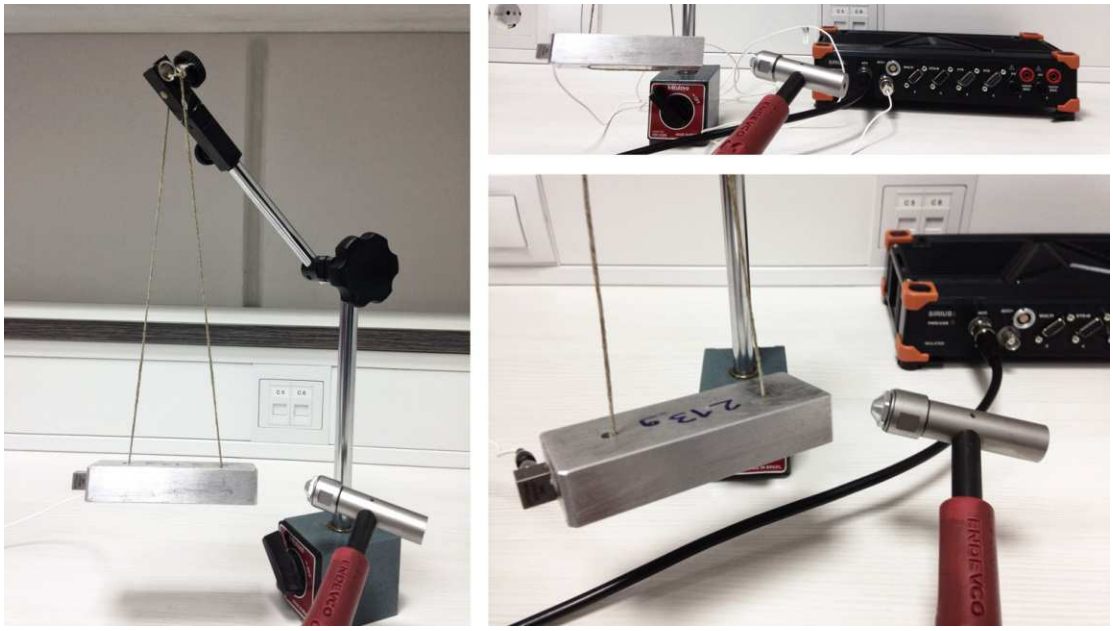
DEWESoft™
measurement innovation

IMPACT HAMMER CALIBRATION

(Document version 1.0)

For impact hammer calibration we will use an accelerometer, known mass, hammer and DEWESoft SIRIUS with 2 ACC (for hammer and accelerometer). Configuration is shown on the picture below:



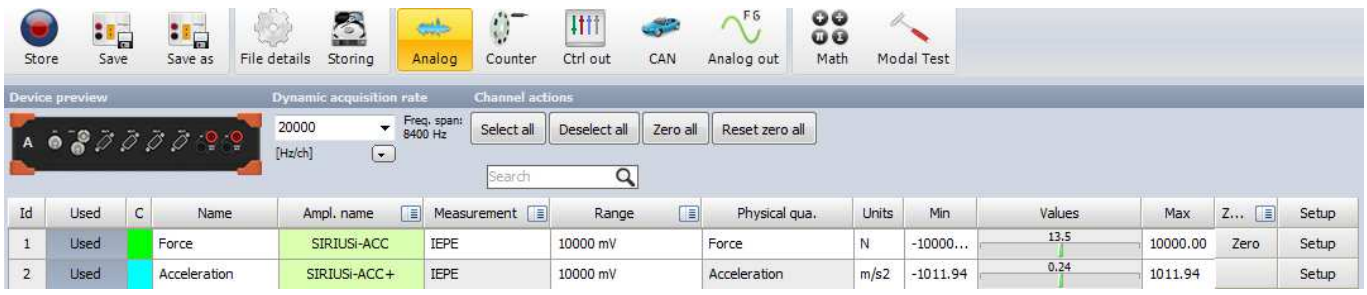
Basic equation is 2. Newton's law: $\boldsymbol{F} = \boldsymbol{m} * \boldsymbol{a}$, where F is force $[N]$, m is mass [kg] and a is acceleration [m/s^2]. Acceleration sensor gives signal in [mV], so to get physical quantity in [m/s^2] we have to change equation:

$$\frac{V_F[mV]}{S_F[mV/N]} = m\ [kg]\ \frac{V_a[mV]}{S_a[mV/(m/s^2)]}$$

Where V_F is a signal from hammer, V_a is a signal from accelerometer, S_F is sensitivity of a hammer and S_a in a sensitivity from accelerometer. For proper hammer calibration we have to calculate his sensitivity S_F – all other parameters are known.

