SITA science line t60

- Manual -

SITA
MESSTECHNIK GmbH

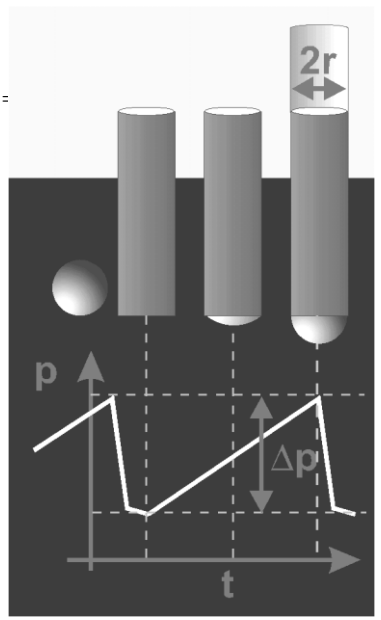
1 Contents

2 SITA science line t60

SITA science line t60 is a hand hold tensiometer for measuring the dynamic surface tension of liquids up to the semi-static range. The device works by measuring bubble pressure. This is done by pumping air through a capillary with the radius r into the liquid to be analysed. According to Young-Laplace, the difference in pressure Δp which is needed to form a bubble is proportional to the surface tension σ:

$$\sigma = \frac{r \cdot \Delta p}{2}$$

The device measures the difference in pressure Δp and



transforms it into a reading of surface tension. Simultaneously, it records the bubble frequency, the lifetime of the bubbles and the temperature of the liquid.

3 Technical Data

Device:	SITA science line t60-1 / t60-2
Memory:	16 Mbyte, non-volatile (several hundred measurements)
Power Supply:	(100...240)V / (47...63)Hz bzw. 4 x Mignon (AA)
max./min. Ambient Temp. (Storage/Operation):	(-20...80)°C / (0...50)°C
max. Power Consumption:	about 3,5 VA
Total Weight (including suitcase):	6300 g
Material of Capillary:	PEEK
Capillary Connector:	Luer Lock Connector

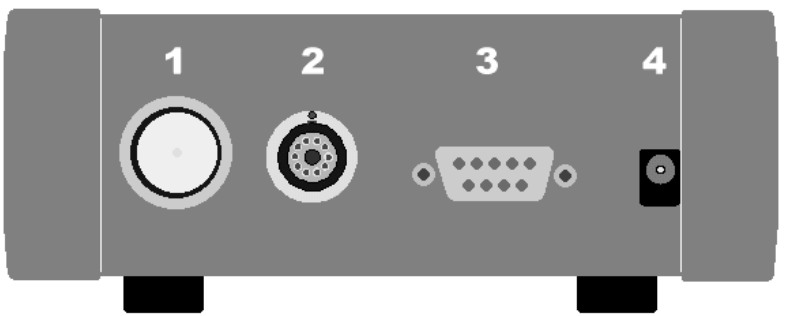
	Surface Tension
Measuring Range	(10...100) mN/m (dyn/cm)
Error	max. 1% f.s.
Resolution	0,1mN/m
Repeatability Error	0,5mN/m

	Temperature of Liquid
Measuring Range	(-10...130)°C
Error	max. 1% f.s.
Resolution	0,1°C
Repeatability Error	0,3K

	Bubble Lifetime
Controlled Range	t60-1: (1000...60000)ms / t60-2: (30...60000)ms
System Deviation	auto-mode: max. 10% / online-mode: adjustable
Resolution	1ms

	Bubble Frequency
Controlled Range	t60-1: (0,008...1)Hz / t60-2: (0,008...10)Hz
System Deviation	auto-mode: max. 10% / online-mode: adjustable
Resolution	3 digits

4 Connectors



1 Drying agent (exchangeable)

2 Socket for pneumatic cable to the sensor head

3 Socket for PC connection

4 Socket for power supply

5 Setting up the Device

Warning
Use this device for the described application only!
Other uses might be dangerous.

