Discom Calibration

How to calibrate sensors in the
Discom TasAlyser application

www.discom.de

HBK
HOTTINGER BRÜEL & KJÆR

Calibration

The TasAlyser measurement application includes a semi-automatic **calibration function**.

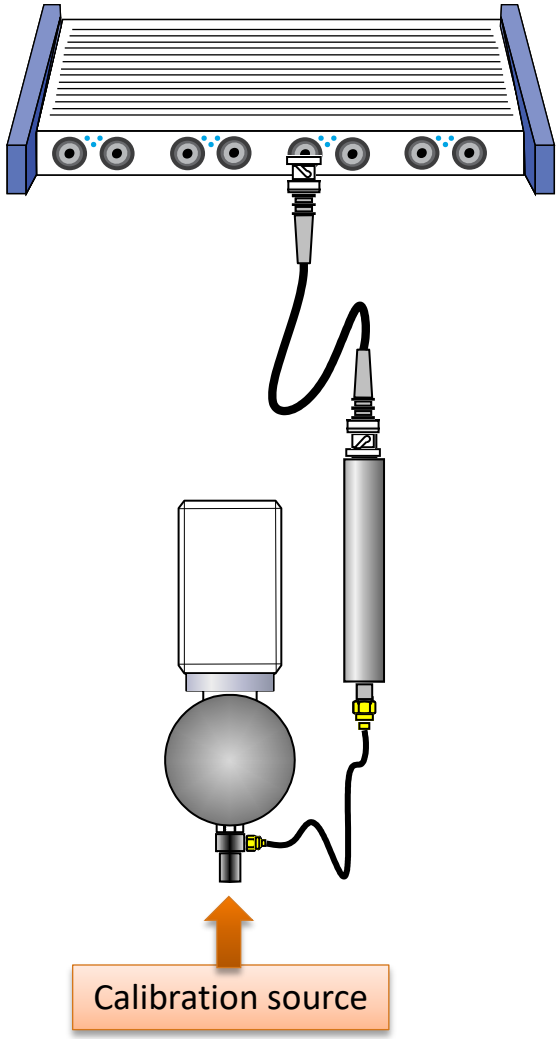
Calibration applies to the complete measurement chain including sensor, amplifier and A/D converter.

The result is the **calibration factor**, which converts a voltage detected by the A/D converter into a physical value (e.g. in m/s^2 or g) which is measured by the attached sensor.

To calculate the calibration factor, a calibration signal of known quantity is necessary. This signal is generated by a **calibration source**, for example a handheld shaker which produces a vibration with exactly 9.81 m/s^2 peak.

The properties of the calibration source have to be entered into the measurement system, so the calibration function knows the reference value and can calculate the factor.

To perform the actual calibration, the calibration control function is started and then the calibration source applied to the sensor. The measurement system will detect automatically the presence of a valid signal and calculate the calibration factor.



Calibration Step by Step

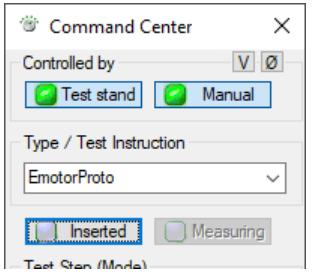
The calibration procedure consists of the following steps:

1. Start A/D converters (initiate a “test run”)
2. Open calibration control window and start calibration
3. Press calibration signal source against all sensors, one by one
4. Check and apply new calibration factors
5. Stop A/D converters (cancel “test run”)
6. Save new settings
7. Project Backup

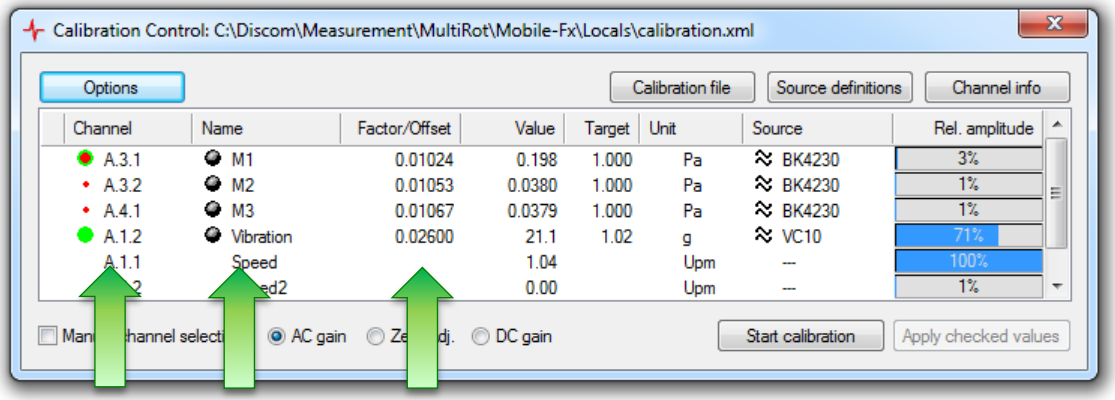
Details about the steps are described on the following pages.

