

TANGO

Sound Level Meter class 1 according DIN EN 61672-1:2003



Version 1.44

June 21, 2016

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ATTENTION! The detachable microphone must be used only with Tango! Otherwise it may be damaged.

Preface

Thank you for choosing the product Tango TM by SINUS Messtechnik GmbH. Please read this manual carefully before using the measuring system. We recommend you to perform several test measurements to get familiar with the instrument before using it for important measuring tasks. The manual includes the following signs to indicate important information:

NOTICE! These are information on the efficient use and correct handling of the analyzer as well as additional information.

CAUTION! These instructions shall avoid any hardware damages or dangers for users.

ATTENTION! These instructions shall avoid any measurement mistakes, hardware damages etc.

Please feel free to contact us for any questions on the functionality and operation of the instrument. Direct your questions or catalogue requests as well as requests on spare parts and accessories to the following address:

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1 General information and design

Tango™ is an integrating sound level meter designed according to DIN EN 61672-1:2003, accuracy class 1 and group Z. This manual refers to firmware version 1.44.

NOTICE! Tango may perform measurements that require an official verification of the calibration and that are legally binding.
(type approval number: 21.21/12.04)

ATTENTION! If Tango is used for legally binding measurements, only original accessories shall be used.

For performing legally binding measurements with Tango only the following accessories are admitted according to the type approval :

- Tango (907000.1)
- Calibrator Cal200 1/2" type1 PCB (800934.4)
- Calibrator Type 4231 B&K (800043.2)
- Windscreen W2 (800253.0)

Using Tango the following sound level values may be measured: L_{AF} , L_{AFmax} , L_{AFmin} , L_{AS} , L_{ASmax} , L_{ASmin} , L_{Cpeak} , L_{Aeq} , L_{Atm} , $L_{Atm} - L_{Aeq}$, L_{AE} , $L_{Cpeak>7s}$ und L_{AF7s} . A detailed description of these values is given in table 1.2.

NOTICE! The number of the firmware version can be displayed (section 2.3.2).

1.1 Important notes

When measuring with the device, please consider the following notes:

- Use the device as described in this manual only.
- Despite of its robust design, protect the device from any unnecessary bumps and vibrations as well as humidity and dirt.
- Do not touch or moisten the sensitive microphone membrane during work.
- Pay attention to the permissible temperatures for using the device.
- Always switch off the device after using.
- Do not expose the device to excess temperature as for example in a car with direct sunlight.
- If necessary, clean the device carefully without using solvents.
- Do not disassemble the device. Do not try to repair the device in case of malfunction. Such manipulation will always cause the loss of warranty and major damages. Make a note of the occurring errors and send us the device for repair.

1.2 Power supply

The device is powered by two batteries of the type LR6A (nominal voltage 1.2 ... 1.5 V, primary cell or rechargeable). Via the according USB cable Tango can be powered by an external source. Therefore the cable has to be connected to a PC or to the public power supply via the provided adapter. The USB access is totally separated from the internal batteries, so that the batteries are not affected, but accumulators are not recharged, too. For legally binding measurements Tango has to be powered by battery, disconnected from the public power supply.

1.2.1 Replace batteries

The battery compartment is located on the back at the bottom of the device (figure 1.1 bzw. 1.2). Follow the instructions below to replace the batteries:

- Move up the lock of the battery compartment.
- Remove the lid.
- Remove the discharged batteries.
- Insert the new batteries paying attention to the polarity (figure 1.2)
- Switch on the device and check the battery status on the display (figure 1.3.2).

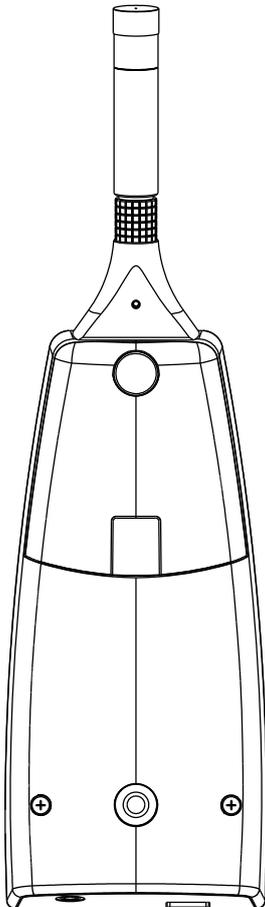


Figure 1.1: Closed battery compartment

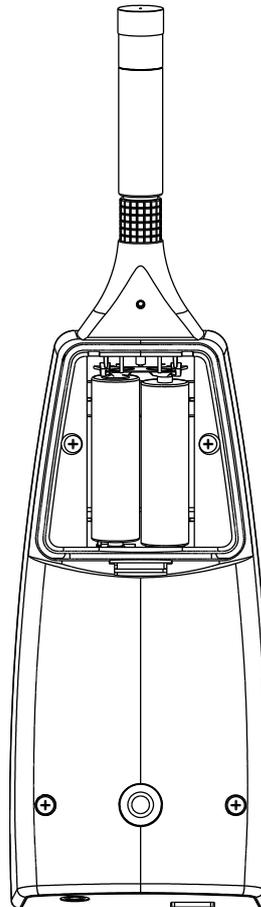


Figure 1.2: Open battery compartment

NOTICE!

The device cannot be switched on without containing charged batteries, i.e. you may not switch on the device connected to a PC via USB without batteries.

ATTENTION!

Changing the batteries causes loss of time and calibration data, if Tango is not connected to external power supply at the same time.

1.3 Design

ATTENTION!

For legally binding measurements Tango has to be powered only by battery. The monitoring output is not approved for this.

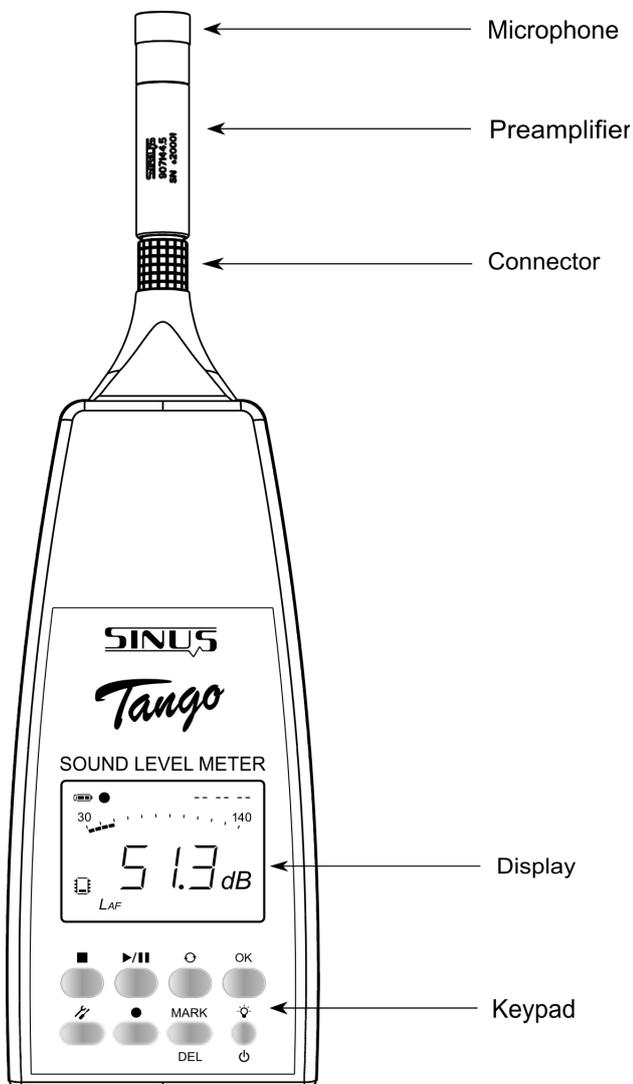


Figure 1.3: Design of the device

Tango contains the following parts: detachable microphone with preamplifier, casing, display, keypad and battery compartment. Opening the device is only necessary for replacing the batteries (figure 1.2.1).

At the bottom of the device the USB socket is located for connecting the device to a PC (type mini five-pole). Next to it there is a socket for a 3.5 mm stereo jack. This monitoring output is used to connect a headset for example, it is *not* approved for legally binding measurements.

A detailed description of the display and keypad is given in the paragraphs 1.3.2 and 1.3.1. Pay also attention to the notes given in paragraph 1.1.

1.3.1 Keypad

If the device is not controlled via PC, you may also use the keypad for setup. Details on operating the device with the keypad are given in section 2.3.2.

Key	Name	Description
	Stop-Button	Stop measurements.
	Play/Pause-Button	Start/pause/continue measurements. However, data is only saved if the Record-Mode is active.
	Scroll-Button	Change displayed value according to the boxes marked with * in figure 2.2.
	OK-Button	Confirm settings in the Setup-Mode. This key is only used in this mode, therefore it is not described in detail.
	Setup-Button	Switch between Display-Mode and Setup-Mode.
	Record-Button	(De)-Activate the Record-Mode.
	Mark-Button	If pressed during a measurement, a mark is saved for the corresponding time interval. This mark may be captured by the software and represented in the level vs. time history. If the device is in Pause-Mode, the last five seconds of the measurement may be deleted by pressing the Mark-Button (back-erase feature).
	On/Off-Button	Switch on/off device (key press > 3 seconds) Switch on/off backlight (short key press)

Table 1.1: Description of keys/buttons

1.3.2 Display

The display shows the measured values and is used for setting up the device. It is refreshed every 500 ms. The individual sections of the display are described in the following paragraphs.