Prior to measuring, the device needs to be set-up. Screw the rod into the base-plate and stand it on a stable surface. Slide the sensor head onto the rod while pushing the lever down. Release the lever once the desired position is reached. Now, connect the sensor head's pneumatic cable to the measuring device. Note that the red markings on both the plug and the socket need to be aligned. Activate the power supply by plugging it into mains or insert 4 mignon (AA) batteries into the battery compartment **(watch for the right polarisation!)**. Additionally, you may want to connect the device to the serial port of your PC. This can be done by means of the interface cable included. Plug the capillary onto the Luer connector on the sensor head (slightly push and then turn right). The tensiometer is now ready for measuring.

6 Inserting or Changing the Battery

For inserting and changing the batteries (4 x Mignon (AA)) open the bottom of the device by depressing the ends of the battery box. Please take care for the correct polarisation.

7 Capillary and Temperature Sensor

Capillaries from PEEK are used to make the bubbles. PEEK can withstand temperatures and is resistant to highly concentrated alkaline solutions as well as non-oxidising acids. The resistance against solvents is excellent, too. PEEK is highly hydrolysis resistant to boiling water.

Note that the PEEK capillaries are not resistant against concentrated sulphuric acid and oxidising chemicals such as concentrated nitric acid and wet chlorine gas.

Do not immerse the complete capillary into the ultrasonic cleaning bath and/or any solvent!

For cleaning the capillary refer to chapter 12.4!

The temperature sensor (Pt 100) is from stainless steel and should be resistant to most chemicals. For critical cases or if you have doubts, you are asked to use a protective sheath from PTFE which the manufacturer can supply on demand.

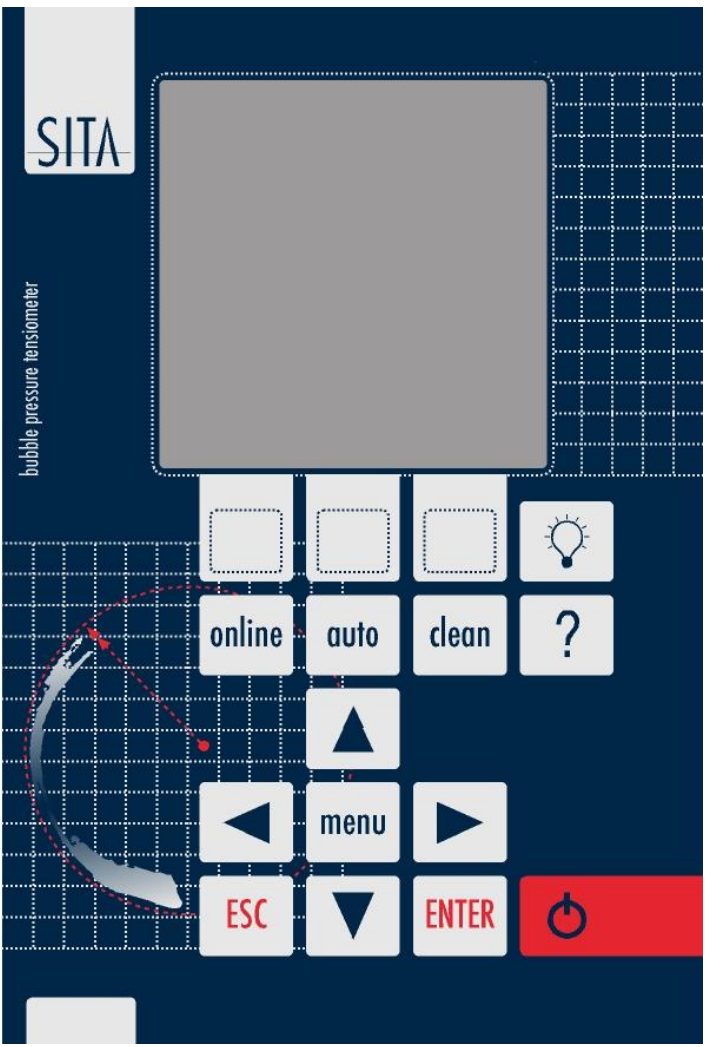
In order to quickly change the capillaries, they come with a Luer Lock connector. For attaching the capillary to the sensor head simply plug it onto the Luer connector and turn to the right. Please, keep the inner seal clean in order to guaranty a sealed system.

8 Drying Agent

The tensiometer has a desiccant cartridge which dries the air used to make the bubbles. This is **only** necessary when the temperature of the liquid to be measured is considerably lower than the ambient temperature. Without the desiccant cartridge, moisture would condense in the capillary. The drying agent in the cartridge absorbs most of the moisture lowering the dew-point. (The dew-point marks the beginning of condensation).

