Tango Plus

Sound Level Meter class 1 according IEC 61672-1:2014

Version 2.12j
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© SINUS Messtechnik GmbH
Foepplstrasse 13, 04347 Leipzig, Germany
http://www.soundbook.de
info@soundbook.de

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Contents

ATTENTION! The detachable microphone must be used only with Tango_Plus! The capsule MK255 and the preamplifier (Order number: 907144.5) are selected as pair by manufacturer and must **not** be devided! If used with other hardware with more than $\pm$ 2.5 V power supply, the preamplifier will be damaged and warranty is lost!

Preface

Thank you for choosing the product Tango_Plus 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 requests on spare parts and accessories to the following address:

Address:	SINUS Messtechnik GmbH Föpplstraße 13 04347 Leipzig, Germany
Telephone:	+49-(0)341-24429-33
Fax:	+49-(0)341-24429-99
E-mail:	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 61672-1:2014, accuracy class 1 and immunity to interference group Z. It can measure also 1/1 and 1/3 octaves according to IEC 61260.

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_{AImax}, $L_{Cpeak>n}$ and L_{AFn}. A detailed description of these values is given in table 1.1 in section 1.6.

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 malfuntion. Such manipulation will always cause the loss of warranty and major damages. Make a note of the occuring 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 1.3.2).

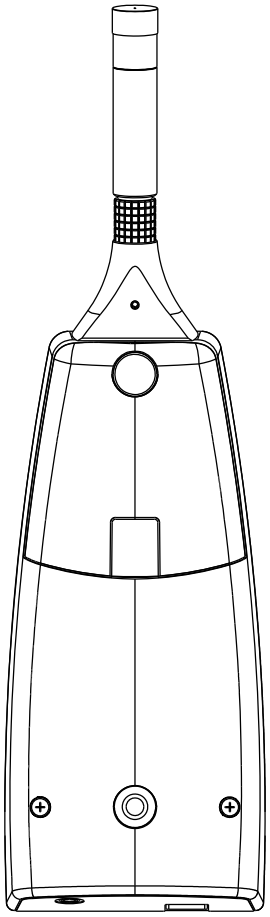


Figure 1.1: Closed battery compartment

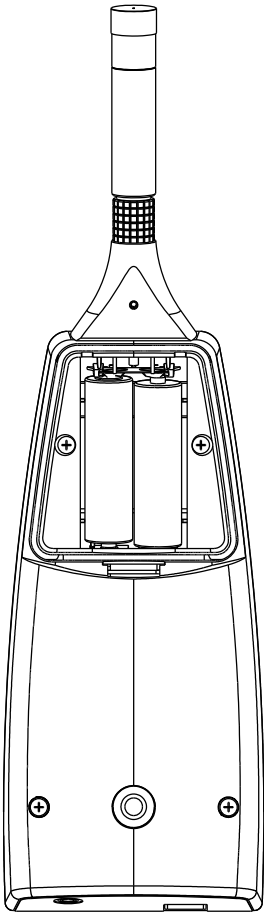
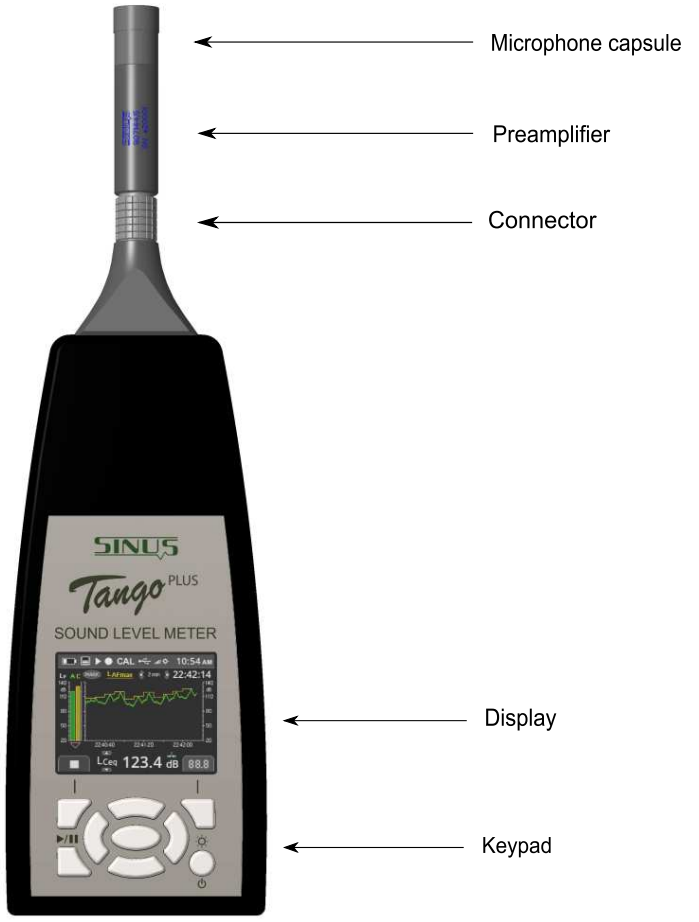


Figure 1.2: Open battery compartment

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 and time. There are three basic modi to display spectra, history data or numeric values:

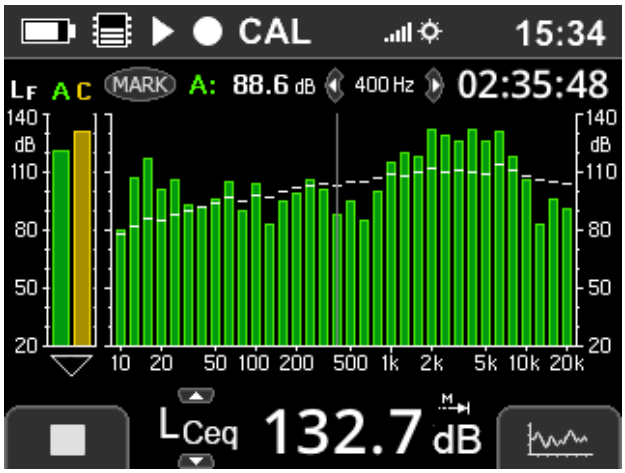


Figure 1.4: Third Octave Display

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 signle 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.

