TECH NOTE :: ClipX Use of a piezoelectric sensor

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Short description

These tips for use describe how to connect a piezoelectric sensor to a ClipX system and a charge amplifier (type CMA/ CMD) and how to put it into operation.

Assembly draft

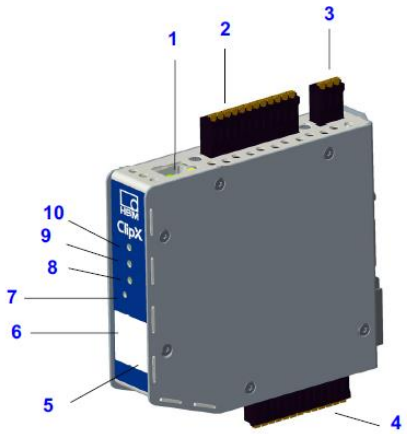
Required equipment

The following equipment is required for implementing the example:

- ClipX system
- Charge amplifier (in this case: CMA/900)
- 1-KAB168 connection cable (for connecting the charge amplifier to the ClipX)
- Piezoelectric sensor (in this case: CFT/20kN)
- 1-KAB143 connection cable (sensor connection cable)

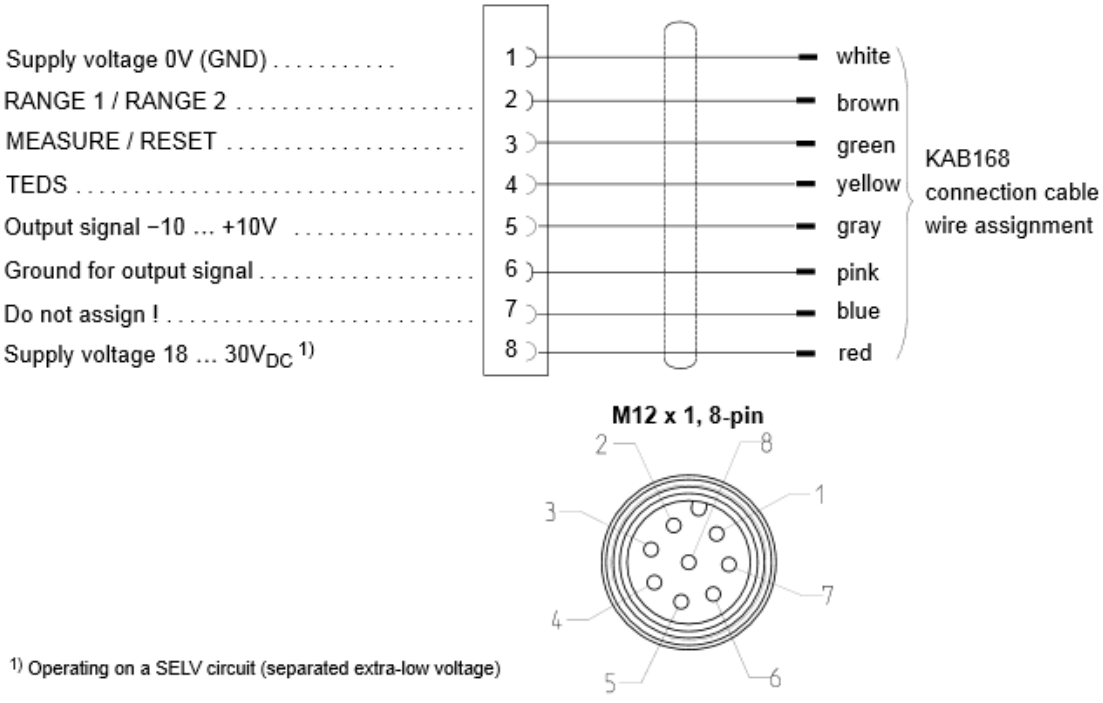
Prerequisites

Connecting the cable to the charge amplifier and the ClipX requires that the wires of the 1-KAB163 connection cable are combined in two plugs; one of these is connected to the Bridge excitation, digital-I/O input, the other to the transducer connection.