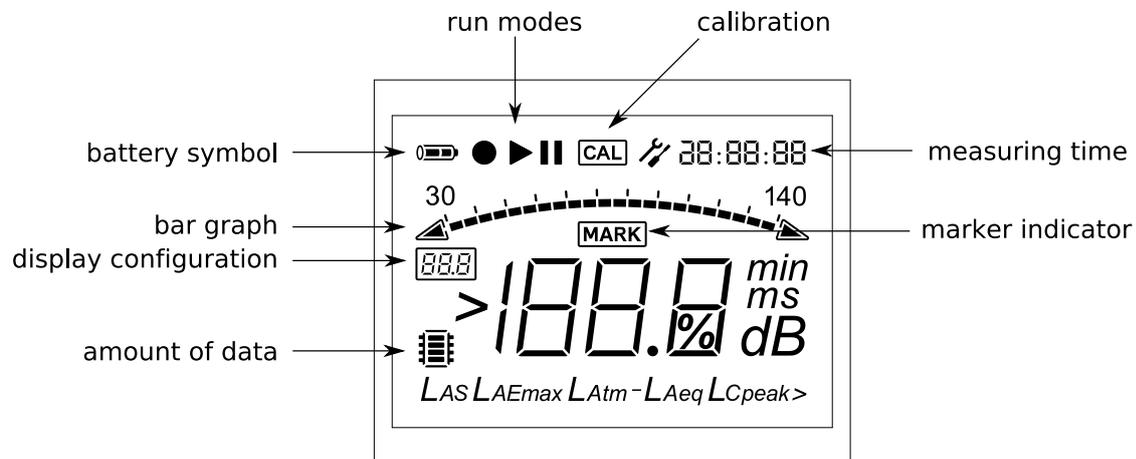


Figure 1.4: Display of the device

Battery symbol

The symbol  on the display shows the battery status. The following three statuses may be displayed:

-  The battery is fully charged. A legally binding measurement may be performed.
-  The battery is charged half. A legally binding measurement may be performed.
-  The battery is discharged. A legally binding measurement may not be performed. The device will automatically turn off if the batteries are not replaced.

1.4 Software installation

First Tango driver must be installed for that Tango is recognized via USB connection. Second **Tango-Utilities** should be installed for configuration of Tango settings and export of data.

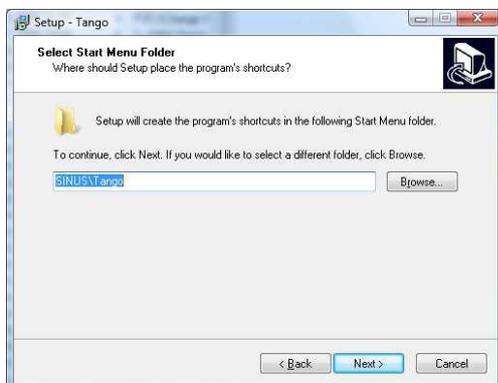
1.4.1 Tango driver installation

Please follow the instructions below to install the SINUS driver on a PC. You find the file on the enclosed CD or on the installation CD of the application software. Use the Windows Explorer to start the driver installation programme. Perform the install setting and confirm always. Depending on the system performance this procedure may take a few minutes.

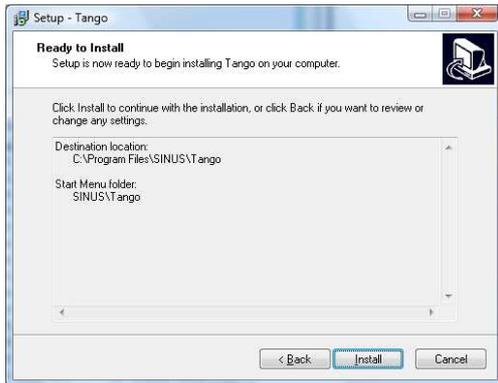
1.4.2 Tango-Utilities installation

Installing the software **Tango-Utilities** resembles the installation procedure of most Windows applications. Follow the instructions below:

- Run the installation program (`Tango_Utilities_Version.exe`).
- The first window shows the software version. Click on **Next** to continue to the next window.
- Set the installation directory in the next window. Click on **Next** to continue to the next dialog.
- In this dialog you may specify the directory in the Windows Start Menu. Click on **Next** to continue to the next dialog.



- This dialog summarizes your settings. Click on **Install** to confirm these and to continue to the next dialog.



- Finish the installation by clicking on **Finish**.

1.5 Calculated values

Level	Description
L_{AF}	Sound pressure level, frequency weighting A, Fast (125 ms time constant)
L_{AFmax}	Level maximum of L_{AF} for the entire measuring period (on the display) or of the last storing interval (stored data).
L_{AFmin}	Level minimum of L_{AF} for the entire measuring period (on the display) or of the last storing interval (stored data). This value is only available by Tango-Utilities .
L_{AS}	Sound pressure level, frequency weighting A, Slow (1 s time constant)
L_{ASmax}	Level maximum of L_{AS} for the entire measuring period (on the display) or of the last storing interval (stored data).
L_{ASmin}	Level minimum of L_{AS} for the entire measuring period (on the display) or of the last storing interval (stored data). This value is only available by Tango-Utilities .
L_{Cpeak}	Peak value of the C-weighted sound pressure level
L_{Aeq}	Equivalent continuous sound pressure level for the entire measuring period (on the display) or of the last storing interval (stored data), frequency weighting A.
$L_{A_{tm}}$	Equivalent continuous sound pressure level calculated from the Taktmaximal levels during the entire measuring period according to DIN 45645-1, maximum sound pressure level of the last 5 s.
$L_{A_{tm}} - L_{Aeq}$	Difference of the values $L_{A_{tm}}$ and L_{Aeq}
L_{AE}	Sound exposure level, frequency weighting A
$L_{Cpeak>n}$	Time in which the L_{Cpeak} exceeded n dB.
L_{AFn}	Percentile levels can be calculated from the L_{AF} ($n = 1, 2, 3$). Data can be stored up to an amount of 8 MB. There are 7 standard percentiles (1, 5, 10, 50, 90, 95, 99).

Table 1.2: Calculated sound levels

NOTICE!

All sound level values may only be reset by manual Start/Stop operation and the integration time for the equivalent continuous sound pressure levels may only be set with this operation.

NOTICE!

All integrated sound levels listed in table 1.2 will be displayed on the device immediately after finishing a measurement/integration.

2 Appliance

2.1 General information

Tango offers different operating modes:

OFF The device is off and no measurements can be performed. Only the clock is running inside.

Stop The device is running. The L_{AF} and the L_{AS} are measured and displayed, if these values have been selected for display. With the Record button  is defined whether the data of the next measurement should be stored. If yes, the circle symbol  must be displayed.

Run The device is on and measuring ( is blinking). If data recording has been activated, data will be stored ( is blinking). You may read the instantaneous measurement values on the display and move between the values using the Scroll-Button.

Pause A running measurement is paused ( is displayed) and so the measuring time. The measurement can be stopped or proceeded any time.

Display	Description
	The device is in Pause-Mode. The measurement has been paused and the measuring time has been stopped.
	Data recording is active. The measured data will be stored in Run-Mode.
	The device is in Run-Mode (Symbol blinks). The measurement has been started. If data recording is active, the measured data are stored. If data recording is inactive, no data will be stored.

Table 2.1: Display of run modes

2.2 First use

Pay attention to the following notes before using the device for the first time:

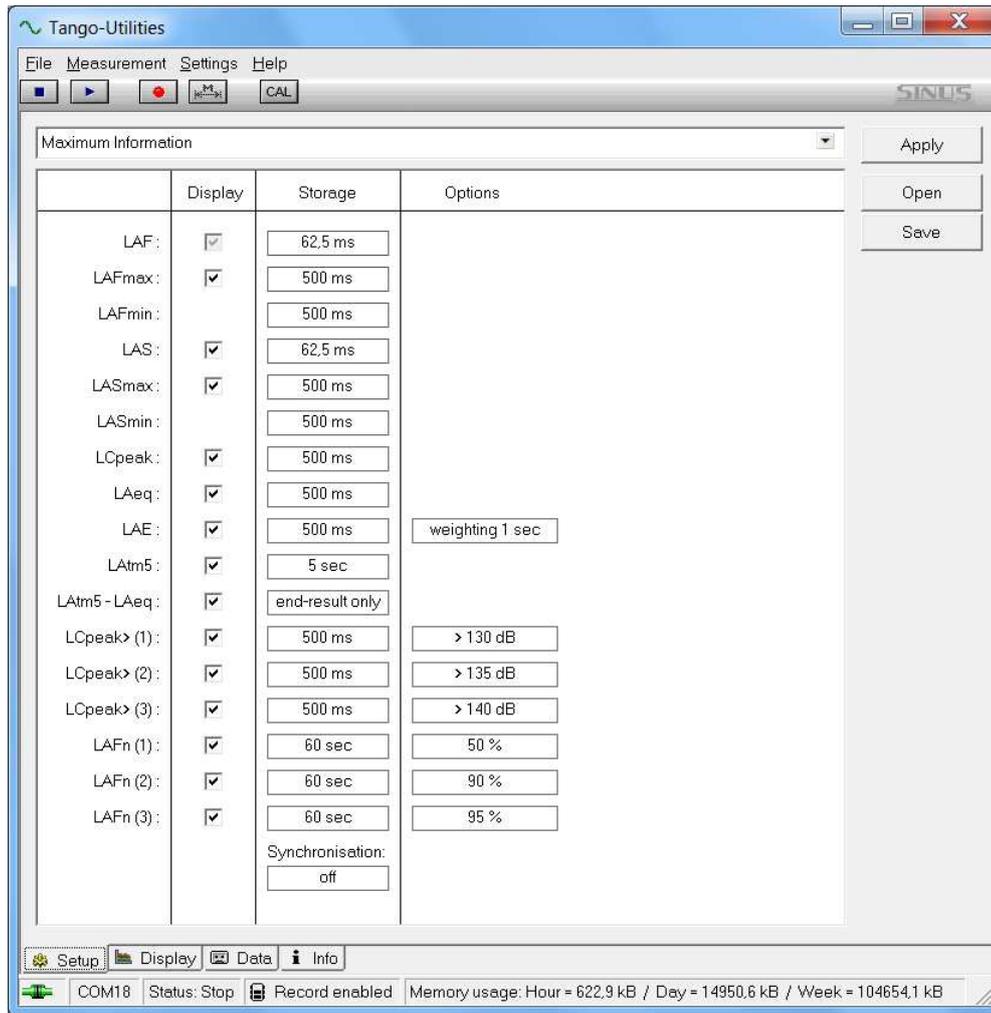
- Read carefully the manual and follow the instructions before using the device!
- Insert the batteries as described in paragraph 1.2.1.
- Install the required software on a PC (driver and **Tango-Utilities**).
- Connect the device with the PC using the supplied USB cable.
- Switch on the device by pressing the On/Off-Button (minimum 3 seconds, see table 1.1).

