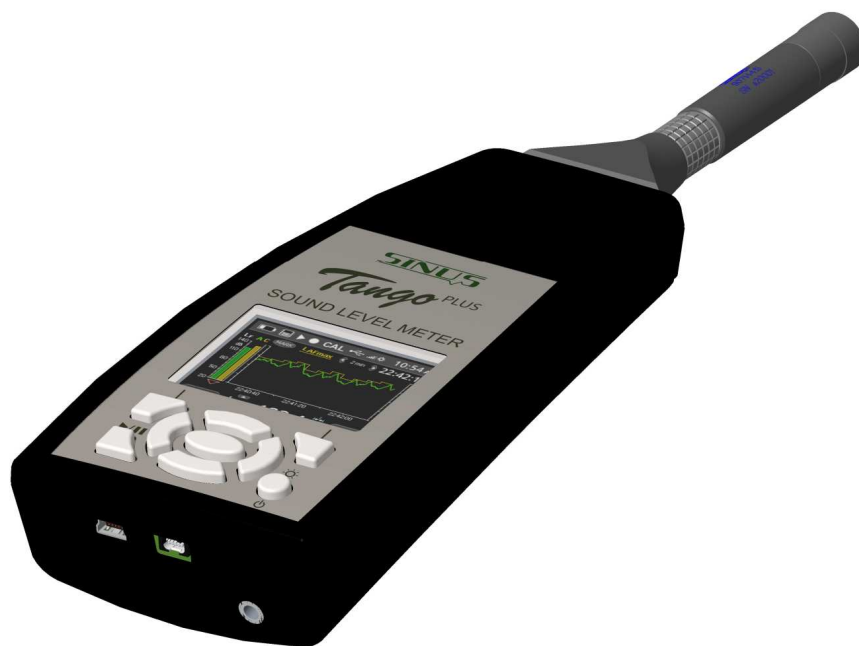


# TANGO *Plus*

Sound Level Meter class 1 according IEC 61672-1:2003



Version 2.12b

March 15, 2017

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|   |
|---|
| <b>ATTENTION!</b> The detachable microphone must be used only with Tango_Plus! Otherwise it may be damaged. |
|---|

## Preface

Thank you for choosing the product Tango™ 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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Föpplstraße 13  
04347 Leipzig, Germany

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E-mail: [info@soundbook.de](mailto:info@soundbook.de)  
Web: <http://www.soundbook.de>

# 1 General information and design

Tango\_Plus is an integrating sound level meter designed according to IEC 61672-1:2003, accuracy class 1 and group Z. It can measure also 1/1 and 1/3 octaves according to IEC 61260. This manual refers to firmware version 2.12b.

**NOTICE!**

Tango\_Plus may perform measurements that require an official verification of the calibration and that are legally binding.  
(type approval applied)

**ATTENTION!**

If Tango\_Plus is used for legally binding measurements, only original accessories shall be used.

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

- Tango\_Plus (907004.2)
- Calibrator Cal200 1/2" type1 PCB (800934.4)
- Calibrator Type 4231 B&K (800043.2)
- Windscreen W2 (800253.0)

Using Tango\_Plus the following sound level values may be measured:  $L_{AF}$ ,  $L_{AFmax}$ ,  $L_{AFmin}$ ,  $L_{CF}$ ,  $L_{CFmax}$ ,  $L_{CFmin}$ ,  $L_{AS}$ ,  $L_{ASmax}$ ,  $L_{ASmin}$ ,  $L_{Cpeak}$ ,  $L_{Aeq}$ ,  $L_{Ceq}$ ,  $L_{Ceq}-L_{Aeq}$ ,  $L_{AE}$ ,  $L_{AFT}$ ,  $L_{AFTeq}$ ,  $L_{AFTeq}-L_{Aeq}$ ,  $L_{Cpeak>72}$  und  $L_{AF72}$ . A detailed description of these values is given in table 1.1.

**NOTICE!**

The number of the firmware version can be displayed (section 2.2.2).

## 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\_Plus can be powered by an external source. For that 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\_Plus 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 ??).

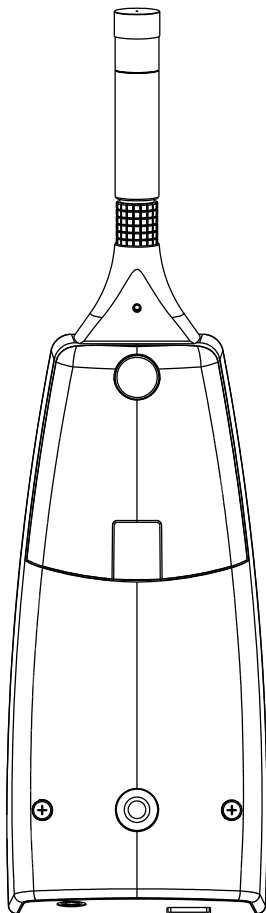


Figure 1.1: Closed battery compartment

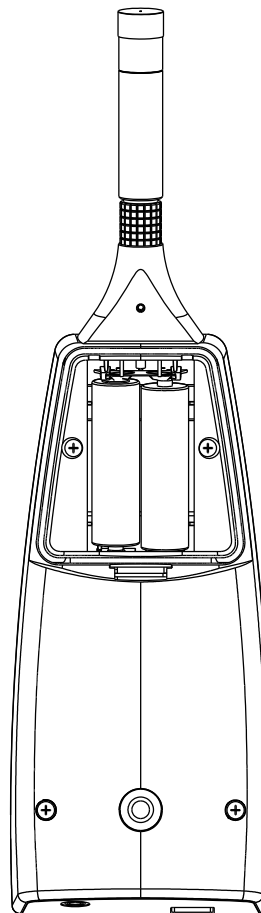
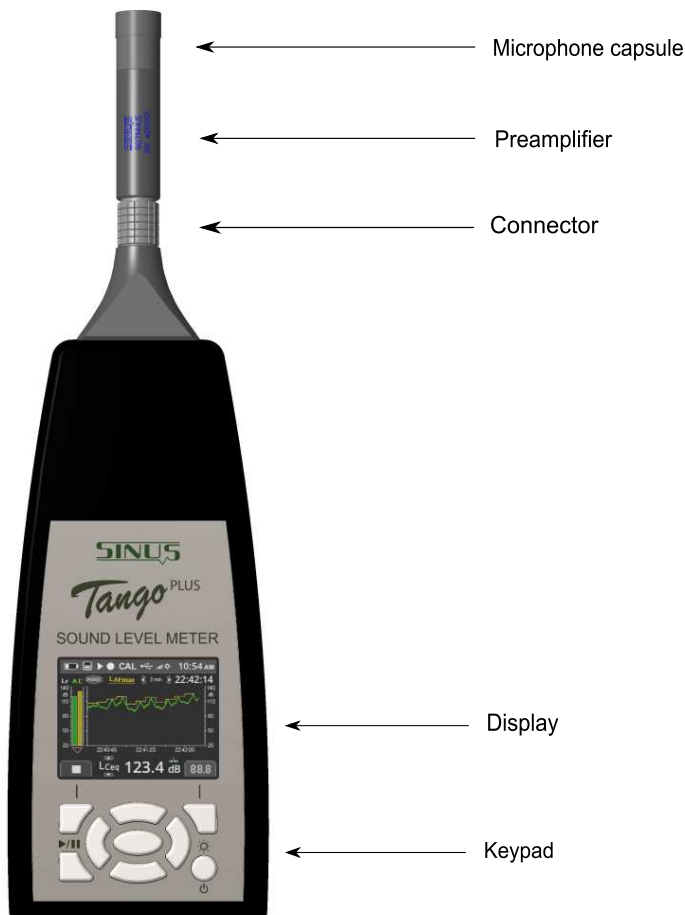


