TECH NOTE - Calculating resulting force

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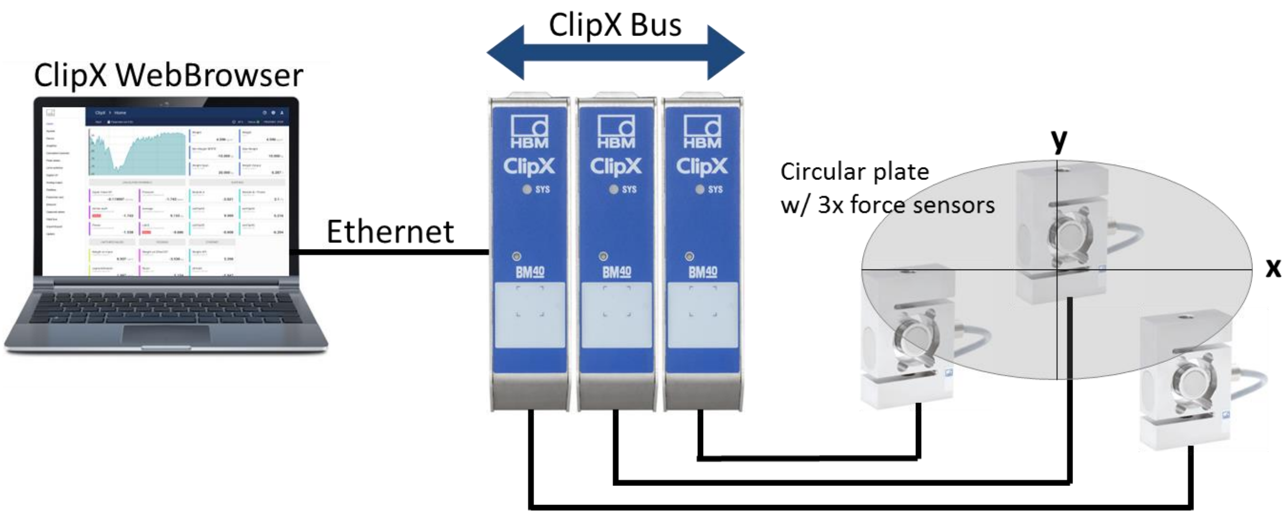
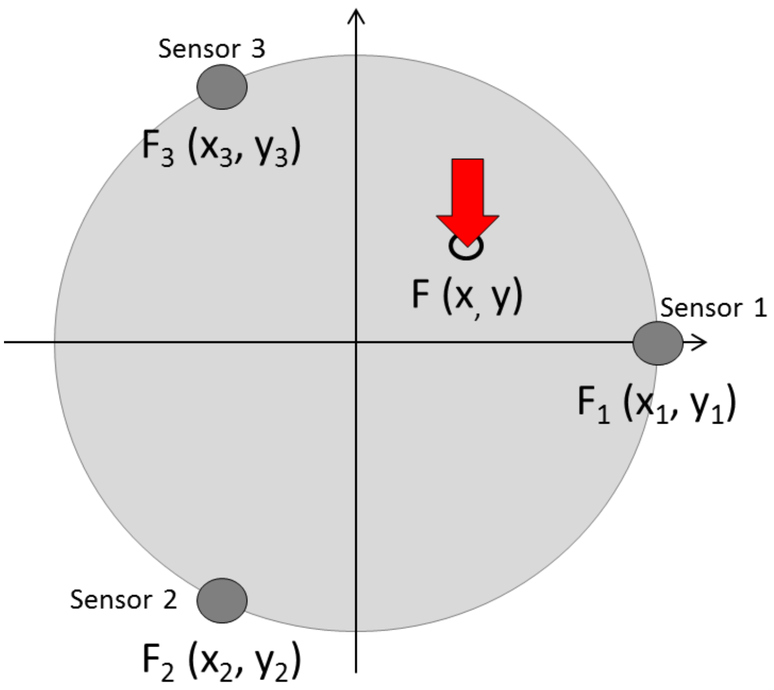
Status: HBM: Public