Opening Calibration Control

To perform the calibration, the A/D converters in the TAS box front end must be active. Therefore, manually initiate a test run using the button [Inserted] in the *command center* window or by pressing F5 on the keyboard. (TasAlyser has to load the parameter data base information to know the signal names and properties.)



Then, open calibration control from the *Favorites* window.



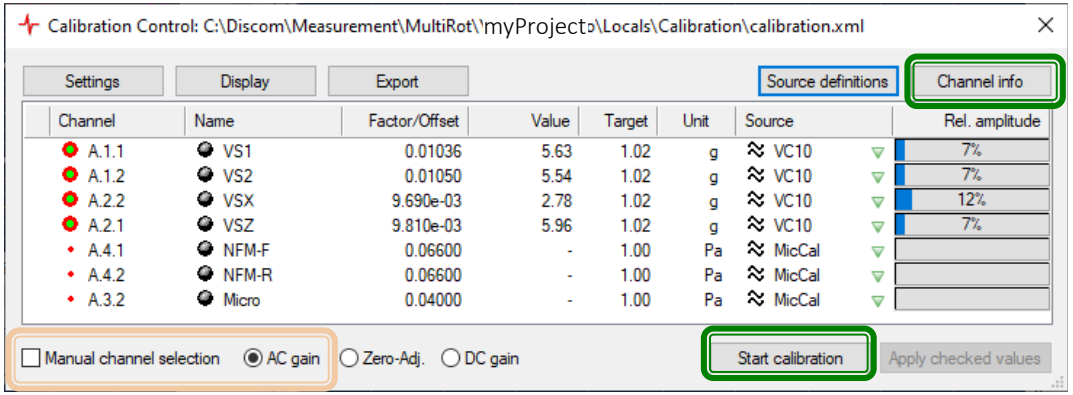
Calibration control shows the TAS box input channels, the assigned signal names and the current calibration factors.

For each sensor you have to specify the calibration signal source (column “Source”) and describe what signal that source provides.
During project setup, according source definitions are prepared and assigned. Changes are only necessary if you switch to a different calibration source.

For details about how to set up calibration signal sources, please read page “Source Definitions”.

Performing calibration

Open the calibration control window and press [**Start calibration**]. From now on, calibration control “listens” on all sensor channels for a calibration signal.



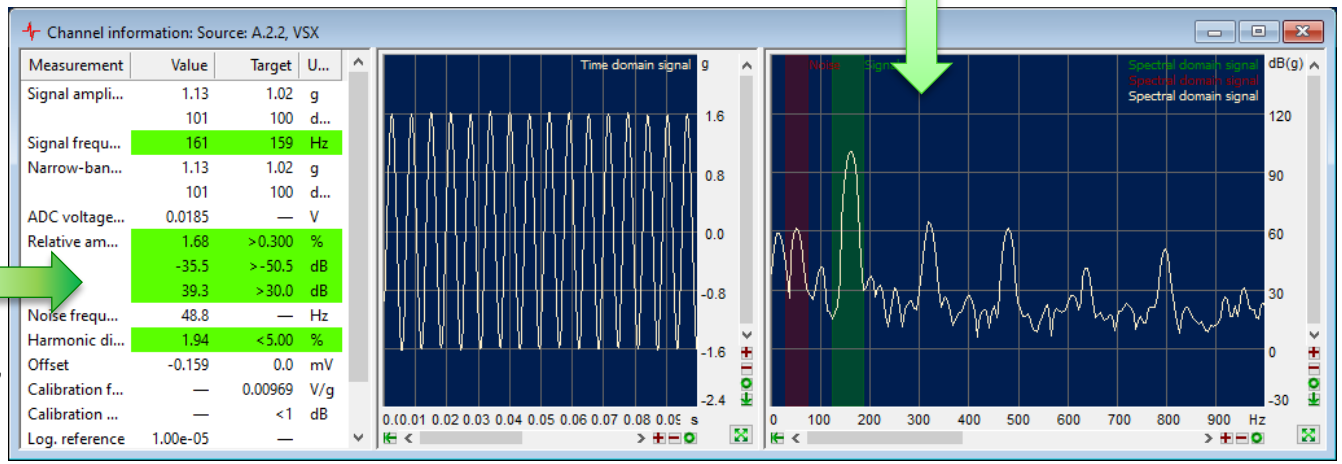
“Manual channel selection” must be switched off and “AC gain” must be selected to enable automatic signal detection.

Press **Channel info** to see the signal and spectrum. Calibration control automatically selects the strongest signal source.