Figure 1.2: Open battery compartment

**ATTENTION!** Changing the batteries causes loss of time, if Tango\_Plus is not connected to external power supply at the same time.

## 1.3 Design



Tango\_Plus 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. Furthermore Tango\_Plus provides a socket to connect a printer directly.

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.

Figure 1.3: Design of the device

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

### 1.3.1 Keypad

If the device is not controlled via PC, you may also use the keypad for setup. In the middle it contains arrow keys with an OK-button in the center. The top corners contain function keys, whose functions are indicated by symbols on the display. The key below on the left is used to start and pause measurements, while the one on the right switches on the device and toggles the brightness level.

### 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 status bar on the top of the display shows symbols for: Battery, Memory, Play/Pause, Storage, Calibra-



tion, USB connection, Level of brightness. There are three basic modi to display spectra, history data or numeric values:

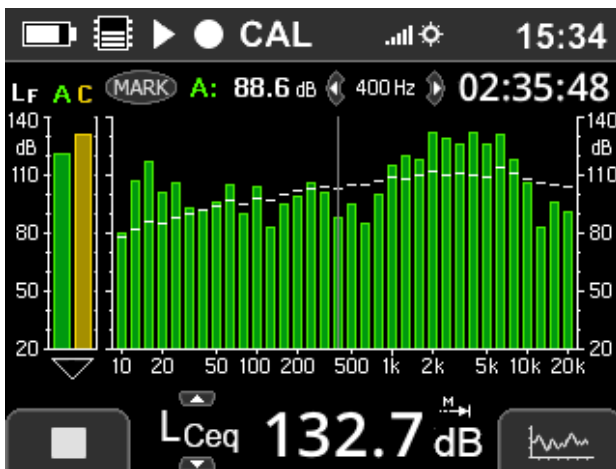


Figure 1.4: Third Octave Display

The Third Octave Display shows a spectrum in the main part with live values as bars and  $L_{eq}$  values as roof top. Via left/right keys the spectral cursor can be moved to select single bands. The band level and the frequency are displayed above the graph as well as the measurement duration. On the left  $L_{AF}$  and  $L_{CF}$  are displayed as bars. The bottom shows numerically one sound level value, which can be switched using the up/down keys.

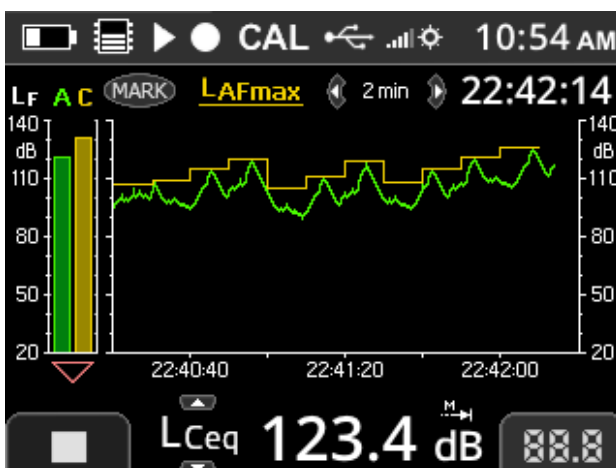


Figure 1.5: History Display

Instead of a spectrum the History Display shows two level graphs in the main part. Which levels are shown is set in the configuration (section 2.2.2). The time length of the x-axis can be toggled with the left/right keys.



Figure 1.6: Numeric Display

The Numeric Display shows the value of the levels selected at the bottom.

## 1.4 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 section 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).

## 1.5 Software installation

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

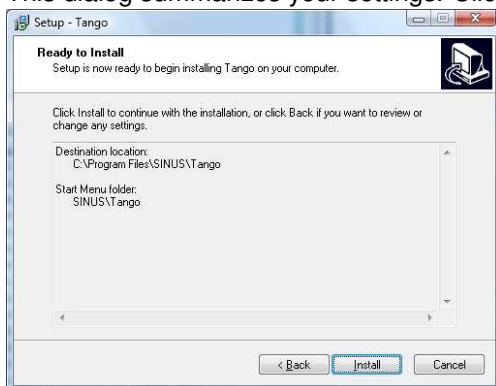
### 1.5.1 Tango\_Plus driver installation

Please follow the instructions below to install the TANGO 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.

### 1.5.2 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\_Uilities\_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 and continue.



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

## 1.6 Calculated values

Tango\_Plus can calculate several sound levels as well as full and 1/3 octaves.

### 1.6.1 Calculated sound levels

| 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 <b>Tango-Utilities</b> .    |
| $L_{CF}$              | Sound pressure level, frequency weighting C, Fast (125 ms time constant)  |
| $L_{CFmax}$           | Level maximum of $L_{CF}$ for the entire measuring period (on the display) or of the last storing interval (stored data).   |
| $L_{CFmin}$           | Level minimum of $L_{CF}$ for the entire measuring period (on the display) or of the last storing interval (stored data). This value is only available by <b>Tango-Utilities</b> .    |
| $L_{AS}$              | 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 <b>Tango-Utilities</b> .    |
| $L_{Cpeak}$           | 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.                     |
| $L_{Ceq}$             | Equivalent continuous sound pressure level for the entire measuring period (on the display) or of the last storing interval (stored data), frequency weighting C.                     |
| $L_{Ceq} - L_{Aeq}$   | Difference of the values $L_{Ceq}$ and $L_{Aeq}$ .  |
| $L_{AE}$              | Sound exposure level, frequency weighting A   |
| $L_{AImax}$           | Maximum sound impulse level, frequency weighting A  |
| $L_{AFT}$             | Maximum $L_{AF}$ of the last 5 s interval.  |
| $L_{AFTeq}$           | Equivalent continuous sound pressure level calculated from the $L_{AFT}$ levels during the entire measuring period according to DIN 45645-1.  |
| $L_{AFTeq} - L_{Aeq}$ | Difference of the values $L_{AFTeq}$ and $L_{Aeq}$ .  |
| $L_{Cpeak > n}$       | Time in which the $L_{Cpeak}$ exceeded $n$ dB.  |
| $L_{AFn}$             | Percentile levels can be calculated from the $L_{AF}$ ( $n = 1, 2, 3$ ). There are 7 standard percentiles (1, 5, 10, 50, 90, 95, 99), but also user defined percentiles are possible. |

Table 1.1: Calculated sound levels

Data can be stored up to an amount of 32 MB.