Brief description

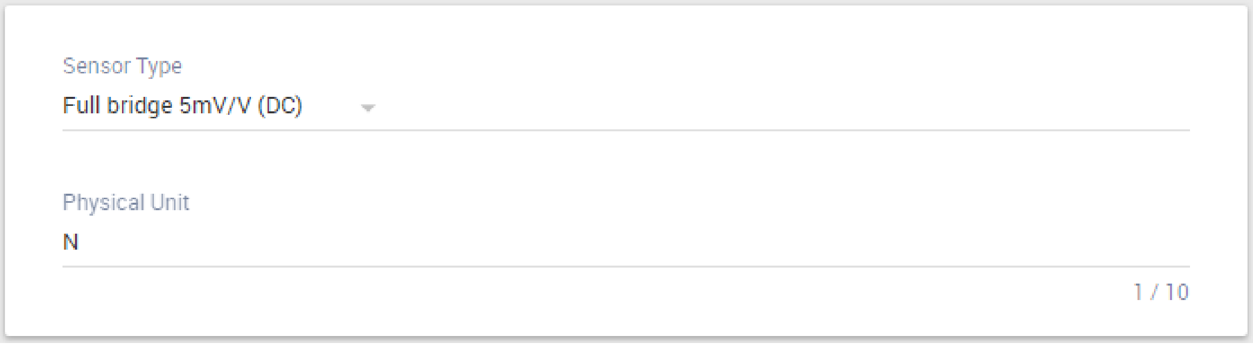
This application is about localizing a force and calculating its result value on a plane surface. Therefor three force sensors are mounted on the bottom of a circular plate. The raw signals from the sensors are further processed by three ClipX measurement amplifiers. Those communicate with each other through the ClipX bus technology. The devices are set up with the ClipX WebBrowser. The basic setup is shown in the figure below.