The desiccant cartridges come in lockable, air tight bags. When new, the drying agent is **blue**. When the agent is saturated with moisture it turns **pink**. The desiccant cartridge should be changed if half of the drying agent has changed colour or if the measurements are getting unstable when measuring in cold liquids. Additional desiccant cartridges can be supplied by the manufacturer.

9 Keyboard


SITA
bubble pressure tensiometer
online
auto
clean
?
menu
ESC
ENTER

For turning the device on and off
hold down for 1 second

(2x)

Start on-line measurement

(2x)

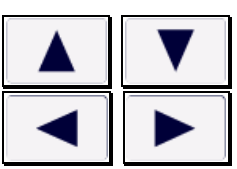
Start auto-measurement

Start cleaning-mode

Call menu

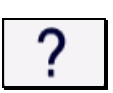
Escape

Confirm



Cursor keys

Display illumination



Help button

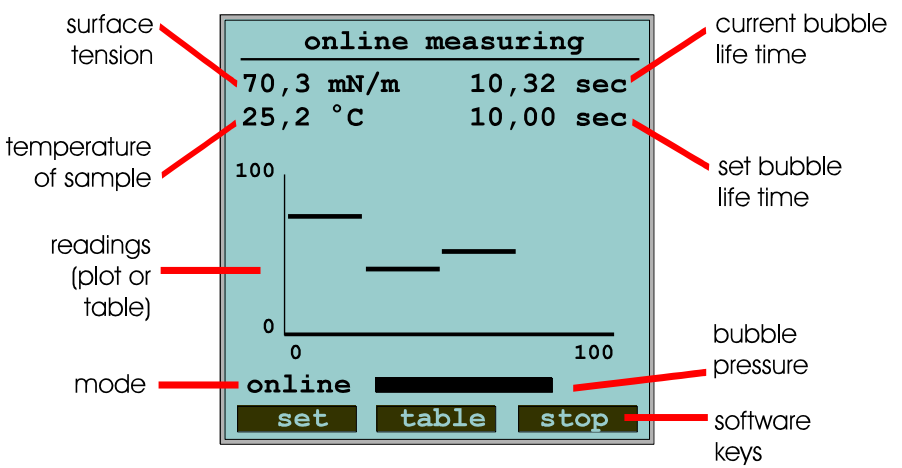
10 Turning the on-line Tensiometer on and off

For switching the tensiometer **on/off** you need to hold down the **on/off** key for at least a second.

11 Display

11.1 Displays

The status of the device, information on the measurement and options, and the current function of the software keys are shown in different areas of the display.



The **Status** is displayed in the first line and second to the last line of the display. The first line shows the title of the current menu. In the second to the last line of the display shows the current measuring mode (online/auto/clean) or error symbols and a bar indicator of the bubble pressure are shown.

The **Information area** shows diagrams, tables and options.
The last line of the display shows the (changing) meaning of the 3 **Software keys**.

11.2 Adjusting Contrast and Brightness

(The procedure here described in detail similarly applies to other set-up procedures as well)

In order to adjust contrast and brightness you need to press the **menu** button and chose "device set-up" by pressing the arrow keys ▲▼ and confirming with the **ENTER** button. From the menu which is displayed, now chose "display setting" and press **ENTER**. The options "contrast" and "backlight" can be chosen with the arrow keys ▲▼. Now, adjust contrast or brightness to the desired value using the arrow keys ◄ ►.

Save the settings by pressing the software key "save". This takes you back to the "Set-up" menu. Alternatively, you may press the software key "exit" which exits the set-up mode without saving.

Press the **menu** or **ESC** key to return to the "Main Menu".

12 Modes

12.1 Calibration

Prior to measuring, it is necessary to calibrate the tensiometer. Generally, the device should be calibrated after any change at the sensor head and after changing or externally cleaning the capillary. If the readings are considerably different from the values given by *Teitelbaum* (refer to ***Surface Tension of Water***) when measuring clear water, then the device needs to be calibrated as well. Please, consider the influence of the temperature on the surface tension when comparing the readings with the table in Surface Tension of Water.