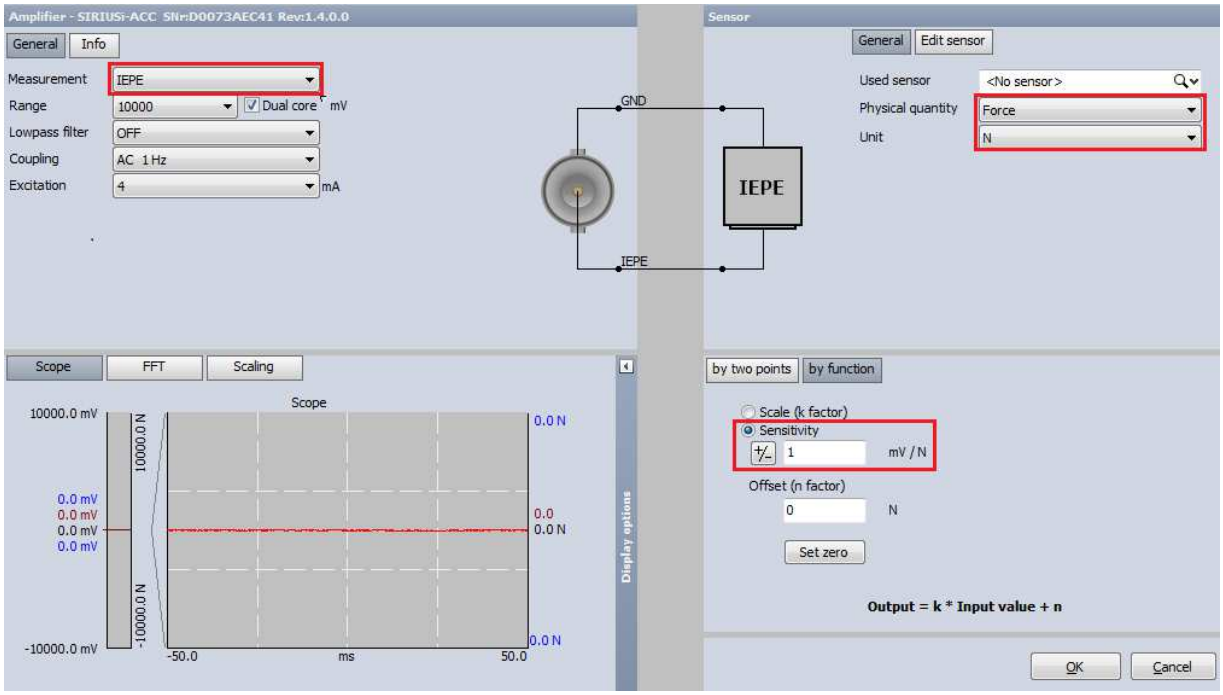
$$S_F = \frac{S_a}{m}\ \frac{V_F}{V_a}$$

We open DEWESoft and in *Channel setup* we can see our sensors.

