

TECH NOTE :: ClipX Mechanical work

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Brief description

This is a guide to measuring mechanical work with the ClipX. This requires two ClipX modules; one to measure the force, the other to measure the distance. The calculation determines the (mechanical) work over a certain period of time from the two variables force and displacement (or torque/angle of rotation). The force must act along the path.

$$W = \int \vec{F} \, d\vec{s}$$



figure 1: measurement force, displacement; Calculation work



Preparations

The following materials are required to perform the measurement:

- 2 ClipX-systems
- Force transducer (here: HBM U9B)
- transducer (here: Novotechnik T25)
- 3 ethernet cables (two to connect the ClipX with the switch; one to connect your pc)
- Switch
- 2 connecttion cable: sensor ←→ClipX

Each ClipX has to be connected to one sensor and both of them must be connected to the switch.

Builduing sketch



Note: The measured force must have the same direction as the displacement.

Presettings in the ClipX

To be able to work with both signals on one ClipX, a few settings have to be made.

In menu item "ClipX-Bus" of one of the two devices, the own address must be set to "1" and the highest address to "2". As source, we select our required signal (here: transducer signal).

ClipX > C	ipX Bus										? ∉
ClipX-1 (1.2.0)	Default name	of parameter set	: (01)				0	52 % State	us: 🔵	EtherNet/IP.	STAND B
Cattings											
Settings											
Own Address					Highest Address						
1					2						
Source											
Source Novotechnik T25 Disp	a (Brutto)										~
Source Novotechnik T25 Disp	a (Brutto)										Ŧ
Source Novotechnik T25 Disp	a (Brutto)										~
Source Novotechnik T25 Disp displacement	a (Brutto)				force						~
Source Novotechnik T25 Disp displacement ClipX bus	a (Brutto)				force ClipX bus						~
Source Novotechnik T25 Disp displacement ClipX bus	a (Brutto)			0.000 cm	force ClipX bus					-0.1	• 04 kt
Source Novotechnik T25 Disp displacement ClipX bus	a (Brutto)			0.000 cn	force ClipX bus					-0.1	04 ki
Source Novotechnik T25 Disp displacement ClipX bus	a (Brutto)			0.000 cn	force ClipX bus					-0.1	04 k
Source Novotechnik T25 Disp displacement ClipX bus Name displacement	a (Brutto)			0.000 cm	force ClipX bus Name force					-0.1	• 04 k
Source Novotechnik T25 Disp	a (Brutto)	Physical I	nit	0.000 cm	force ClipX bus Name force			Physical Unit		-0.1	• 04 kl
Source Novotechnik T25 Disp displacement ClipX bus Name displacement Decimal Places on	a (Brutto)	Physical U	nit	0.000 cm	force ClipX bus Name force Decimal Place	15		Physical Unit kN		-0.1	04 k

In the second ClipX the own address must be set to "2" and the highest address to "2". As source, we select our required signal (here: force transducer signal).

ClipX >	ClipX Bus				◇ ⑦ ⊕
ClipX 📔	Default name of parameter set (01)			O 50 % Status	Fieldbus: Off
Settings					
Own Address			Highest Address		
2			2		
Gross (Gross)	v				
displaceme ClipX bus #1	nt		force ClipX bus #2		
		-0.106			-1.580
Name displacement			Name force		
		12/22			5 / 22
.000 v	Physical Unit		.000 V	Physical Unit	
		0/10			

In this menu, names are assigned to the two buses for a better overview (here: force, displacement; yellow framed).

Now both ClipX-systems can work with the signal of the other.

Measurement of the mechanical work

Settings in the ClipX

At first, in the menu item "Calculated Channels" a new function block with type "Physical work" must be added.

	Calculated Channels					+ 2	¢ 0
ClipX-1 (1.2.0)	E Default name of parameter set (01)				O 51 %	Status: 🌒 Eth	herNet/IP: STA
Function Blo	ocks						
Order Fur	ction					R	Result Channel
#1 Phy	rsical work						
#1 Phy Sources	sical work						Ou
#1 Phy Sources Force	sical work		Work	-			Ou
#1 Phy Sources Force Distance	sical work 0 0	`	Work Work Max	-			Ot
#1 Phy Sources Force Distance Start with	sical work 0 0 0 0 0		Work Work Max Force Max	-			Ot

Now the sources are defined:

• <u>Force:</u> Here you select the ClipX-Bus on which the force signal resides (here: named as "force" in the ClipX-Bus settings).

#1 Phy	ysical work				^
Sources					Outputs
Force	0	~	Work	-	~
Distance	Electrical Value (Feldwert) Novotechnik T25 Displa (Brutto)	^	Work Max	-	~
Start with	Net (Netto) Analog Output (Analogausgang)		Force Max	-	~
Stop with	Spitzenwerte Minimum (Minimalwert)		Displacement Max	-	~
↓ DOWN	Maximum (Maximalwert) Peak to Peak (Spitze-Spitze)				Telete
	Gehaltene Werte				
#2	Captured Value 1 Captured Value 2				~
	ClipX-Bus				
#3	displacement force	-			\sim
#4	ClipX Bus Value 3 ClipX Bus Value 4				~

- <u>Displacement:</u> Here you select the ClipX-Bus on which the displacement signal resides (here: named as "displacement" in the ClipX-Bus settings).
- <u>Start with:</u> "Digital input 1" is selected here as the start signal (any digital signals are possible here).
- <u>Stop mit:</u> "Digital input 2" is selected here as the start signal



Now the settings look like this:

#1 Phy	vsical work			^	
Sources				Output	S
Force	force	~	Work		
Distance	displacement	~	Work Max		
Start with	Digital input 1	~	Force Max		~
Stop with	Digital input 2	~	Displacement Max		·
↓ DOWN				DELETE	

Now the Outputs are defined:

#1	Physical work			1 0.000 2 0.000 3 0.000 4 0.000 A
Sources				Outputs
Force	force	~	Work	Calculated Channel 1
Distance	displacement	~	Work Max	Calculated Channel 2
Start with	Digital input 1	~	Force Max	Calculated Channel 3
Stop with	Digital input 2	~	Displacement Max	Calculated Channel 4
↓ DOWN				DELETE

The calculated channels can be renamed below for a better overview. Also a physical unit can be added.





Measurement

- The measurement starts with the rising flank of digital input 1
- It is finished with the rising flank of digital input 2
- At start of the measurement all measurement values are set to zero

Visualization

In menu item "Visualization", the signals can be visualized as y(t)-graph, level display or digital display.

This is shown here as an example for a signal. Click the "+"-button to add a new signal and make for example the following settings.



The finished visualization for all signals looks like this:



Disclaimer

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