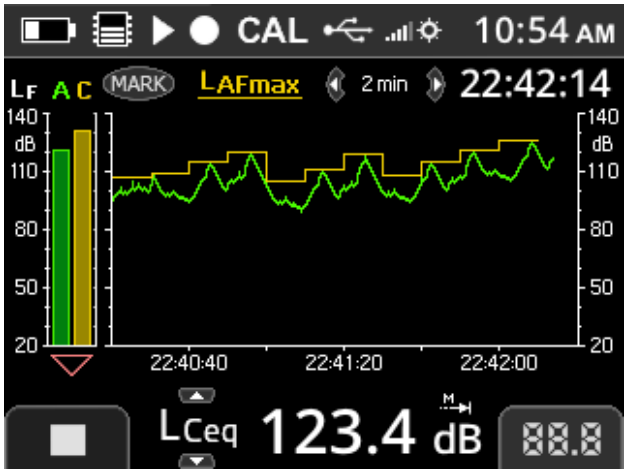


Figure 1.5: History Display

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.

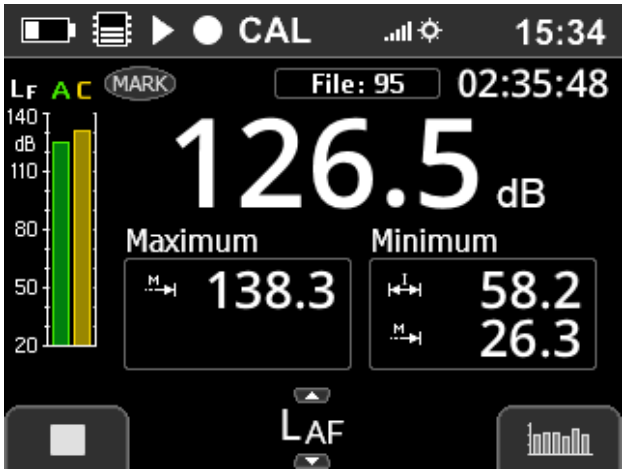


Figure 1.6: Numeric Display

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.

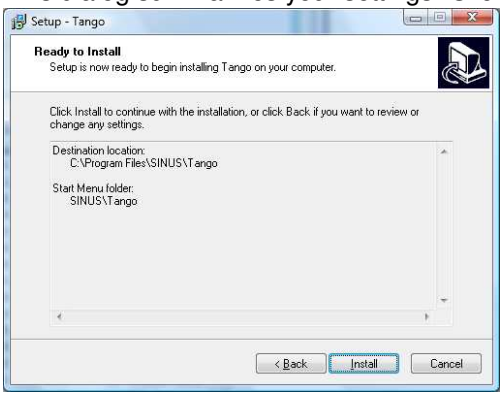
1.5.1 Tango_Plus driver installation

Please follow the instructions below to install the TANGO driver on a PC. You find the file on the enclosed USB stick. 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_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 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); only available by **Tango-Utilities**.
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); 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); 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_{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 weigthing 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.
	Fixed Duration	Measurement ends after a fixed time.
	Reset Storage File ID	Resets File ID to the smallest possible number: Assume stored measurements are labled with IDs 1 to 6. If for example measurements 3, 5, and 6 are deleted and the File ID is reset, the next measurement will be labled with the number 5.
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 Spectrum		
	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.

2.3.1 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, $\overset{blinken}{\longleftrightarrow}$ Record-Mode on (Recording);
Marker Status: MARK;
Memory usage: per Hour, Day and Week

2.3.2 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.

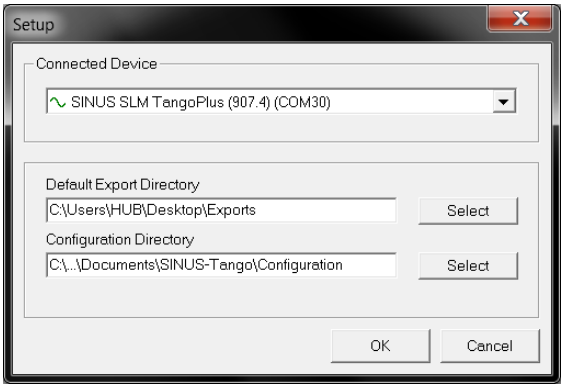


*Figure 2.1: **Tango-Utilities** - Program settings*

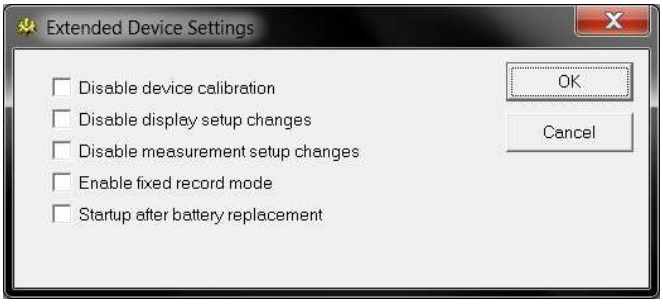


*Figure 2.2: **Tango-Utilities**- Extended device settings*

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 progam settings

2.3.3 Info Tab

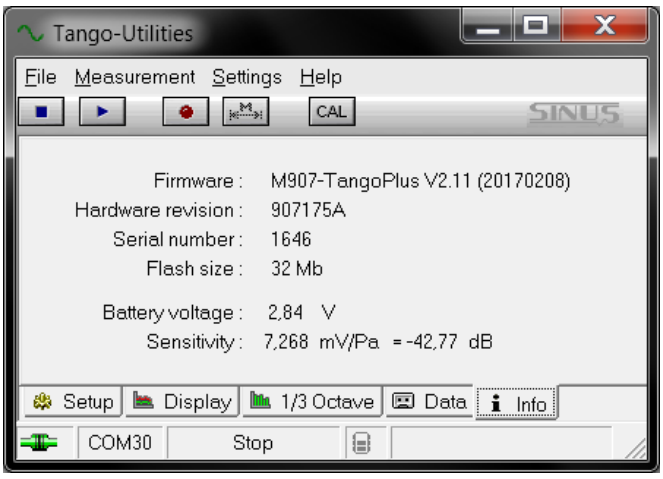


*Figure 2.3: **Tango-Utilities** - Info Tab*

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

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).