In the spectrum, the detected calibration signal and the strongest noise source are marked.

Press the calibrator source (e.g. shaker) to the sensor. When calibration control detects a “clear” signal, all lines in the channel information table will change to green.

If the signal is stable long enough, a new calibration factor is calculated and then shown in the list in calibration control window.



In Channel Information display you can check whether you have a proper calibration signal. If not, check the sensor and cable connections!

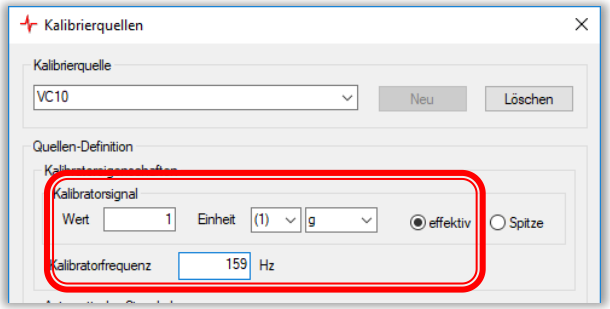
Press [**Stop Calibration**] in the control window when you are done with all sensors.

Typical Accelerometer Calibration

The typical calibration sources for accelerometers produce a signal of 1 g (9.81 m/s²) RMS at a frequency of 159.2 Hz.

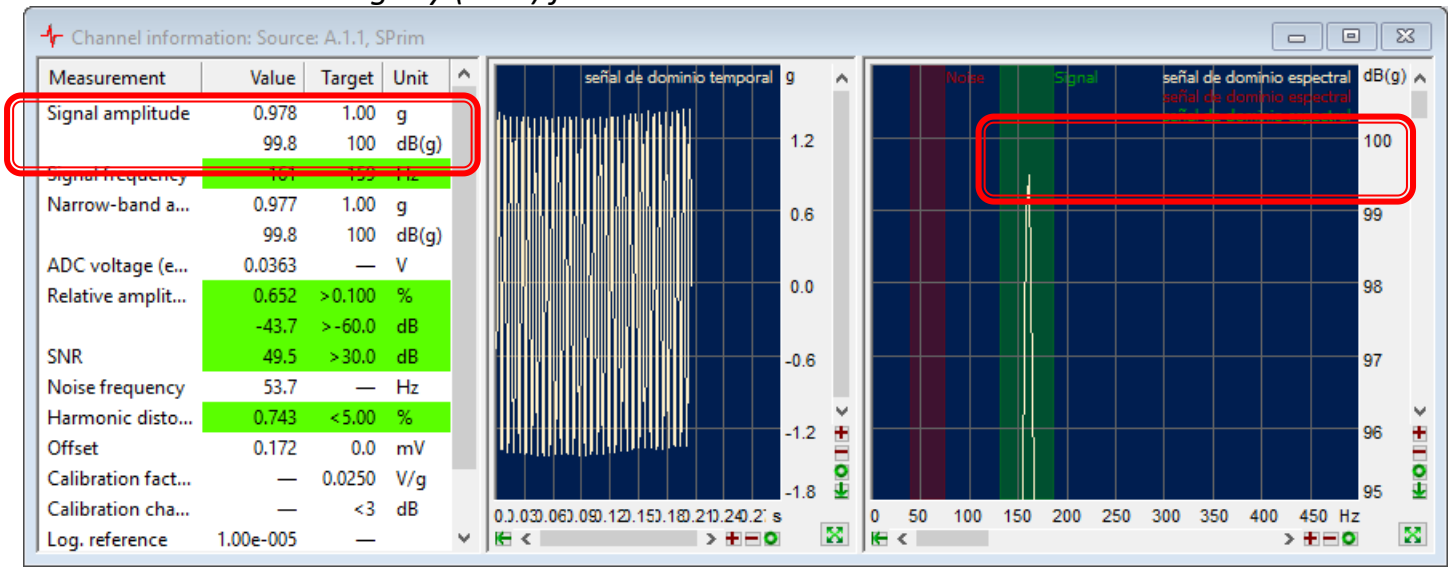
For such sources and the logarithmic reference of 10^{-5}g (standard value), the calibration signal corresponds to exactly 100 dB. You can read this value in the table in the [Channel information] window:

You can read these signal properties in the calibration source definition:



159.16 = 1000/2π

The actual measured value may deviate slightly (±0.3) from 100.



The peak in the spectrum will typically show a lower value than displayed in the table. The reason is the limited spectral resolution of the spectrum shown in the scope window and does not reduce calibration precision.

