using a 5V USB port on any PC/Laptop/Powerbank or with an 5V AC socket adapter.

If the board is correctly powered, the status LED on the HCU should be active (green, blinking).



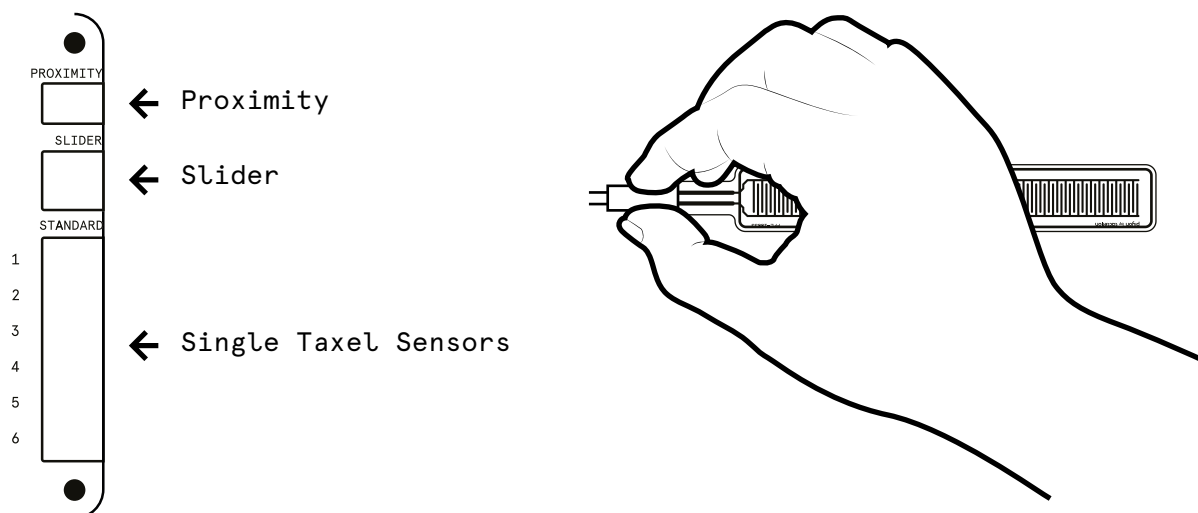
ATTENTION: Connect to one power supply only! either USB or through the pin header input (read more about powering the system via the pin header in chapter 8). Connecting two power supplies simultaneously may result in damages to the device and sensors or injury and property damage.

6.2 Connecting Sensors

You can connect the pylon® flex sensors in two different ways:

1. directly connecting the crimped flex-tail of the sensor to the socket connector on the PCB. This way tangling cables are avoided and the setup can be kept clean and simple.
2. using jumper wires to bridge between the PCB crimped flex-tail to have more flexibility in positioning the sensors. We added a set of jumper wires to the kit. Feel free to use any length of male/female jumper wires to fit your purpose.

The following sketch shows the implemented pin layout and labelling.



Proximity: only pylon® flex Square, Stripe or Medium sensor must be connected to the proximity channel. (reference designs with a 2 pin connector)

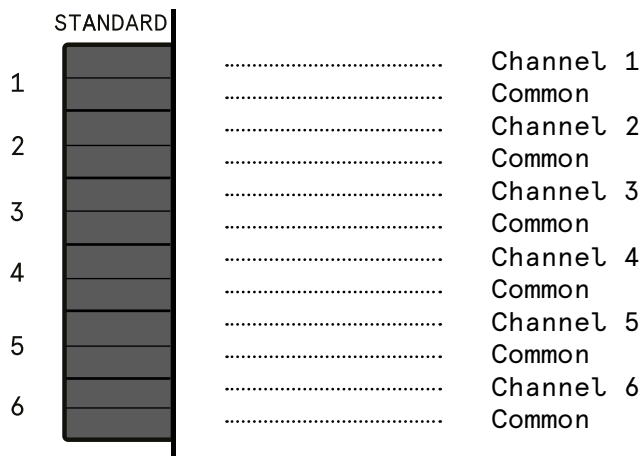
Slider: only the pylon® flex Slider will be functional using this channel.

Standard (1-6): all single taxel sensors (pylon® flex Square, Stripe, Medium and Array) sensor can be connected to the „Standard” channels. For properly connecting the Array there is additional information available in chapter 5.1.2.2.

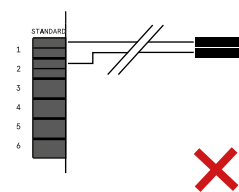
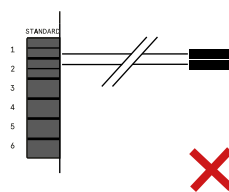
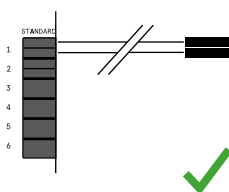
6.2.1 Single Taxel Sensors

plyon® flex Square (PFL-10020)
 plyon® flex Medium (PFL-10021)
 plyon® flex Stripe (PFL-10033)

The following sketch shows the layout of the pins primarily used to connect individual single taxel sensors.