2.3.4 Setup Tab

The Setup tab of **Tango-Utilities** (figure 2.5) provides the configuration of Tango_Plus for a measurement.

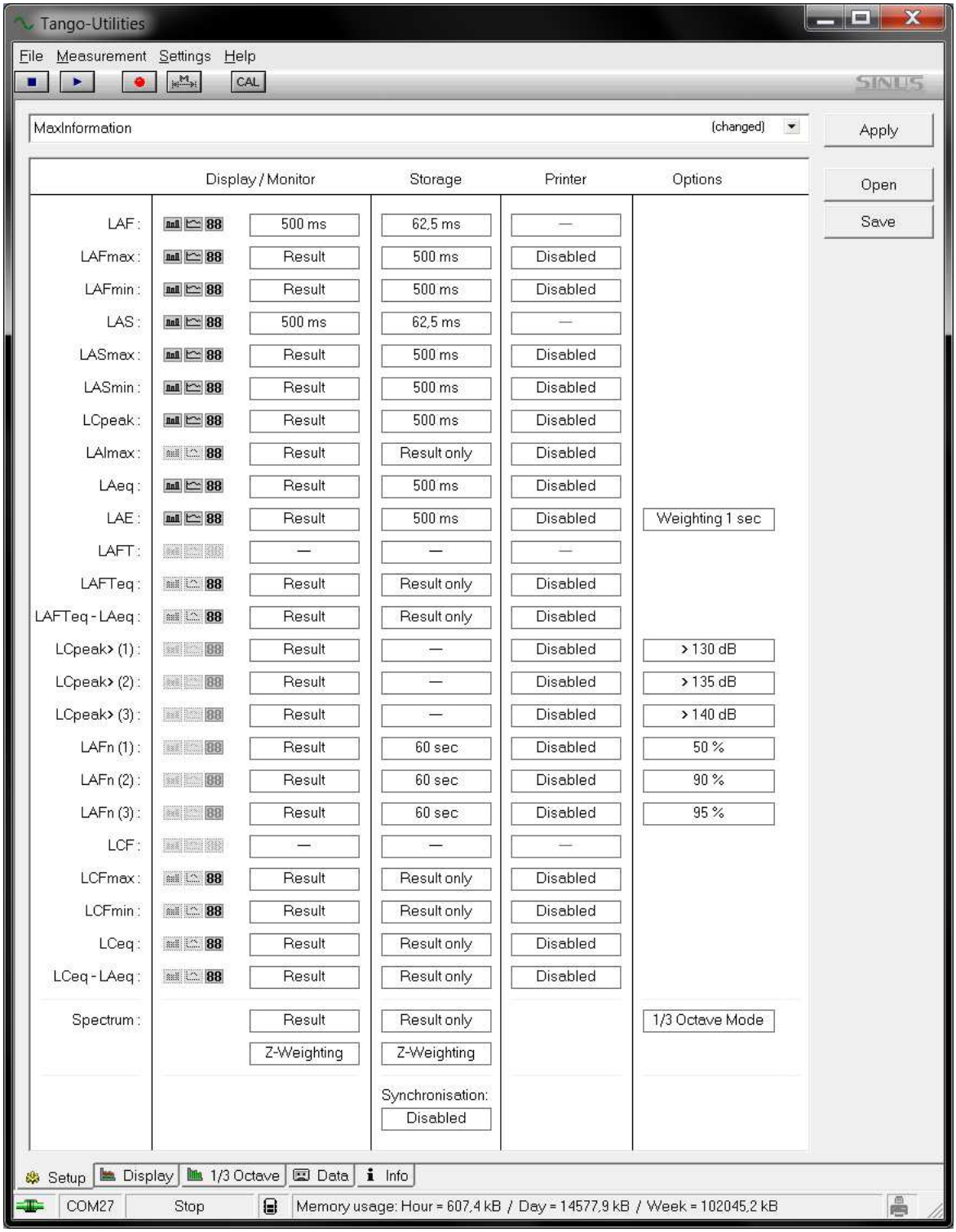


Figure 2.5: Configuration in setup tab

The first column shows the items, the second the configuration for display, the third for storage and the fourth for printer. Some items provide special settings, configured in the last column. Changes are to be confirmed with the **Apply** button. Setups can be saved and opened using the other buttons.

2.3.5 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

2.3.6 Octave Tab

Figure 2.7: Show spectral values in Octave Tab

In the “1/3 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 weigthing (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.

2.3.7 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 export data (**Export**).