#### 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 1.1 will be displayed on the device immediately after finishing a measurement/integration.

### 1.6.2 Calculated spectra

Tango\_Plus can calculate full and 1/3 octaves. A, C or Z weighing may be applied. The frequency range is: 10 Hz - 20 kHz. The storage interval defines the number of individual spectra, that are linear averaged.

## 2 Appliance

### 2.1 General information

Tango\_Plus 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  $L_{CF}$  are measured and displayed. If Record mode is enabled, the circle symbol ● is 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 Up/Down keys.

**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 Device configuration

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

#### 2.2.1 Configuration using Tango-Utilities

For configuring the device via PC, you have to install the TANGO Driver and **Tango-Utilities** software first (section 1.5). Possible settings in **Tango-Utilities** are adjusted in the **Setup** tab. In the column **Display** use the check boxes to enable individual values and comboboxes to set the graphic refresh rate for display. 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\_Plus by clicking on **Apply**.

In the column **Storage** the correspondig 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 intervall 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\_Plus to **Tango-Utilities**.

### 2.2.2 Manual configuration

The manual configuration of the device without PC is shown in the following table 2.2:

| Item                | Description   |
|---------------------|---|
| Measurement         |   |
| Record Mode         | Select values to be stored or just displayed.                                   |
| Sync at Full Hour   | Synchronize time intervals to full hours.                                       |
| Calibration         |   |
| Start Calibration   | Start the process of calibration.   |
| Calibration Level   | Set the calibration level.  |
| Measurement Values  | (Select a sound level e.g. $L_{AFmax}$ and adjust the following properties.)    |
| Display Location    | Select on which graph the value shall be shown.                                 |
| Display Interval    | Select the rate of display refresh (500 ms, . . . , 60 min, End Result only).   |
| Storage Interval    | Set the storage interval (No storage, 500 ms, . . . , 60 min, End Result only). |
| Print Result        | Decide whether the result shall be printed.                                     |
| Octave Spectra      |   |
| Octave Mode         | Select whether 1/3 or full octaves shall be measured.                           |
| Frequency Weigthing | Available weigthings: Z, A, C   |
| Display Range       | Adjust the scaling of the Y-axis.   |
| Display Interval    | Select the rate of display refresh (125 ms, . . . , 60 min, End Result only).   |
| Storage Interval    | Set the storage interval (No storage, 125 ms, . . . , 60 min, End Result only). |
| Storage Weigthing   | Available weigthings: Z, A, C   |
| History Graph       |   |
| Display Range       | Adjust the scaling of the Y-axis.   |
| History Time        | Adjust the scaling of the X-axis.   |
| Graph 1             | Select which value shall be displayed as yellow.                                |
| Graph 2             | Select which value shall be displayed as green.                                 |
| Device              |   |
| Time                | Set time and select 12h or 24h format.  |
| Display             | Set Display properties.   |
| Info                | Read off version numbers of firmware and hardware.                              |
| Print Results       |   |

Table 2.2: Manual configuration menu of Tango\_Plus

## 2.3 Tango-Utilities

**Tango-Utilities** is the basic software to configure Tango\_Plus and export values from measurements. It is not meant to perform further analysis calculations.

### Status bar

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

**Connection Status:** disconnected, connected, but Tango\_Plus off, connected, Tango\_Plus on;

**Virtual COM Port;**

**Measurement Status:** Stop, Measurement, Pause;

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

**Marker Status:** MARK;

**Memory usage:** per Hour, Day and Week

## Program settings and Extended device settings

Via the main menu **Settings->Program...** the following settings are available (figure 2.1): Selection of the connected device **Tango\_Plus (Connected Device)**, default export directory (**Default Export Directory**) and the default directory for configuration data. The Extended device settings *cannot* be adjusted manually without PC.

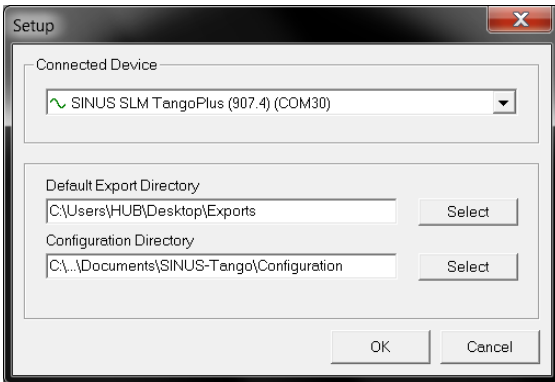


Figure 2.1: **Tango-Utilities** - Program settings

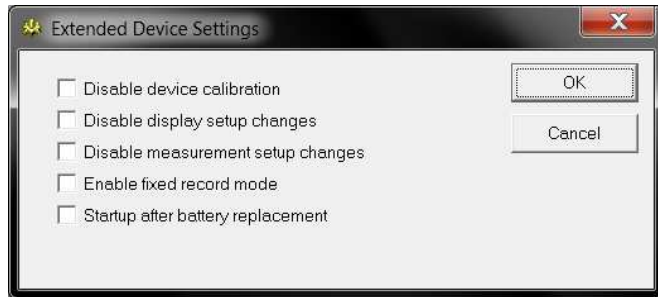


Figure 2.2: **Tango-Utilities**- Extended device settings

| 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.      |
| Startup after battery replacement | Automatic start of Tango_Plus after changing the batteries.         |

Table 2.3: Extended program settings

### 2.3.1 Info Tab

You may view the software version of **Tango-Utilities** in the main menu selecting **Help -> About** (figure 2.4). The firmware version of the device is displayed in the Info-Tab (figure 2.3).