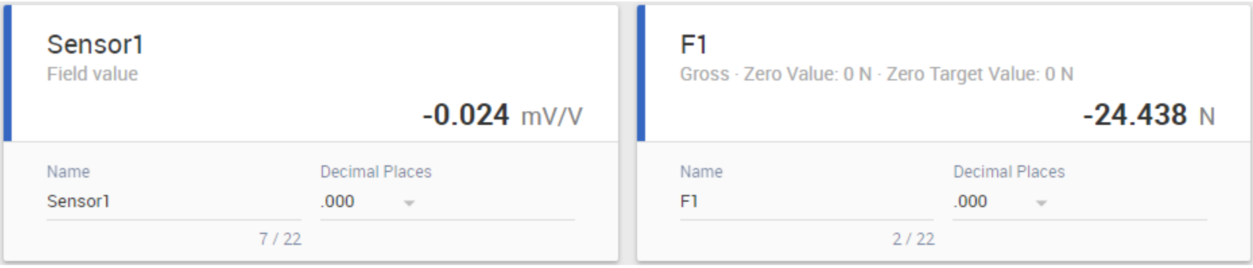


Sensor scaling

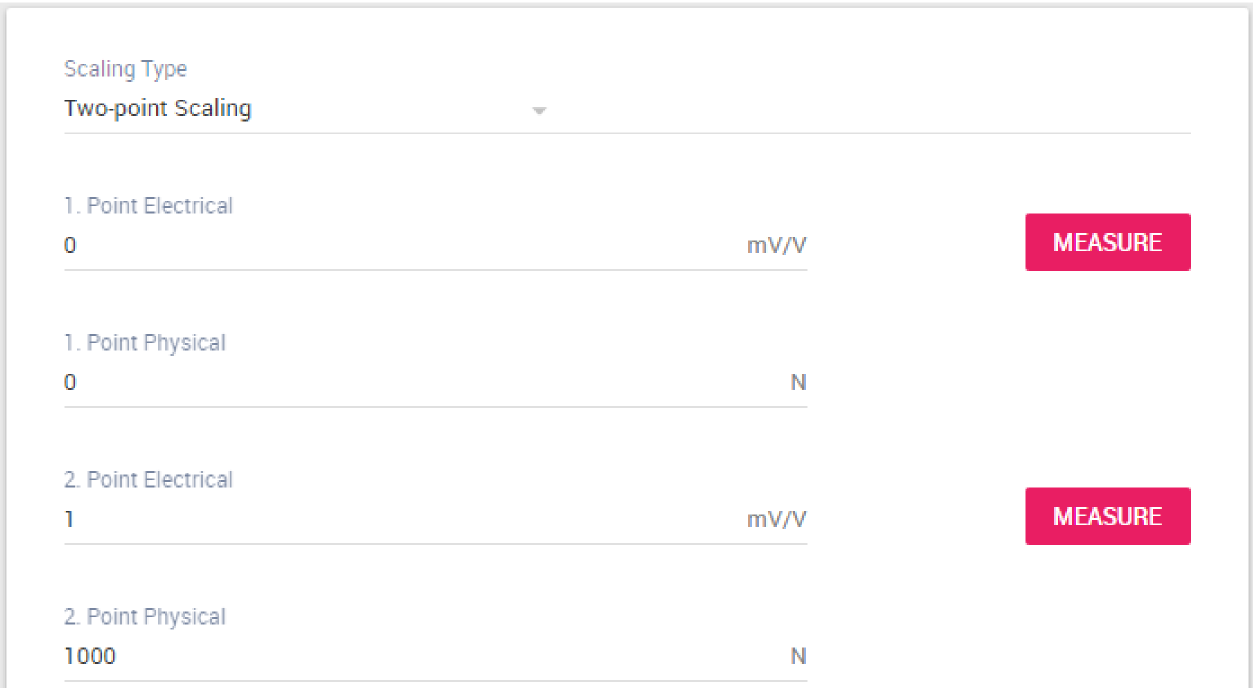
First go to the amplifier section on the left side and select the correct sensor type and physical unit.



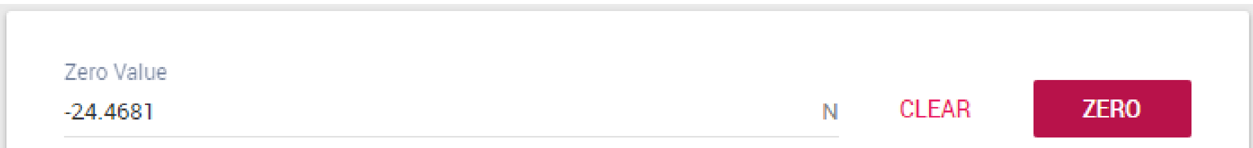
Then give the signal a reasonable name.



Next step is to scale the sensor according to its sensitivity. Look it up on the sensor itself or in its datasheet.

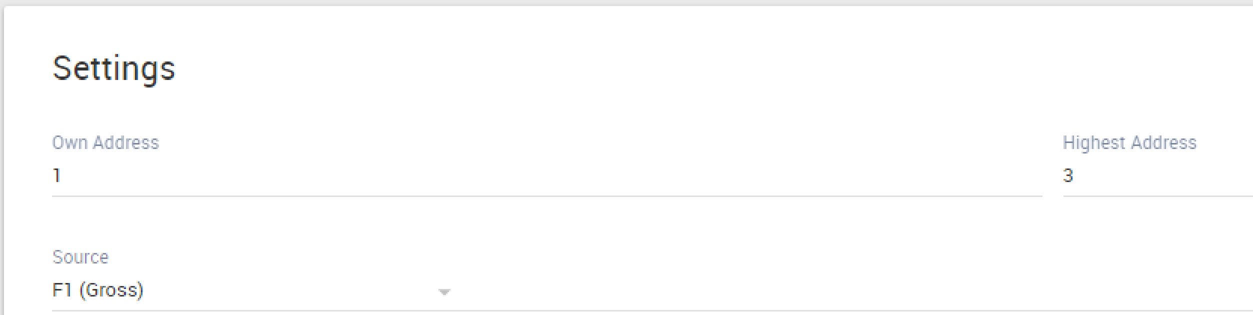


Last step is to set the current value to zero. **Repeat for all three amplifiers.**