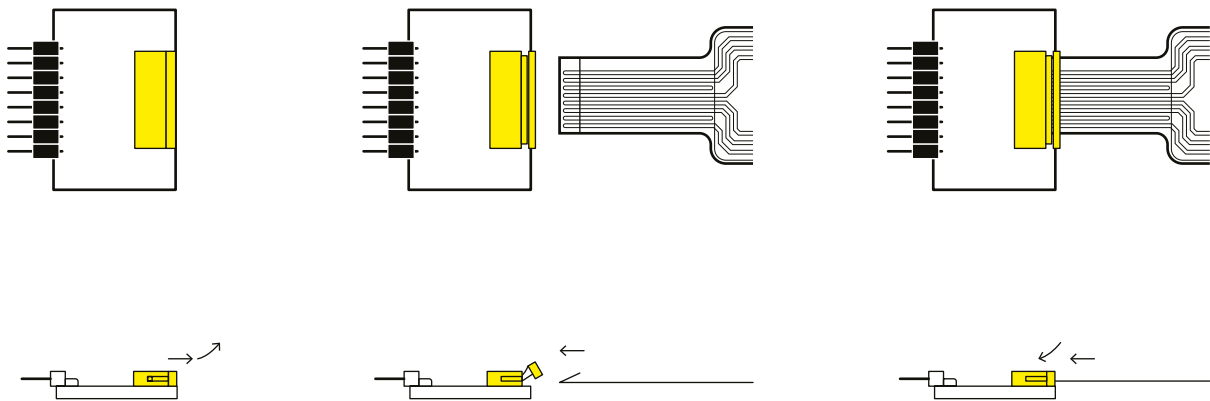
Please stick to the following schematic. Incorrectly connected sensors may result in corrupted or no readout.



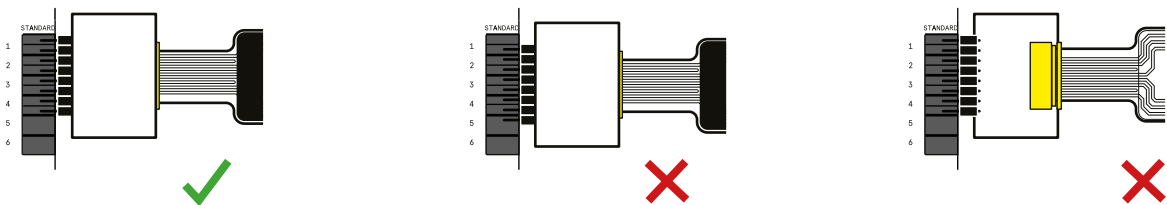
6.2.2 Connecting the Array

plyon® flex Array (PFL-10022)

In order to connect the plyon® flex 4 taxel array sensor insert the flex-tail into the ZIF connector of the adapter board. It is crucial to connect it with the printed conductive traces facing down/the sensor module facing upwards as shown below.



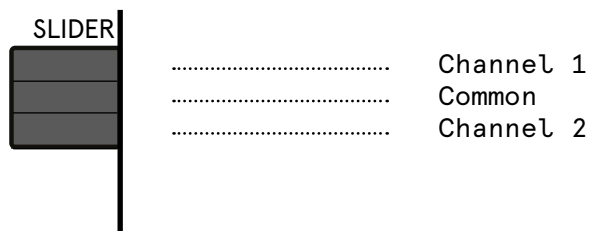
The ZIF adapter board is subsequently attached to the electronics as shown below. Make sure the silicone side of the sensor is facing you.



6.2.3 Connecting the Slider

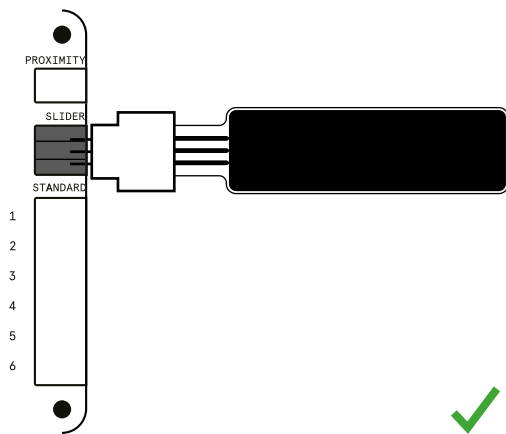
plyon® flex Array (PFL-10023)

The design of the sensor allows using the sensor 2 ways.

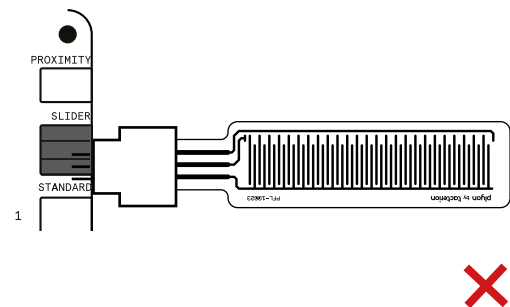
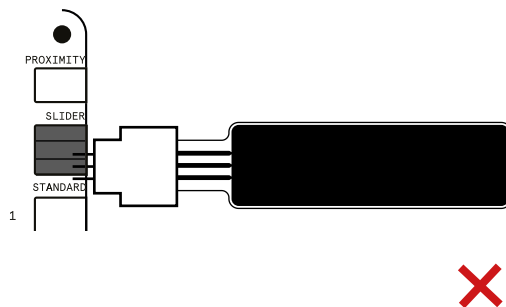
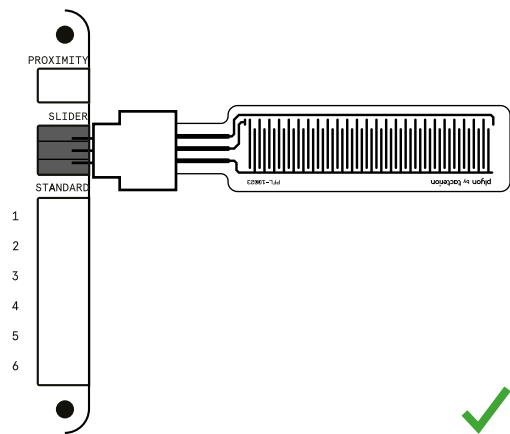


1. Regular: Silicone side up
2. Upside Down: PET side up

(1)

