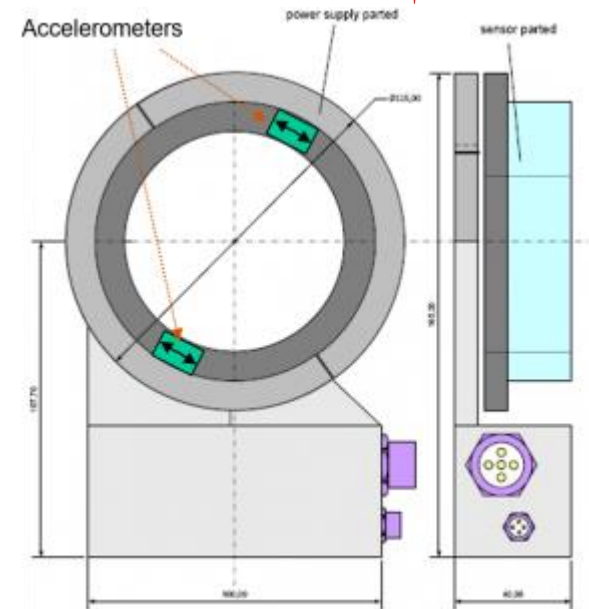


TAC Calibration, Principle

The TAC system houses two sensors, mounted tangentially on a rotor. They are placed opposing each other at the system's rim, pointing in opposite directions. Both sensors pick up the torsional acceleration signal as well as a periodic signal by rotating in the earth's gravity field. For the sum of both sensor's signals, this configuration causes the torsional acceleration signals to add up, while the gravitational signals are canceled out.

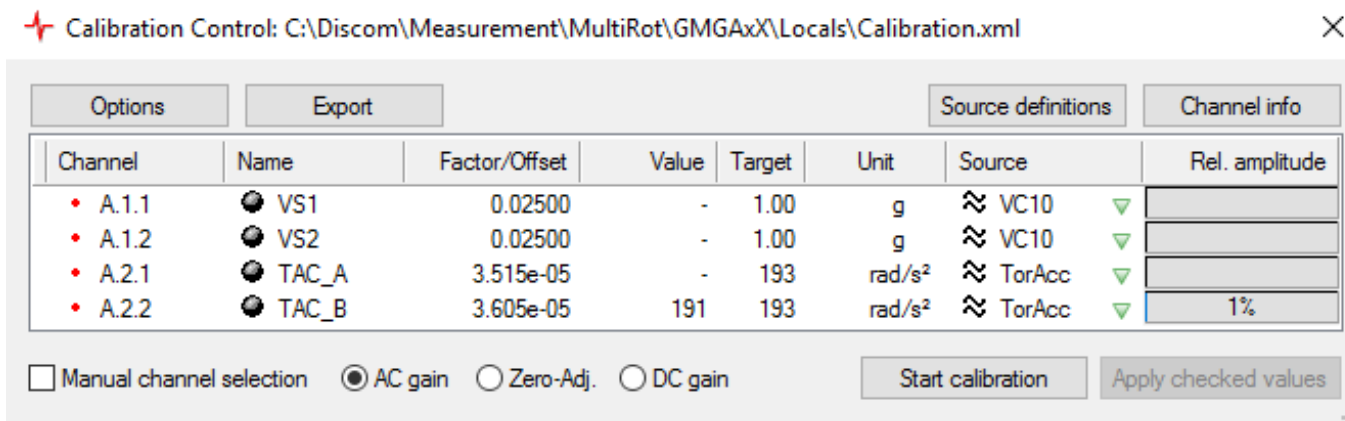
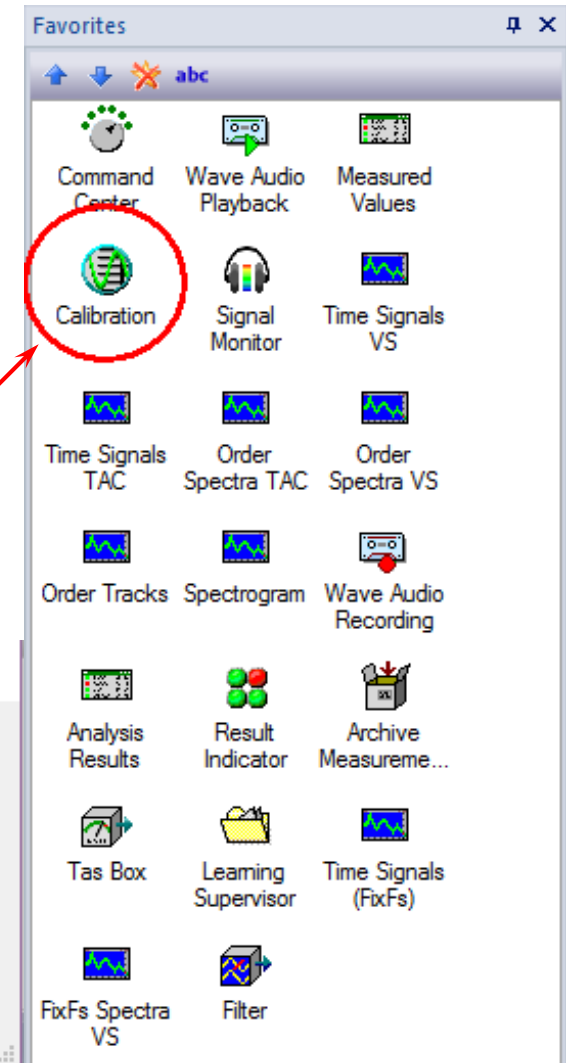
But we can use the gravitational signal to calibrate the sensors. To facilitate this, both sensor signals are transmitted individually and are available in the measurement system. Turning the shaft uniformly without load and just looking at the signals from both sensors separately, a signal with a specific amplitude from earth gravity is measured. The TAC15 will be calibrated in rad/s^2 , which depends also on the sensor's radial distance as will be shown later.