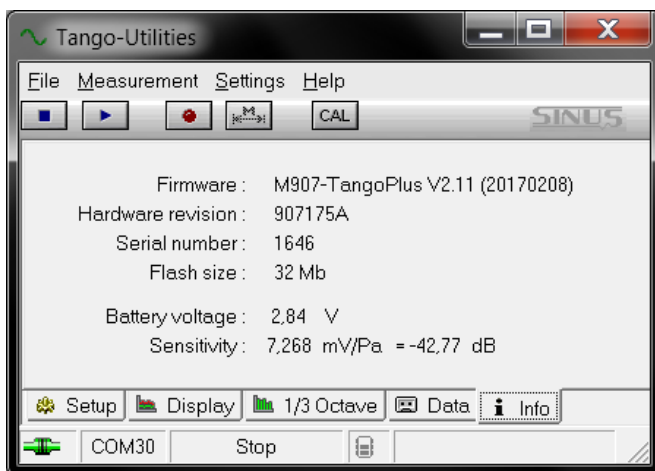


Figure 2.3: **Tango-Utilities** - Info Tab



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

### 2.3.2 Setup Tab

The Setup tab of **Tango-Utilities** (figure 2.5) provides the configuration of Tango\_Plus for a measurement. The first column shows the items, the second the configuration for display and the third for storage. Some items provide special settings, configured in the fourth column.

|                | Display                                    | Storage              | Options   |
|----------------|--|----------------------|---|
| LAF:           | <input type="checkbox"/> 500 ms            | 125 ms               |   |
| LAFmax:        | <input checked="" type="checkbox"/> Result | 1 sec                |   |
| LAFmin:        | <input type="checkbox"/> Result            | Off                  |   |
| LAS:           | <input type="checkbox"/> 500 ms            | Off                  |   |
| LASmax:        | <input checked="" type="checkbox"/> Result | 60 sec               |   |
| LASmin:        | <input type="checkbox"/> Result            | Off                  |   |
| LCpeak:        | <input checked="" type="checkbox"/> Result | 60 sec               |   |
| LAeq:          | <input checked="" type="checkbox"/> Result | 60 sec               |   |
| LAE:           | <input checked="" type="checkbox"/> Result | 60 sec               | Weighting 1 sec                                     |
| LAFT:          | <input checked="" type="checkbox"/> 5 sec  | 5 sec                |   |
| LAFTeq:        | <input checked="" type="checkbox"/> Result | Result only          |   |
| LAFTeq - LAeq: | <input checked="" type="checkbox"/> Result | Result only          |   |
| LCpeak> (1):   | <input type="checkbox"/> Result            | Result only          | > 130 dB  |
| LCpeak> (2):   | <input type="checkbox"/> Result            | Result only          | > 135 dB  |
| LCpeak> (3):   | <input type="checkbox"/> Result            | Result only          | > 140 dB  |
| LAFn (1):      | <input type="checkbox"/> Result            | 60 min               | 90 %  |
| LAFn (2):      | <input type="checkbox"/> Result            | 60 min               | 95 %  |
| LAFn (3):      | <input type="checkbox"/> Result            | 60 min               | 99 %  |
| LCF:           | <input checked="" type="checkbox"/> 500 ms | Off                  |   |
| LCFmax:        | <input type="checkbox"/> Result            | Off                  |   |
| LCFmin:        | <input type="checkbox"/> Result            | Off                  |   |
| LCeq:          | <input checked="" type="checkbox"/> Result | Off                  |   |
| LCeq - LAeq:   | <input checked="" type="checkbox"/> Result | 60 sec               |   |
| 1/3 Octave:    | 125 ms<br>Z-Weighting                      | 1 sec<br>A-Weighting | <input checked="" type="checkbox"/> 1/3 Octave Mode |
|                |  | Synchronisation:     | Off   |

Figure 2.5: Configuration in setup tab

### 2.3.3 Display Tab

In the Display tab history values are shown (figure 2.6), 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. 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. The context menu of the graph provides Zoom and axes scaling functionality.

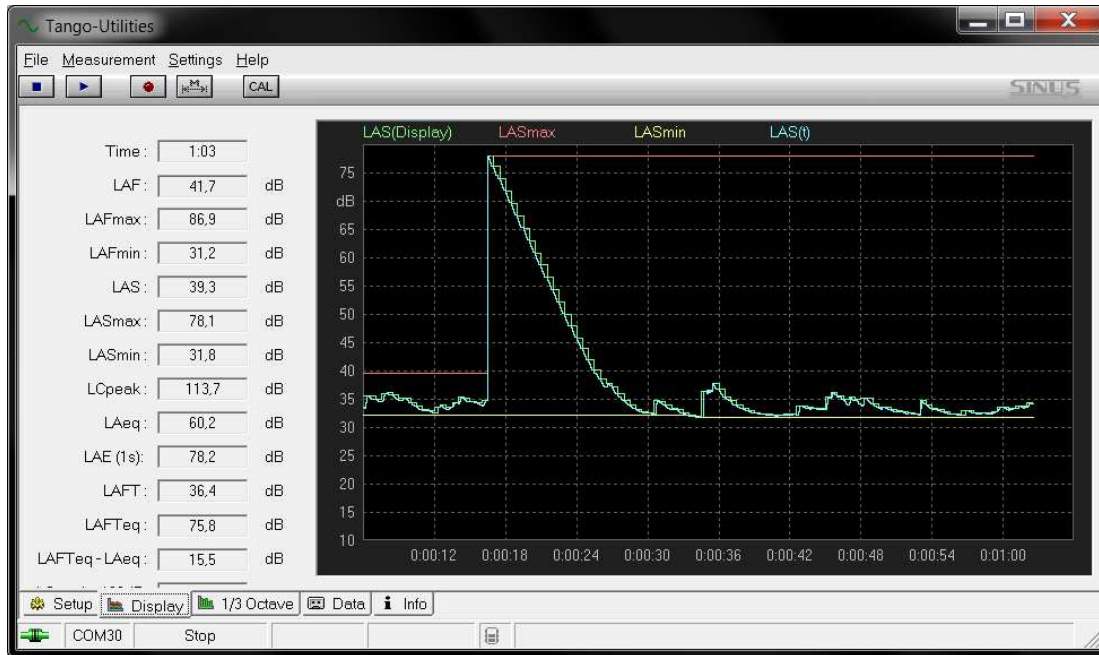


Figure 2.6: Show history values in Display Tab

### 2.3.4 Octave Tab



Figure 2.7: Show spectral values in Octave Tab



In the Octave tab spectral values are shown (figure 2.7), which are calculated by the device during a measurement (according to the settings in the Setup-Tab). To adjust weighting (Z-blue, A-green, C-yellow) or refresh rate for graphical display click on the corresponding items in the header of the graph. The context menu of the graph provides scaling functionality. Also displayed is a coordinate cross. The vertical line shows the current value of the selected band while the horizontal line shows the sum value.

### 2.3.5 Data-Tab

On the right side of the Data-Tab (figure 2.8) a table containing the recorded files 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**).