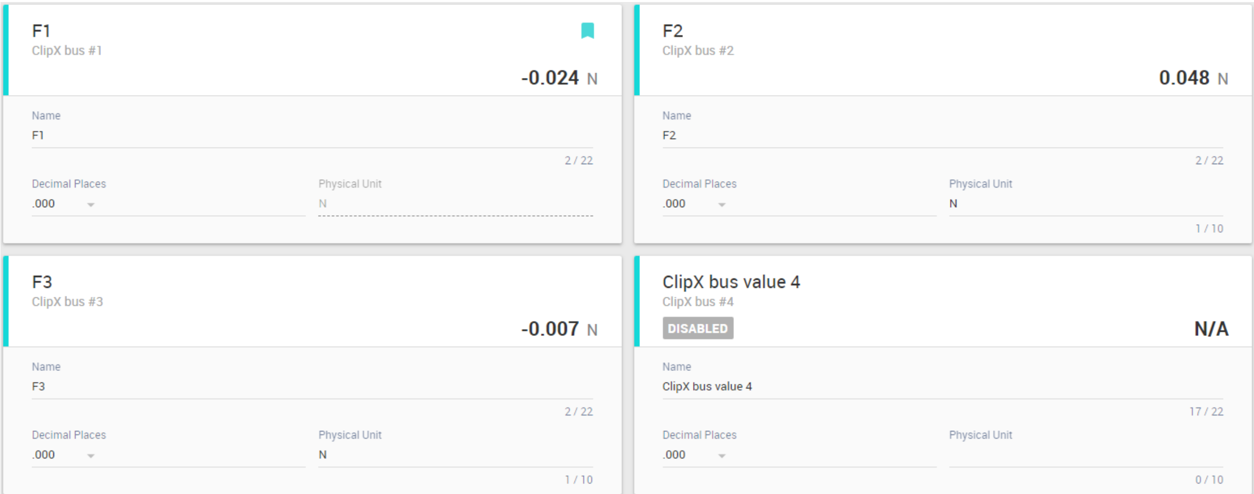


Transmit measurement values via ClipX bus

Go to the ClipX bus section. Give the devices an address (1 to 3). Enter 3 as highest address for all devices. Select the signal that should be sent on the bus as source.



After giving all signals on the bus a name the result looks like this. **Repeat for all three amplifiers.**



Calculate the result signal and its coordinates

The equations below are needed to calculate the force and its coordinates.