TAC Calibration, Process

The calibration process for the TAC system is quite similar to the procedure for calibrating microphones or accelerometers. Instead of a transducer or shaker, the earth is our calibration source. The frequency of the signal is given by the shaft's rotational speed. This speed will typically be quite low, so the calibrator's sampling frequency must be set low too, best to 500Hz. For a general description of the calibrator and its details, please refer to the TasAnalyser manual, section "Signal Monitoring, Calibration, Filter".

Open the calibrator by double-clicking its icon form "Favorites" to open the calibration control.



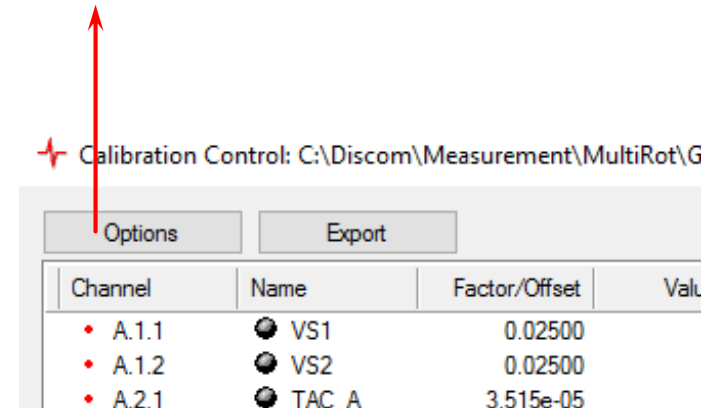
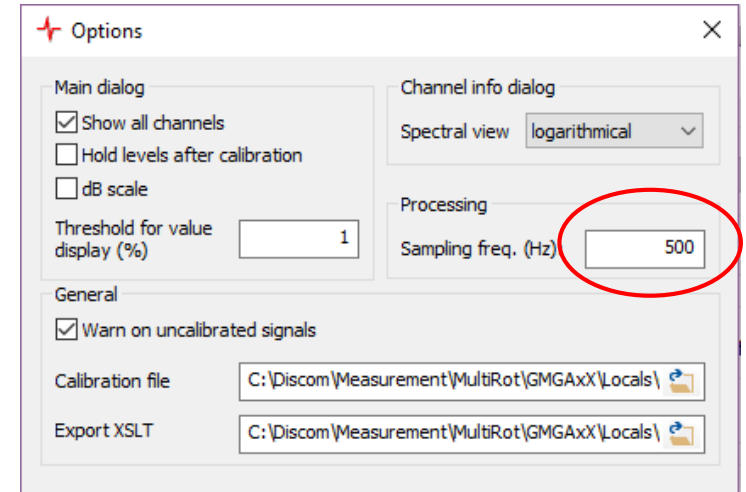
TAC Calibration, Sampling Frequency

In the calibration control, top-left, there is a button “Options”. There, you should set the sampling frequency to about 20 times of your expected signal frequency.