2.3 Device configuration

You may configure the device via PC using the software **Tango-Utilities** or manually.

2.3.1 Configuration using Tango-Utilities

For configuring the device via PC, you have to install drivers and **Tango-Utilities** software first (section 1.4). Possible settings in **Tango-Utilities** are adjusted in the **Setup** tab.

Figure 2.1: *Tango-Utilities*- Setup Tab

Use the check boxes in the column **Display** to (de-)select individual values for display on the device and on your PC. Several values offer optional parameters, which you may set in the column **Options**. By the buttons **Open** and **Save** you may open a configuration from the PC or save the current one to it. The same can be done by using the menu points **File** → **"Open Configuration"** and **File** → **"Save Configuration As"**. The current configuration is transmitted to Tango by clicking on **Apply**.

In the column **Storage** the corresponding storage conditions are adjusted. The storage can be turned off, limited to one finish result or done in regular intervals. For the interval time span several values are provided from 62,5 *ms* up to 60 *min* depending on the measurement value. Even if the interval storage is selected a finish result over the whole measurement time is calculated and stored additionally. This would always be saved, even if the interval storage would have been aborted because of full memory. In this case the record symbol ● would stop blinking.

NOTICE! For the interval storage of the percentiles only the same interval time span can be selected.

If **Synchronisation** is enabled, the interval storage will be synchronised with the full hours of day time. So every full hour the current interval is closed and a new one is started. The clock is set every time, when connecting Tango to **Tango-Utilities**.

2.3.2 Manual configuration

The manual configuration of the device without PC is shown in the following diagram (figure 2.2):

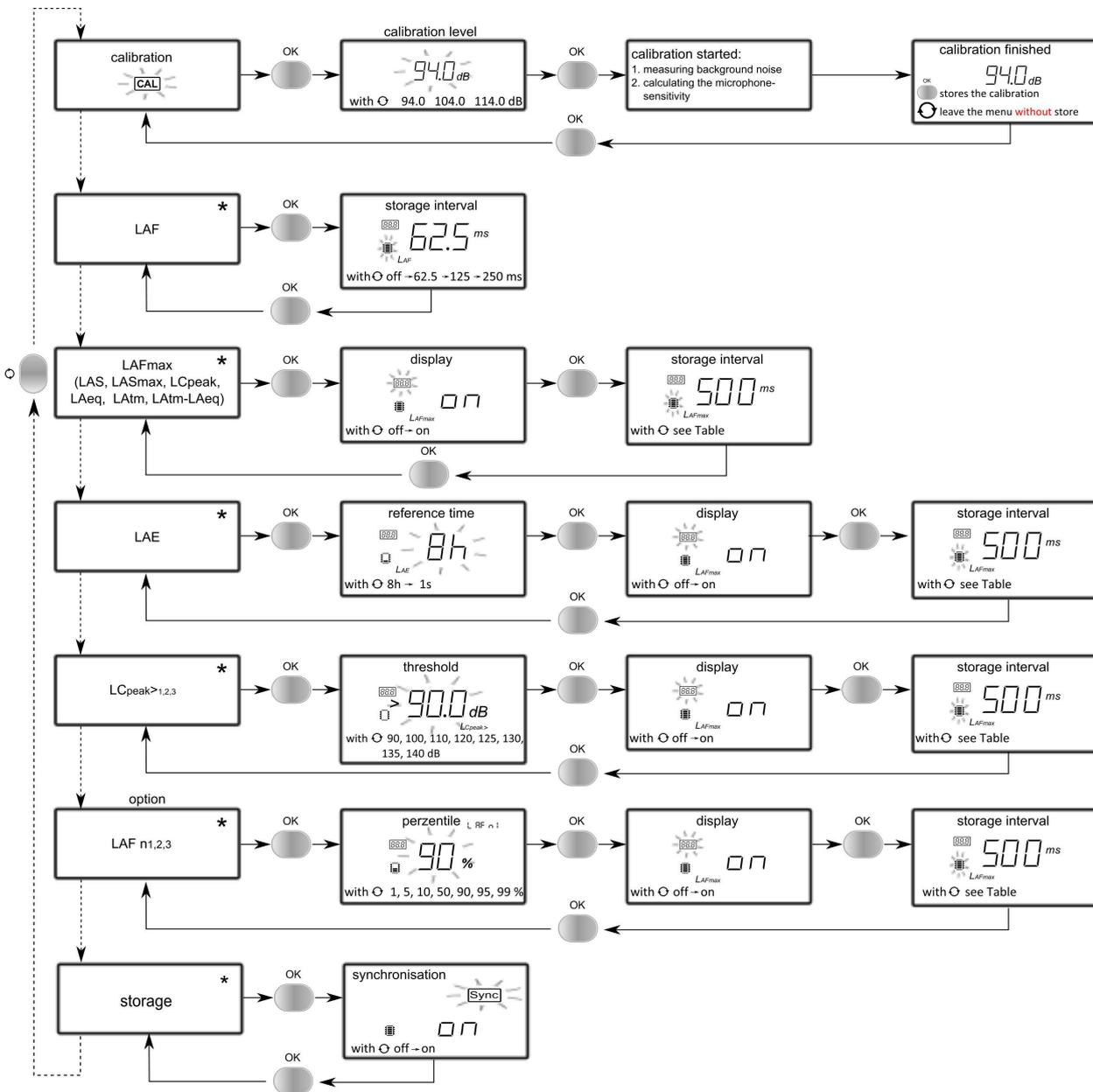


Figure 2.2: Configuration menu

Press the Setup-Button to toggle between Display- and Setup-Mode. The first menu item in the Setup-Mode is Calibration (for details see section 2.6). Use the Scroll-Button to move between the items of the individual menu. Press the OK-Button to open the corresponding sub-menu. During configuration the parameter which is being adjusted is blinking. In figure 2.2 the blinking is represented by $\Rightarrow \leftarrow$.

The *firmware version* is displayed as long as the Setup button is pressed at the same time Tango is switched on.

2.4 Tango-Utilities

The structure of **Tango-Utilities** resembles that of other Windows applications. It contains a main menu, a working section and a status bar (see following figures). In the main menu you may select various items (e. g. **Firmware Update**, **Program Settings**, **Save as**). You may view the software version of **Tango-Utilities** in the main menu selecting **Help -> About** (figure 2.4). The firmware version of the dive is displayed in the Info-Tab (figure 2.3).

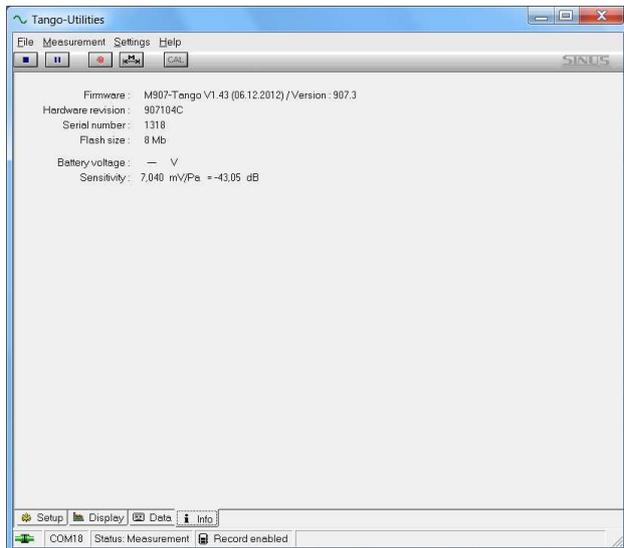


Figure 2.3: **Tango-Utilities** - Info Tab



Figure 2.4: **Tango-Utilities** - About-Box

NOTICE!

Using **Tango-Utilities** you can adjust all settings. Configuring manually you may only adjust a restricted selection of parameters.

2.4.1 Setup-Tab

In the **Setup** tab the configuration is done with **Tango-Utilities** (section 2.3.1).

The **status bar** displays various status information from left to right:

Connection Status: disconnected, connected, but Tango off, connected, Tango on;

Virtual COM Port; Measurement Status;

Record Status: Record-Mode off, Record-Mode on, Record-Mode on (Recording);

Marker Status: MARK; **Storage Requirement/(Overflow Underrange)/Storage Status.**

Program settings

Via the main menu **Settings->Program...** the following settings are available (figure 2.5.): selection of the connected device Tango (**Connected Device**), default export directory (**Default Export Directory**) and the default directory for configuration data.