The resulting force value F: $$F = F_1 + F_2 + F_3 \qquad \text{eq.1}$$

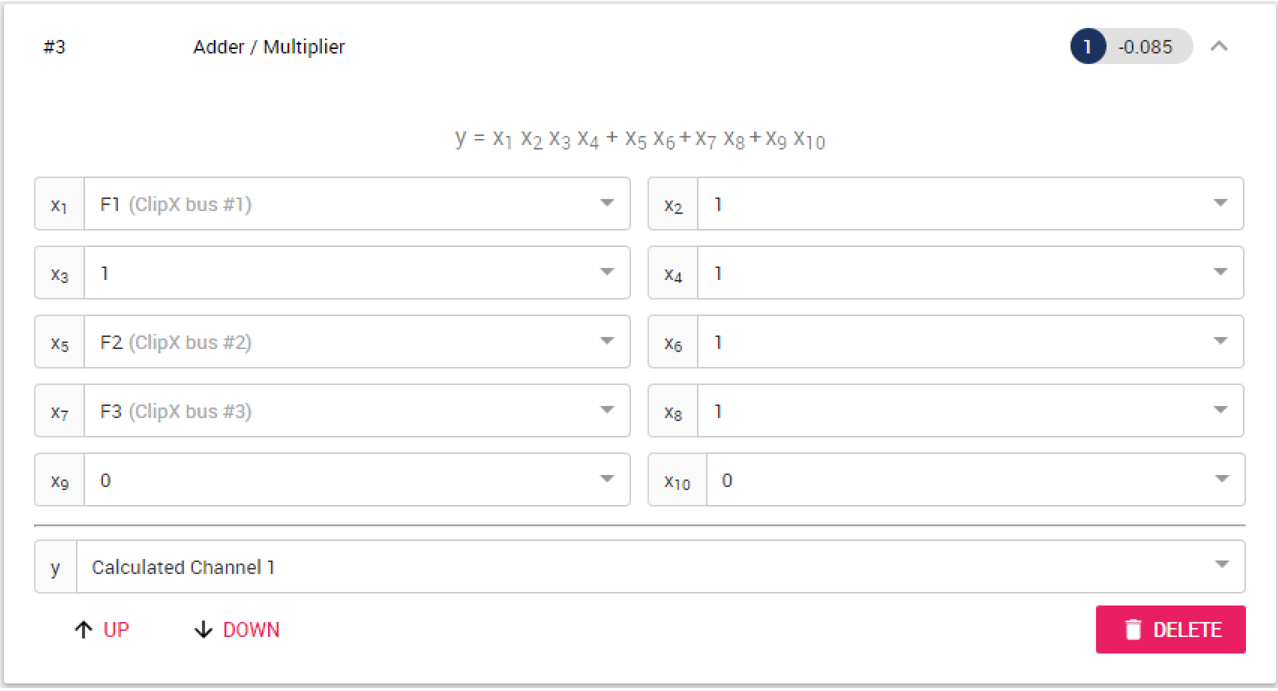
The x-coordinate of F: $$x = \frac{F_1 \cdot x_1 + F_2 \cdot x_2 + F_3 \cdot x_3}{F} \qquad \text{eq.2}$$

The y-coordinate of F: $$y = \frac{F_1 \cdot y_1 + F_2 \cdot y_2 + F_3 \cdot y_3}{F} \qquad \text{eq.3}$$

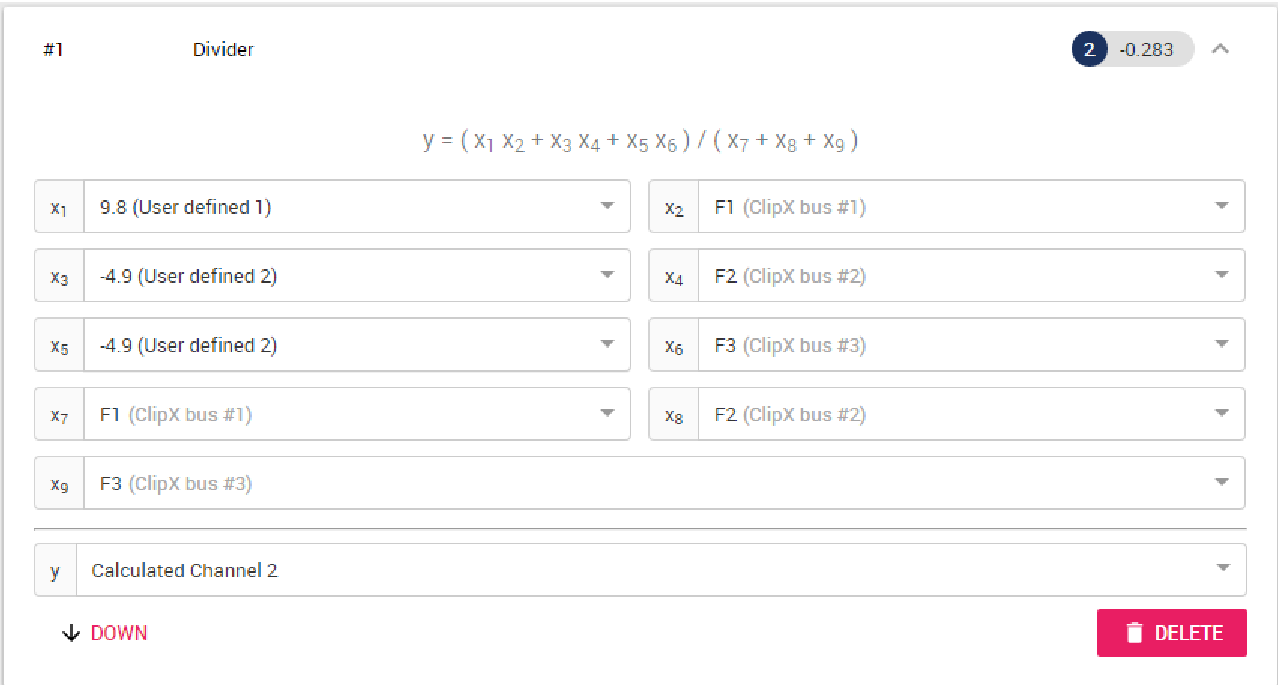
The x-coordinate of each sensor: $$x_n = r \cdot \cos\left(\frac{360°}{n_{max}} \cdot n\right) \qquad \text{eq.4}$$