Example:

Speed 1200 Rpm = 20 Hz: $F_s = 400$ Hz, here 500 Hz was selected.

The exact value is not important, but it must be at least five times but not higher than 100× the rotational frequency (in this example between 100 and 2000 Hz).



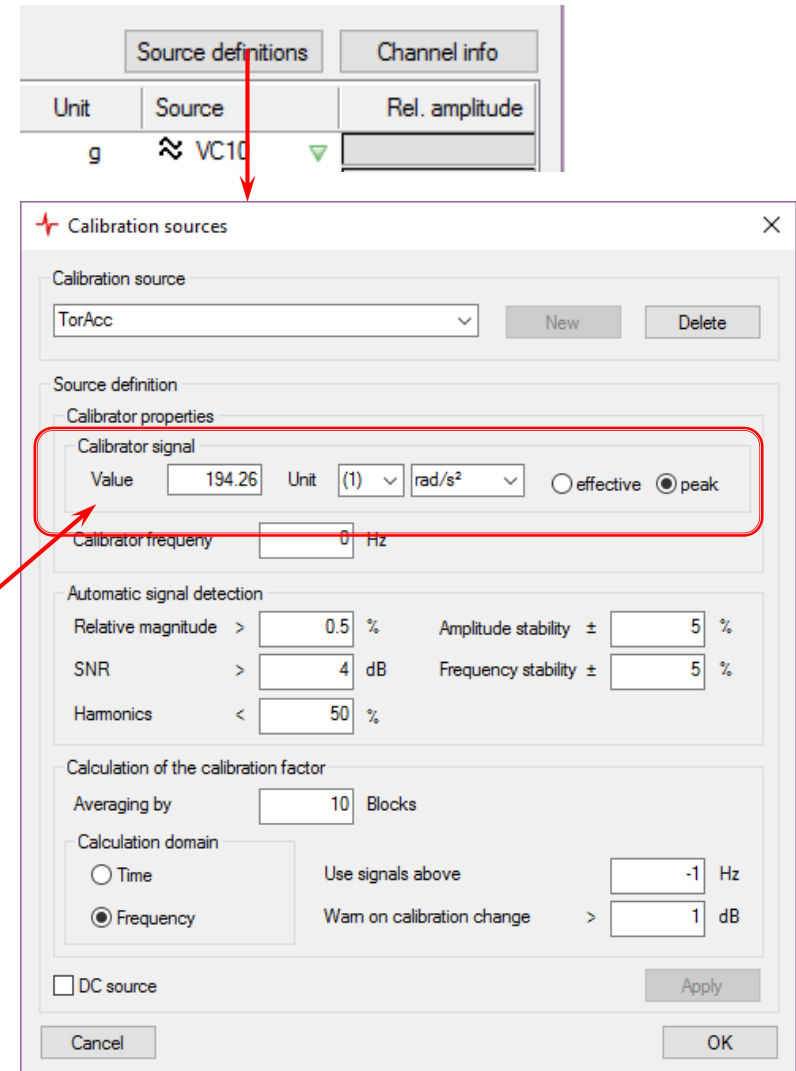
TAC Calibration, Source Definition

In calibration control, you see the two TAC sensor signals, here *TAC_A* and *TAC_B*. Both are assigned the same “Source definition”, *TorAcc* in this example. To open it, press the button “Source definitions” and choose the appropriate source if necessary. There, you can confirm the signal’s settings, especially its “Value”, which depends on the geometry of your TAC system. You find this value in the calibration certificate that comes with your TAC system. Press OK to accept and close.