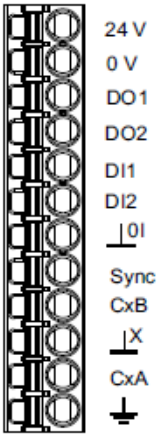
2 → Bridge excitation, digital-I/O 4→ transducer connection

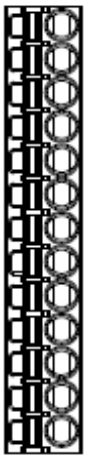
1-KAB168 pin assignment



1) Operating on a SELV circuit (separated extra-low voltage)

Pin assignment

Plug 1 (Bridge excitation, digital-I/O)			
	*PIN*	*Cable wire*	*Connection at ClipX(2)*
	1	red and 24V supply voltage	24V
	2	white and 0V supply voltage	0V
	3	green	DO 1
	4	brown	DO 2
	5		DI 1
	6		DI 2
	7		DI GND
	8		Sync
	9		ClipX-Bus-B (RS485-)
	10		ClipX-Bus GND
	11		ClipX-Bus-B (RS485+)
	12		Masse

Plug 2 (transducer connection)			
	*PIN*	*Cable wire*	*Connection at ClipX (4)*
	1		PT100
	2	yellow	TEDS
	3		
	4		Measurement signal-
	5		Measurement signal +
	6		Sense lead -
	7		Bridge excitation lead -
	8		Sense lead +
	9		Bridge excitation lead +
	10		Outer shield
	11	pink	Cable shield
	12		I IN
	13	grey	U IN

Note: As shown above, the blue wire of the connection cable is not connected.

Cabling with ClipX

1-KAB143 cable is used to connect the piezoelectric sensor to the charge amplifier. The latter is connected to the PX401 (plug 1) and PX878 (plug 2) measuring cards via the 1-KAB163 cable using the two plugs assembled as described above. The sensor can be put into operation after having been correctly configured.

Configuring sensor and charge amplifier

Characteristic values of the components used in the example

Sensor: CFT/20kN	
Nominal (rated) force	20 kN
Sensitivity	-7,7 pC/N

Amplifier: CMA/900	
Max. electrical charge	0,011 mV/pC

The following calculations are made for configuring the sensor and the charge amplifier (note: please note the units; both pC[10^{-12}] and nC[10^{-9}] are being used)

1 Max. amplification range of the amplifier:

$$\text{Max. amplification range} = \frac{U_{Output,max.}}{Charge\ amplification} = \frac{10V}{0.011\frac{mV}{pC}} = 900nC$$

2 Max. force that can be measured using the amplifier:

$$max.pC = max.Force \times Sensitivity$$

$$max.Force = \frac{\text{max.}\,pC}{Sensitivity} = \frac{900nC}{7.7\frac{pC}{N}} = 116.9kN$$

The charge amplifier used enables maximum forces up to 116 kN to be measured. The sensor used in this case allows a maximum of 20 kN. Hence, the sensor's entire measuring range can be covered with the charge amplifier.