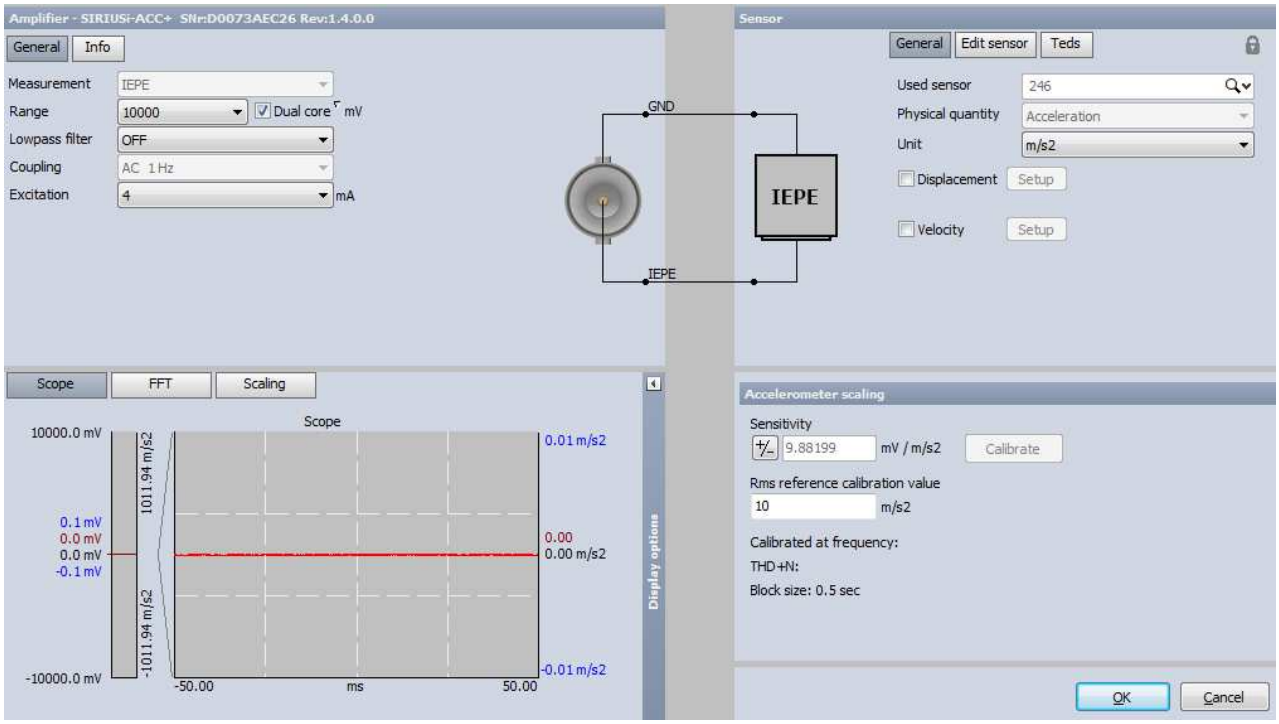


Id	Used	C	Name	Ampl. name	Measurement	Range	Physical qua.	Units	Min	Values	Max	Z...	Setup
1	Used		Force	SIRIUSi-ACC	IEPE	10000 mV	Force	N	-10000...	13.5	10000.00	Zero	Setup
2	Used		Acceleration	SIRIUSi-ACC+	IEPE	10000 mV	Acceleration	m/s2	-1011.94	0.24	1011.94		Setup

I have hammer on Channel 1 (Force) and accelerometer on Channel 2 (Acceleration). We click on setup for channel 1 – in general we choose IEPE and our physical quantity is Force. Sensitivity is what we are looking for (we leave it at 1).

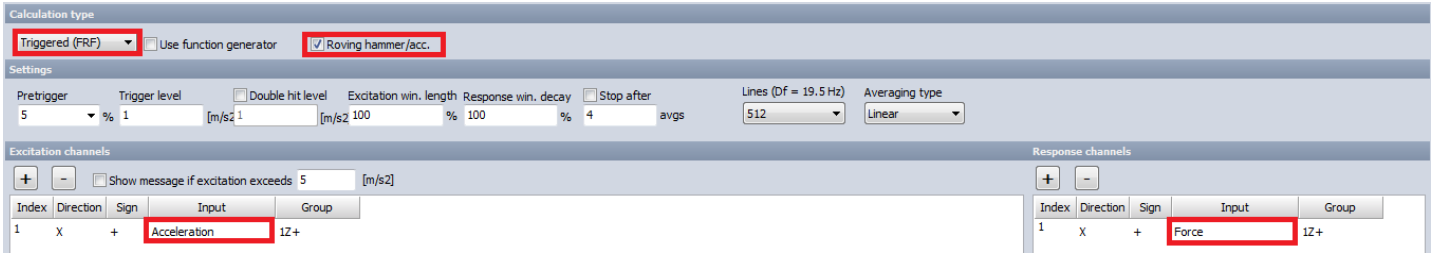


In setup for channel 2 we can see that our accelerometer is already scaled properly and we don't need to change anything.