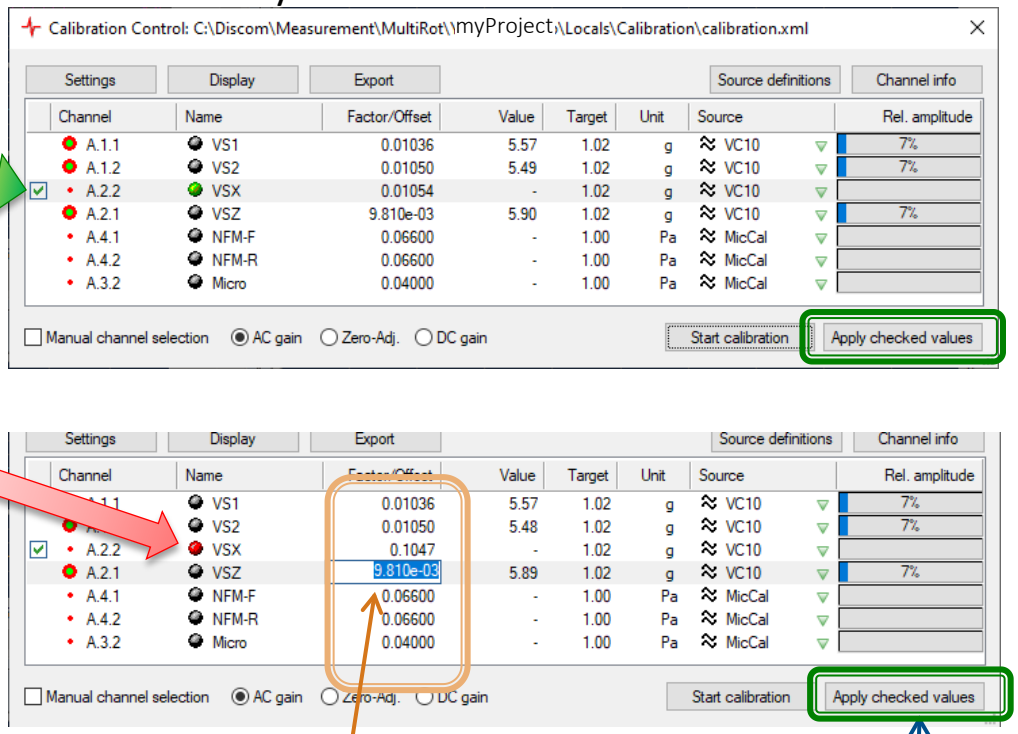
Applying a new calibration

Press [**Stop Calibration**] in calibration control window when you are done with all sensors.

When for a sensor channel the calibration was completed successfully, a green check mark appears in front of that line and the new factor is displayed.

If the new factor deviates from the previous one so much that a difference in the measurement results of more than 3 dB has to be expected, a red bulb and no check mark will appear. You still can set the check manually.

When you are done, press the **Apply selected values** button to activate the new values.



You can enter calibration factors manually. Just click into the according field in the **Factor/Offset** column and enter the desired value. Set the check mark and press the **Apply checked values** button.

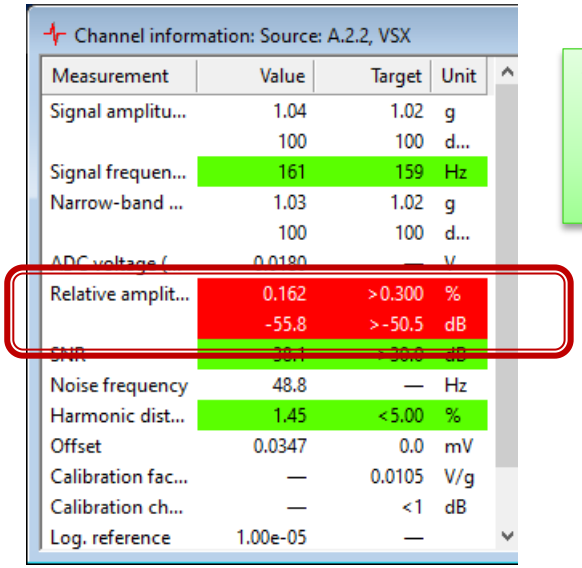
The typical calibration factor of KS91D sensor (BKS03 with amplifier) is about 0,025 V/g, for KS91E sensor (no amplifier) it is about 0.01 V/g, for NFM 0.066 V/Pa.

Adjusting Calibration Source Settings

The Calibration function will only accept a proper and clear calibration signal.

To ensure this, several signal properties are checked, e.g. signal-to-noise ratio, harmonic distortion and relative amplitude.