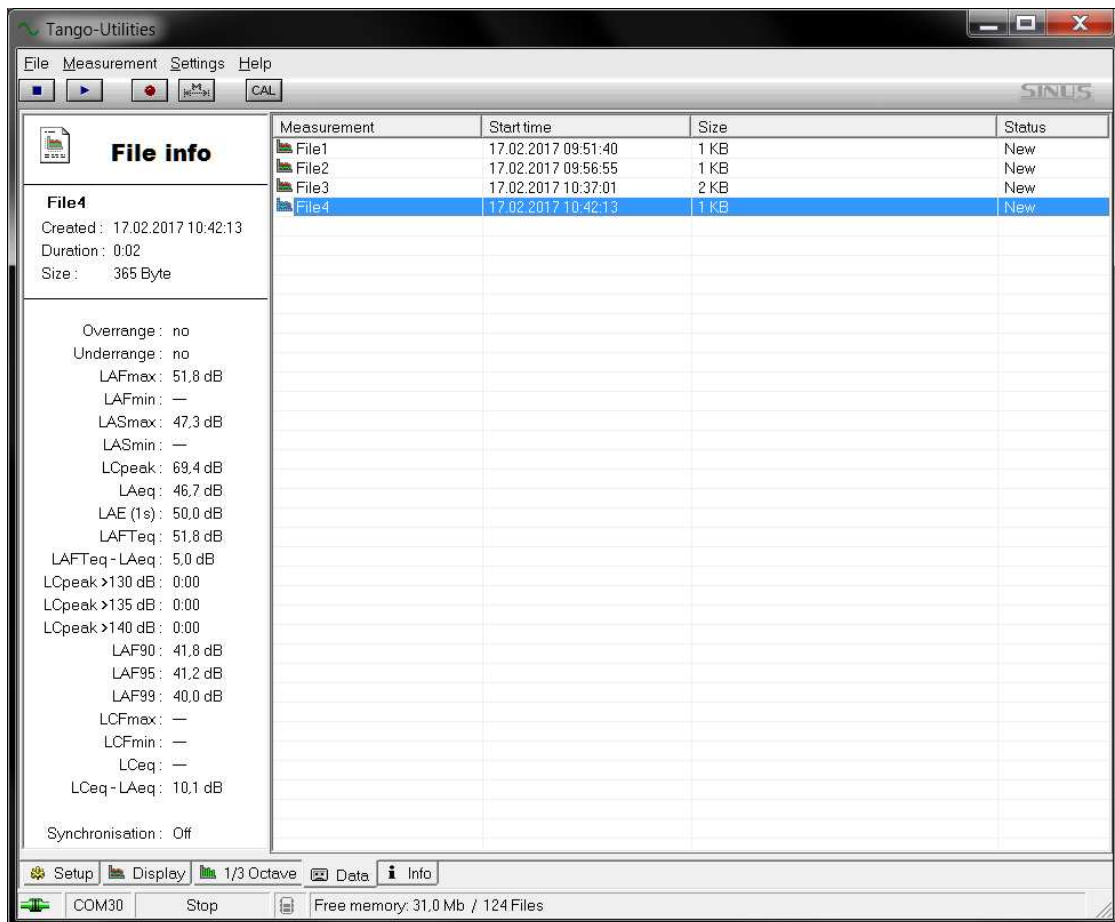


Figure 2.8: Export measurements in Data Tab

### 2.3.6 Data export

Measured data are saved to the internal storage of the device (32 MB). The data sets are listed in the Data-Tab (section 2.3.5). By right-clicking you may open a context menu, that provides access to the Export window (figure 2.9). It provides tabs for user defined metainformation, smr export for AUDITOR, txt export (figure 2.10) for only end results as well as a tab for csv export (for excel) (figure 2.11).

The last tab include two lists. The left one shows the values which are part of the measurement, but which have not been selected for export yet. The right list shows the values, 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**.

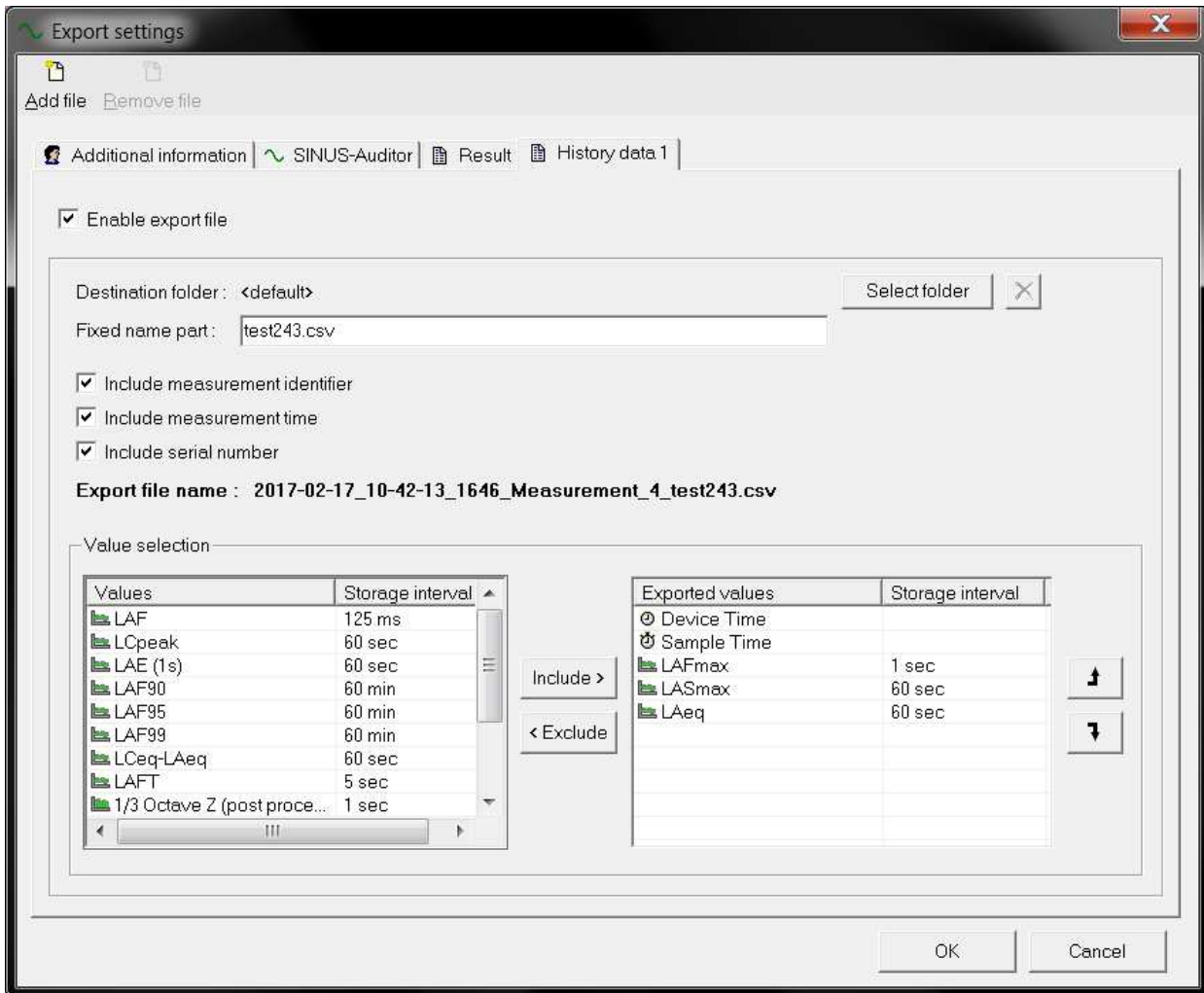


Figure 2.9: Export window

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 2.10: Example txt-Export Results