Extended device settings

NOTICE!

The changes you apply will be saved on the device until you adjust them again using **Tango-Utilities**.

These settings *cannot* be adjusted manually without PC.

Parameter	Description
Disable Device Calibration	Select this parameter to disable calibration feature on the device.
Disable display setup changes	Select this parameter to lock the display settings.
Disable measurement setup changes	Select this parameter to lock measurement recording settings.
Enable fixed record mode	Select this parameter to activate the Record-Mode permanently.
Enable backlight permanently	Enables background light of the display permanently.
Startup after battery replacement	Automatic start of Tango after changing the batteries.

Table 2.2: Extended program settings

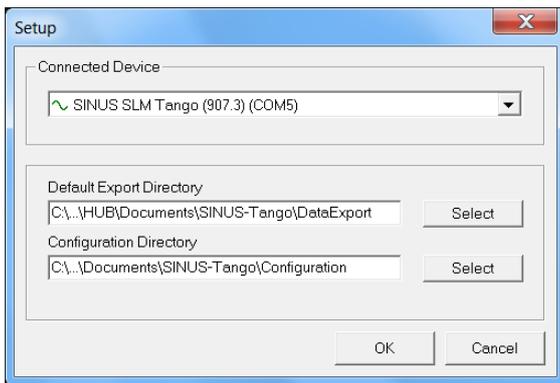


Figure 2.5: **Tango-Utilities** - Program settings

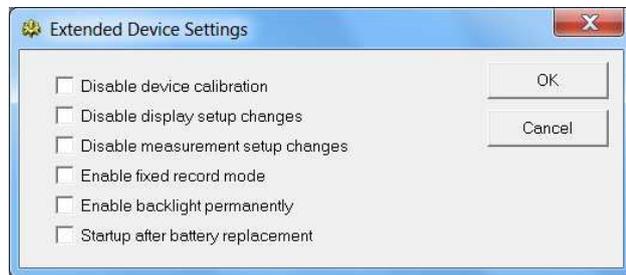


Figure 2.6: **Tango-Utilities** - Extended device settings

2.4.2 Display-Tab

In the Display-Tab the values are shown, which are calculated by the device during a measurement (according to the settings in the Setup-Tab). On the left side you will find a table of values which are available for display in the graph on the right side.

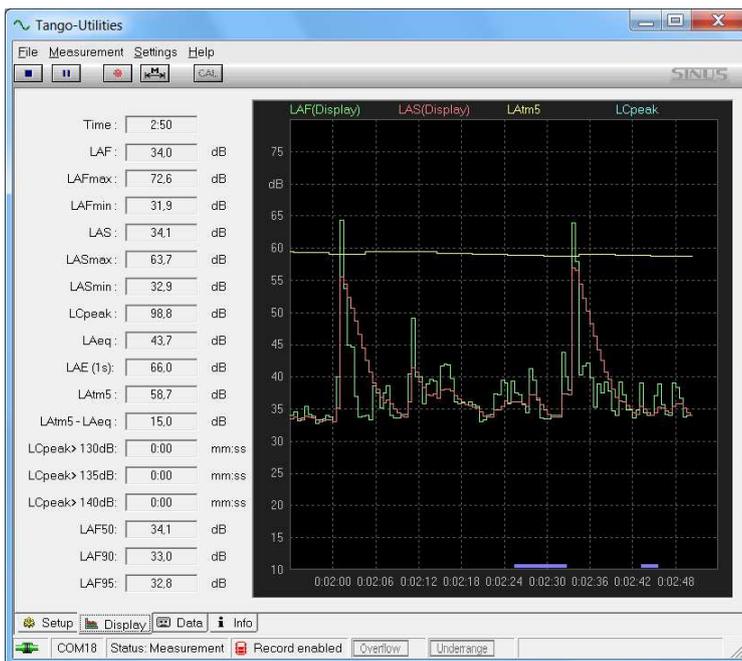


Figure 2.7: **Tango-Utilities** - Display Tab

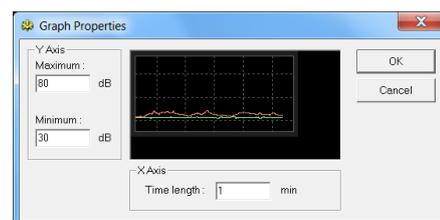


Figure 2.8: **Tango-Utilities** - Graph Properties

To select a value for graphical display click on the individual values in the header of the graph. You may select a maximum of four values for simultaneous display. You may change the axis settings by right-clicking on the graph. A context menu will open in which you will find the item **Properties**. A click on this item will open the window in figure 2.8. The context menu also contains controls for zooming in and out.

2.4.3 Data-Tab

On the right side of the Data-Tab a table containing the recorded data is displayed. On the left side a summary of the selected measurement is displayed. By right-clicking on an entry in the table you will open a context menu in which you may delete the measurement (**Delete**) or save data to the PC (**Export**).

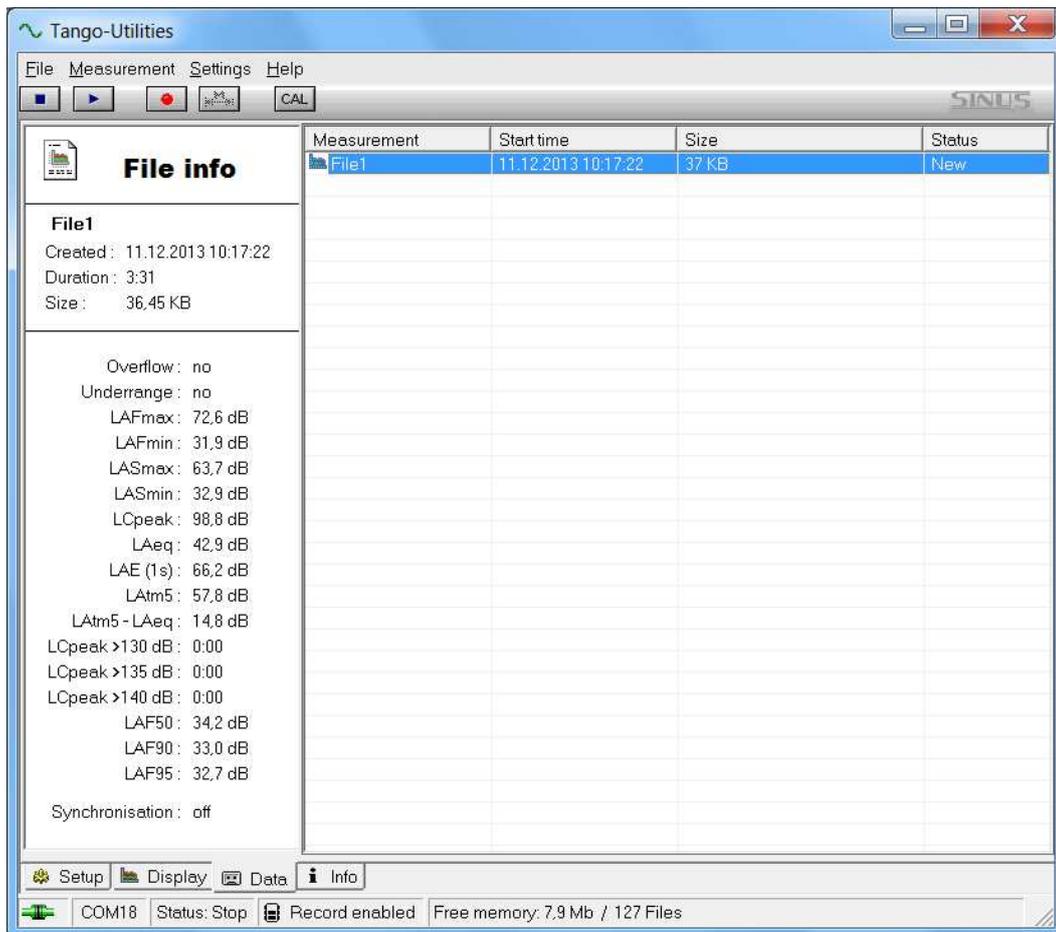


Figure 2.9: **Tango-Utilities** - Data Tab

2.4.4 Data export

Measured data are saved to the internal storage of the device (8 MB). The data sets are listed in the Data-Tab (section 2.4.3). By right-clicking you may open a context menu. The item **Save as** may be used to export/store data to the PC. Specify the name of the file containing the final values of a measurement in the Result tab (figure 2.10).

Specify the name for the file containing interval values in the other tabs, csv compatible with Excel (figure 2.11) or smr compatible with Auditor. This tabs also include two lists. The left list shows the values which are part of the measurement, but which have not been selected for export yet. The right list shows the val-

ues which have been selected for export already. To add or remove values from these lists use the buttons **Include** and **Exclude**. To add new files for export use the button **Add File**, to remove files use **Remove File**.