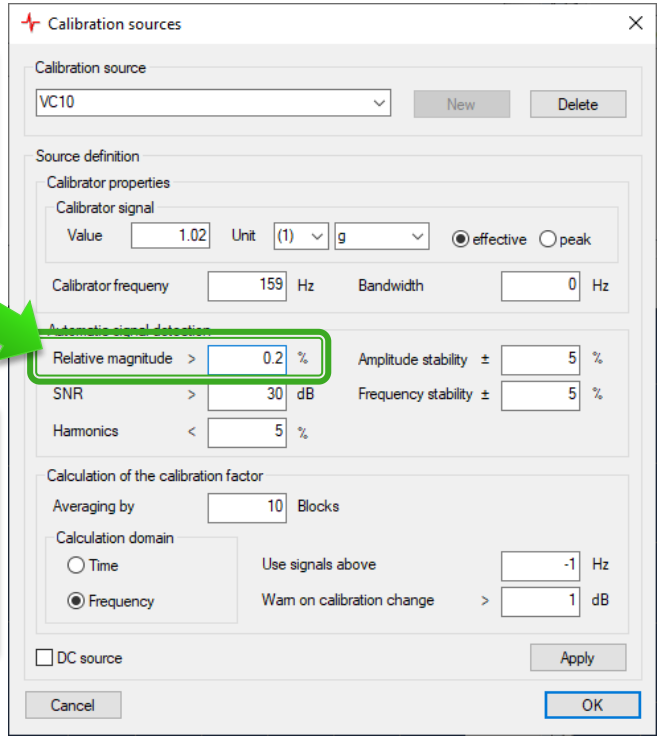
When you get red lines for the “relative amplitude” in the Channel Info window, one possible reason is that the signal from the calibrator device is relatively weak. The Tas Box is typically configured for much stronger (“louder”) input signals than a typical calibrator unit provides, therefore the relative amplitude seems to be too low for calibration.



Changes in the calibration source definition are stored in the Calibration.xml file, so any adjustments need to be done only once.

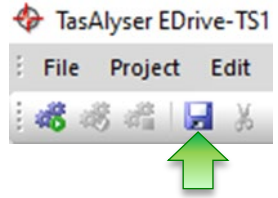
The solution is to change the threshold for “relative magnitude” in the calibration source definition.

Besides relative magnitude, other signal properties like harmonic distortions are also checked, so reducing this threshold is considered safe.



Finalizing Calibration

When [Apply checked values] is pressed in calibration control, the new calibration factors take effect immediately. Additionally, a report documenting the changes is created (see page “Calibration Reports”).



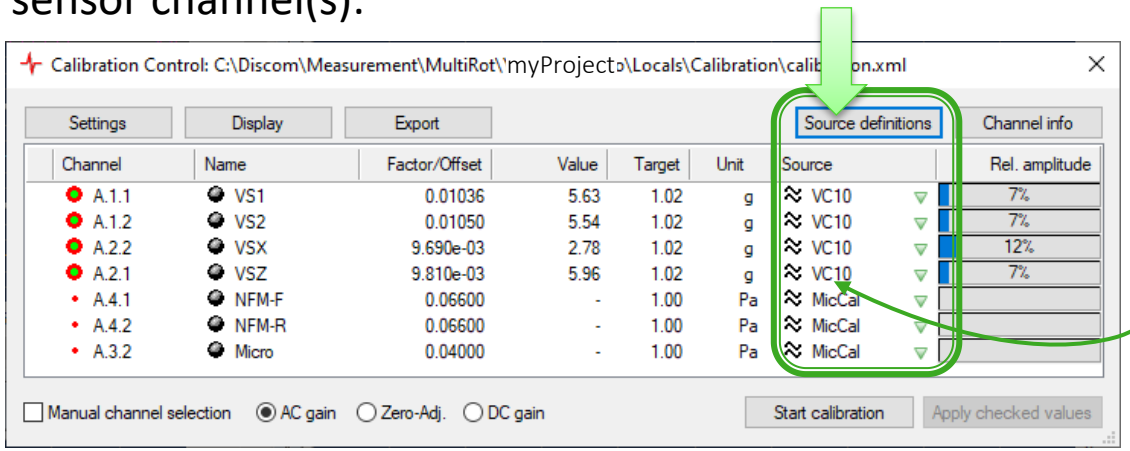
Close the calibration control and channel info windows. Then, press the “Save” button of TasAlyser main window, or call the Save command from menu File.

Cancel the “test run” by pressing F8 or switching off the [Inserted] button in Command Center window. There is also an according button in the TasAlyser tool bar (red symbol, third from left).

We recommend to create a measurement project backup after calibration. On the measurement PC desktop, you will find a folder “Rotas for Experts” and within the “Tas Backup Tool” (also called “Software Maintenance Tool”). Start it and simply press the [Perform Project Backup] button.