The earth gravity produces the following peak value on the sensors as follows:

60 mm TAC15: 272.50 rad/s²

90 mm TAC15: 194.26 rad/s²



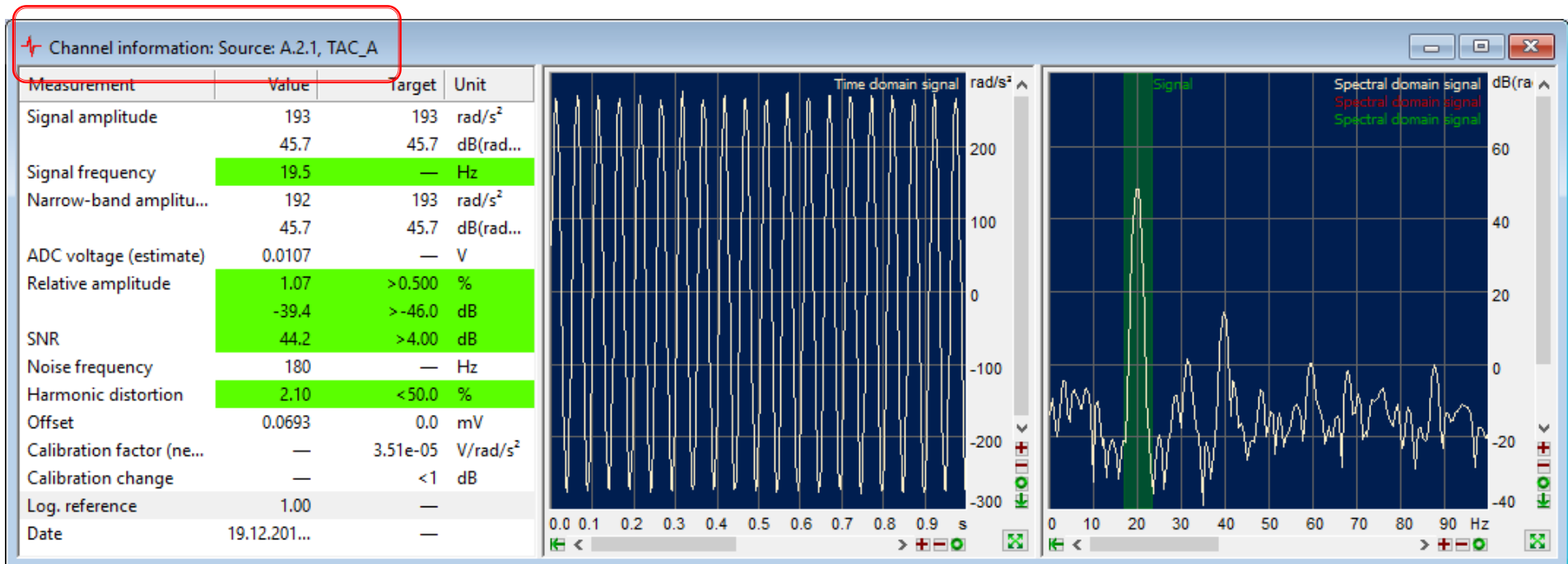
Calibration Certificate



Product:	Torsional accelerometer Rotas TAC15-90-90 TAC15-RCV SN: 150214-148-4
Customer:	Bepco
Calibration Procedure:	Calibration through inherited PTP certified primary standard to ISO/IEC guides 25/58 and EN 45000 Reference: Gravitation of the earth with 9,81 m/s ²
Radius of measurement: (rotating sensor)	0,0505m signal: 9,81m/s ² signal in rad: 194,26 rad/s ²

You can check for accurate sampling and a good quality by pressing “Channel info” in calibration control. This window shows the observed sensor in its title bar. If it is showing the wrong channel, just click the one you want to see in calibration control.