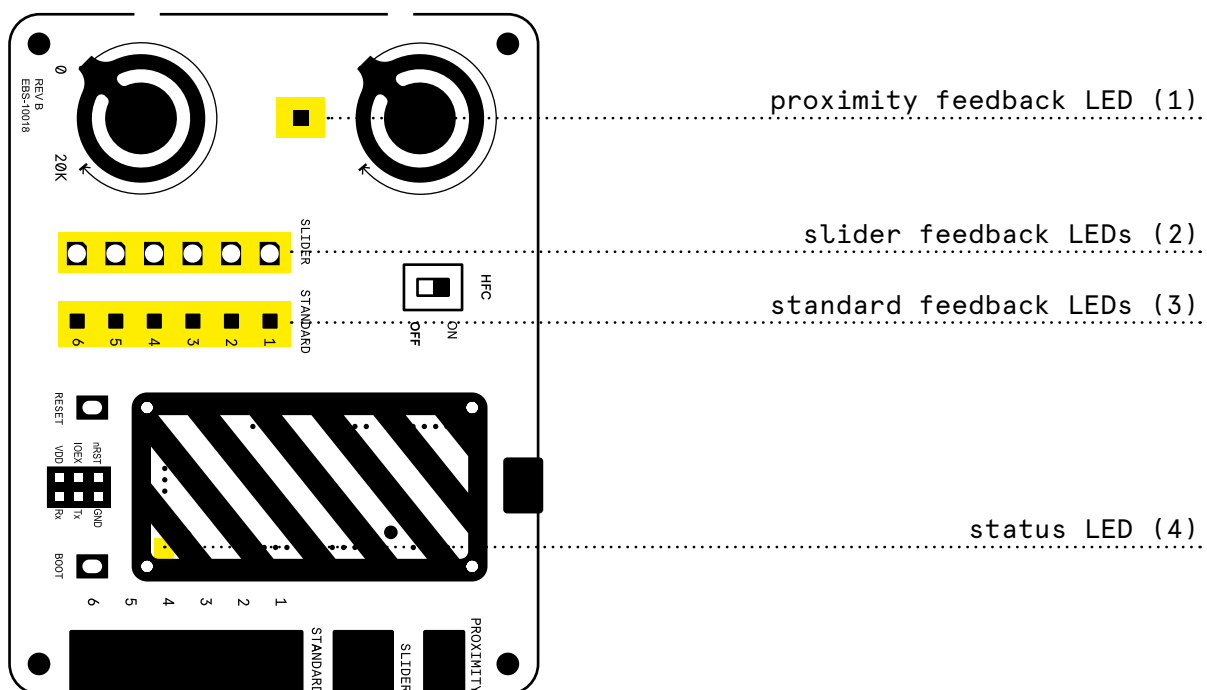


(2)



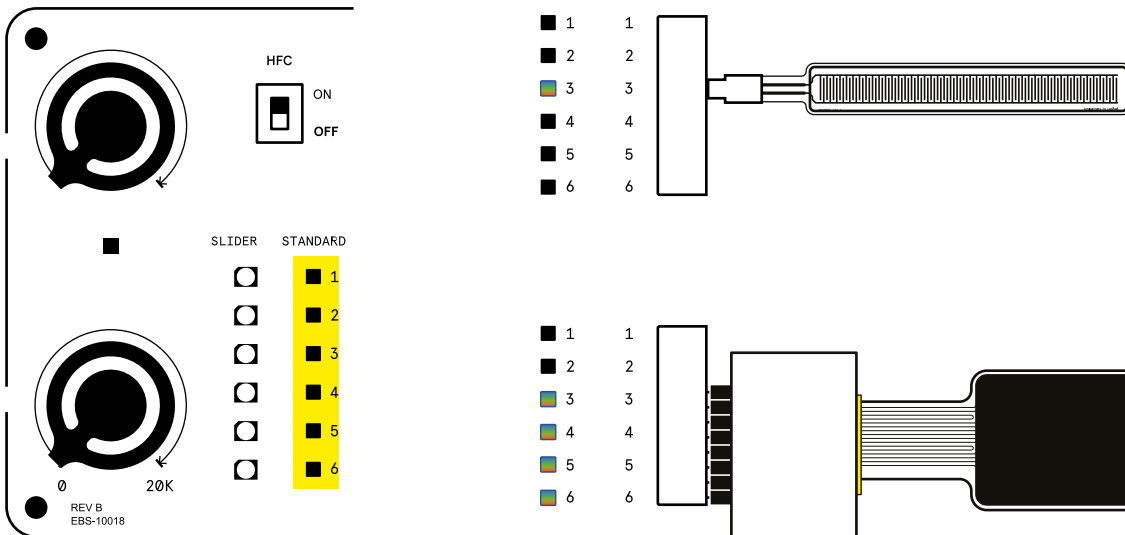
6.3 LED Feedback

The D-01 carries 3 areas (1-3) to provide realtime visual feedback of the interaction forces and one system status LED (4).



1. proximity feedback LED: 2 color status diode indicating the approximation of e.g. a human hand once set up correctly. Only active with sensors connected to the „PROXIMITY“ socket.
2. slider LEDs: white unicolor LED array indicating position and force intensity at the given position (change in brightness). Only active with sensors connected to the „SLIDER“ socket.
3. standard feedback LEDs: RGB LED array indicating different force levels through gradient color. Only active with sensors connected to the „STANDARD“ sockets.
4. status LED: blinks green if board is powered.

6.3.1 Standard Channel LED Array explained



Clusters, Channels and feedback LEDs are labeled and numbered accordingly. Standard Channel 1 → Standard LED 1, Standard Channel 2 → Standard LED 2...

We took a fairly simple approach of mapping increasing interaction forces to colors representing increased temperature.

