

Discom Calibration

How to calibrate sensors in the

Discom TasAlyser application





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/s² 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/s² 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.



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.

Options)			C	alibration file	Source definition	ns Channel info
Channel	Name	Factor/Offset	Value	Target	Unit	Source	Rel. amplitude
• A.3.1	M1	0.01024	0.198	1.000	Pa	≈ BK4230	3%
 A.3.2 	M2	0.01053	0.0380	1.000	Pa	8K4230	1%
 A.4.1 	M3	0.01067	0.0379	1.000	Pa	BK4230	1%
🔶 A.1.2	Vibration	0.02600	21.1	1.02	g	≈ VC10	71%
<u>A</u> .1.1	Speed	•	1.04		Upm		100%
2	ed2		0.00		Upm		1%
Man hannel	selecti 💿 AC gai	in 🔘 Ze dj.	🔘 DC gain			Start calibration	Apply checked value

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.

Settings	Display	Export				Source defi	nitions	Channel info
Channel	Name	Factor/Offset	Value	Target	Unit	Source		Rel. amplitud
• A.1.1	VS1	0.01036	5.63	1.02	g	≈ VC10		7%
A.1.2	VS2	0.01050	5.54	1.02	g	≈ VC10		7%
A.2.2	VSX	9.690e-03	2.78	1.02	g	≈ VC10	∇	12%
A.2.1	VSZ	9.810e-03	5.96	1.02	g	≈ VC10		7%
 A.4.1 	NFM-F	0.06600	-	1.00	Pa	≈ MicCal		
 A.4.2 	NFM-R	0.06600	-	1.00	Pa	℅ MicCal		
 A.3.2 	Micro	0.04000		1.00	Pa	℅ MicCal		

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

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.

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.



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.

Offset

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. $_{l}$

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



🕂 Kalibrierquellen			×
Kalibrierquelle			
VC10	~	Neu	Löschen
Quellen-Definition			
Kalibratorsignal			
Wert 1 Einheit (1) v g	\sim	effektiv	◯ Spitze
Kalibratorfrequenz 159 Hz			
159.16	- 10	00/2π	

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.

Settings	Display	Export				Source def	initions	Channel info
Channel	Name	Factor/Offset	Value	Target	Unit	Source		Rel. amplitude
• A.1.1	VS1	0.01036	5.57	1.02	g	≈ VC10		7%
• A.1.2	VS2	0.01050	5.49	1.02	g	≈ VC10		7%
• A.2.2	VSX	0.01054	-	1.02	g	≈ VC10		
A.2.1	VSZ	9.810e-03	5.90	1.02	g	≈ VC10		7%
• A.4.1	NFM-F	0.06600	-	1.00	Pa	≈ MicCal		
• A.4.2	NFM-R	0.06600	-	1.00	Pa	≈ MicCal		
• A.3.2	Micro	0.04000	-	1.00	Pa	≈ MicCal	\bigtriangledown	

Settings	Display	Export				Source defi	initions	Channel info
Channel	Name	Feater/Offeat	Value	Target	Unit	Source		Rel. amplitude
111	VS1	0.01036	5.57	1.02	g	≈ VC10		7%
0	VS2	0.01050	5.48	1.02	g	≈ VC10		7%
• A.2.2	🖊 🧶 VSX	0.1047	-	1.02	g	≈ VC10	_ ⊽ [
• A.2.1	VSZ	9.810e-03	5.89	1.02	g	≈ VC10		7%
 A.4.1 	NFM-F	0.06600	-	1.00	Pa	℅ MicCal	_ ⊽ [
• A.4.2	NFM-R	0.06600	-	1.00	Pa	℅ MicCal	⊽ [
 A.3.2 	Micro	0.04000	-	1.00	Pa	😣 MicCal	_ ₹ [
] Manual channel s	election (AC gain	O Zero-Adj. ODC g	ain			Start calibration	A	pply checked values

You can enter calibration factors manually. Just click in to 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.