The y-coordinate of each sensor: $$y_n = r \cdot \sin\left(\frac{360°}{n_{max}} \cdot n\right) \qquad \text{eq.5}$$

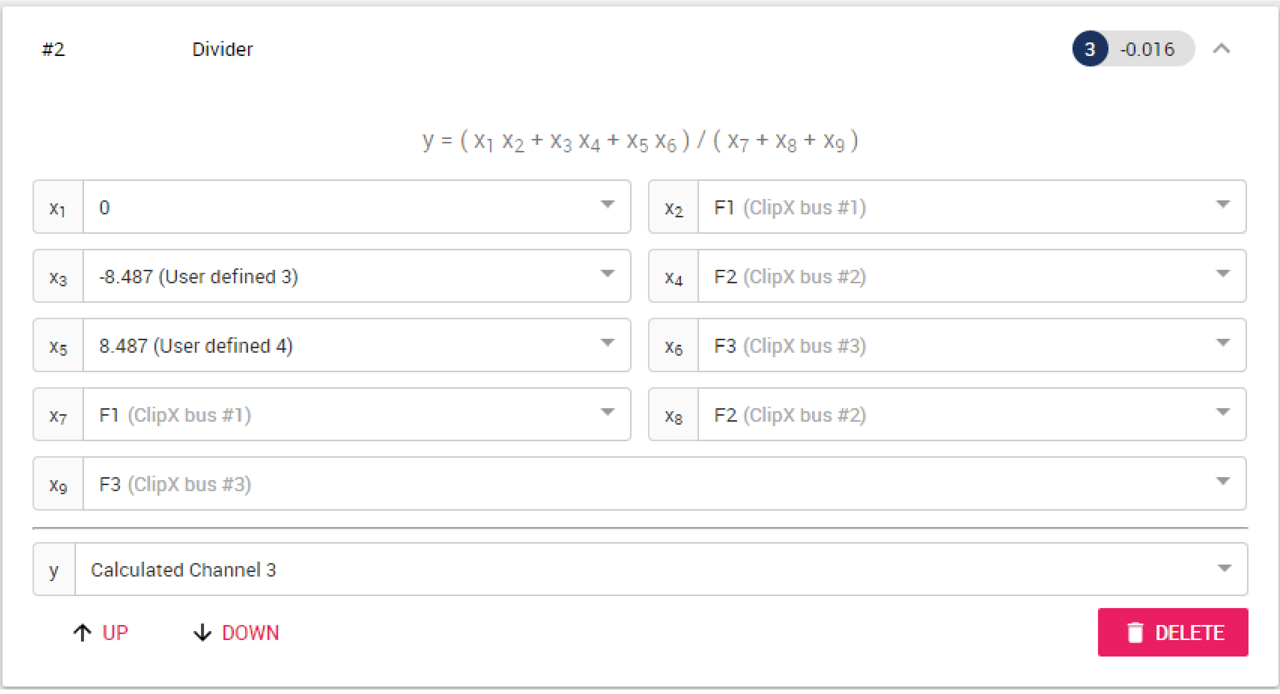
The goal is to locate and define the result force signal. First step is to calculate the summed force by using an Adder / Multiplier in the ClipX calculated channels. Simply enter equation eq.1.