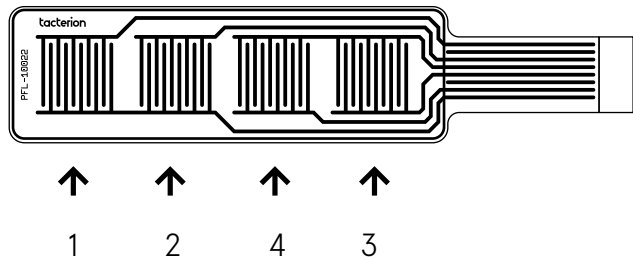
RGB „STANDARD“ LED color temperature scale:



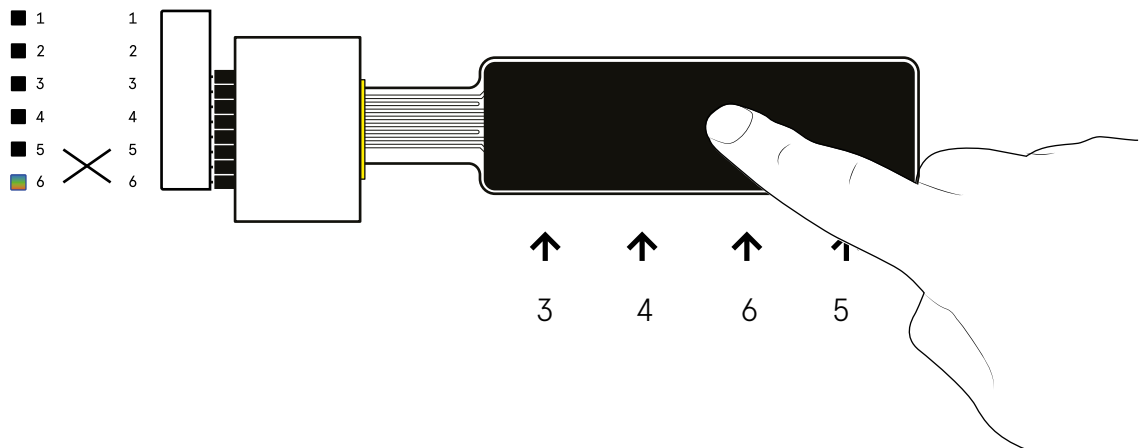
6.3.2 Special Case: the pylon® flex Array

Due to the advanced routing of the sensor and the connector socket pin allocation the last 2 taxels of the Array sensor are reversed on the STANDARD LED array.

pylon® flex Array taxel routing:



Exemplary readout for the pylon® flex Array:



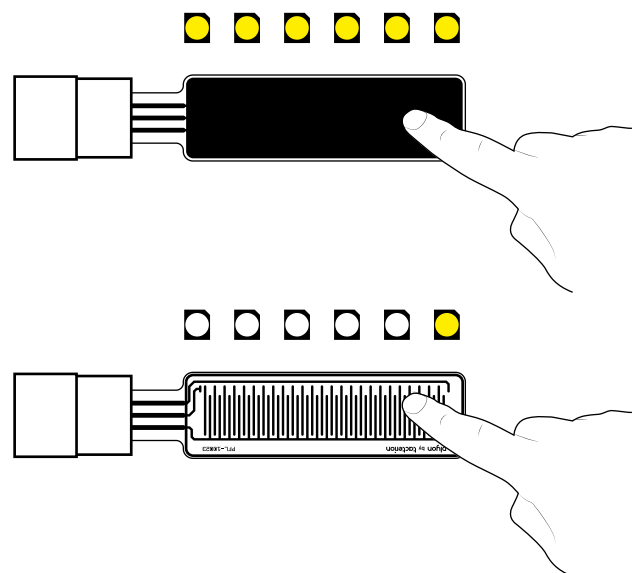
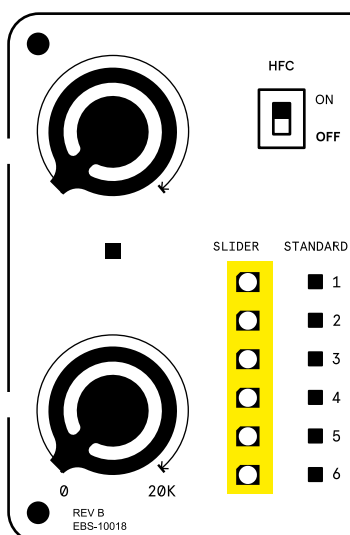
6.3.3 pylon® flex Slider Feedback LEDs

For the slider feedback unicolor white LEDs with a change in brightness are used.

The logic behind it can be read as follows:

1. 6x1 LED array to indicate the finger position with 1 being closest to the flex-tail and 6 being the tip of the sensor.
2. The illuminated LEDs add up, e.g. for position 4, LEDs 1-4 remain active.
3. the brightness indicates the force level at the given position with
low intensity = low force
high intensity = high force

HINT: The slider sensor works either way: silicone or PET side up. Again, due to fixed routing, flipping the sensor also flips the direction of the mapping for the LED sequence.



6.4 Resistive and HFC readout

HFC (hybrid force compensation): Our latest feature optimizes the sensor for static load by enabling an almost drift free readout over time.

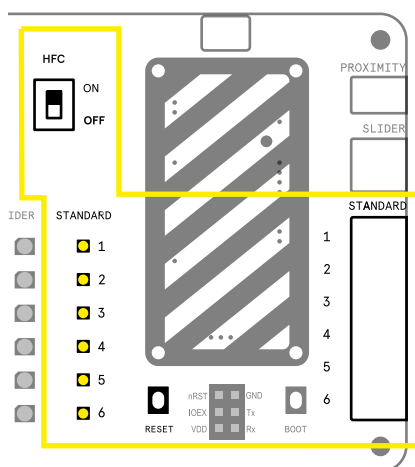
The most noticeable change next to the drift minimization lies within the force required to actuate the sensor. Now that we are utilizing both, capacitive and resistive readout, the force required to actuate the sensor is noticeably decreased.