-↓- Channel informa	ation: Source: A	.2.2, VSX			
Measurement	Value	Target Uni	^	The solution is to change the	Calibration source
Signal amplitu	1.04	1.02 g			VC10 VC10 Delete
	100	100 d		threshold for "relative magnitude"	Source definition
Signal frequen	161	159 Hz		in the calibration source definition.	Calibrator properties
Narrow-band	1.03	1.02 g			Calibrator signal
ADC ushans (0.0190	100 d			Value 1.02 Unit (1) v g v @ effective O peak
Relative amplit	0.162	>0.300 %			Calibrator frequeny 159 Hz Bandwidth 0 Hz
	-55.8	>-50.5 dB			Automatic signal datastics
	30,1	+30.0 dB			Relative magnitude > 0.2 % Amplitude stability ± 5 %
Noise frequency	48.8	— Hz			SNR > 30 dB Frequency stability ± 5 %
Harmonic dist	1.45	< 5.00 %		Resides relative magnitude	Hamonics < 5 %
Offset	0.0347	0.0 mV		Desides relative magnitude,	
Calibration fac	_	0.0105 V/g		other signal properties like	Calculation of the Calibration factor
Calibration cn	1.0005	<1 05		harmonic distortions are also	
1 Log. reference	1.002-05	_	*	checked so reducing this	O Time Use signals above -1 Hz
	hha aalih.			checkeu, so reducing this	Frequency Warn on calibration change A
Changes in t	the callb	ration so	lice	definition threshold is considered safe.	
are stored in	n the Cal	ibration.>	ml	file, so any	DC source Apply
adjustments	s need to	be done	on	y once.	Cancel

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

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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):

Settings	Display	Export				Source def	initions	Channel info
Channel	Name	Factor/Offset	Value	Target	Unit	Source		Rel. amplitud
• A.1.1	VS1	0.01036	5.63	1.02	g	≈ VC10		7%
A.1.2	VS2	0.01050	5.54	1.02	g	≈ VC10	_	7%
O A.2.2	VSX	9.690e-03	2.78	1.02	g	≈ VC10		12%
• A.2.1	VSZ	9.810e-03	5.96	1.02	g	≈ vc <u>10</u>		7%
 A.4.1 	NFM-F	0.06600	-	1.00	Pa	≈ MicCa	_ ⊽ []	
 A.4.2 	NFM-R	0.06600	-	1.00	Pa	≈ MicCal		
 A.3.2 	Micro	0.04000	-	1.00	Pa	📯 MicCal	- ⊽ [/	

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].

	_
★ Calibration so ★ Calibration so	
Calibration source	
Vero Delete	
Source definition	
Calibrator properties Calibrator signal	
Value Unit (1) v g v @ effective O peak	
Calibrator frequeny 159 Hz Bandwidth 0 Hz	
Automatic signal detection	
Relative magnitude > 0.2 % Amplitude stability ± 5 %	
SNR > 30 dB Frequency stability ± 5 %	
Hamonics < 5 %	
Calculation of the calibration factor	
Averaging by 10 Blocks	
Calculation domain	
O Time Use signals above -1 Hz	
Frequency Warn on calibration change > 1 dB	
DC source Apply	
Cancel	

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:

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.

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.

Torque				~	New	Dele	te
Source definition							
Calibrator properties							
Calibrator signal	_						
Value	1	Unit (1) ~ [Nm ~) effec	tive 💿 pea	k
Calibrator frequeny		0	Hz	Bandwidth	[0	Ha
Automatic signal det	ection						
Relative magnitude	>	5	%	Amplitude sta	bility ±	5	%
SNR	>	30	dB	Frequency st	ability ±	0	%
Unmenies		F					
Hamonics	`	5	7.				
Calculation of the ca	libratior	n factor					
Averaging by	Γ	10	Blocks				
Calculation domain							
Time		Use	signals a	above		0	Ha
Frequency		War	n on cali	bration change	> [3	%
					l		
						App	



DC Offset Calibration

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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].