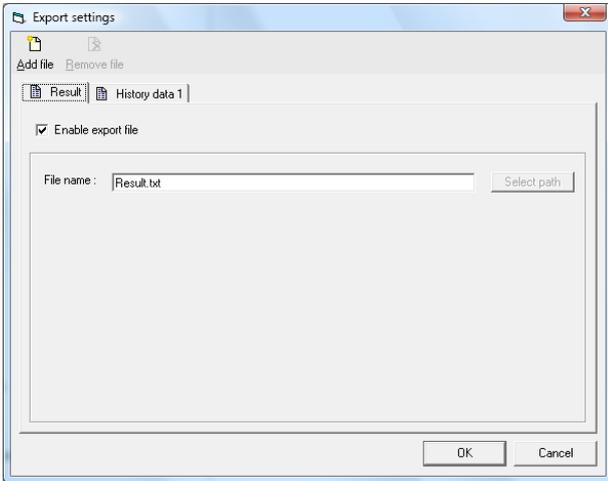


Figure 2.10: **Tango-Utilities** - Export window 1

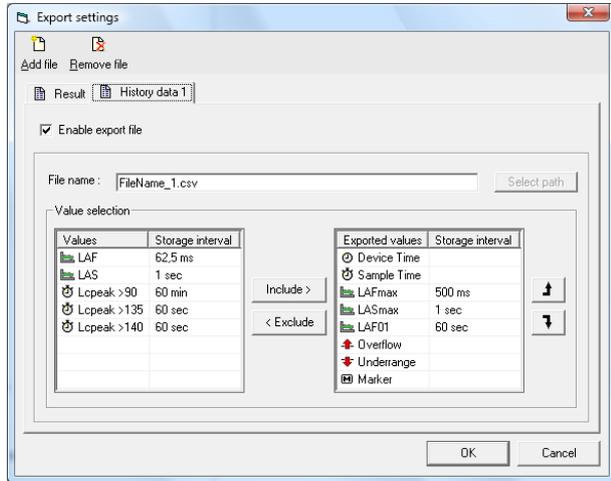


Figure 2.11: **Tango-Utilities**- Export window 2

```
Measurement file: File7
Start time: 02.06.2009 08:45:09
Duration: 2:57
Overflow: no
Underrange: no
LAFmax: 77,4 dB
LASmax: 68,5 dB
LCpeak: 103,3 dB
LAeq: 48,4 dB
LAE: 70,9 dB
LATm5: 62,7 dB
LATm5-LAeq: 14,3 dB
LCpeak >90dB: 0:01 min:sec
LCpeak >135dB: 0:00 min:sec
LCpeak >140dB: 0:00 min:sec
LAF90: 40,3 dB
LAF95: 40,0 dB
LAF99: 39,7 dB
```

Figure 2.12: **Tango-Utilities** - Example *Result.txt* from fig. 2.10

	A	B	C	D	E	F	G	H
1	Device Time	Sample Time	LAF	LAS	LCpeak	Underrange	Marker	Overflow
2	08:45:09,13	0,13	41,2			0	0	0
3	08:45:09,25	0,25	40,9			0	0	0
4	08:45:09,38	0,38	40,6			0	0	0
5	08:45:09,50	0,5	41,1			0	0	0
6	08:45:09,63	0,63	41,1			0	0	0
7	08:45:09,75	0,75	41,3			0	0	0
8	08:45:09,88	0,88	42			0	0	0
9	08:45:10,00	1	42,9	41,7	65,3	0	0	0
10	08:45:10,13	1,13	44,3			0	0	0
11	08:45:10,25	1,25	43,2			0	0	0
12	08:45:10,38	1,38	41,9			0	0	0
13	08:45:10,50	1,5	41,2			0	0	0
14	08:45:10,63	1,63	40,2			0	0	0
15	08:45:10,75	1,75	40,4			0	0	0
16	08:45:10,88	1,88	41			0	0	0
17	08:45:11,00	2	40,7	41,4	65,3	0	0	0
18	08:45:11,13	2,13	40,8			0	0	0
19	08:45:11,25	2,25	40,9			0	0	0
20	08:45:11,38	2,38	40,8			0	0	0
21	08:45:11,50	2,5	41,3			0	0	0
22	08:45:11,63	2,63	41			0	0	0
23	08:45:11,75	2,75	40,7			0	0	0
24	08:45:11,88	2,88	40,6			0	0	0
25	08:45:12,00	3	40,9	41,1	63,9	0	0	0

Figure 2.13: **Tango-Utilities**- Example *Filename_1.csv* from fig. 2.11

2.5 Measure

For legally binding measurements the device must run on batteries/rechargeables. Therefore the device has to be controlled with the keypad. Follow the instructions below to perform a binding measurement:

1. Position the device (held in the hand or mounted upon a tripod).
2. Switch on the device.
3. Check the battery charge status (see paragraph 1.3.2).
4. Use the Record-Button to enable/disable data recording.
5. Press the Start-Button to start the measurement.
6. Press the Stop-Button to stop the measurement.

2.5.1 Measure low sound levels

You do not have to make special preparations for measuring low level sounds.

2.5.2 Overload and Underrange

The display for overload and underrange is arranged left and right of the bar graph (figure 1.4). It is displayed, when the linearity range is left. The representation on the display is explained in the following table 2.3.

Tango-Utilities	Display	Description
		No overload has occurred in current measurement.
		Overload has occurred in current measurement.
		Currently an overload occurs.
		No underrange has occurred in current measurement.
		Underrange has occurred in current measurement.
		Currently an underrange occurs.

Table 2.3: Display of overload and underrange

NOTICE!

A reset of the overload or underrange display is only possible by stopping and restarting the measurement.

2.6 Calibrate

A list of the approved calibrators and the accuracy classes achieved is given in section 5. Follow the instructions below to calibrate the device at 1 kHz:

2.6.1 Calibrate using Tango-Utilities

1. Connect Tango to the PC.
2. Start **Tango-Utilities**.
3. Insert the microphone into the calibrator and activate the calibration signal. The reference calibration level is 94 dB for this method.
4. Press the **CAL** button in **Tango-Utilities**. "Calibration activated" appears in the status bar. To cancel the calibration procedure, press the stop button.
5. Having finished you are asked to adopt the new calibration values. If something went wrong, an error message appears.

2.6.2 Calibrate Tango directly

1. Switch on the device.
2. Press the Setup-Button. The configuration menu will be displayed (figure 2.2) and **CAL** is blinking.
3. Press the OK-Button. The reference calibration level will be blinking on the display (e.g. 94 dB). You may adjust this value with the Scroll-Button (94 dB, 104 dB or 114 dB).
4. Switch on the calibrator (select the corresponding level on the calibrator, if necessary) and insert the microphone into the calibrator.

5. Press the OK-Button. Calibration starts. First, the noise level of the device is measured and second the calibrator signal. During calibration, **CAL** is blinking on the display. When **CAL** stops blinking, the calibration is finished. The measured level is displayed enabling you to check the calibration result.
6. Press the OK-Button to save the new sensitivity value or press the Setup-Button to reject.
7. You have left the calibration menu and the device is in STOP-Mode.

If the calibration has been affirmed the symbol **CAL** is shown on the display until the next start of Tango. The calibration data is stored until the next change of the batteries. This will reset Tango to factory defaults.

NOTICE!

If the new value deviates more than 3 dB from the old one, it is not accepted. The message "Error" is displayed in this case.

3 Testing information

3.1 Acoustic test

3.1.1 Microphone alignment for measuring the influence of mechanical vibrations according to DIN EN 61672-1:2003.

For this test you need a second sound level meter with officially verified calibration as reference device. The microphone of the reference device has to be positioned in a maximum distance of 0.2 m from the microphone of the tested device and must not be exposed to the mechanical vibrations of the exciter.

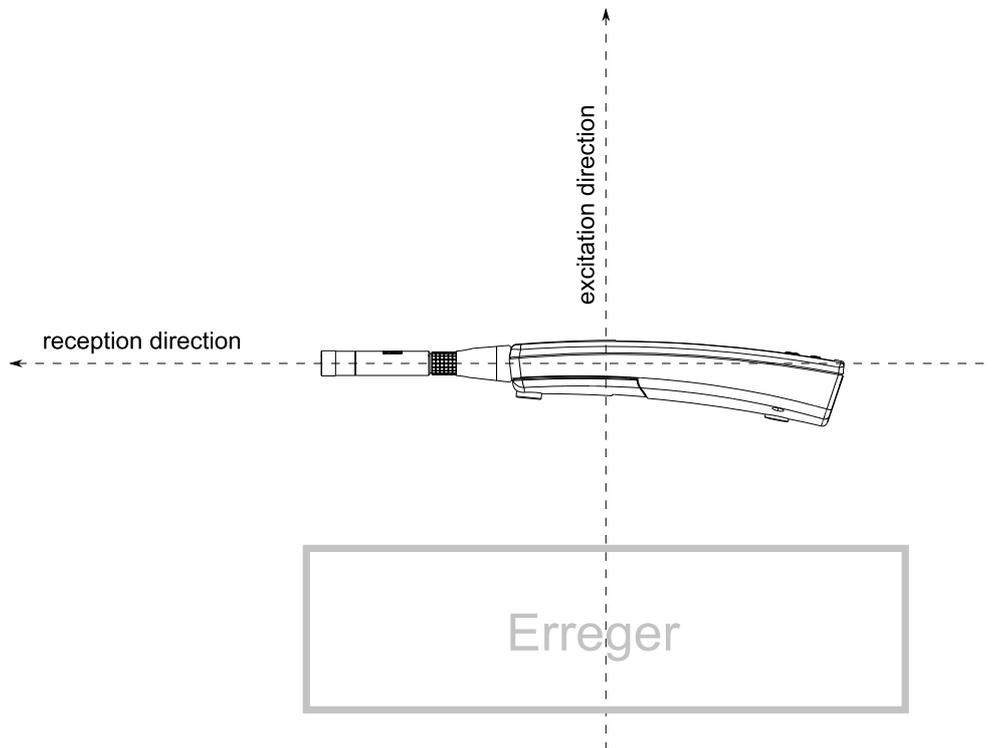


Figure 3.1: Alignment for vibration test

3.2 Electrical test

For electrical testing use the equivalent electrical impedance device K65 only (section 5) (manufacturer specifications: $22 \text{ pF} \pm 12\%$ with a parallel resistance of $81 \text{ M}\Omega \pm 12\%$).