Source Definitions

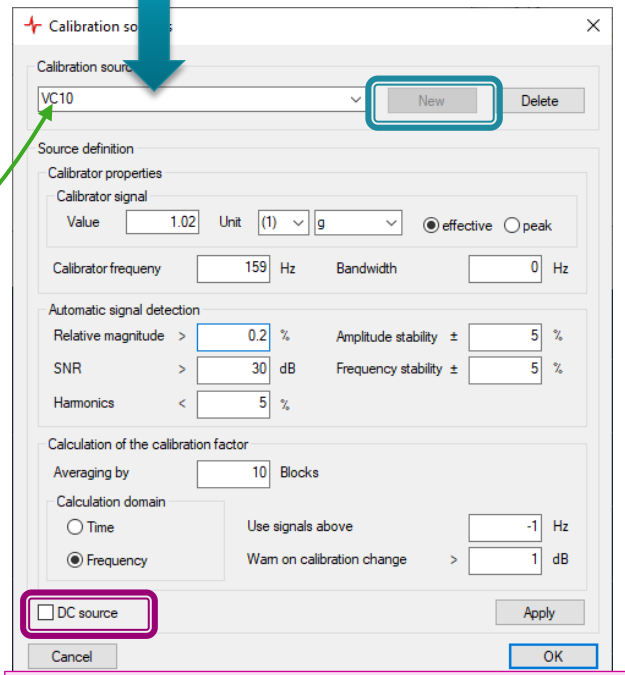
To perform calibration, you first need the external source of your calibration signal.
In the **calibration control** window, you create an according **source definition** and then assign it to the appropriate sensor channel(s):



Each sensor which needs a calibration factor also needs an appropriate source definition (using the correct unit). Therefore, you also have to create and assign source definitions for signals like torque, force, or position, where the calibration factor is not measured but directly entered as a number from a data sheet.

The source definition has to be set up and selected only once, at the first calibration (or when the source is changed).

To create a new source definition, type the desired name into the list text field and press button [New].

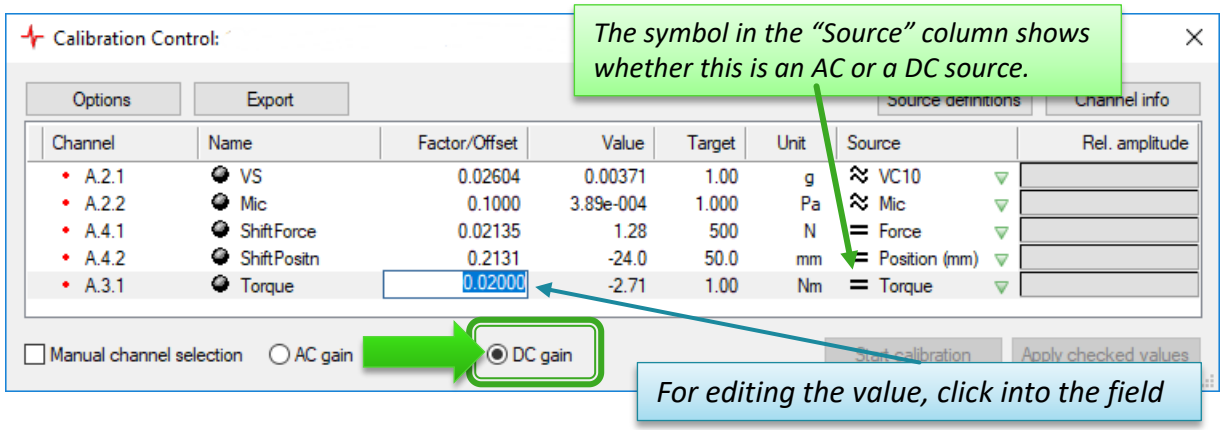


For DC signals like Torque, you have to create a “DC source” definition (see “Calibration for DC Sources” on next page).

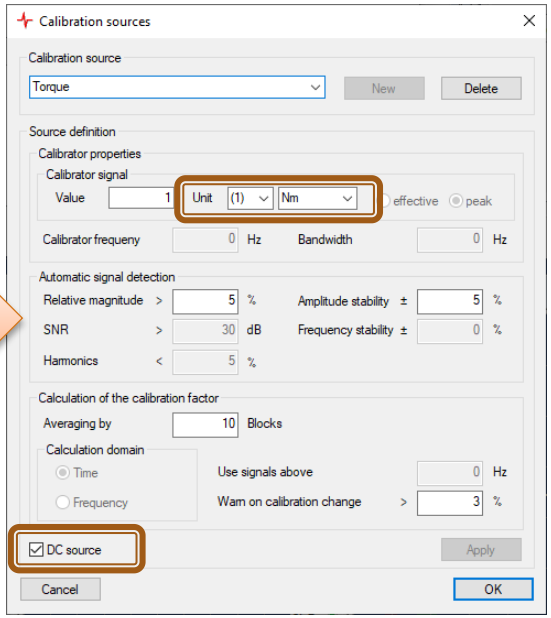
Calibration for DC Sources

Noise sensors like accelerometers, microphones or laser vibrometers generate oscillating voltage (AC signals). Other sensors, for example for torque or force, generate DC voltage signals. For this type of sensors, a **DC Calibration** must be done. In most cases, you will simply enter the calibration factor directly.