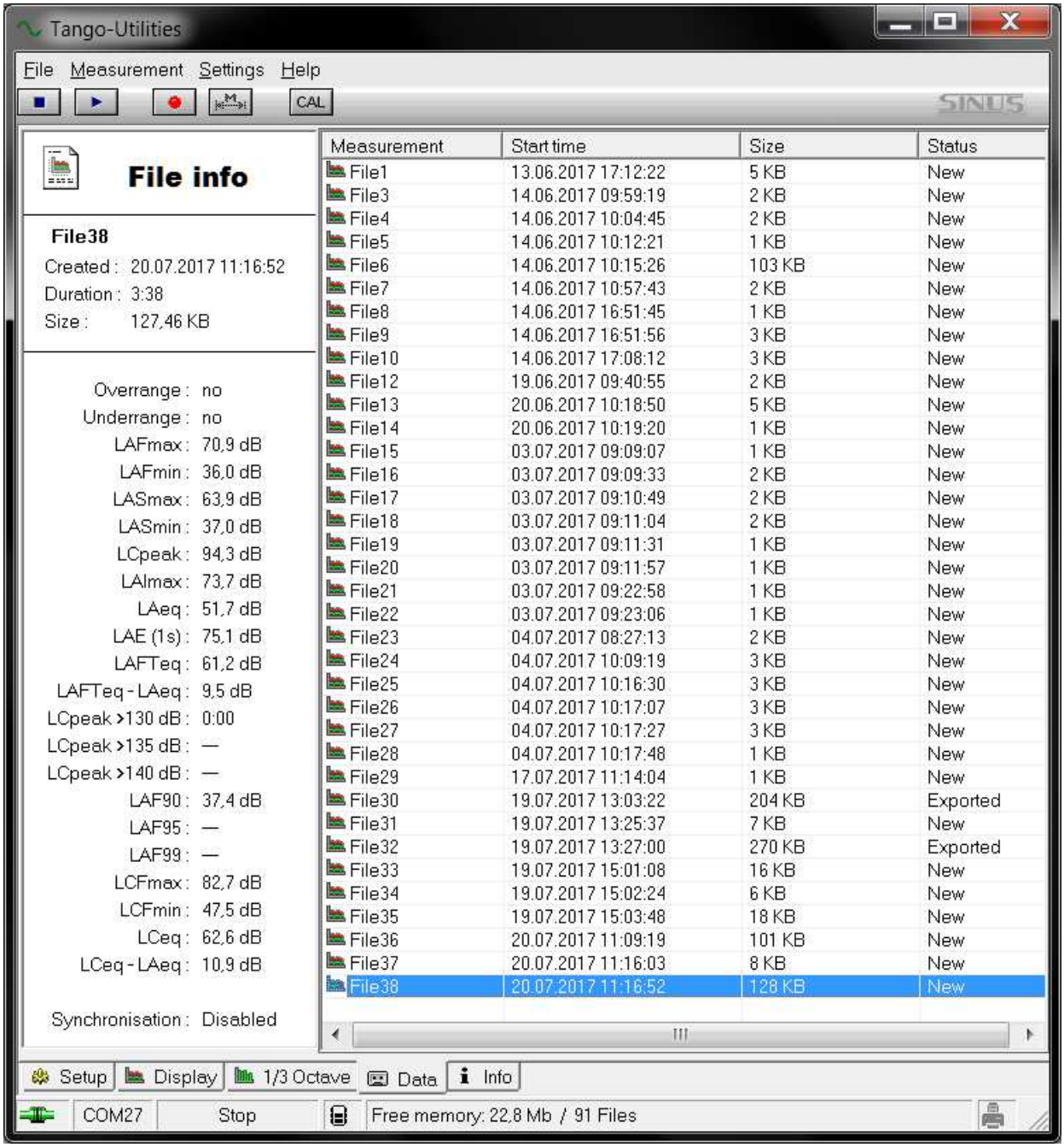


Figure 2.8: Data Tab

2.3.8 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 2.3.7). By right-clicking you may open a context menu, that provides access to the Export window (figure 2.9).

History Data tab

This tab provides the export of time histories of level or spectra to the Excel compatible csv format. To use it, check the “Enable Export file” box. You may specify the name, check automatic attributes to be given to the export file name and select the values, which that file should contain. Via the **Add File** button, you can create more History Data tabs, to get several different configured export files from the same measurement in the same export process.

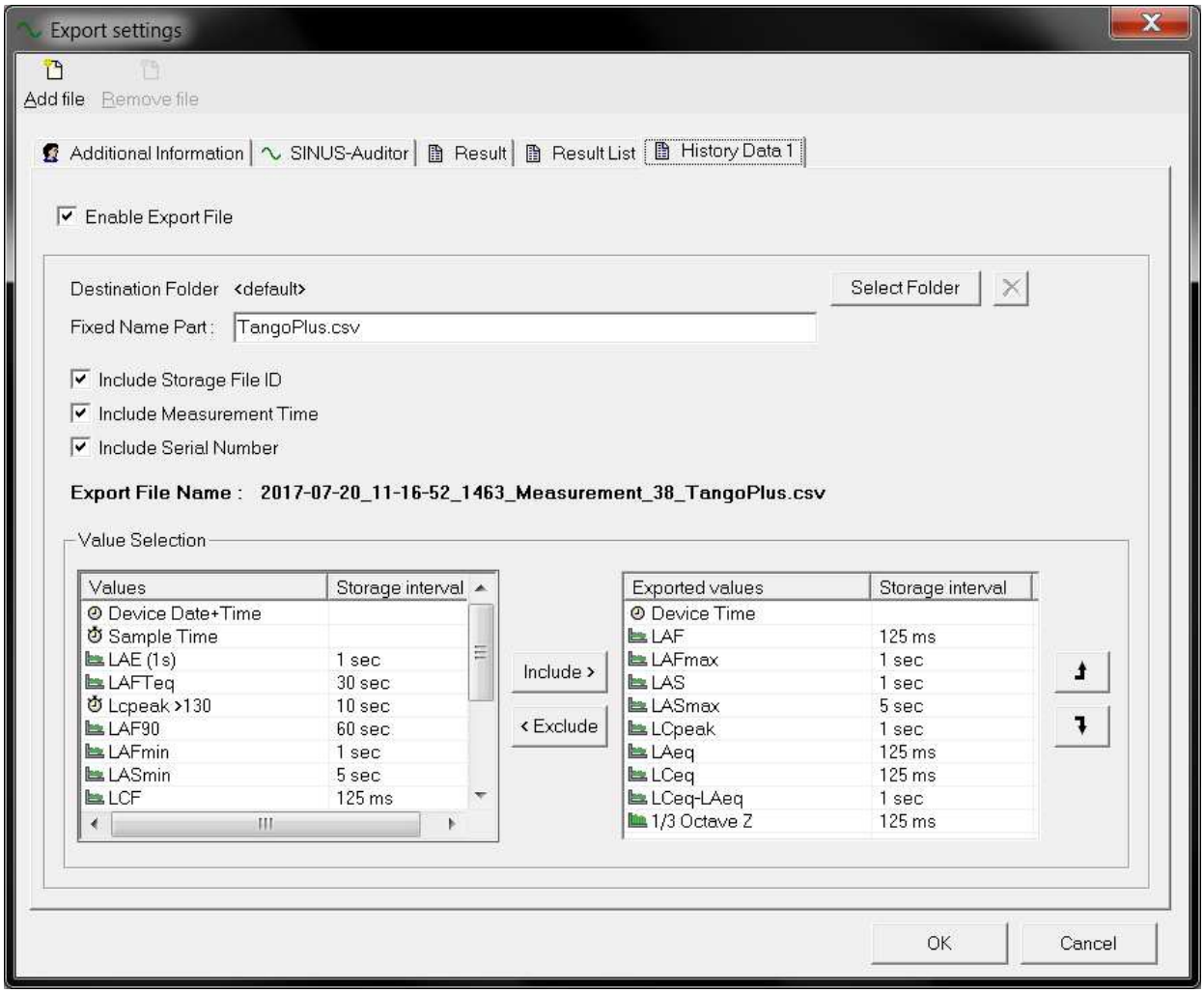


Figure 2.9: Export - History Data

Result List tab

Enable this way of export to collect Endresults of all exported measurements in csv format. The configuration is similar to the History Data tab.