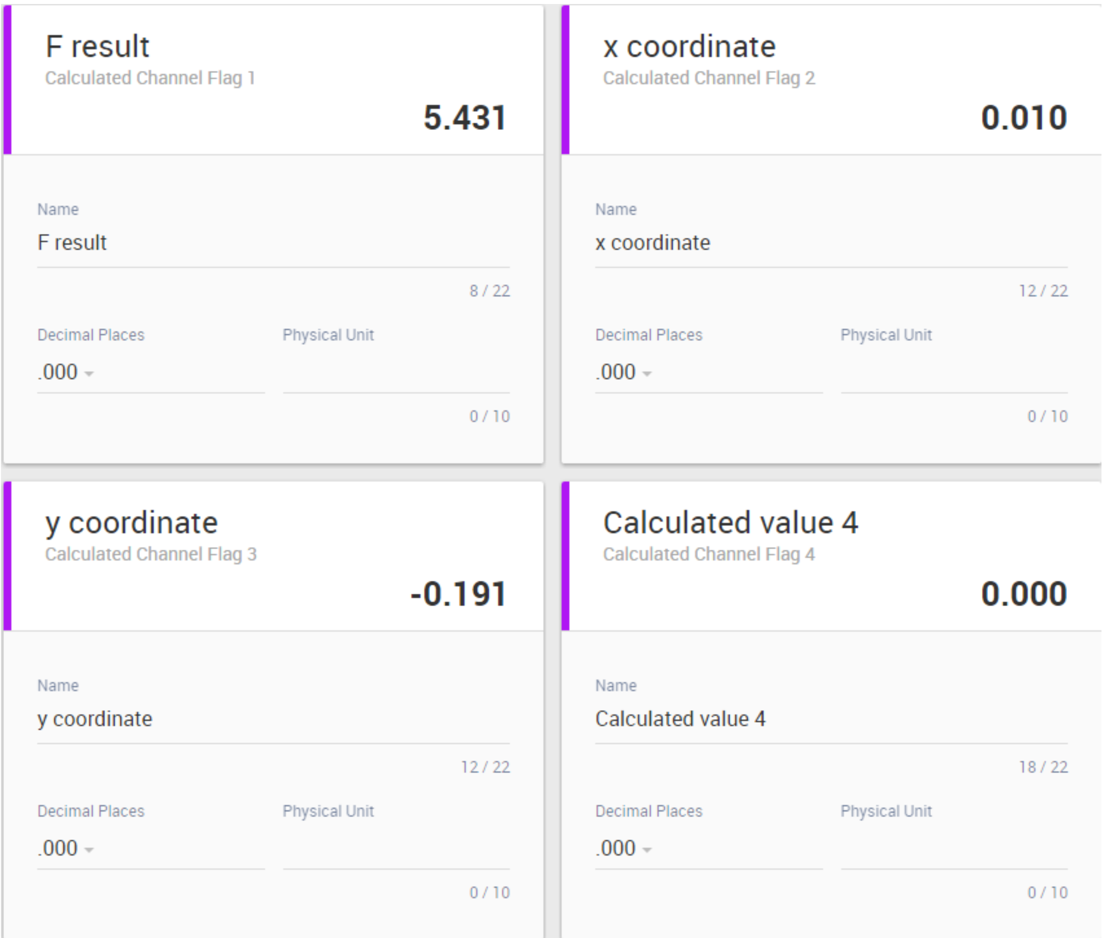
Then finally we want to know where exactly the result force F is coming from. To get the x-coordinate of F equation eq.2 can be entered in a Divider. To get the multiplier constants equation eq.4 has to be calculated before with a pocket calculator. Alternatively, the distances can be measured. **The constants have to be entered on the bottom of the calculated channel page before they can be used.**



Analog to the x-coordinate the y-coordinate is calculated by using equation eq.3 and eq.5.



The result looks like this.



Note: When not applying a force, the values are full of noise. See equation eq.2 and eq.3.

Disclaimer

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