Switch to DC Gain below the list in the calibration control window. Now you can enter the calibration factors for DC signal sources:



In this example, according to the data sheet the torque sensor produces 10 Volts at 500 Nm. The calibration factor calculates as 10V ÷ 500 Nm = 0.02 V/Nm.



Although you may be copying the calibration factor directly from the data sheet of your sensor and entering it into the list, you still have to define and assign a valid calibration source. For such source definitions, only the Unit matters.

After entering the values, press the button [**Apply checked values**] in the same way as you do after normal (AC) calibration.

DC Offset Calibration

The A/D converters in the Tas Box have a hardware related voltage offset: even if the input signal is zero, there is a small internal voltage producing a non-zero output value.

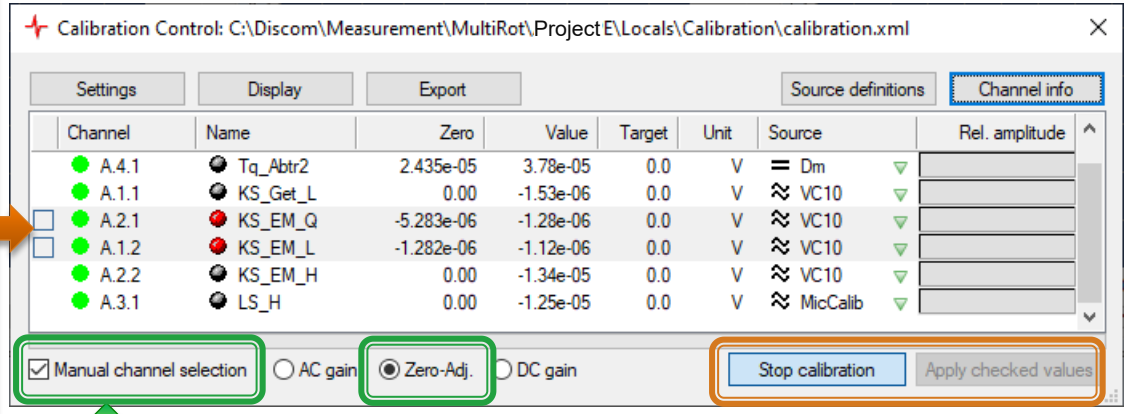
This offset can be compensated with DC offset calibration.

In Calibration Control, below the channel list, switch to “Zero-Adjustment” and activate “Manual channel selection”.

Then press [Start Calibration] button.

Click into the list rows for the sensors you want to calibrate, one by one, and each time wait a moment until the bullet mark turns red and the value in column “Zero” is updated.

Finally, press [Stop calibration], set check marks into all boxes in front of the according list rows, and press [Apply checked values].



Remember to switch off “Manual channel selection” before starting a normal vibration sensor calibration.

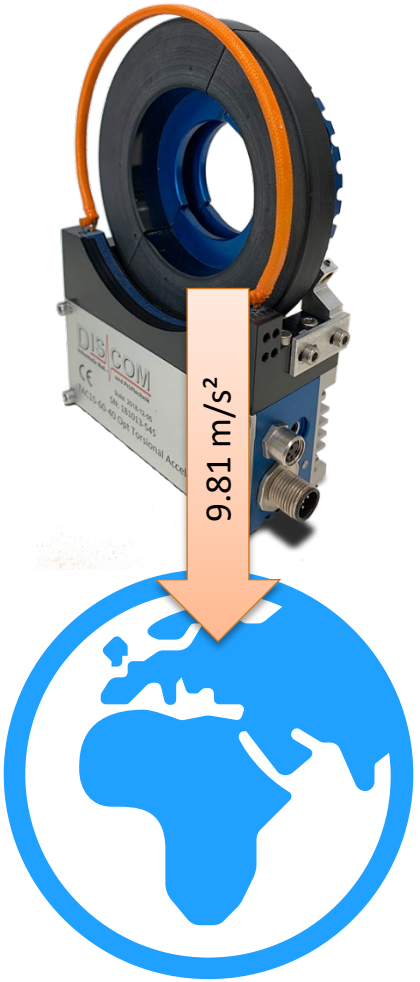
For noise sensors like accelerometers or microphones the DC offset does not influence the results. Vibrations are analyzed for their changes (frequencies), not their absolute values. Nevertheless, a DC offset calibration can be done also for these channels.

For sensors where the absolute value is used (like torque, force, position), a DC offset calibration is recommended.

TAC Calibration

The TAC torsional accelerometer sensor is calibrated by rotating it on a horizontal shaft. The calibration signal source is earth's gravity, 9.81m/s².