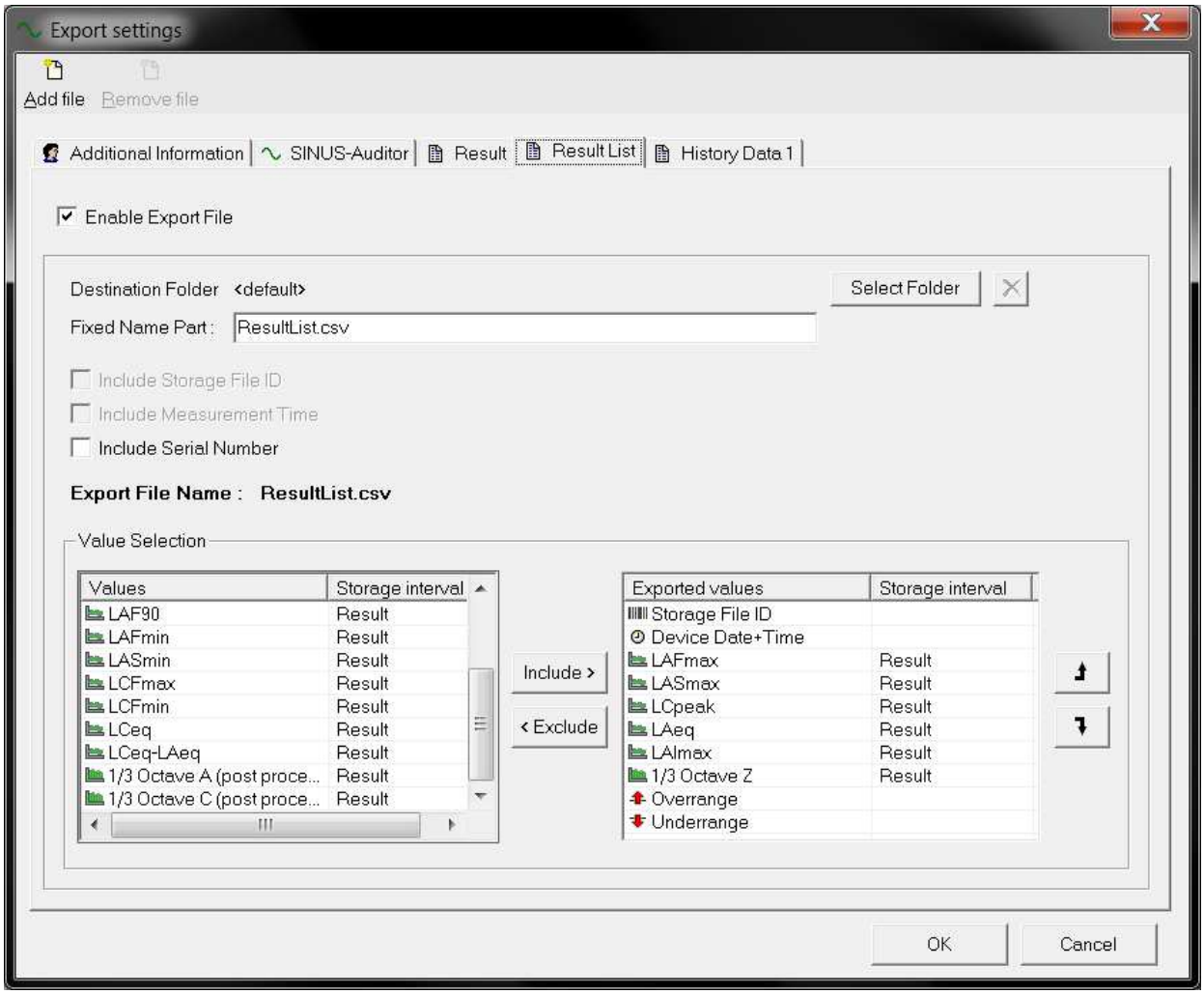


Figure 2.10: Export - Result List

Result tab

This tab provides the export only of end results as txt or csv. Just type the filename with the desired format.

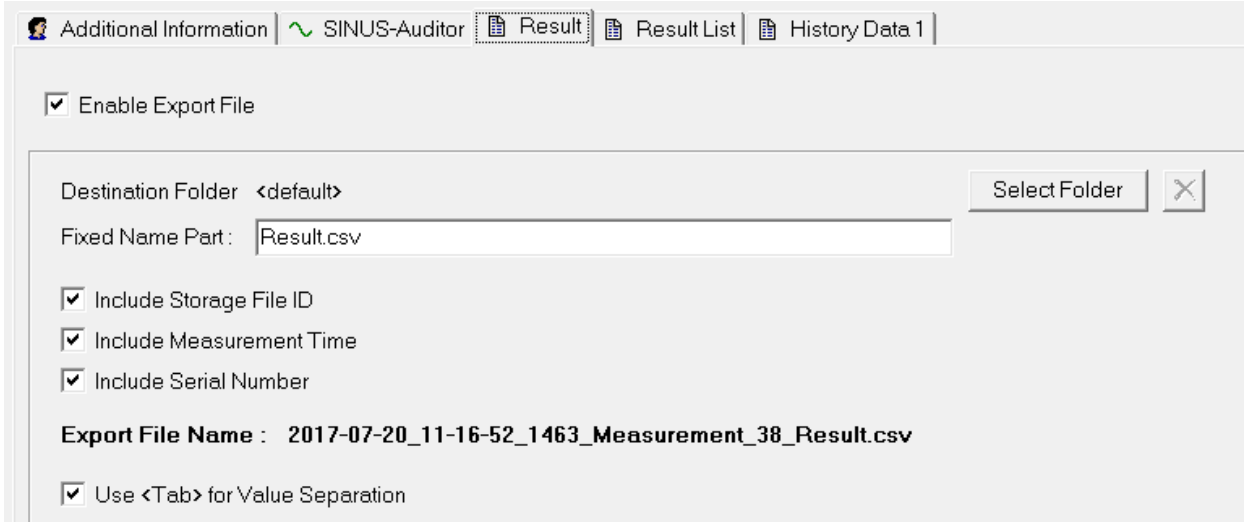


Figure 2.11: Export - Result

Auditor tab

This tab provides the export of full data as Auditor readable smr format.