Activating HFC readout:

1. Set the switch to „ON“ position
2. The RGB readout LEDs will light up because the capacitive value requires further calibration
3. Hit the „RESET“ button
4. The signal is now calibrated

Activating resistive readout:

1. Set the switch to „OFF“ position
2. The resistive signal does not require additional calibration → the resistive readout is available again



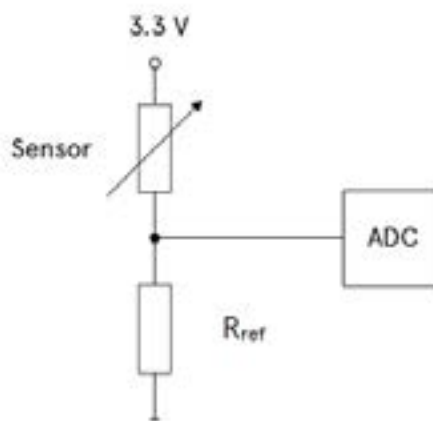
HINT: The HFC calibration is affected by channel, sensor & environment. If you experience unexpected readout behavior one of those factors most likely has been changed → simply hit the reset button again.

If the setup remains untouched after initial calibration, switching between hfc and resistive is possible without further repetitive calibration.

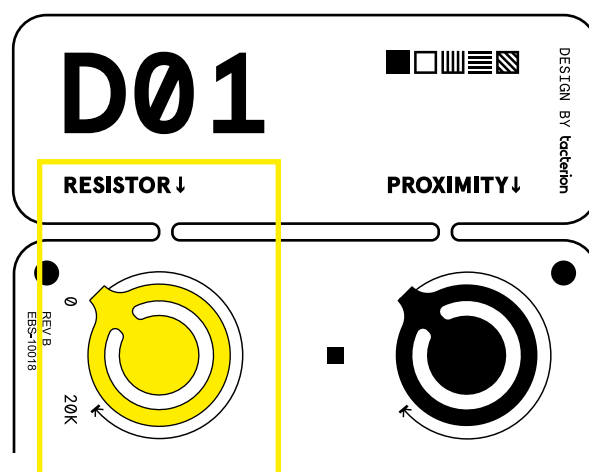
HINT: The HFC readout only impacts the standard single taxel channels. Slider and Proximity functionalities remain untouched by the changes.

6.5 Adjusting the reference resistor

The plyn® flex sensor changes resistance depending on the applied force. For the correct readout of the sensor, a voltage divider is used. The sensor is wired in series with a reference resistance and a voltage of 3.3V is applied. An analog-to-digital converter (ADC) is connected to the center node of the divider. By making use of the measured output voltage, the input voltage of 3.3V, and the reference resistance, the resistance of the sensor can be computed.



The left/lower rotary potentiometer allows full manual control over the reference resistor in a value range between 0 to 20 k Ω .



Adjusting the poti affects the resistive readout for:

1. standard single taxel channels 1-6
2. slider channel

Some effects of increasing (clockwise) the reference resistor while in „resistive“ readout mode include:

1. low forces: the required onset force for the single taxel, array and slider is reduced
2. high forces: the sensors saturate quicker

For the HFC readout being more complex, the felt difference adjusting the reference resistor are minor compared to the resistive only readout.

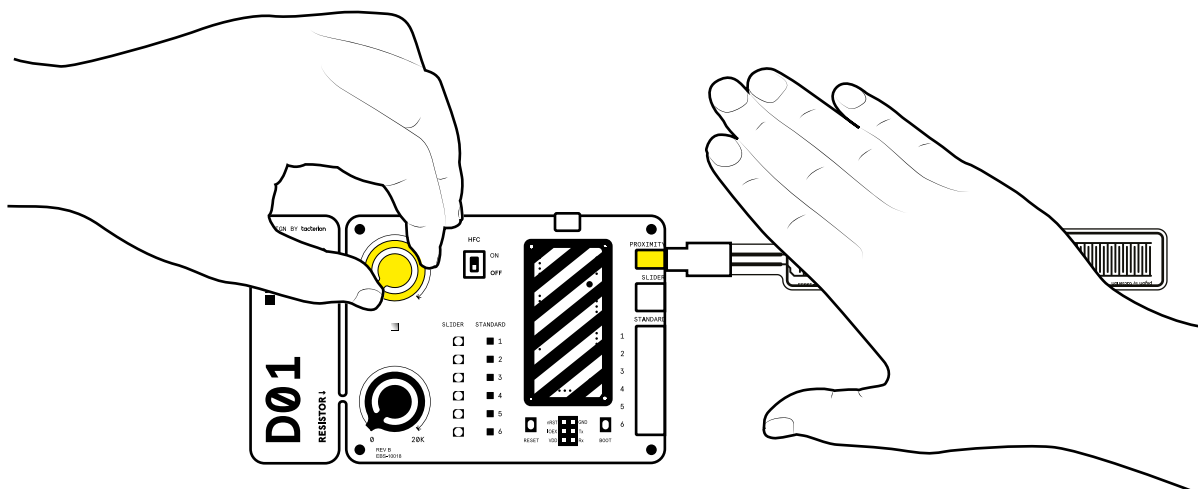
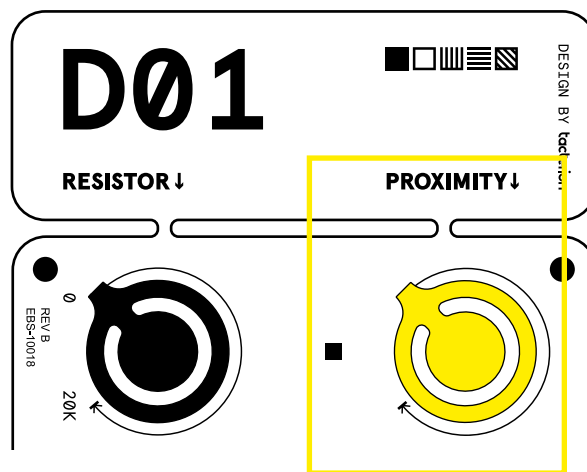
Some effects of increasing (clockwise) the reference resistor while in „HFC“ readout mode include:

1. low forces: effects on the onset force are negligible
2. high forces: the sensors saturate slower

HINT: Because the proximity feature is capacitance based, it remains unimpressed by any changes of the reference resistor.