+	Calibration Co	ontrol: C:\Discom\Mea	asurement\Multi	<mark>Rot</mark> ∖Project	E\Locals\	Calibrati	on\calibration	.xml		×
	Settings	Display	Export				Source def	initions	s Channel info	
	Channel	Name	Zero	Value	Target	Unit	Source		Rel. amplitude	^
	A.4.1	Tq_Abtr2	2.435e-05	3.78e-05	0.0	V	= Dm	∇		
	🔶 A.1.1	KS_Get_L	0.00	-1.53e-06	0.0	V	≈ VC10			
	🔶 A.2.1	KS_EM_Q	-5.283e-06	-1.28e-06	0.0	V	≈ VC10	∇		
	🔶 A.1.2	KS_EM_L	-1.282e-06	-1.12e-06	0.0	V	≈ VC10	∇		
	🔶 A.2.2	KS_EM_H	0.00	-1.34e-05	0.0	V	≈ VC10	∇		
	🔶 A.3.1	LS_H	0.00	-1.25e-05	0.0	V	🛠 MicCalib	∇		,
	Manual channe	el selection O AC gain	🖲 Zero-Adj.) DC gain			Stop calibration		Apply checked valu	ies
	Rememi before s	ber to switch o tarting a norm	ff "Manual al vibratio	l channel n sensor	select	tion" ation.				-

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.

Discom Calibration

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.

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✤ Calibration Control: C:\Discom\Measu	rement\MultiRot\ Project	Locals\calib	ration.xml					×	(
Options Export						Source definition	ons Char	nnel info	
Channel Name	Factor/Offset	Value	Target	Unit	Source		Rel.	amplitude]
A.4.1 Torque	0.05000	-	100	Nm	= Torqu	e ⊽			
• A.3.2 • VS1	9.02331	-	1.02	g	≈ VC10	∇			
+ Options X	905	-	1.02	g	≈ VC10	∇			
	0.0	-	1.02	g	≈ VC10 ≈ VC10	, v	[
Main dialog Channel info dialog	0.01020		1.02			· ·	I		
Show all channels			Calibration Rep	port X	+ ~			-	ЦХ
Hold levels after calibration		$\leftarrow \rightarrow$	0 û	file:///C;	/Discom/Meas	urement/MultiRot,	□ ☆	喧 侃	<i>ier …</i>
dB scale		Calib	rotion						
Threshold for value		Cano	ration						
display (%) Sampling freq. (Hz): 5000		EOL3	DX ALG3	3					
General		2017-09	9-21.13:56	:37					
) Zero-Adj. 🕧 DC gain	Saman	C-libertion D-	ta Eastar		66 (1 17)			
		Torque	27/06/2016 10:4	19 0.0	5 V/Nm -0	0.020723			
Calibration file C: \Discom \Measurement \MultiRot \PrjF \Locals \calibi		VS1 (07/03/2017 13:2	0.0233	059 V/g	0			
		CM_1 CM_2	27/06/2016 11:2 27/06/2016 11:3	26 0.0100 34 0.0101	949 V/g 524 V/g	0			
C: \Discom \Measurement \MultiRot \PrjF \Locals \Calib \		CM_I	27/06/2016 11:3	0.0102	844 V/g	0			
In the Options, among other settings the			alibrat	tion r	enort	s are ir	XMI a	nd ca	n he
leastion of the collibration file and the			· .			o are n			
location of the calibration me and the		V	lewed	in we	eb bro	owsers.			
Export folder can be specified.		A	An acco	ordina	g style	sheet	for gen	eratir	ng a
		ſ							
		T	ormatt	ed o	utput	is crea	ted aut	omat	ically.

Default storage location of the exported reports:

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

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