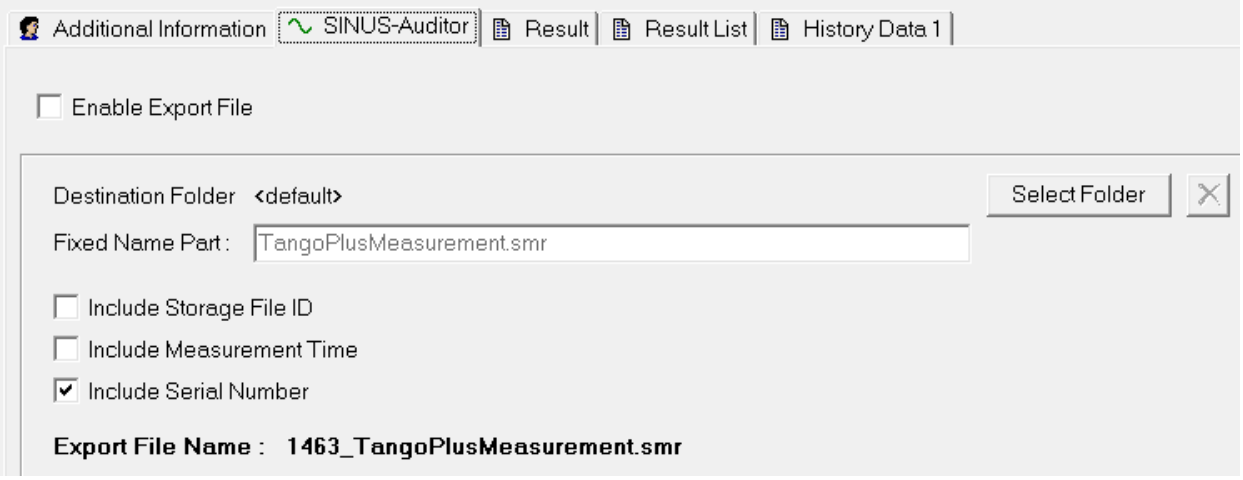


Figure 2.12: Export - Auditor

Additional Information tab

This tab allows to put additional information showing up in all export files. Especially a measurement time can be applied manually using the **Set Time** button.

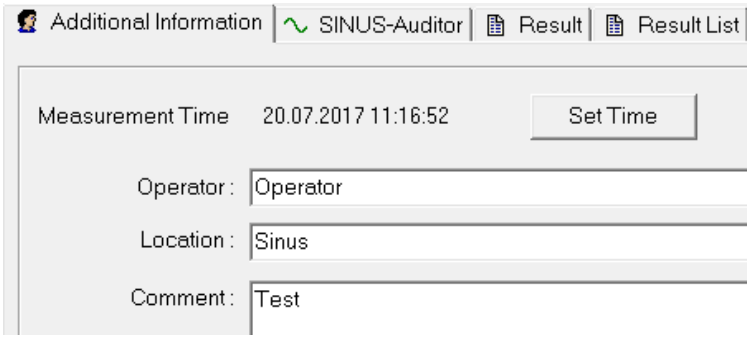


Figure 2.13: Export - Additional Information

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
Overflow		No overload has occured in current measurement.
Overflow		Overload has occured in current measurement.
Overflow		Currently an overload occurs.
Underrange		No underrange has occured in current measurement.
Underrange		Underrange has occured in current measurement.
Underrange		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.

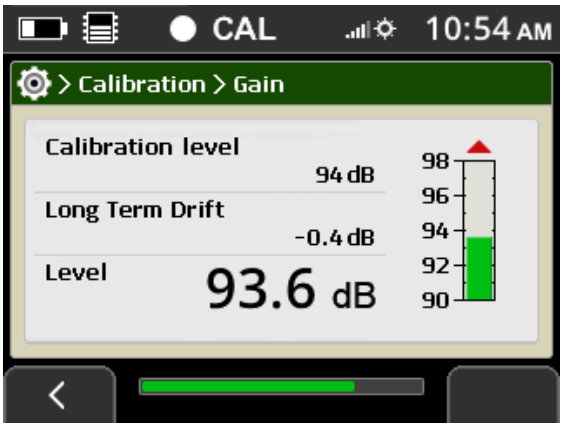


Figure 2.14: Calibration menu

3 Testing information

3.1 Acoustic test

3.1.1 Microphone alignment for measuring according to IEC 61672-1:2014.

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.