6.6 Proximity Detection

The dedicated proximity channel utilizes the printed electronics conductors as an antenna. The proximity detection function needs to be adjusted for each sensor individually (amongst other things because the amount of printed conductive ink is different). That is what the right/upper rotary potentiometer is for.



Here is how you tune in the proximity detection for each sensor layout:

1. Connect any of the following sensors:

plyon® flex Square (PFL-10020)
plyon® flex Medium (PFL-10021)
plyon® flex Stripe (PFL-10033)
plyon® flex Slider (PFL-10023)

2. Check the proximity feedback LED right next to the rotary potentiometer for one of the following statuses:



(a) LED off =
no signal



(b) LED white =
proximity detected



(c) LED red =
contact detected

Make sure your hand is not in range of the currently connected sensor and adjust the potentiometer to achieve the following targeted status/position:

LED stably off, but as close as possible to turning white.

- (a) Slowly turn the potentiometer clockwise until it transitions from Off to white. Finetune it counterclockwise until it is Off again. Now you should have found the sensor specific „sweetspot” for proximity detection.
- (b) Turn the potentiometer counter clockwise into MIN position, repeat (a)
- (c) Turn the potentiometer counter clockwise into MIN position, repeat (a)

HINT: The plyon® flex reference designs included in the kit are not optimized for proximity detection. It simply serves demonstration purposes of proximity being an option in your sensor design. For your serial product you can expect higher proximity detection distances.

7 DATA STREAM

RGB LEDs are nice and everything - but let's talk real sensor data here. For streaming the preprocessed data from the D-01 all it takes is a Windows or Mac OS based Computer that can host an external Micro USB device. In the following chapters we will lead you through setting up your system.

7.1 Connecting the D-01 to a Computer

Use the enclosed USB cable (or any standard Micro USB cable) to connect the D-01 PCB to your computer. Two things should be happening:

1. The status LED on the HCU/D-01 board starts blinking
2. Your OS detects the D-01 as a serial device at the dedicated COM port

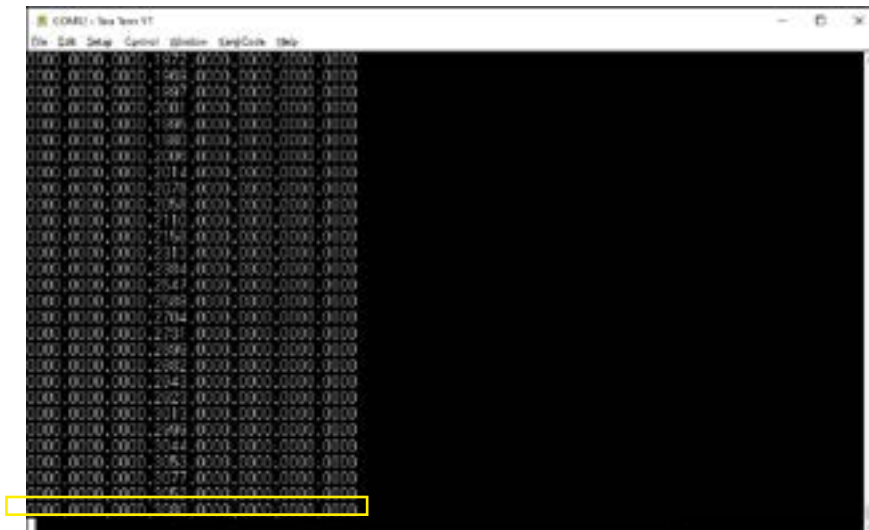
Now that a stable connection between the board and your computer is established, the only thing we need to do is visualize the data stream. There are two ways of streaming the data:

1. Comma separated string using a 3rd party software called „Tera Term“
2. Serial graph visualization using an additional 3rd party software called „kst“

7.2 Comma separated string - Tera Term

1. Download the Tera Term ([link](#)) application
2. Unzip the archive
3. (Connect the electronics to the device using any Micro USB cable)
4. Open Tera Term by launching the "ttermpro.exe"
5. Select "Serial" connection and the COM Port assigned to the electronics, confirm by clicking "OK"
6. If everything is properly set up, the serial data stream should be visible in the Tera Term window

1. For logging your data stream, click on the "File" menu and select "Log..." to save the data in a text file on your PC. This text file will be constantly updated with the data streamed from the electronics



Format	ASCII characters comma separated
	HFC off: res1,res2,res3,res4,res5,res6,position0,force0
	HFC on: hfc1,hfc2,hfc3,hfc4,hfc5,hfc6,position0,force0
	With: resX = resistive value sensor channel X
	hfcX = hybrid value sensor channel X
	postion0 = position value for slider sensor channel 0
	force0 = force for slider sensor channel 0

Conn. speed:	115200baud
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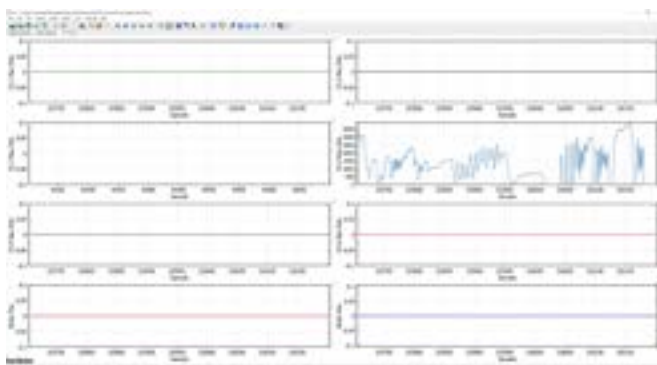
Sampling rate	~30Hz
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Range	Range Resistive Value: 0...4095
	Range Hybrid Value: dynamic

Startup delay	143ms (release RESET, time until first UART transmission)
---------------	---