|    | 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        |
| 3  | 08:45:09,25 | 0,25        | 40,9 |      |        |            | 0      | 0        |
| 4  | 08:45:09,38 | 0,38        | 40,6 |      |        |            | 0      | 0        |
| 5  | 08:45:09,50 | 0,5         | 41,1 |      |        |            | 0      | 0        |
| 6  | 08:45:09,63 | 0,63        | 41,1 |      |        |            | 0      | 0        |
| 7  | 08:45:09,75 | 0,75        | 41,3 |      |        |            | 0      | 0        |
| 8  | 08:45:09,88 | 0,88        | 42   |      |        |            | 0      | 0        |
| 9  | 08:45:10,00 | 1           | 42,9 | 41,7 | 65,3   |            | 0      | 0        |
| 10 | 08:45:10,13 | 1,13        | 44,3 |      |        |            | 0      | 0        |
| 11 | 08:45:10,25 | 1,25        | 43,2 |      |        |            | 0      | 0        |
| 12 | 08:45:10,38 | 1,38        | 41,9 |      |        |            | 0      | 0        |
| 13 | 08:45:10,50 | 1,5         | 41,2 |      |        |            | 0      | 0        |
| 14 | 08:45:10,63 | 1,63        | 40,2 |      |        |            | 0      | 0        |
| 15 | 08:45:10,75 | 1,75        | 40,4 |      |        |            | 0      | 0        |
| 16 | 08:45:10,88 | 1,88        | 41   |      |        |            | 0      | 0        |
| 17 | 08:45:11,00 | 2           | 40,7 | 41,4 | 65,3   |            | 0      | 0        |
| 18 | 08:45:11,13 | 2,13        | 40,8 |      |        |            | 0      | 0        |
| 19 | 08:45:11,25 | 2,25        | 40,9 |      |        |            | 0      | 0        |
| 20 | 08:45:11,38 | 2,38        | 40,8 |      |        |            | 0      | 0        |
| 21 | 08:45:11,50 | 2,5         | 41,3 |      |        |            | 0      | 0        |
| 22 | 08:45:11,63 | 2,63        | 41   |      |        |            | 0      | 0        |
| 23 | 08:45:11,75 | 2,75        | 40,7 |      |        |            | 0      | 0        |
| 24 | 08:45:11,88 | 2,88        | 40,6 |      |        |            | 0      | 0        |
| 25 | 08:45:12,00 | 3           | 40,9 | 41,1 | 63,9   |            | 0      | 0        |

Figure 2.11: Example csv-Export

## 2.4 Measure

For legally binding measurements the device must run on batteries/rechargeables. Therefore the device has to be controlled with the keypad (section 1.3.1). 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.
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.

### 2.4.1 Measure low sound levels

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

### 2.4.2 Overload and Underrange

Overload and underrange are displayed, when the linearity range is left. The representation on the display is explained in the following table 2.4.











| 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 2.4: Display of overload and underrange

#### NOTICE!

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

## 2.5 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:

### 2.5.1 Calibrate using Tango-Utilities

1. Connect Tango\_Plus 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 methode.

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.

### 2.5.2 Calibrate Tango\_Plus directly

1. Switch on the device.
2. Press the Setup-Button and navigate to the calibration menu.
3. Adjust the calibration level and execute “Start Calibration”. 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 correspondig level on the calibrator, if necessary) and insert the microphone into the calibrator.
5. Press the OK-Button and 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\_Plus.

#### 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.

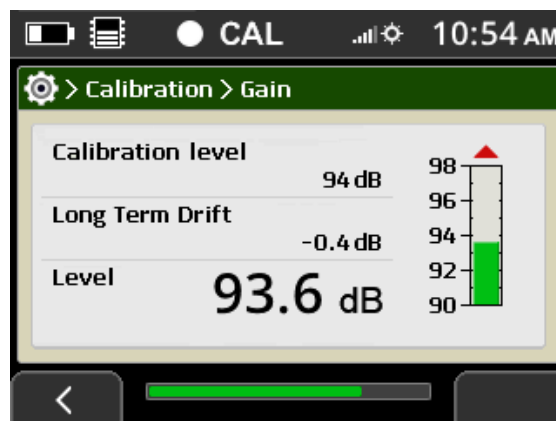


Figure 2.12: Calibration menu

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## 3 Testing information

### 3.1 Acoustic test

#### 3.1.1 Microphone alignment for measuring according to IEC 61672-1:2003.

To measure the influence of mechanical vibrations 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.