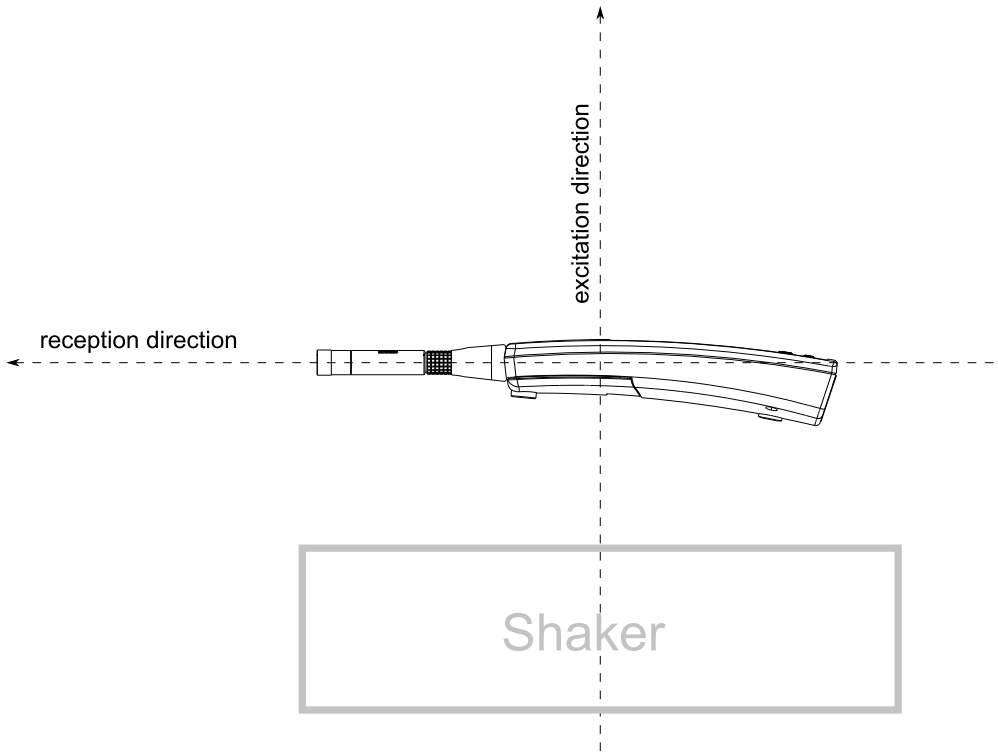


Figure 3.1: Alignment for vibration test

3.2 Electrical test

For eletrical testing use the equivalent electrical impedance device K65 only (section 5) (manufacturer specifications: 22 pF $\pm$12% with a parallel resistance of 81 MΩ $\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

Maximim 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 4.4.

4 Technical specifications

Property	Value
Software	**Tango-Utilities**
Number of channels	1
Accuracy	Class 1 according to IEC 61672-1:2014
Display of measured values	Colour TFT 320 x 240
Frequency weighting	A, C (simultaneously), no optional frequency weightings
Time weighting	Fast, Slow, Peak (simultaneously), Impulse
Data storage	Yes
Self-generated noise	$\leq$19 dB(A)
Max. Sound Pressure Level	see table 4.7
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 μs
Time weighting Impulse	Rise time constant = 0.035 s, decay time constant = 1.5 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)
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_Plus

According to IEC 61672-1:2014 Tango_Plus has been tested under the following conditions:

Property	value
Frequency range (Free field frequency response)	20 Hz bis 20 kHz
Level range	section 4.1
Restriction of linear level range due to mechanical vibration	section 4.7.2
Temperature range	-10 °C bis 50 °C
Static air pressure	65 kPa bis 108 kPa
Relative humidity	25 % bis 80 %
Electrostatic discharge	section 4.6
High frequency fields	section 4.7.1
Mechanical vibration	section 4.7.2
Apply signal via equivalent capacitance	K65 (Microtech Gefell)

Table 4.2: Test conditions for Tango_Plus

4.1 Level linearity range

The following table 4.3 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_{AE} in dB(A)	L_{Cpeak} in dB(C)
25...140	ab 30	37...140

Table 4.3: 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 in dB(A)
16 Hz	84	25	59	74
31,5 Hz	100	25	75	74
1 kHz	139	25	119	94
4 kHz	140	25	115	94
8 kHz	139	25	114	94
12,5 kHz	135	25	110	94

Table 4.4: 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 in dB(C)
16 Hz	126	41	85	74
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 4.5: Linear operating ranges C-weighted (f is the frequency of the sine signal) and starting values for the level linearity tests.

4.3 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
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 4.6: A- and C-weighted frequency response

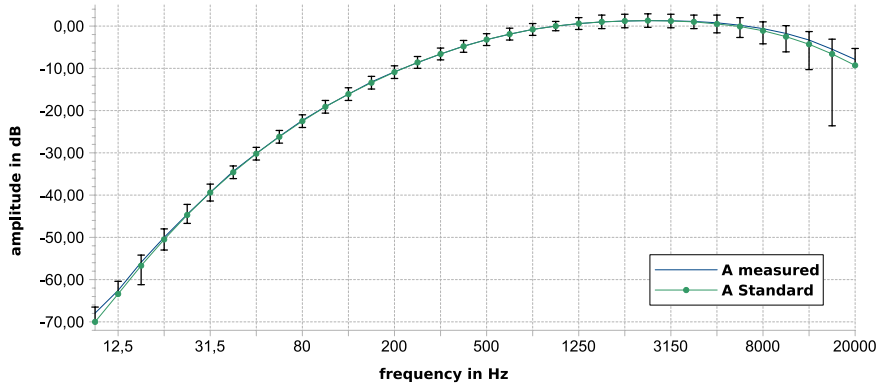


Figure 4.1: A-weighted frequency response

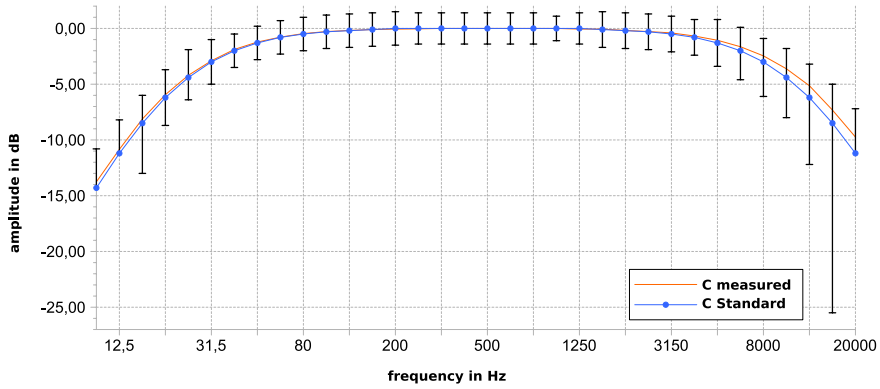


Figure 4.2: C-weighted frequency response

4.4 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 61672-1:2014. The effect of the windscreen on the directional characteristics of the microphone is negligible. As a result all corresponding correction values are specified with ± 0.1 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 ± 0,02 mm
without protection lid	12,7 ± 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 4.7: Technical data MK255

4.4.1 Random incidence and free-field correction

f in Hz	**Free field cor.** in dB	**Diffuse field cor.** in dB
25	0	0
31.5	0	0
40	0	0
50	0	0
63	0	0
80	0	0
100	0	0
125	0	0
160	0	0
200	0	0
250	0	0
315	0	0
400	0	0
500	0	0
630	0	0