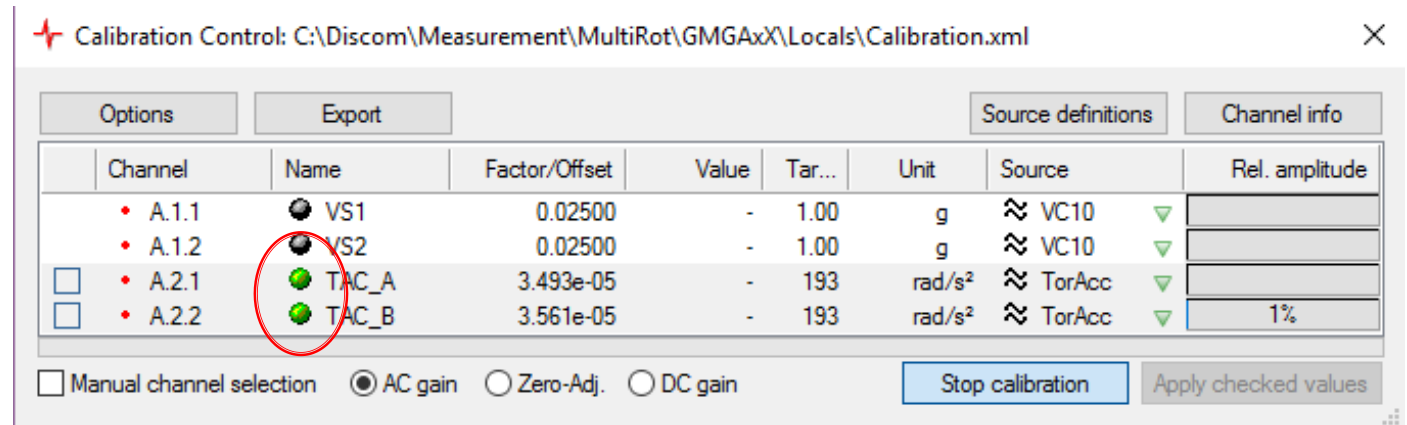
You should be a good signal as shown below, with all entries in the property pane left “green”. If it is not green, you will probably have to revisit the “Source Definition” and adapt some of its requirements.



TAC Calibration, Calibration

If everything looks fine so far, you are ready to calibrate the signals. Press “Start calibration” in calibration control and wait until both TAC sensor signals gets calibrated.

The calibration is done when both signals are marked green. Due to the low sampling frequency, this will take ten times longer than a standard calibration (microphone or accelerometer). So be patient!



Calibration Control: C:\Discom\Measurement\MultiRot\GMGAxX\Locals\Calibration.xml

Channel	Name	Factor/Offset	Value	Tar...	Unit	Source	Rel. amplitude
• A.1.1	VS1	0.02500	-	1.00	g	VC10	
• A.1.2	VS2	0.02500	-	1.00	g	VC10	
<input type="checkbox"/> • A.2.1	TAC_A	3.493e-05	-	193	rad/s ²	TorAcc	
<input type="checkbox"/> • A.2.2	TAC_B	3.561e-05	-	193	rad/s ²	TorAcc	1%

Manual channel selection AC gain Zero-Adj. DC gain

If the calibration is done,

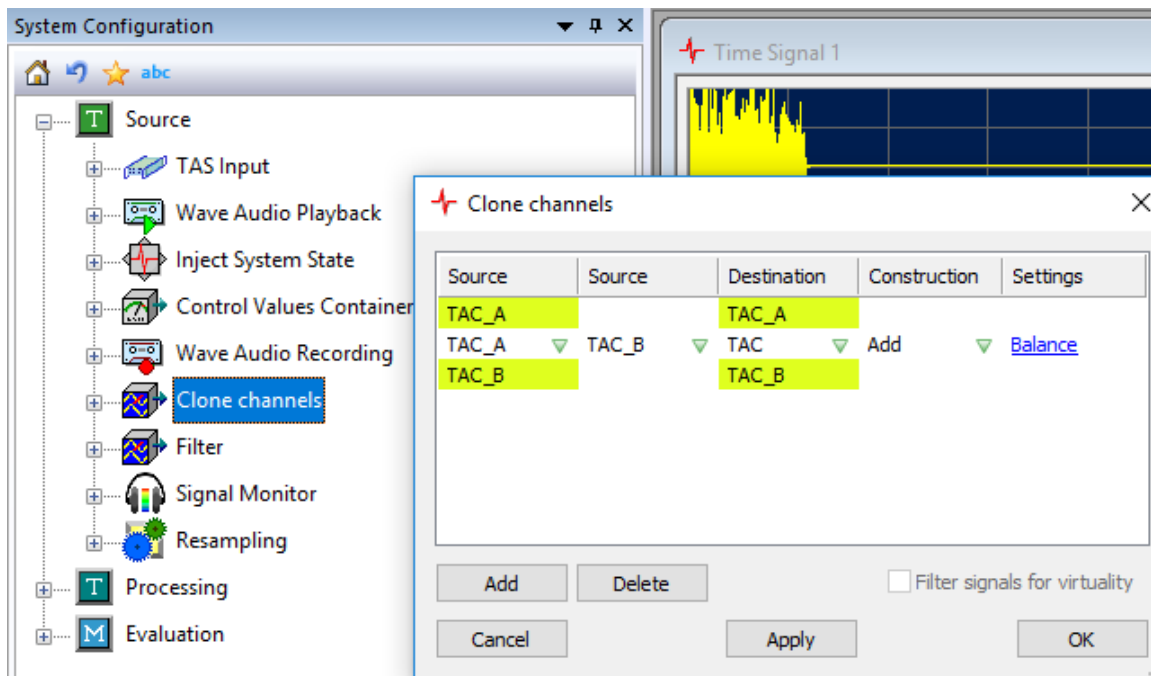
- 1) Check if the new calibration value is close to the old value: No more than 10% changes should be allowed.
- 2) If this looks good, accept the new calibration value with “Stop calibration” and “Apply checked values”.