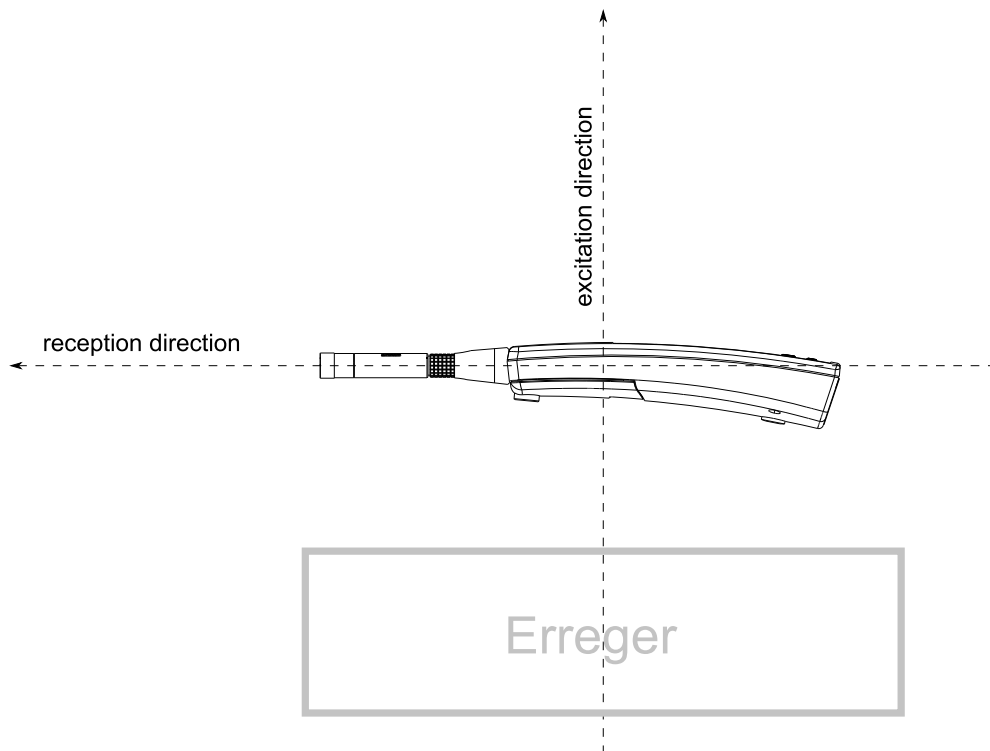


Figure 3.1: Alignment for vibration test

### 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  | <b>Tango-Utilities</b>                                  |
| Number of channels                                    | 1   |
| Accuracy  | Class 1 according to IEC 61672-1:2003                   |
| Display of measured values                            | Colour TFT 320 x 240                                    |
| Frequency weighting                                   | A, C (simultaneously), no optional frequency weightings |
| Time weighting  | Fast, Slow, Peak (simultaneously)                       |
| Data storage  | Yes   |
| Self-generated noise                                  | $\leq 19$ dB(A)   |
| Max. Sound Pressure Level                             | see table 4.6   |
| Linearity range                                       | 25...140 dB(A) (at 1 kHz)                               |
| Nominal measuring range for $L_{Cpeak}$               | 37...140 dB(C)  |
| Max. electr. measuring range                          | $\pm 2$ V   |
| Max. input voltage at the input of the feeding device | $\pm 2,5$ V   |
| $U_{max}$ at input                                    | $\pm 2,5$ 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 $\mu$ s                         |
| Shortest integration time                             | 16 ms   |
| Longest integration time                              | 194 days (100 h running on rechargeables)               |
| Interfaces  | USB 2.0, serial printer port                            |
| 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   | 2 x AA, 40 operation hours                              |
| External power supply                                 | via USB (see accessories)                               |
| Dimensions  | 266 mm x 76 mm x 38 mm                                  |
| Weight  | 320 g (batteries inserted)                              |
| <b>Reference conditions</b>                           |   |
| 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\_Plus

## 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 for microphone sensitivity of 50 mV/Pa.

| Fast/Slow/Leq in dB(A) | L <sub>AE</sub> in dB(A) | L <sub>Cpeak</sub> in dB(C) |
|------------------------|--------------------------|-----------------------------|
| 25... 140              | ab 30                    | 37... 140                   |

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

## 4.2 Linear operating ranges

The operating ranges given below are only valid for calibrated devices! The last columns show 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    | 139          | 25           | 114            | 94              |
| 4 kHz    | 140          | 30           | 110            | 94              |
| 8 kHz    | 139          | 30           | 109            | 94              |
| 12,5 kHz | 135          | 30           | 105            | 94              |

Table 4.3: Linear operating ranges A-weighted ( $f$  is the frequency of the sine signal) and starting values for the level linearity tests.

| $f$      | max in dB(C) | min in dB(C) | Range in dB(C) | Starting values |
|----------|--------------|--------------|----------------|-----------------|
| 16 Hz    | 126          | 41           | 85             | 94              |
| 31,5 Hz  | 137          | 42           | 95             | 94              |
| 1 kHz    | 139          | 39           | 100            | 94              |
| 4 kHz    | 139          | 38           | 101            | 94              |
| 8 kHz    | 137          | 39           | 98             | 94              |
| 12,5 kHz | 133          | 38           | 95             | 94              |

Table 4.4: Linear operating ranges C-weighted ( $f$  is the frequency of the sine signal) 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 capacitance and  $50\Omega$  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.

### 4.3.1 Measurement of low noise levels

For the measurement of low noise levels not special preparation is required.

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

## 4.4 Frequency weighting

| $f$  | A Tango_Plus | C Tango_Plus | 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_Plus | C Tango_Plus | 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 4.5: A- and C-weighted frequency response

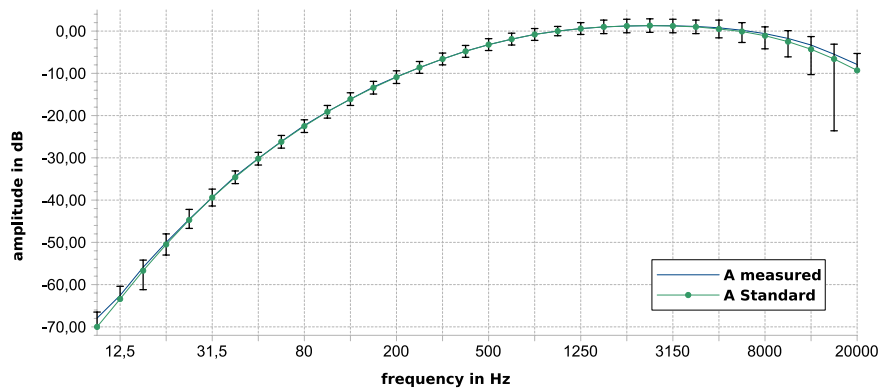


Figure 4.1: A-weighted frequency response

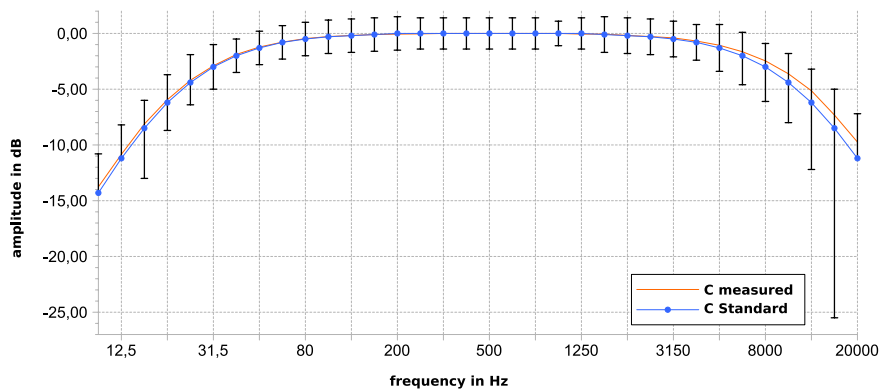


Figure 4.2: C-weighted frequency response



## 4.5 Microphone

Only the original microphone capsule MK255 by MICROTECH GEFELL is approved for measurements with Tango\_Plus. The directional characteristics of the microphone correspond to the limits specified in IEC 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 ( $\pm 2$ 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 4.6: Technical data MK255