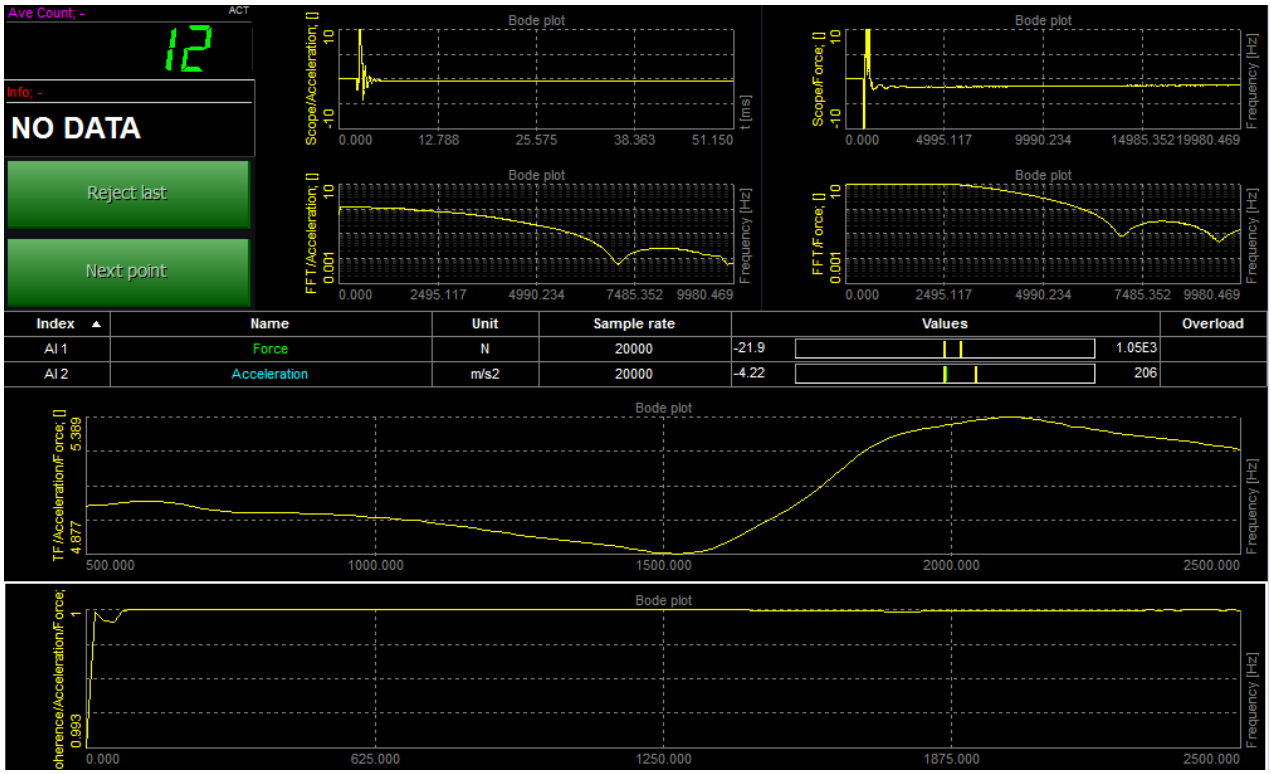
We click on Modal test plug-in.

We choose Triggered (FRF), and Roving Hammer/acc. It is very important what we choose for Excitation and Response channel. Transfer function is a ratio of signal amplitudes and it is defined as output/input. From equation for sensitivity S_F we can see that we need a transfer function V_F/V_a, so for Excitation channel we choose Acceleration and our Response channel is Force.

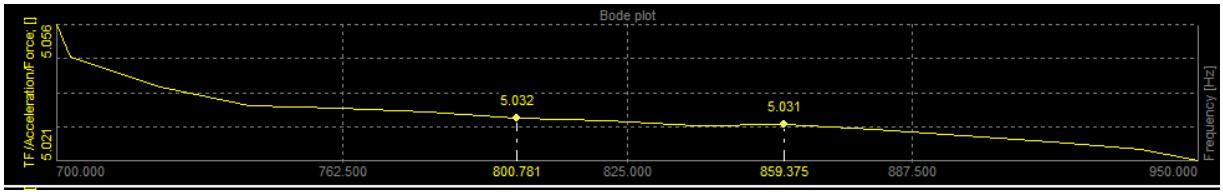


We go to Measure and click on automatically generated Modal Test:

We are doing this to obtain our transfer function and see in which area the transfer function in linear. We hit the mass with the hammer several times. We can see the transfer function:



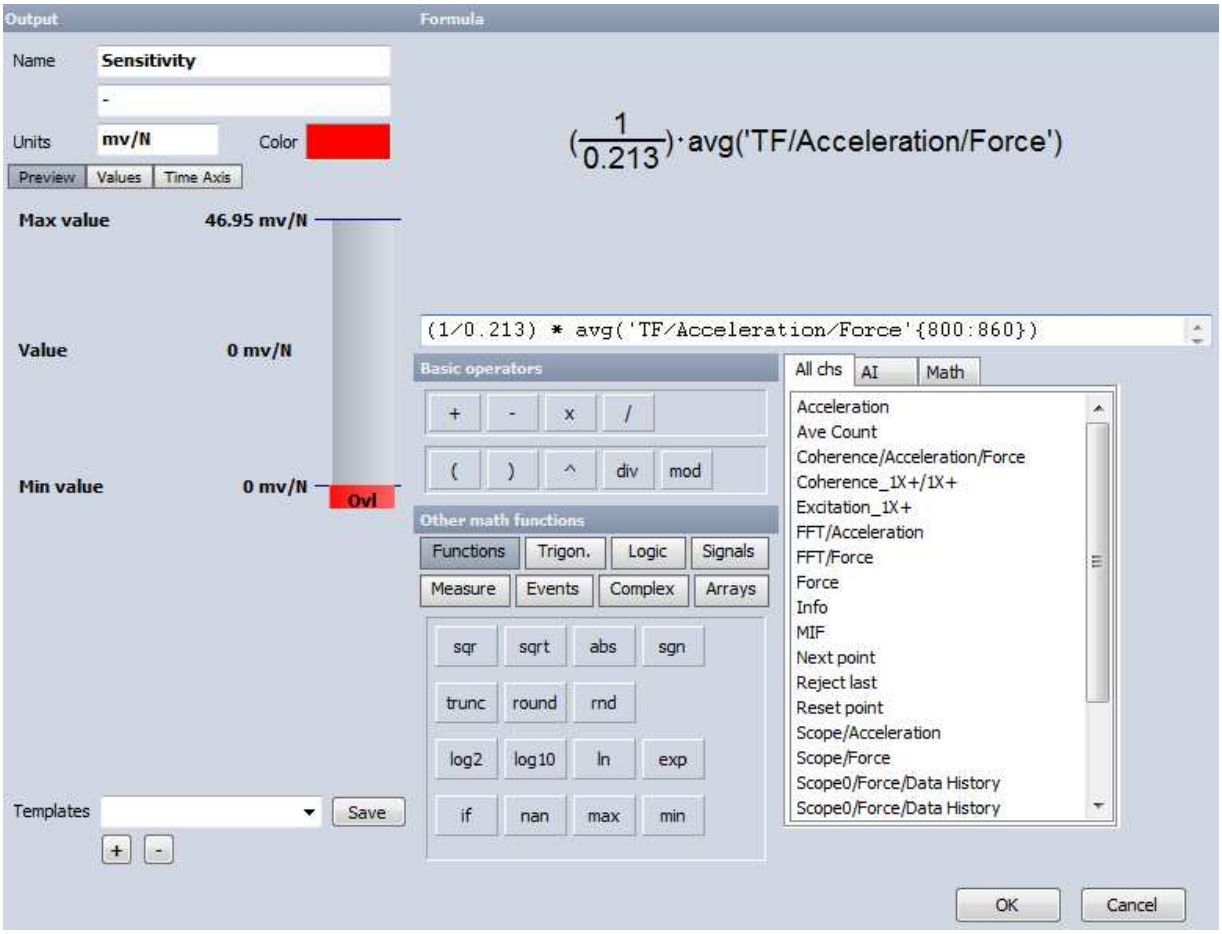
We zoom in the transfer function and we can see that it is approximately linear in area from 800 Hz to 860 Hz (different tips of the hammer have different linear areas !!).