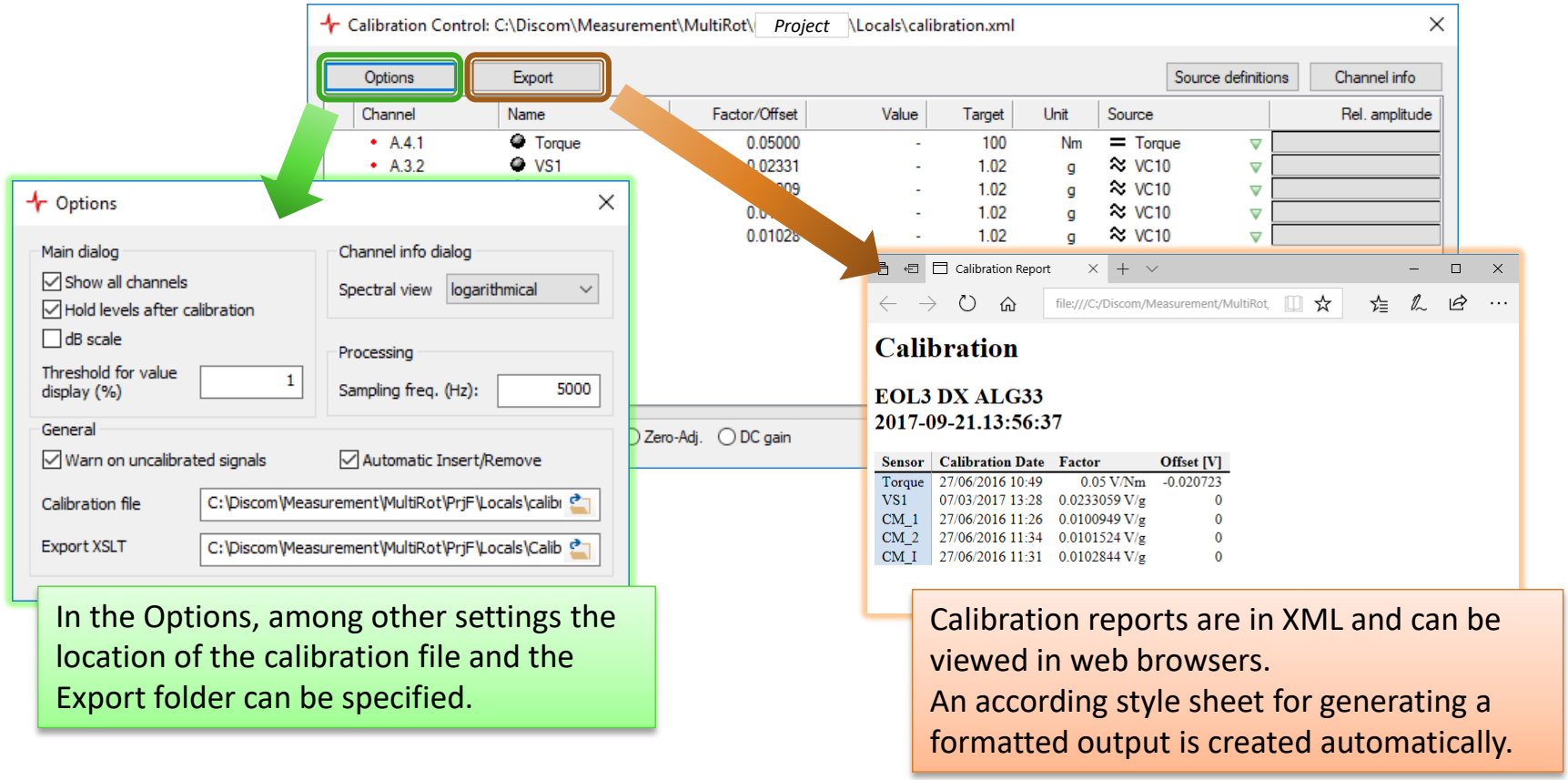
If in your test stand the TAC rotor is mounted on a vertical shaft (so the rotor itself is oriented horizontally), you cannot perform the calibration directly in the test stand. You have to send the rotor (only the rotor) to Discom for calibration.



If your TAC rotor is rotating vertically, you can perform the calibration yourself. Please refer to the according specific documentation which is available on the Discom download website.

Calibration Reports

Use the “Export” function to create a formatted report about the current calibration factors. Each time when you [Apply checked values], a report is created automatically.



In the Options, among other settings the location of the calibration file and the Export folder can be specified.

Calibration reports are in XML and can be viewed in web browsers.
An according style sheet for generating a formatted output is created automatically.

Default storage location of the exported reports:

C:\Discom\Measurement\MultiRot\(Projektordner)\Locals\Calibration