### 4.5.1 Random incidence and free-field correction

| $f$<br>in Hz | Freifeldkorr.<br>in dB | Diffusfeldkorr.<br>in dB | $f$<br>in Hz | Freifeldkorr.<br>in dB | Diffusfeldkorr.<br>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 4.7: Free-field and random incidence corrections (manufacturer's specification: measurement uncertainty at 95% certainty  $\pm 0.6$  dB)

## 4.6 Details on EMC

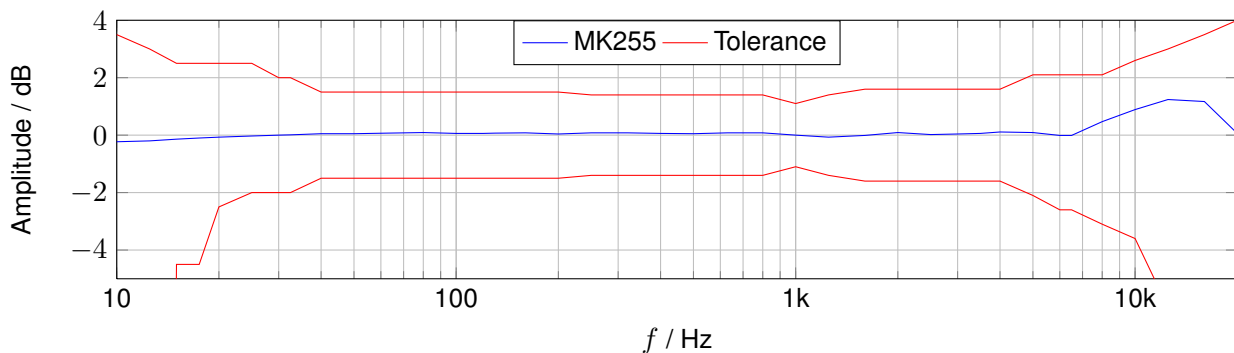
When the device is exposed to electromagnetic emissions the lower limits of the ranges in table 4.2 are increased by 5 dB. Within these changed ranges the error limits according to IEC 61672-1:2003 are maintained. The level linearity range changes to 40...107 dB(A) when the device is exposed to electromagnetic 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).

### 4.6.1 Directional characteristics



Figure 4.3: Mikrofonachse

### 4.6.2 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\_Plus 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.

### 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\_Plus complies with IEC 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\_Plus 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 IEC 61672-1:2003 Tango\_Plus is *not* appropriate to measure levels lower than 74 dB for an electric field strength exceeding 10 V/m.

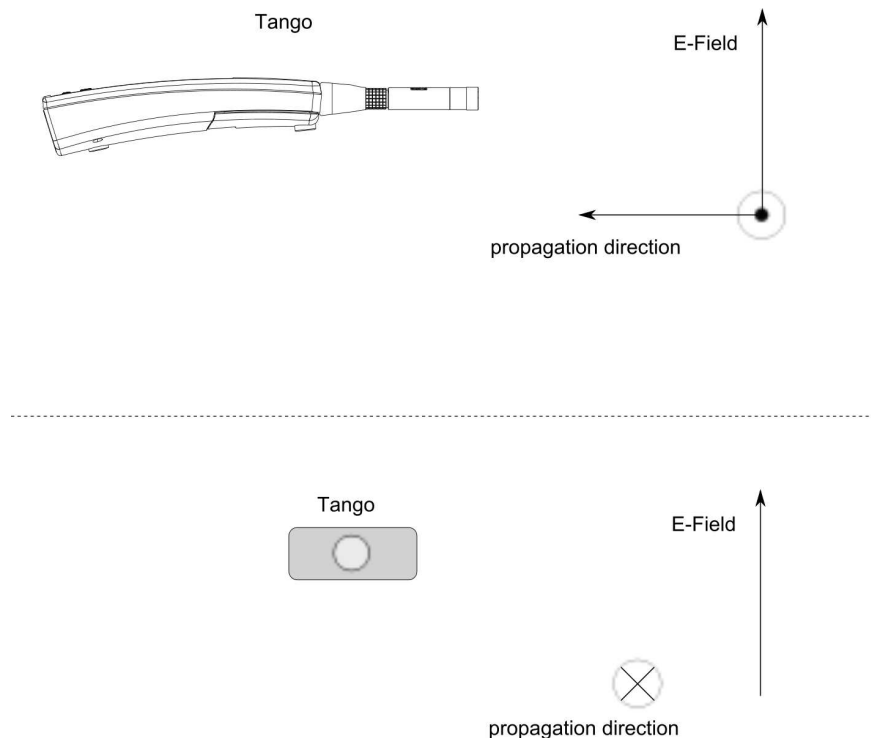


Figure 4.4: Alignment measurement HF immunity

#### 4.7.2 Effect of mechanical vibration

If the device is exposed to mechanical vibration with an acceleration of  $1 \text{ m/s}^2$  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  $1 \text{ m/s}^2$  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\_Plus! Otherwise it may be damaged.

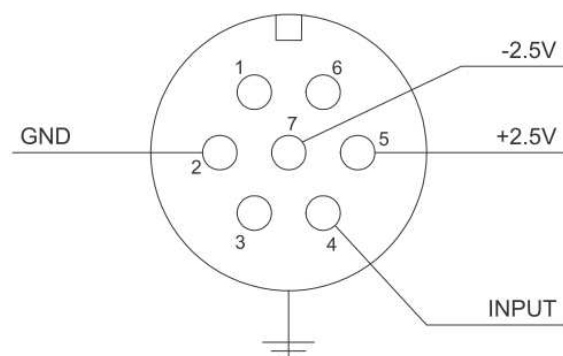


Figure 4.5: Pin assignment for the detachable microphone

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

## 5 Accessories

Tango\_Plus achieves accuracy class 1 of IEC 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\_Plus

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

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## 6 Declaration of Conformity

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

### Sound Level Meter Tango\_Plus

Part Number: 907004.2

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<br>DIN 45657  |
|                               | Third-octave analyzer: | IEC 61260 (09/2001) class 1   |
| Electromagnetic Compatibiliy: | Emission               | IEC 61000.6.3 or DIN EN 61000-6-3<br>IEC 61672 or DIN EN 61672                              |
|                               | Immunity               | IEC 61000.6.2 or DIN EN 61000-6-2<br>IEC 61326 or DIN EN 61326<br>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_Plus |
|                                      | - Testing rules for Tango_Plus           |

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

Gunther Papsdorf  
Managing Director

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