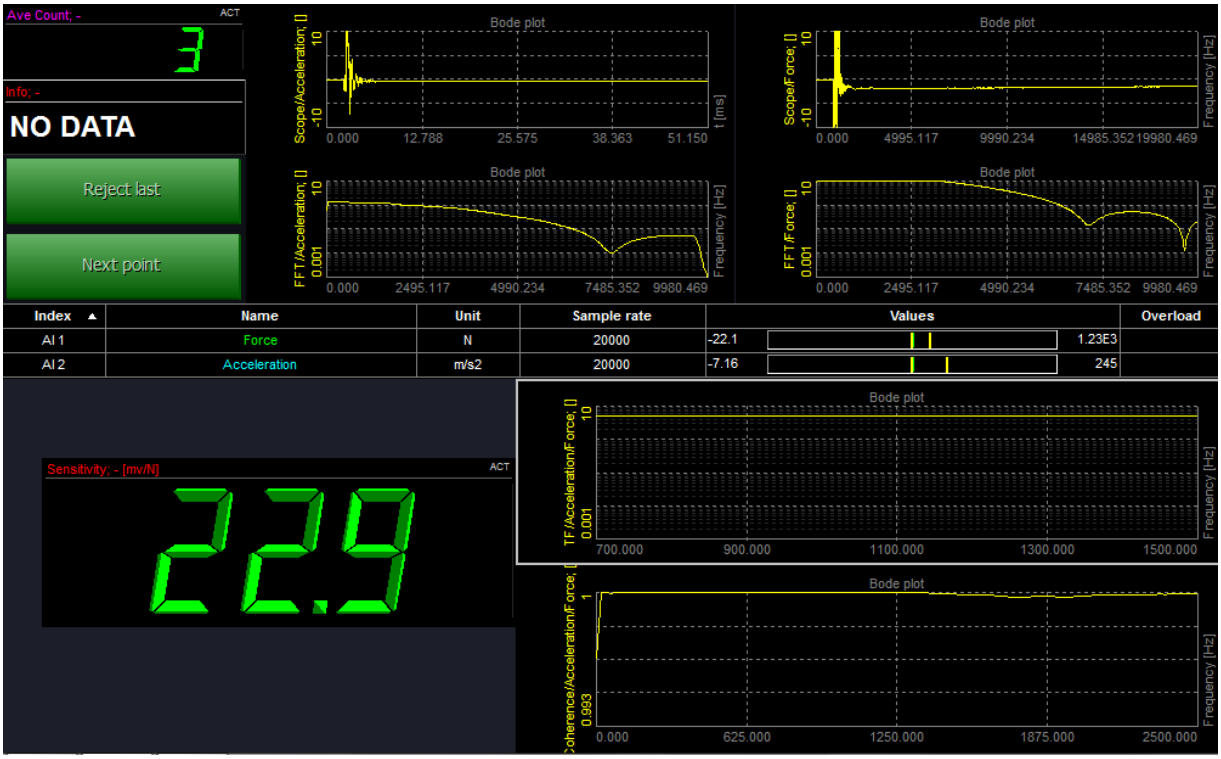
We go back to Channel setup and click on Math:

We will make a formula for hammer's sensitivity.

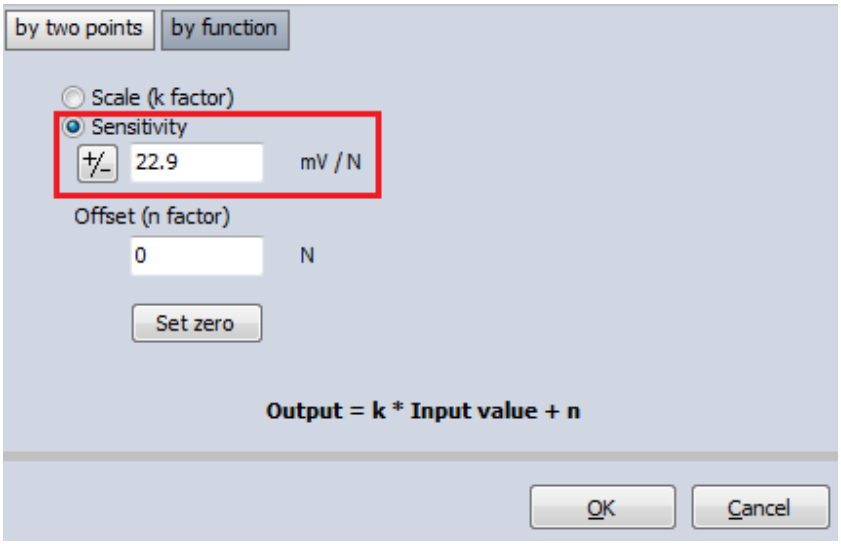
Formula for sensitivity of a hammer is already written for S_F. Accelerometer is already scaled so we don't have to put the S_a factor in equation (S_a = 1). First we divide with mass (in my case 213 g or 0.213 kg) and then we take an average of our transfer function V_a/V_F on an interval from 800 Hz to 860 Hz (transfer function must be linear).



Then we go back to Measure, select a free Display meter in Design and put our formula for Sensitivity on it. The number which is shown is our result.



Sensitivity of our hammer is 22.9 mV/N. We use this information in Setup at Channel 1.



Now our impact hammer is ready to use.