

TECH NOTE - Indirect force measurement

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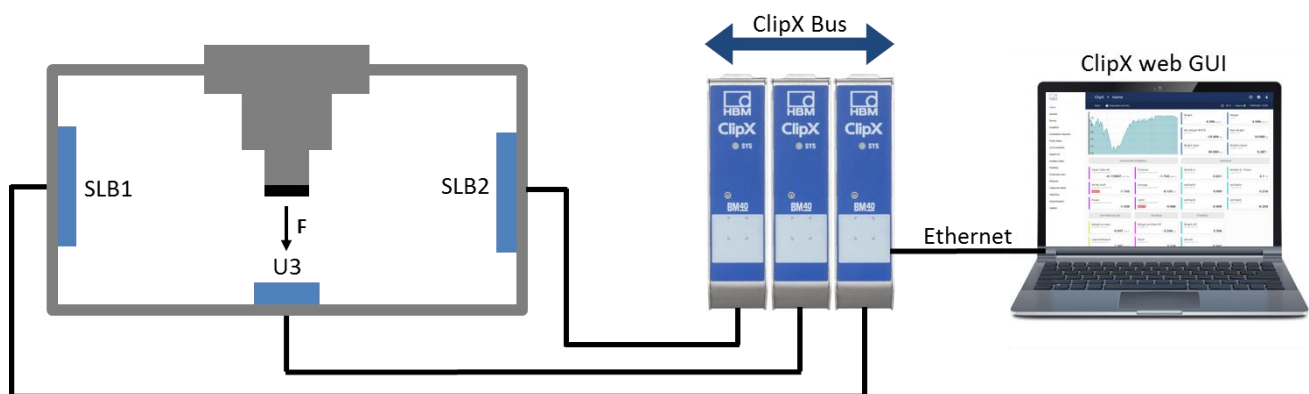
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Status: HBM: Public

ClipX

Brief description

The press model used for this example consists of two strain sensors (SLB) mounted to the left and right leg of a metal frame. Additionally, there is a force sensor (U3) under the punch of the press in the middle. The strain sensors are scaled via the force sensor as reference. So, in fact the pressing force is determined by measuring the strain in the force bypass (indirect force measurement). Every sensor is connected to one of the three ClipX measurement amplifiers. Those amps are connected to each other via the ClipX bus and so are able to exchange and compute measurement values. The setup is shown below.



Measuring the direct force value with U3:

$$F = F_{U3} \quad \text{eq.1}$$

Measuring the indirect force value with both SLBs:

$$F = F_{SLB1} + F_{SLB2} \quad \text{eq.2}$$

Sensor connection and setup

After every sensor is plugged into one ClipX amplifier, open the internet browser of your choice and enter the name or IP address of the first ClipX. When the web GUI has opened, go to the amplifier site. Now select the correct sensor type for the connected sensor (e.g. Full bridge).

Sensor Type

Full bridge 5mV/V (DC) ▼

Physical Unit

N

1 / 10

Enter a physical unit, select the number of decimal places and give the value a reasonable name.

Electrical value Field value <div style="text-align: right;">-0.024 mV/V</div> <table border="1"> <thead> <tr> <th>Name</th> <th>Decimal Places</th> </tr> </thead> <tbody> <tr> <td>Electrical value</td> <td>.000</td> </tr> </tbody> </table> <div style="text-align: right;">16 / 22</div>	Name	Decimal Places	Electrical value	.000	SLB_left Gross - Zero Value: 0 N - Zero Target Value: 0 N <div style="text-align: right;">-0.024 N</div> <table border="1"> <thead> <tr> <th>Name</th> <th>Decimal Places</th> </tr> </thead> <tbody> <tr> <td>SLB_left</td> <td>.000</td> </tr> </tbody> </table> <div style="text-align: right;">8 / 22</div>	Name	Decimal Places	SLB_left	.000
Name	Decimal Places								
Electrical value	.000								
Name	Decimal Places								
SLB_left	.000								

Check that the sensors are unloaded and set the channel to zero.

Zero Value <div style="text-align: right;">-24.4681</div>	N	CLEAR	ZERO
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Repeat for all three amplifiers and sensors

Sensor scaling

Scale the U3 force sensor in the amplifier section. The sensitivity is printed onto the label of the sensor.

Scaling Type Two-point Scaling			
<hr/>			
1. Point Electrical			MEASURE
0		mV/V	
<hr/>			
1. Point Physical			N
0			
<hr/>			
2. Point Electrical			MEASURE
2		mV/V	
<hr/>			
2. Point Physical			N
2000			

Make sure the sensors are without any load. Then go to the scaling settings for both SLBs. Press measure for the first point electrical.

MEASURE

Then put a load onto the sensors by tightening the screw on top of the press frame. The value of the load does not matter. Just keep in mind that big values generate a better accuracy when scaling with a reference.

U3_press_force

Gross - Zero Value: -6.634029 N - Zero Target Value: 0 N

405.364 N

Because the press force is equally split to both strain sensors, enter half the value to scale the second point physical of the SLBs. The corresponding electrical value is then set with the red measure button.

Scaling Type		
Two-point Scaling		
<hr/>		
1. Point Electrical		
-0.219382	mV/V	MEASURE
<hr/>		
1. Point Physical		
0	N	
<hr/>		
2. Point Electrical		
-0.174848	mV/V	MEASURE
<hr/>		
2. Point Physical		
202.682	N	

Afterwards be sure to unload again and set all sensors to zero.

ClipX bus values and calculated channels

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.

Settings	
Own Address	Highest Address
1	3
<hr/>	
Source	
Gross (Gross) -	
<hr/>	

ClipX bus value 1 ClipX bus #1	ClipX bus value 2 ClipX bus #2	ClipX bus value 3 ClipX bus #3
158.928 N	162.714	161.251
<hr/>		
Name	Name	Name
ClipX bus value 1	ClipX bus value 2	ClipX bus value 3
<hr/>		
Decimal Places	Physical Unit	Decimal Places
.000 -	N	.000 -
<hr/>		
17 / 22	17 / 22	17 / 22
<hr/>		
0 / 10	0 / 10	0 / 10

Repeat for every amplifier

Then go to any of the ClipX calculated channel section. Use an Adder / Multiplier to calculate the difference between direct and indirect force value. The equation that must be entered is:

$$\Delta F = F_{SLB1} + F_{SLB2} - F_{U3}$$

Use the ClipX bus values that have been defined before.

#1 Adder / Multiplier 1 0.005 N

$y = x_1 x_2 x_3 x_4 + x_5 x_6 + x_7 x_8 + x_9 x_{10}$

x_1	ClipX bus value 1 (ClipX bus #1)	x_2	1	x_3	1
x_4	1	x_5	ClipX bus value 2 (ClipX bus #2)	x_6	1
x_7	ClipX bus value 3 (ClipX bus #3)	x_8	-1	x_9	0
x_{10}	0				
y	Calculated Channel 1				

DOWN
DELETE

Double-check the difference. The closer the result is to zero, the more accurate the scaling has been.

Sum(Find) - Fdir
Calculated Channel Flag 1

0.078 N

Disclaimer

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