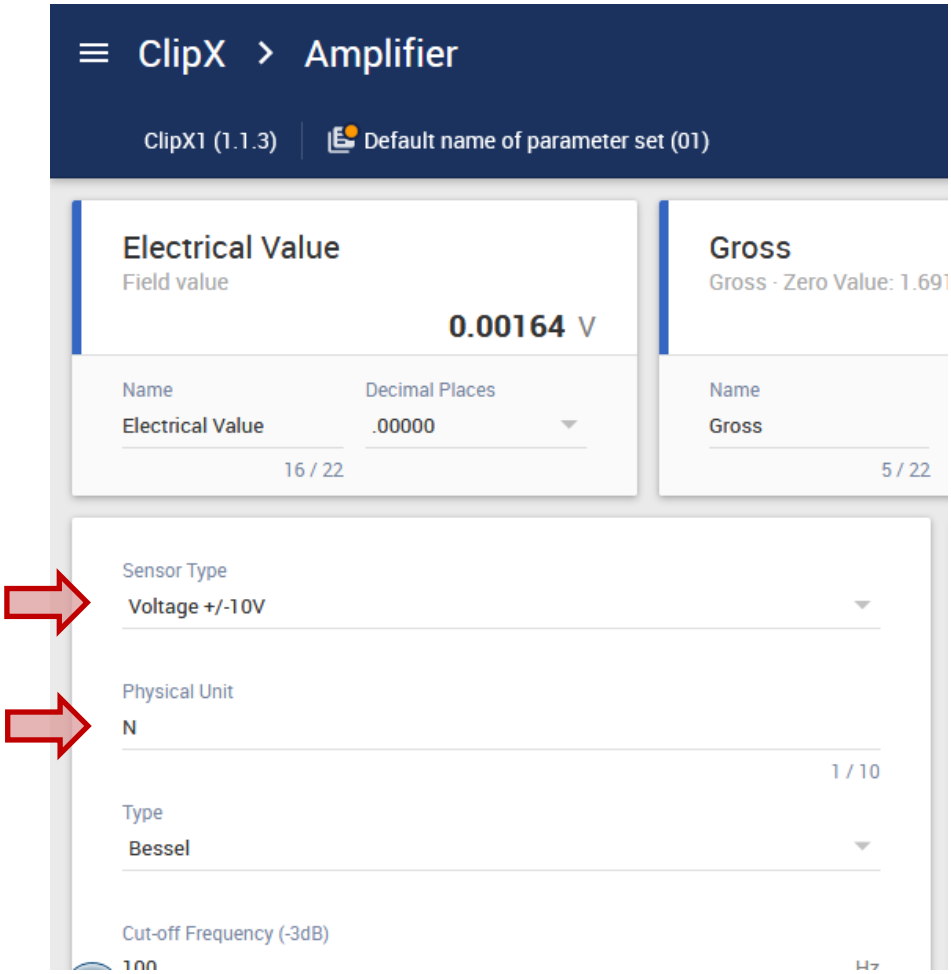
3 Calculate the voltage value that is displayed when the maximum measured value is reached.

$$Volt = pC\ (at\ max.meas.value) \times chargeamplification$$

Settings in the ClipX

Set sensor type and physical unit

- Go to the menu item ‘Amplifier’
- Change here (if not already selected) the sensor type to ‘Volt +/-10’
- Change (if not already selected) the physical unit to Newton



Characteristic calculation

We need two points, i.e. two ratios between the measured voltage and the force applied to the sensor.
The first point is the starting point. Logically, an applied force of 0 Newton should correspond to a voltage of 0 Volt.
Point 1: 0V → 0N

For the second point a calculation is necessary.
The data sheets of the sensor and the charge amplifier show their conversion factors (already listed above)::

Sensor: (-)7,7pC/N
Amplifier: 0,011mV/pC

The combined conversion constant (here called k) is calculated as follows:

$$k = \frac{U}{F} = 7{,}7\frac{pC}{N} \times 0{,}011\frac{mV}{pC} = \ 0{,}0847\frac{mV}{N}$$

At this point we choose, to be able to check the result, a weight 2kg. This corresponds to a force of

$$F = m \times g = 2kg \times 9{,}81\frac{N}{kg} = 19{,}62N$$

The following applies to the voltage:

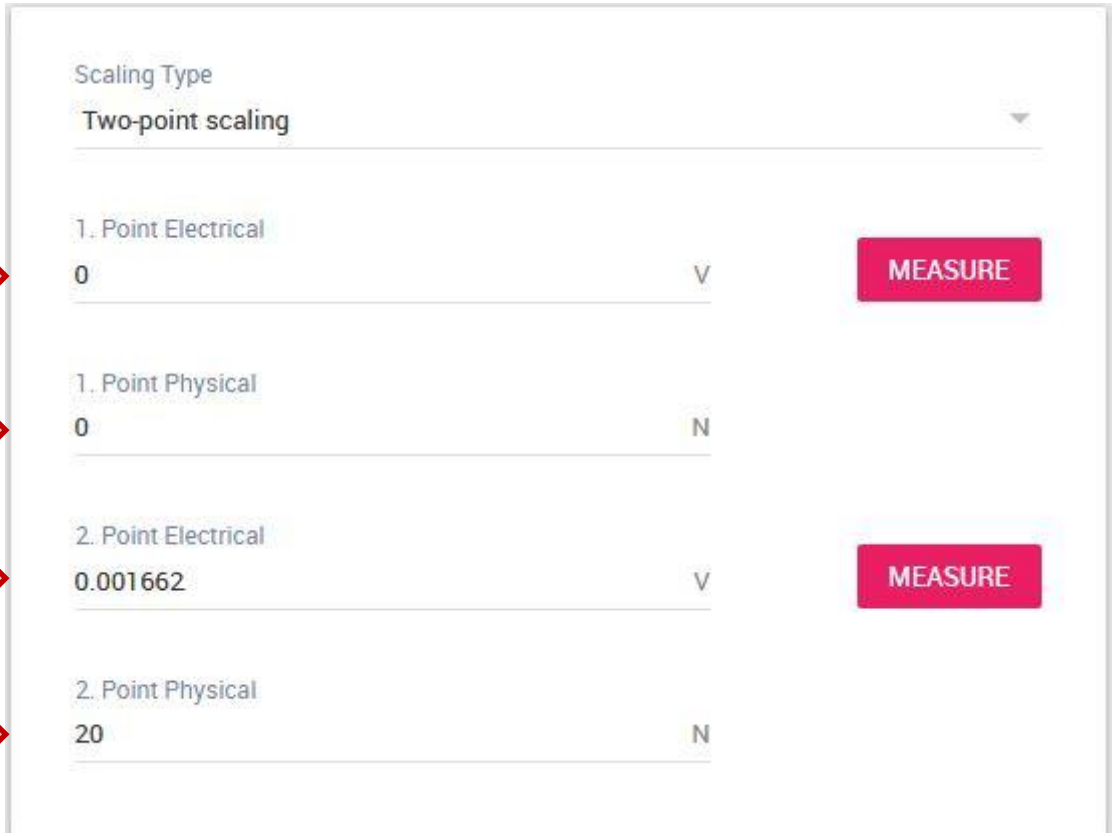
$$U = F \times k = 19{,}62N \times 0{,}0847\frac{mV}{N} = 1{,}662mV$$

Point 2: 1,662mV = 0,001662V → 19,62N

Charakteristic in the ClipX

To enter the characteristics in ClipX, follow the steps below:

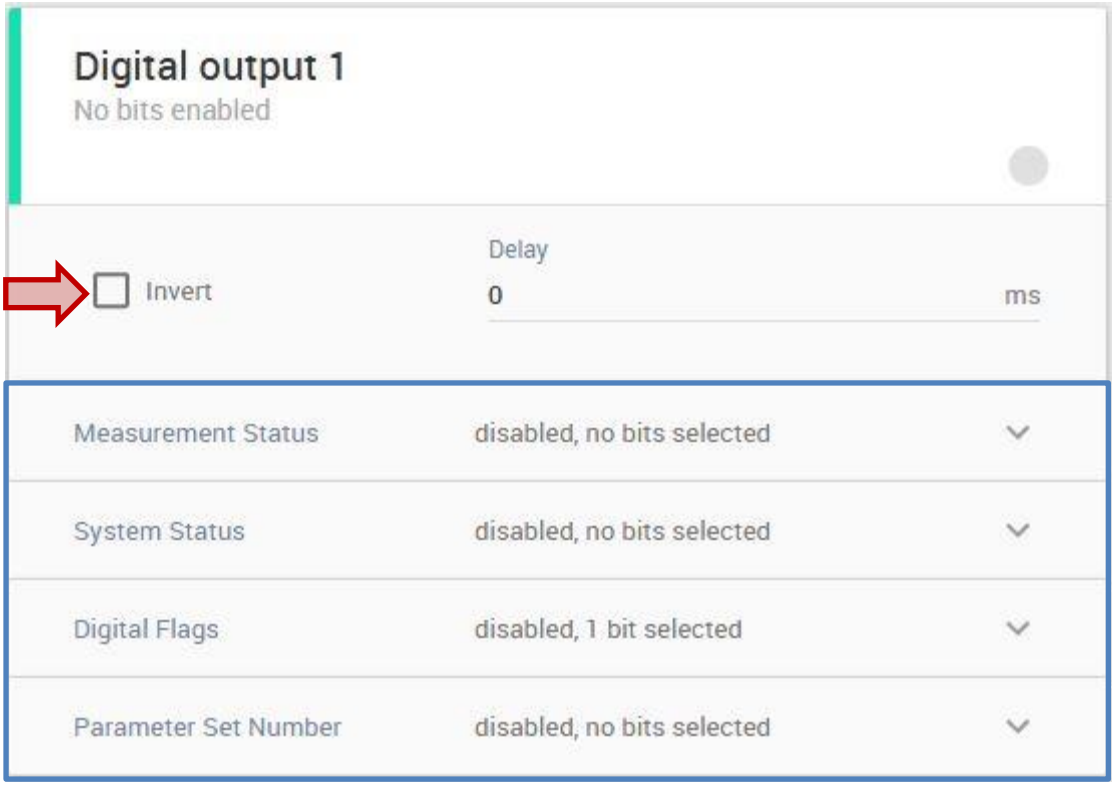
- Change to the menu item ‘Amplifier’
- Here you can now enter the calculated points for scaling.