7.3 Serial Graph Visualization - kst

1. Download Kst ([link](#)) application selecting the version for your operating system (for Windows please download the 32bit version), this will lead you to a new webpage: click on the green "Code" button and then "Download ZIP".
2. Unzip the archive
3. Download the tacterion specific kst configuration file ([link](#)) and extract the file from the ZIP archive
4. (Connect the electronics to the PC via USB)
5. Open Tera Term by launching the "ttermpro.exe"
6. Select "Serial" connection and the COM Port assigned to the electronics, confirm by clicking "OK".
7. If everything is properly set up, the serial data stream should be visible on the Tera Term window
8. Click on the "File" menu and select "Log..." to save the data in a text file on your PC. This text file will be constantly updated with the data streamed from the electronics.
9. Go to the "kst" folder and there to the "bin" folder and launch the "kst2.exe" application.
10. Click on the "File" menu and then on "Open...".
11. Select the recently downloaded tacterion kst configuration file "20220222-tct-DevKit-visualization-NewKit".
12. A window will pop up asking to select a new data file. Select the path to the file created with Tera Term at (8.), then click on "Change".
13. The data streamed from the different channels should now be visible through the Kst application.
14. There are different tabs, the start up screen shows Standard Channels 1-6, the 2nd tab shows the slider only and the 3rd tab all 8 on one screen.
15. Finally, we suggest adapting the increment of the "Period between updates (ms)" parameter in the Kst settings to 50 ms. This can be achieved by going to the "Settings" tab in the Kst application and clicking on "Configure Kst". There change the "Period between updates (ms)" value from the default value to 50.



8 PROTOTYPE

The following sketch shows the pin header connector on the D-01. The pin header connector can be used to supply power as well as connecting the readout electronics to a 3rd party microcontroller board like an arduino.



#	Name	Voltage	Type	Comment
1	Rx	5V tolerant	Input	UART communication line, data input
2	VDD	3.3V	Power	If USB is connected: 3.3V out (Imax = 50mA) If no USB is connected: 3.3V in
3	Tx	5V tolerant	Output	UART Communication line, data output
4	IOEX	5V tolerant	Output	Reserved for future use, can be driving output low/high, do not connect signals
5	GND		Power	System GND, can be used to connect GND to external devices
6	nRST	3.3V	Input w. int. pull up, open drain	System reset, can be used to externally reset the system

ATTENTION: Connect the readout electronics to one power supply only, either USB or through the pin header input. Connecting the readout electronics to two power supplies may result in damages to the devices and sensors, injury, or property damage.

HINT: VDD 3.3V input won't be sufficient to power the onboard LEDs

HINT: Maximum current supply capability of VDD out = 50mA, if exceeded the D-01 shuts down

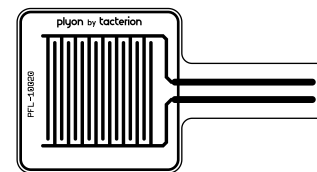
HINT: The data output is identical for USB-CDC and UART-out and is sent simultaneously. For details please check chapter 4.2.2

9 ADDITIONAL INFORMATION

9.1 SENSORS

9.1.1 pylon flex® Square

Model No.:	PFL-10020
Type:	single taxel
Sensing area:	16x16 mm
Module size:	24x24x0.5 mm

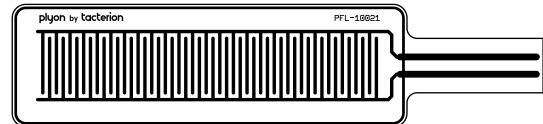


TrueZero	+
HFC	+
Proximity	+

Description: The „Square“ is a well rounded small sized single taxel sensor. Its sensing area is predestined to prototype single button interfaces with multiple force levels. It is the closest of our reference designs to a generic mechanical button.

9.1.2 pylon flex® Medium

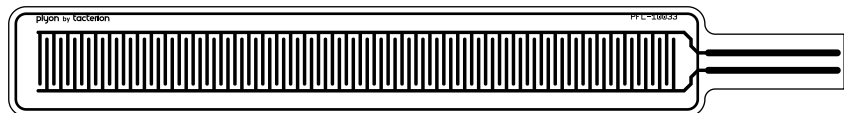
Model No.: PFL-10021
 Type: Single Taxel
 Sensing area: 10x50 mm
 Module size: 18x58x0.5 mm



TrueZero	+
HFC	+
Proximity	+

Description: The „Medium“ is an off the shelf medium sized single taxel sensor. The increased sensing area allows to cover more surface area and allows for the first operator presence sensing prototype builds. It can also be utilized as a „long button“ Maybe even bent around the ridge of your handheld device to allow LH/RH use in just one sensor?

9.1.3 pylon flex® Stripe

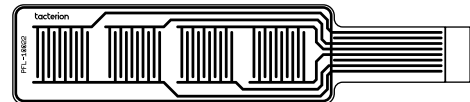


Model No.: PFL-10033
Type: Single Taxel
Sensing area: 8.5x90 mm
Module size: 16x100x0.5 mm

TrueZero	+
HFC	+
Proximity	+

Description: The „Stripe“ is our longest single taxel sensor and made for operator presence detection e.g. in handheld devices. Its dimensions are optimized to fit a broad range of hand sizes.

9.1.4 pylon flex® Array

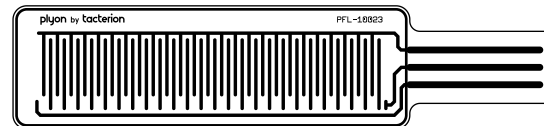


Model No.:	PFL-10022
Type:	Taxel Line Array
Sensing area:	Taxel size: 10x10 mm, Gap between Taxels: 4mm
Module size:	18x58x0.5 mm

TrueZero	+
HFC	+
Proximity	-

Description: The „Array“ is a medium sized multi taxel line array. Multiple sensing elements in a close proximity to each other allow not only for single taxel (single button) readout but also for inter taxel transition & directional gestures. It would be possible e.g. to detect the slide from one end to another just by interpreting the actuation sequence of the sensing elements.