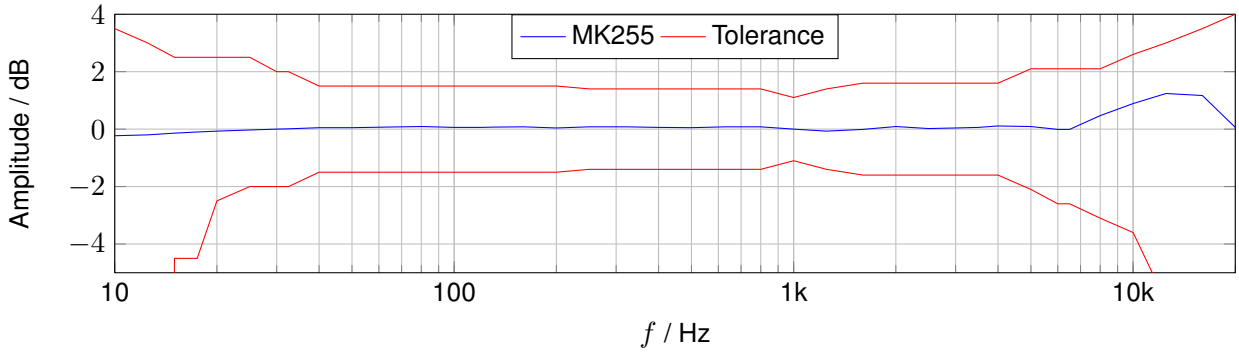
f in Hz	**Free field cor.** in dB	**Diffuse field cor.** in dB
0.8 k	0	0
1 k	0	0
1.25 k	-0.03	0
1.6 k	0.03	0
2 k	0.21	-0.1
2.5 k	0.36	-0.1
3.2 k	0.56	0
4 k	0.88	0.1
5 k	1.36	0.2
6.3 k	2.01	0.4
8 k	2.99	0.7
10 k	4.25	0.9
12.5 k	6.14	1.8
16 k	8.77	3.4
20 k	9.9	3.2

Table 4.8: Free-field and random incidence corrections (manufacturer's specification: measurement uncertainty at 95% certainty ±0.6 dB)

4.4.2 Directional characteristics

Figure 4.3: Mikrofonachse

4.4.3 Frequency response of the microphone



4.5 Self-generated noise

The self-generated electrical noise of the device including preamplifier (measured with equivalent capacitance 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.

4.5.1 Measurement of low noise levels

For the measurement of low noise levels no special preparation is required.

4.6 Details on EMC

When the device is exposed to electromagnetic emissions the lower limits of the ranges in table 4.3 are increased by 5 dB. Within these changed ranges the error limits according to IEC 61672-1:2014 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 tp 4 kV and air discharge up to 8 kV).

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

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 61672-1:2014 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 61672-1:2014 Tango_Plus is *not* appropriate to measure levels lower than 74 dB for an electric field strength exceeding 10 V/m.

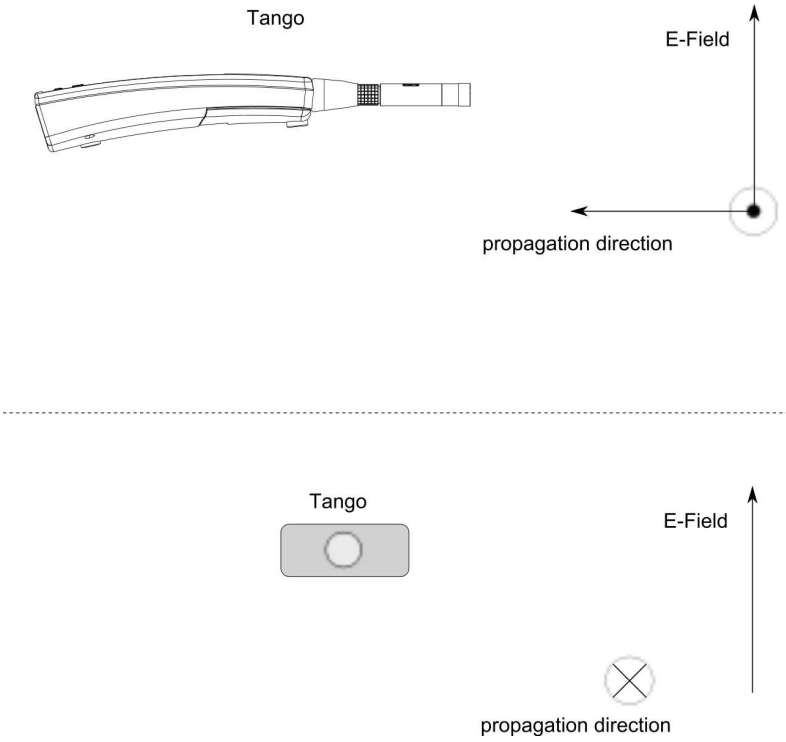


Figure 4.4: Alignment measurement HF immunity

4.7.2 Effect of mechanical vibration

If the device is exposed to mechanical vibration with an acceleration of 1 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 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.

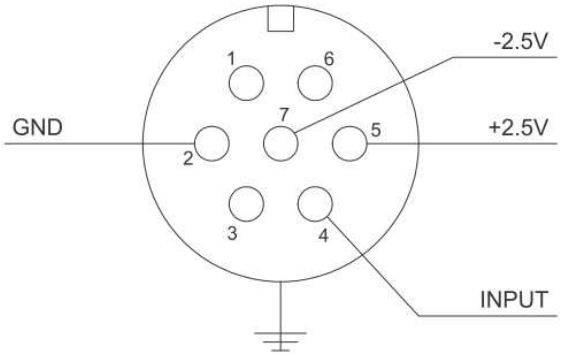


Figure 4.5: Pin assignment for the detachable microphone

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 61672-1:2014 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 ±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 ±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 ±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

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: # 01000

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 61672-1:2014 DIN EN 45657
	Third-octave analyzer:	DIN EN 61260:2003 class 1
Electromagnetic Compatibiliy:	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_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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