Don't forget to set the sampling rate back to, say, 5kHz to avoid confusion with the next standard calibration of accelerometers.

Setting up channel addition

The noise analysis is performed on the sum of the two internal TAC signals (TAC-A and TAC-B). This way, all lateral acceleration (like gravitation or test stand vibrations) are cancelled out.

To set up or check the channel addition, go to the “System Configuration” and double-click on the **Clone Channels** module:



If the row which represents the channel addition is missing, select one of the other rows (TAC_A or TAC_B) and press the [Add] button. A new line will be created. Set up the entries as shown in the picture.

The resulting signal 'TAC' should show no spectral component at order 1 and no sign of earth gravitation in the time signal. If the lateral acceleration is not cancelled out completely, you can press on “Balance” to adjust the weighting of the two channels.

TAC Calibration, Example Calibration Certificates



System TAC15-60-40



Calibration Certificate

Product:	Torsional accelerometer Rotas TAC15-60-40 TAC15-RCV SN: 150607-268-6
Customer:	[REDACTED]
Calibration Procedure:	Calibration through inherited PTP certified primary standard to ISO/IEC guides 25/58 and EN 45000 Reference: Gravitation of the earth with 9,81 m/s ²
Radius of measurement: (rotating sensor)	0,036m signal: 9,81m/s ² signal in rad: 272,50 rad/s ²
Measurement Conditions:	Measurement of the power spectrum of the measurement chain consisting of: <ul style="list-style-type: none"> • gravitation with 9,81m/s² • torsional accelerometer Rotas TAC15-60-40 sensor • torsional accelerometer TAC15-RCV • RotasTAS28 measurement system with digital input adapter SPD28
Measurement Procedure:	Measurement of the power spectrum of the measurement chain. Evaluation of the calibration factor such that the peak level shows: <ol style="list-style-type: none"> 1.) Sensor TACA 272,50 rad/s² peak. 2.) Sensor TACB 272,50 rad/s² peak.
Measurement Result:	Calibration factor of the measurement system: <ol style="list-style-type: none"> 1.) TACA: 3,553 e-5 V/rad/s² 2.) TACB: 3,635 e-5 V/rad/s²
Date:	2016-01-20. Calibration performed by J. Lorenz Signature: <i>JL</i>

System TAC15-90-90



Calibration Certificate

Product:	Torsional accelerometer Rotas TAC15-90-90 TAC15-RCV SN: 150214-148-4
Customer:	[REDACTED]
Calibration Procedure:	Calibration through inherited PTP certified primary standard to ISO/IEC guides 25/58 and EN 45000 Reference: Gravitation of the earth with 9,81 m/s ²
Radius of measurement: (rotating sensor)	0,0505m signal: 9,81m/s ² signal in rad: 194,26 rad/s ²
Measurement Conditions:	Measurement of the power spectrum of the measurement chain consisting of: <ul style="list-style-type: none"> • gravitation with 9,81m/s² • torsional accelerometer Rotas TAC15-90-90 sensor • torsional accelerometer TAC15-RCV • RotasTAS28 measurement system with digital input adapter SPD28
Measurement Procedure:	Measurement of the power spectrum of the measurement chain. Evaluation of the calibration factor such that the peak level shows: <ol style="list-style-type: none"> 1.) Sensor TACA 194,26 rad/s² peak. 2.) Sensor TACB 194,26 rad/s² peak.
Measurement Result:	Calibration factor of the measurement system: <ol style="list-style-type: none"> 1.) TACA: 5,146 e-5 V/rad/s² 2.) TACB: 4,757 e-5 V/rad/s²
Date:	2016-04-12. Calibration performed by J. Lorenz Signature: <i>JL</i>