For calibrating the tensiometer, the sensor head's capillary and temperature sensor must be immersed in **water**. Lower the sensor head until the water surface is within the grey marking on the temperature sensor.

The water used for calibration must be free of any surface active substances. If you are uncertain about the water quality, use distilled or de-ionised water.

Then, press the **menu** key and choose the menu item **CALIBRATION** using the cursor keys ▲▼. The calibration window will be shown in the display after pressing the **ENTER** key. You can start the calibration by pressing "start". If a measurement is running at this moment you need to press the left software key ("yes") in order to terminate the measurement.

The progress of the calibration is shown with a bar indicator in the display. During calibration the device sweeps through bubble lifetimes from 0.03s to 2s. The tensiometer then automatically ends the calibration and returns to the main menu.

12.2 On-line Measurement

The readings taken during an on-line measurement can be displayed as either a plot or a table. You may switch the display between these two modes by pressing the middle software key ("table" ⇔ "graph").

When in online-mode the surface tension will be measured at the set frequency. Make sure that the tensiometer has already been calibrated (the calibration is explained in ***Calibration***).

Switch on the device and lower the sensor head until the grey marking on the temperature sensor is level with the surface of the liquid to be measured. In order to start a measurement you need to press the **online** key two times. (The first punch takes you to the measuring and display options menu. Here, you may check or change the parameters of the measurement to be started).

You can start the on-line measurement from the menu, too. Press the **menu** key and select **online measure** using the cursor keys ▲▼. Select the on-line measurement by pressing the **ENTER** key. The device automatically displays the menu for setting the measuring parameters and display options. The measurement starts as soon as the software key "start" is hit.
In case an on-line measurement is already running, the set-up menu will not be displayed and the right software keys show "stop". Pressing the left software key "set" takes you to the set-up menu. In order to continue the measurement you need to press the middle software key "go on".

By using the cursor keys ◄ ► you can scroll the x-axis (number of reading).

The following measuring parameters and display options can be set (saving in case of starting a new measurement):

control: Either the bubble "lifetime" or the bubble "frequency".

tlife / freq: Desired bubble lifetime / bubble frequency.

average: Number of readings to be averaged. Can be set in the range from 1 to 32.

auto clr data: Clear the *shown data (diagram or table)* by starting a new measurement („on“ / “off“)

autosave: Save the *shown data (diagram or table)* into the device memory after the measurement is finished ("on" / "off"). It is useful to set “*auto clr data*” on.

graphic settings...

Setting the range of the y-axis of the plot (minimum and maximum value).

table settings...

Menu for the table options ("EDIT TABLE“). Go to the various settings by choosing a menu entry with the arrow keys ▲▼, confirm with **ENTER** or by pressing the left software key ("edit").

add new value: Determines at which position new readings will be inserted into the table: at the "top" or appended at the "end".

show value of: *Defines which measured value is to be shown: the bubble lifetime ("t-life"), the bubble frequency ("frequency")* or period ("t-period“).

sort Parameter: Defines which parameter the readings are to be sorted by: "number", period ("t-period“), "frequency" or bubble lifetime ("t-life“).

cursor speed: Sets the cursor speed for navigating in the table: "slow", "medium", "fast".

Press the right software key ("return") to exit the "EDIT TABLE“ menu.

12.3 Auto-Measurement

The auto-mode is useful for analysing the dynamic behaviour of surface tension. Switch on the device, calibrate and lower sensor head until the grey marking on the temperature sensor is level with the surface of the liquid to be measured. The calibration is explained in ***Calibration***. Press the **auto** key twice to start the auto-measurement. In order to start a measurement you need to press the **online** key two times. (The first punch takes you to the measuring and display options menu. Here, you may check or change the parameters of the measurement to be started).

You can start the auto measurement from the menu, too. Press the **menu** key and select **auto measure** using the cursor keys ▲▼. Select the auto measurement by pressing the **ENTER** key. The device automatically displays the menu for setting the measuring parameters and display options. The measurement starts as soon as the software key "start" is hit. In case the menu item "**auto-measurement**" was selected and an auto measurement is already running the set-up menu will not be displayed and the right software key will show "stop". Pressing the left software key "set" takes you to the set-up menu. In order to continue the measurement you need to press the middle software key "go on".