3.2.1 EMC test

The measurement is performed for the following configurations:

Low interference immunity: USB cable linked to public power supply and microphone extension cable connected

Maximum interference immunity: USB cable and microphone extension cable disconnected

3.2.2 Level linearity

The starting values for the level linearity tests are listed in the last column of table 4.3.

4 Technical specifications

Property	Value
Software	Tango-Utilities
Number of channels	1
Accuracy	Class 1 according to DIN EN 61672-1:2003
Display of measured values	LCD display
Frequency weighting	A, C _{peak} (simultaneously), no optional frequency weightings
Time weighting	Fast, Slow, Peak (simultaneously)
Data storage	Yes
Self-generated noise	≤19 dB(A)
Max. Sound Pressure Level	see table 4.5
Linearity range	25...140 dB(A) (at 1 kHz)
Nominal measuring range for L _{Cpeak}	37...140 dB(C)
Max. electr. measuring range	± 2 V
Max. input voltage at the input of the feeding device	± 2,5 V
U _{max} at input	± 2,5 V
Integration response	immediate
Time weighting F	Rise or decay time constant = 0.125 s
Time weighting S	Rise or decay time constant = 1 s
Time weighting Peak	Rise time constant = 20 μs
Shortest integration time	16 ms
Longest integration time	194 days (100 h running on rechargeables)
Interfaces	USB
Stabilizing time after switch-on	1 min
Warm-up time	1 min
Calibration frequency	1 kHz
Max. time of day drift	max. 1.73 s in 24 h
Battery	2xLR6A, >100 operation hours without display backlight
External power supply	via USB (see accessories)
Dimensions	266 mm x 76 mm x 38 mm
Weight	320 g (batteries inserted)
Reference conditions	
Reference direction	Along the microphone axis
Reference sound pressure level	94 dB
Reference frequency	1 kHz
Reference measuring range	25...140 dB(A)
Reference air temperature	23 °C
Reference air pressure	101.325 kPa
Reference relative humidity	50 %

Table 4.1: Technical data Tango

4.1 Level linearity range

The following table 4.2 contains the measurement ranges for A-weighted sound levels and the C-weighted peak sound level.

Fast/Slow/Leq dB(A)	L _{AE} dB(A)	L _{Cpeak} dB(C)
25...140	ab 30	37...140
Data in dB and for a microphone sensitivity of 50 mV/Pa		

Table 4.2: Level linearity ranges for A-weighted sound levels

4.2 Linear operating ranges

The operating ranges given below are only valid for calibrated devices! The last column shows the starting values for the level linearity tests.

f	max in dB(A)	min in dB(A)	Range in dB(A)	Starting values
16 Hz	84	30	54	74
31,5 Hz	100	30	70	84
1 kHz	140	25	115	94
4 kHz	141	30	111	94
8 kHz	140	30	110	94
12,5 kHz	137	30	107	94

Table 4.3: Linear operating ranges (f is the frequency of the sine burst.) and starting values for the level linearity tests.

4.3 Self-generated noise

The self-generated electrical noise of the device including preamplifier (measured with equivalent electrical impedance and 50Ω at the input) amounts to approx. 16 dB(A) on the display. The acoustic noise is 16 dB. This is a total noise level of 19 dB. The highest noise level may be expected when externally powered.

ATTENTION! Legally binding measurements *must not* be performed, if the device is connected to public power supply.

4.4 Details on EMC

When the device is exposed to electromagnetic emissions the lower limits of the ranges in table 4.2 are increased by 5 dB. Within these changed ranges the error limits according to DIN EN 61672-1:2003 are maintained. The level linearity range changes to 40...107 dB(A) when the device is exposed to electromagnetic emissions. There will be no performance loss in the device after electrostatic discharges (touch discharge up to 4 kV and air discharge up to 8 kV).

4.5 Frequency weighting

f	A Tango	C Tango	A Standard	C Standard	Diff A	Diff C
10	-67,93	-13,76	-70,00	-14,30	2,07	0,54
12,5	-62,56	-10,84	-63,40	-11,20	0,84	0,36
16	-55,90	-8,12	-56,70	-8,50	0,80	0,38
20	-50,00	-5,94	-50,50	-6,20	0,50	0,26
25	-44,54	-4,20	-44,70	-4,40	0,16	0,20
31,5	-39,36	-2,90	-39,40	-3,00	0,04	0,10
40	-34,36	-1,88	-34,60	-2,00	0,24	0,12
50	-30,14	-1,22	-30,20	-1,30	0,06	0,08
63	-26,12	-0,78	-26,20	-0,80	0,08	0,02
80	-22,32	-0,46	-22,50	-0,50	0,18	0,04
100	-19,06	-0,28	-19,10	-0,30	0,04	0,02
125	-16,12	-0,18	-16,10	-0,20	-0,02	0,02
160	-13,22	-0,10	-13,40	-0,10	0,18	0,00
200	-10,82	-0,06	-10,90	0,00	0,08	-0,06
250	-8,66	-0,04	-8,60	0,00	-0,06	-0,04
315	-6,62	0,00	-6,60	0,00	-0,02	0,00
400	-4,74	0,00	-4,80	0,00	0,06	0,00

f	A Tango	C Tango	A Standard	C Standard	Diff A	Diff C
500	-3,22	0,00	-3,20	0,00	-0,02	0,00
630	-1,92	0,00	-1,90	0,00	-0,02	0,00
800	-0,78	0,00	-0,80	0,00	0,02	0,00
1000	0,00	0,00	0,00	0,00	0,00	0,00
1250	0,58	-0,06	0,60	0,00	-0,02	-0,06
1600	0,98	-0,06	1,00	-0,10	-0,02	0,04
2000	1,20	-0,18	1,20	-0,20	0,00	0,02
2500	1,28	-0,28	1,30	-0,30	-0,02	0,02
3150	1,26	-0,40	1,20	-0,50	0,06	0,10
4000	1,10	-0,68	1,00	-0,80	0,10	0,12
5000	0,78	-1,06	0,50	-1,30	0,28	0,24
6300	0,20	-1,64	-0,10	-2,00	0,30	0,36
8000	-0,60	-2,46	-1,10	-3,00	0,50	0,54
10000	-1,74	-3,62	-2,50	-4,40	0,76	0,78
12500	-3,30	-5,14	-4,30	-6,20	1,00	1,06
16000	-5,48	-7,32	-6,60	-8,50	1,12	1,18
20000	-7,90	-9,74	-9,30	-11,20	1,40	1,46

Table 4.4: A- and C-weighted frequency response

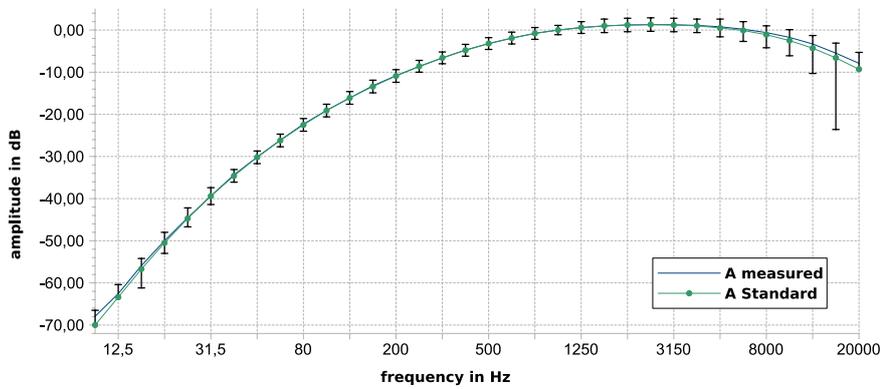


Figure 4.1: A-weighted frequency response

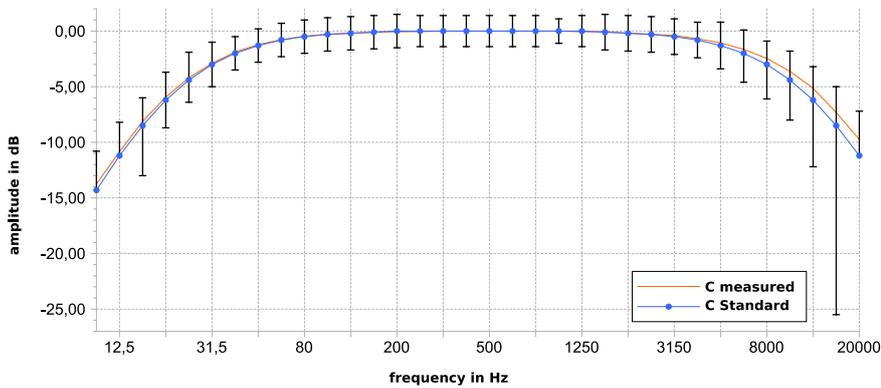


Figure 4.2: C-weighted frequency response

4.6 Microphone

Only the original microphone capsule MK255 by MICROTECH GEFELL is approved for measurements with Tango. The directional characteristics of the microphone correspond to the limits specified in DIN EN 61672-1:2003. The effect of the windscreen on the directional characteristics of the microphone is negligible. As a result all corresponding correction values are specified with $pm0.1$ dB. The acoustic center point and microphone reference point are located at the middle of the microphone membrane.