Reset the amplifier and zero the measurement value

To ensure an accurate measurement, a reset of the amplifier should be performed and then zero the measured value at the ClipX.
Since we have already connected the reset pin to digital output 1, it is very easy to do this manually.

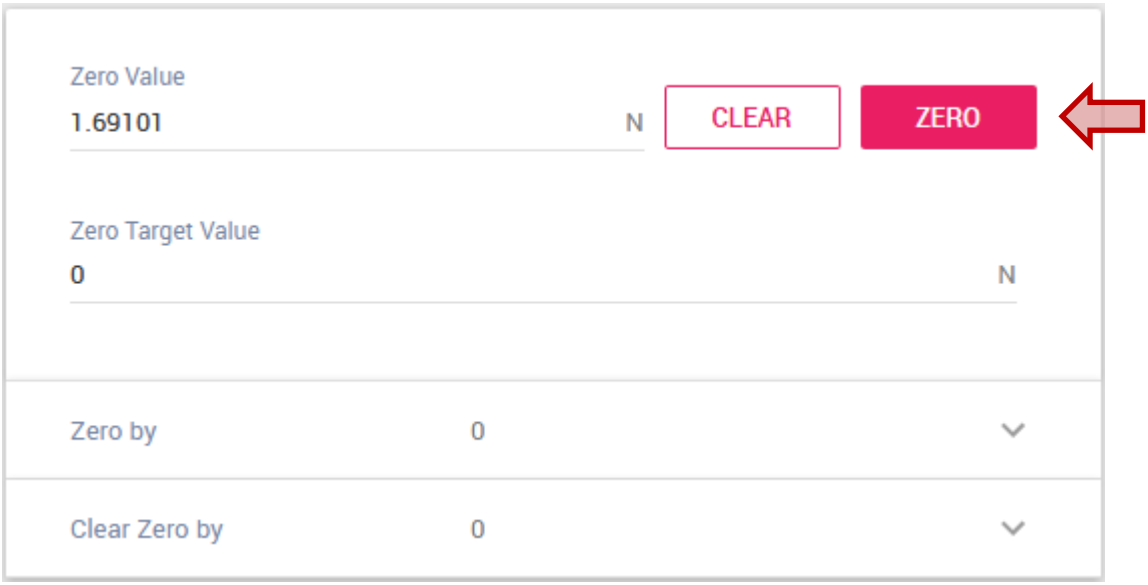
- Change to menu item 'Digital-I/O' and scroll to digital output 1
- By activating 'invert' you set the signal at DO 1 to „1", which will cause the reset
- After doing that, deactivate 'invert'



Note: The reset can of course be done by any flags (framed in blue).

Now we are going to zero the measured value at our ClipX.

- For that, change to the menu item ‘Amplifier’
- On the left side further down you will find ‘zero value’ with the button ‘zero’
- Press ‘zero’



Attention: Please note that the system must be in idle (no force acts on sensor) during reset and zeroing. Carry out the described steps in the indicated order before your measurement in order to minimize the influence of drift in the amplifier.

Disclaimer

These examples are for illustrative purposes only. They cannot be used as the basis for any warranty or liability claims.