9.1.5 pylon flex® Slider

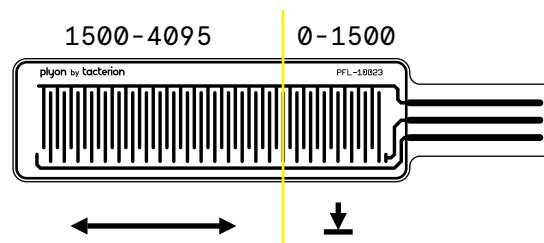


Model No.: PFL-10023
 Type: Resistive Slider
 Sensing area: 10x50mm
 Module size: 18x58x0.5 mm

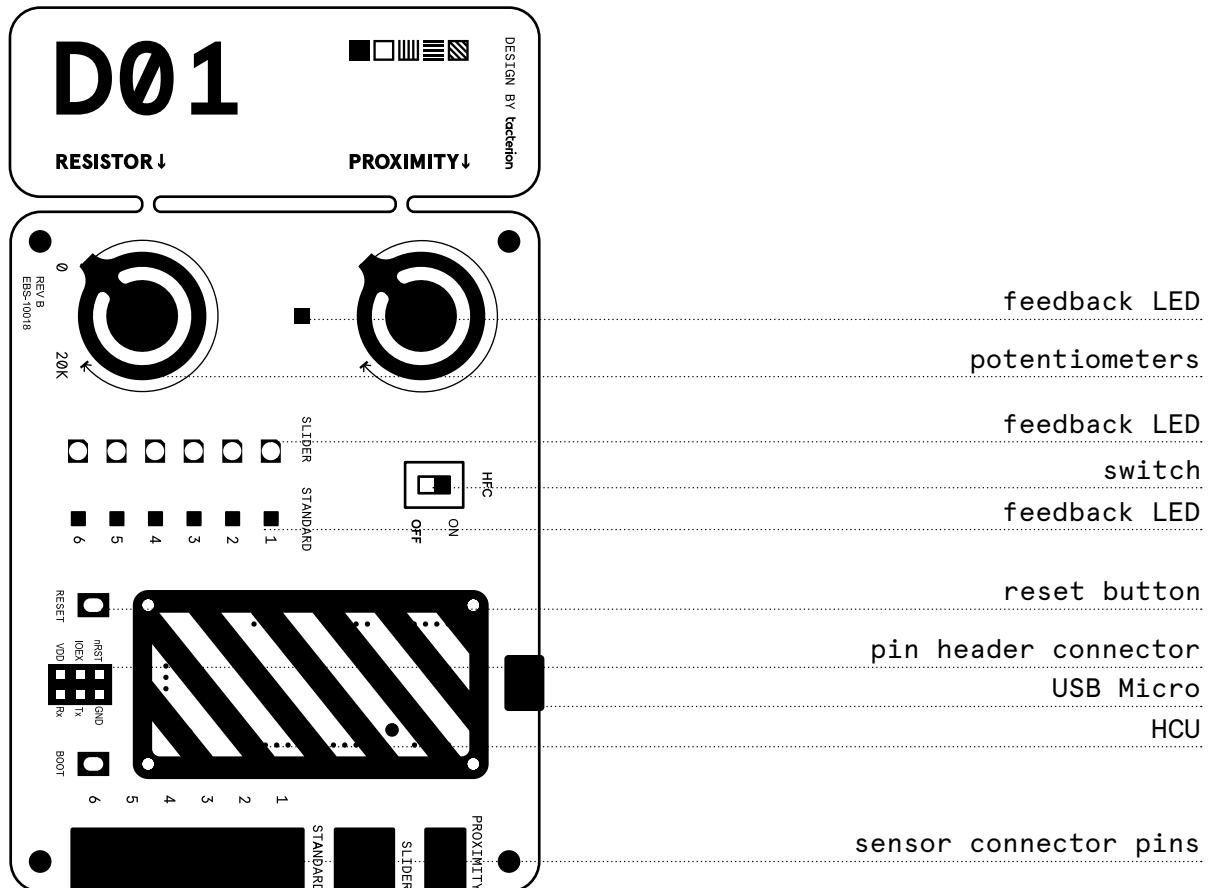
TrueZero	+
HFC	-
Proximity	+

Description: The „Slider“ is an advanced layout that optimizes accuracy and sensitivity for sliding gestures (one direction). It detects position and force applied. Multitouch gestures are not possible.

The slider provides a value range from 0-4095. The sensing area can logically be segmented to achieve different functional areas. In the example below, the value range 0-1500 is a separate „single taxel button“ with a specific actuation threshold, while 1500-4095 is dedicated to a slide gesture. The areas cannot be used simultaneously.



9.2 D-01 PCB



Model No.:	EBS-10018
Module size:	117x70x20 mm
Power Supply:	5 V
Communication Interfaces:	USB (CDC/Virtual COM Port), UART, 6 PIN

10 RECOMMENDATIONS FOR INTEGRATION

The sensor can be integrated into your prototype product for evaluation and testing in different ways. Common integration options are:

- (a) fastening by friction
- (b) double-sided adhesive tape

(a) is a non-destructive option and can be realized e.g. by positioning the sensor as a layer between the product surface and a protective layer.

HINT: The area above the four single tactile sensors can be used to secure the sensor in place, e.g. with a latch. This area is insensitive to applied pressure.

HINT: Make sure that any protective layer is applied with enough pressure to secure the sensor, but not to activate the resistive readout. Too much pressure can trigger the resistive readout or reduce the possible bending radius with true zero readout.

(b) can provide better adhesion and can make additional fixings unnecessary. However, it may not be possible to remove the tape or sensor without damaging the sensor.

ATTENTION: Adhesive tapes or other adhesives can make it impossible to remove the tape or the sensor without damaging or destroying the sensor.

11 CONTACT

Thank you for purchasing our product and trusting our company. We are always available to answer your questions on this product and other solutions.

Ask and challenge our sales representative, or get in contact via the options mentioned below:

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