Property	Value
Model Transducer type	Capacitive pressure transducer
Polarization	backelectret
Frequency range free-field	3.5 Hz ... 20 kHz (± 2 dB)
Sensitivity	ca. 50 mV/Pa
Max. SPL for 3 % , distortion at 1 kHz	146 dB
Self-generated noise with preamplifier	15 dBA
Capacitance	17 pF
Operating temperature range	-50 ... +100 °C
Ambient temperature coefficient	$leq 0.01$ dB/°C
Ambient pressure coefficient	-0.01 dB/kPa
Diameter	1/2"
with protection lid	$13,2 \pm 0,02$ mm
without protection lid	$12,7 \pm 0,02$ mm
Length	16,4 mm
Weight	7,5 g
Thread for preamplifier	11,7 mm 60 UNS
Thread for protection	12,7 mm 60 UNS

Table 4.5: Technical data MK255

4.6.1 Random incidence and free-field correction

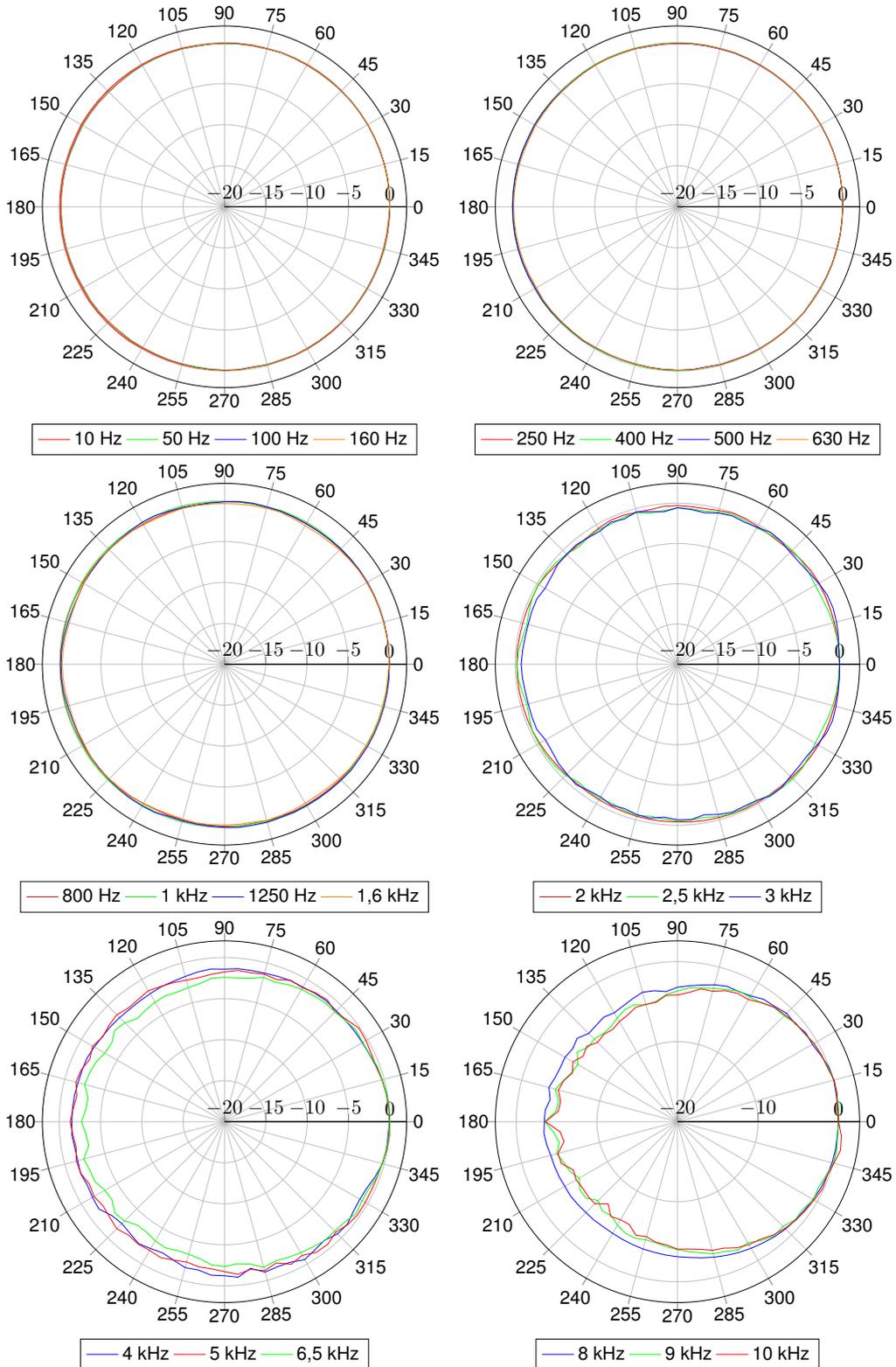
f in Hz	Freifeldkorr. in dB	Diffusfeldkorr. in dB	f in Hz	Freifeldkorr. in dB	Diffusfeldkorr. in dB
25	0	0	0.8 k	0	0
31.5	0	0	1 k	0	0
40	0	0	1.25 k	-0.03	0
50	0	0	1.6 k	0.03	0
63	0	0	2 k	0.21	-0.1
80	0	0	2.5 k	0.36	-0.1
100	0	0	3.2 k	0.56	0
125	0	0	4 k	0.88	0.1
160	0	0	5 k	1.36	0.2
200	0	0	6.3 k	2.01	0.4
250	0	0	8 k	2.99	0.7
315	0	0	10 k	4.25	0.9
400	0	0	12.5 k	6.14	1.8
500	0	0	16 k	8.77	3.4
630	0	0	20 k	9.9	3.2

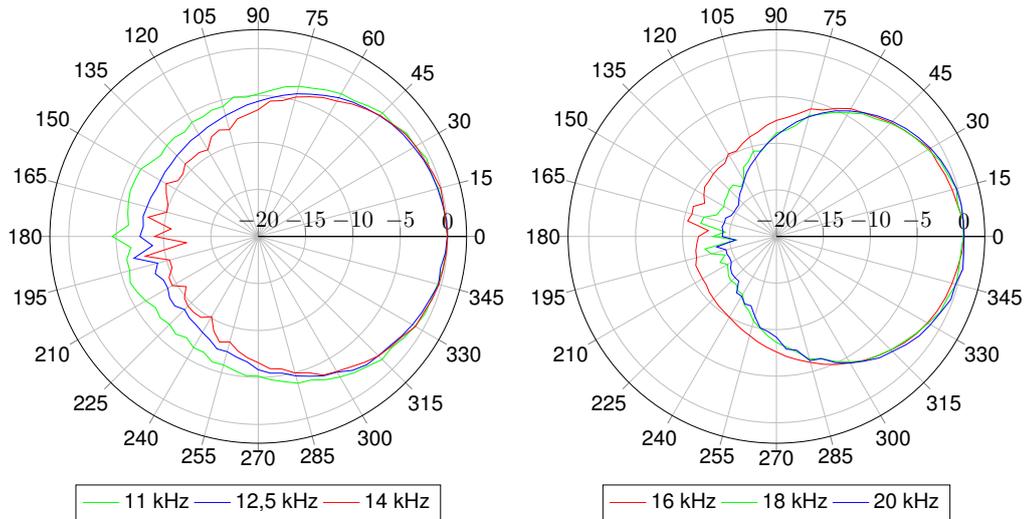
Table 4.6: Free-field and random incidence corrections (manufacturer's specification: measurement uncertainty at 95% certainty ± 0.6 dB)

4.6.2 Directional characteristics

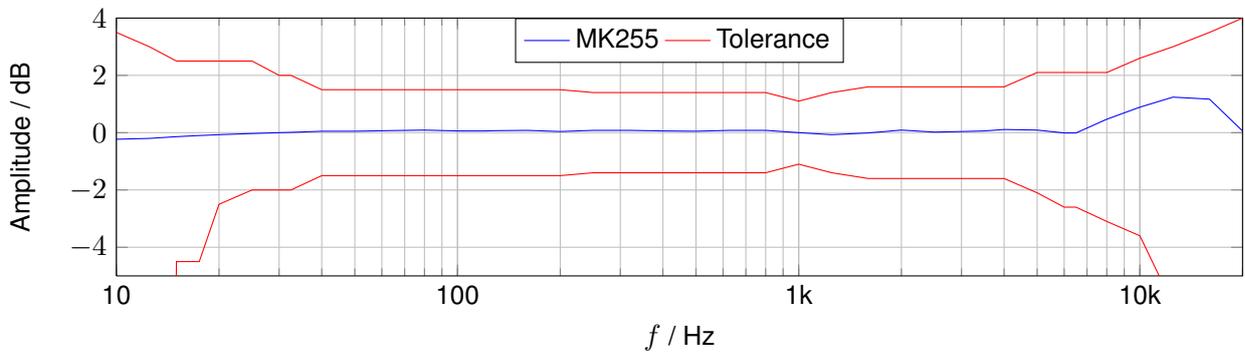


Figure 4.3: Mikrofonachse





4.6.3 Frequency response of the microphone



4.7 Effect of environmental conditions

In order to avoid the effect of sound reflections from the body of the operator interfering with the measurement, Tango should be located as far as possible from the body. Thus, when actually performing the measurement, the operator should place himself at a distance behind the tripod-mounted meter, or extend the hand-held meter as far from the body as is comfortable.

Property	Value
Temperature	Calibration deviation < 0,3 dB within a temperature range from -20 °C to + 50 °C and at a relative humidity of 65 %
Humidity	calibration deviation < 0,1 dB within a humidity range from 25 % to 90 % and at a temperature of 40 °C
Pressure	calibration deviation < 0,1 dB within a range from 65 kPa to 108 kPa
Magnetic fields	A field of 80 A/m (50 Hz) causes a reading of < 28 dB(A)
Vibration	see paragraph 4.7.2
Storage conditions	-20 °C . . . +60 °C, humidity max. 95 %
Electromagnetic compatibility	
Emission	complies with EN 50081-1 (1992)
Immunity	complies with EN 50082-1 (1997)

Table 4.7: Environmental conditions for the device

NOTICE!

When the temperature changes by more than 15 °C an acclimatization time of 30 min must be safeguarded.

4.7.1 Mains frequency and high-frequency fields

Tango complies with DIN EN 61672-1:2003 with respect to interference immunity to mains frequency and high-frequency fields. The interference immunity to mains frequency and high-frequency fields is highest when the device is running on batteries/rechargeables without USB cable connected.

If Tango is connected to a PC and measuring high-frequency emissions are highest. Additionally, the interference immunity to mains frequency and high-frequency fields is lowest in this configuration (alignment see fig. 4.4). The next lowest emission level is reached in the same configuration, but in STOP-Mode.

In compliance with paragraph 6.6.9 of DIN EN 61672-1:2003 Tango is *not* appropriate to measure levels lower than 74 dB for an electric field strength exceeding 10 V/m.

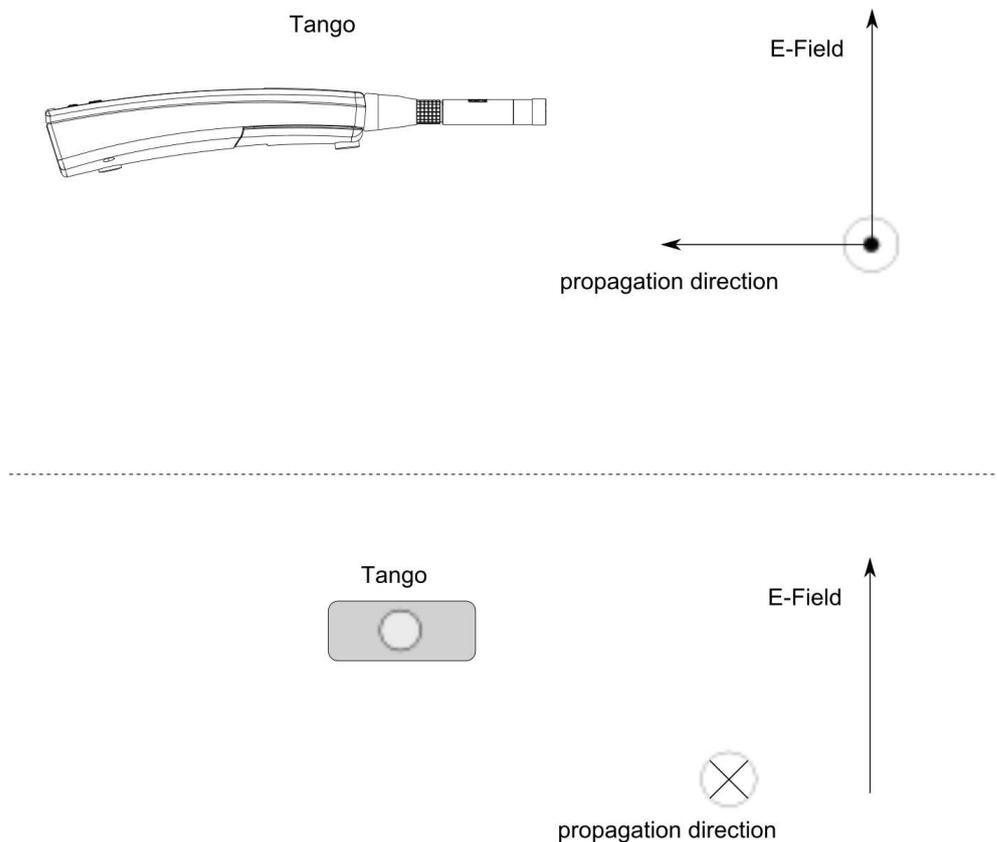


Figure 4.4: Alignment measurement HF immunity

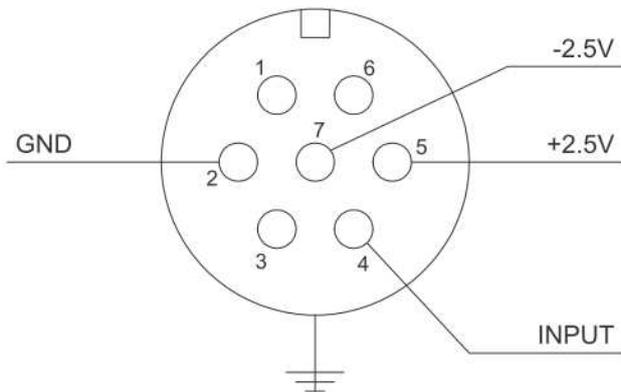
4.7.2 Effect of mechanical vibration

If the device is exposed to mechanical vibration with an acceleration of 1 m/s² perpendicular to the membrane plane of the microphone, the lower limit of the linear operating range increases to 75 dB for the frequencies 31,5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz and 1000 Hz, frequency weighting A.

If the device is exposed to mechanical vibration with an acceleration of 1 m/s^2 parallel to the membrane plane of the microphone, the lower limit of the linear operating range increases to 58 dB for the frequencies 31,5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz and 1000 Hz, frequency weighting A.

4.8 Connection assembly of the detachable microphone

ATTENTION! The detachable microphone must be used only with Tango! Otherwise it may be damaged.



The microphone of Tango is detachable and connected to the analyser via LEMO FGG.1B.307. The pin assignment is shown in figure 4.5.

Figure 4.5: Pin assignment for the detachable microphone

5 Accessories

Tango achieves accuracy class 1 of DIN EN 61672-1:2003 in all possible device-accessories-alignments without the necessity of applying any correction values.

Accessory	Manufacturer	Item number
Cal200	PCB, 1 kHz, 94 dB or 114 dB	800934.4
Type 4231	B&K, 1 kHz, 94 dB bzw. 114 dB	800043.2
Windscreen W2	MICROTECH Gefell	800253.0
USB cable A-Bmini 5 Pol 1.8 m	SINUS Messtechnik GmbH	801038.7
USB power supply adaptor	SINUS Messtechnik GmbH	601092.6
Equivalent electrical impedance K65	MICROTECH Gefell	800030.3

Table 5.1: Available accessories for Tango

The *Windscreen W2* is black coloured and spherically with a diameter of 69 mm.

5.1 Technical specifications of the calibrators

Feature	Value
Standards	IEC 60942:2003 and ANSI S1.40-1984, Class 1
Sound pressure level	94 dB, 114 dB \pm 0.1 dB
Supported microphone types	1/2", 1/4", 3/8"
Weight	156 g
Sound pressure stability	<0.1 dB
Surrounding conditions each for \pm 0.3 dB tolerance	
Static pressure	65 kPa ... 108 kPa
Humidity	10% ... 90% RH
Temperature	-10 °C ... + 50 °C

Table 5.2: Technical specifications Cal200

Feature	Value
Standard	IEC 60942:2003, Klasse 1
Sound pressure level	94 dB, 114 dB \pm 0.2 dB
Supported microphone types	1", 1/2"
Weight	approx. 150 g
Sound pressure stability	<0.05 dB
Surrounding conditions	
Static pressure	65 kPa ... 108 kPa
Humidity	10 % ... 90 %RH
Temperature	-10 °C ... + 50 °C

Table 5.3: Technical specifications Type 4231

5.2 Tango Outdoor kit

With the optional outdoor kit Tango can be used as temporary monitoring station for environmental noise. The runtime from the external battery depends on the measurement configuration, a typical value is 2 month. The data are stored locally. The following items are included in the outdoor kit (figure 5.1):

- Peli Case 1500 with foam insert and LEMO7 Cable intern
- V-Mount Li-Accu 14.8V/6.1A
- BSV1TV Li-Ion Travel Charger
- DC/DC-Adapter
- LEMO7 Extension Cable 3m
- WS1 Microphone Weather Protector
- Tripod



Figure 5.1: Optional accessories "Outdoor kit" (Tango itself not included)

6 Approved functions concerning legally binding measurements

The following functions are approved:

- Start/Stop/Pause function (section 1.3.1)
- Sound levels (table 1.2 in section 1.5)
 - Taktmaximal level
 - Percentile levels: L_{AF90} , L_{AF95} , L_{AF99}
 - Time weightings (Fast, Slow, Peak)
 - Frequency weightings (A, C_{peak})
 - Level linearity
 - Inherent noise level
- Kalibration (section 2.6)
- Overload (section 2.5.2)

7 Declaration of Conformity

We, **SINUS Messtechnik GmbH**, Foeppelstrasse 13, 04347 Leipzig, Germany, declare that the product

Sound Level Meter Tango

Part Number: 907000

Serial Number:

to which this **CE**-declaration relates, is in conformity with the following standards and other documents:

Technical Parameters	Sound Level Meter:	IEC 61672 or DIN EN 61672 class 1 DIN 45657
Electromagnetic Compatibility:	Emission	IEC 61000.6.3 or DIN EN 61000-6-3 IEC 61672 or DIN EN 61672
	Immunity	IEC 61000.6.2 or DIN EN 61000-6-2 IEC 61326 or DIN EN 61326 IEC 61672 or DIN EN 61672
Safety		IEC 61010.1 or DIN EN 61010-1

The measuring system is intended for use with measuring microphones according to IEC 1094-1. This product has been manufactured and tested in compliance with the following binding internal documentation from SINUS Messtechnik GmbH:

Manufacturing and Testing documents:	- Quality assurance manual - Manufacturing documents for Tango - Testing rules for Tango
--------------------------------------	--

This product was tested and found to comply with all specifications.



Gunther Papsdorf
Managing Director

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