By using the cursor keys ◄ ► the x-axis (bubble lifetime) can be zoomed in and out.

The following measuring parameters and display options can be set (saving in case of starting a new measurement):

control: Either the bubble "lifetime" or the "frequency" can be controlled. (For setting the control to "frequency" assume "bubble frequency" instead of "bubble lifetime" in the following explanation.)

bubble lifetime / bubble frequency

start: Start value of bubble lifetime / frequency.

stop: End value of bubble lifetime / frequency.

factor: Determines the step by which the start value will be changed until the end value was reached. For each step the current lifetime / frequency will be multiplied by this factor.

auto clr data: Clear the *shown data (diagram or table)* by starting a new measurement („on“ / “off“)

autosave: Save the *shown data (diagram or table)* into the device memory after the measurement is finished ("on" / "off"). It is useful to set “*auto clr data*” on.

graphic settings...

Please, refer to 12.2 "On-line Measurement“.

table settings...

Please, refer to 12.2 "On-line Measurement“.

12.4 Cleaning Mode

In cleaning mode, air is blown through the capillary, removing particles of dust and fuzz which may have settled on the capillary's surface. Cleaning should be carried out when unstable readings occur or when the device can not control the bubble frequency any longer. It helps to carry out the cleaning procedure with the tip of the capillary (about 10mm) in an ultrasonic cleaning bath. **Do not immerse the complete capillary into the ultrasonic cleaning bath, especially into acetone! This can heavily damage the glued capillary assembly and so causing air leakage.**
Press the **clean** key to start the cleaning procedure. You can also start the cleaning by choosing **CLEANING** from the main menu (**menu** key). Press the right software key ("stop") to end the cleaning procedure.

13 Memory and Device Parameters

13.1 Memory

The device has a memory for storing the data which are shown in diagram or table. The readings will be stored in case of switching of the device too.

The menu "*Memory*" has the options as follow:

save data to mem	:	save the actual measurement (refer to *autosave* 12.2, 12.3)
load saved data	:	show saved measurements
clear data	:	clear showed data (diagram or table)
clear memory	:	clear all saved measurement

13.2 Setting the Options

For setting the options, select the menu “device setup” and confirm by pressing the **ENTER** key.

Choose one of the following options and press the **ENTER** key to modify them:

Display settings: "Contrast“ and Brightness ("backlight“) can be adjusted here. Please refer to chapter 11.2.

Date / time: Here, date and time can be set. Use the arrow keys to highlight the entry to be changed. After pressing the **ENTER** key an input mask will come up showing the current values. Navigate to the desired position using the arrow keys ◄ ► and adjust the value using the other pair of arrow keys ▲▼.

Beeper: The alarm for a number of events can be switched on and off. Highlight the event by using the arrow keys ▲▼ and change the setting by pressing the **ENTER** key. The alarm will sound if the event is checked (✔).

The following events can be indicated with an alarm:

rs232:	Receiving commands from the PC.
key valid:	Wrong key pressed.
key error:	Inactive key pressed (low tone).
new value:	Measure again.
low battery:	Battery low.
warnings:	An error occurred.

data handling: These settings determine the action of the device in case of the measurement is to long for screening (the data area is made for 2048 readings).

Pressing the **ENTER** key twice gives you two options:

1. *"if data area overflow: no change but send to PC"* New readings will not be shown anymore. However, if a PC is connected the readings will still be sent to the PC.
2. *"if data area overflow cut oldest values"* For each new reading the oldest reading will be overwritten and shifted to the first position in the buffer (ring buffering).

   If the option "auto save" was chosen (see chapter 12.2 or 12.3, Setting the Measuring Parameters and Display Options) readings of the overflown data area will be saved into the device memory.

value log.: kind of getting the readings

"*direct*" One bubble will be used for getting one reading.

"*adapted*" In case of lower bubble lifetimes several bubbles will be used for getting one reading.

language helptext: Changing the language of the on-line help.

default settings: The device is delivered with the following factory settings:

On-line Measurement:

control:	lifetime
tlife:	5 seconds
average:	1 pts
auto clr data:	off
auto save:	off

Auto Measurement

Control:	lifetime
Values p. lifetime:	1 pts
Start:	1 sec
Stop:	10 sec
Factor:	1,5
auto clr data:	off
auto save:	off

The values of the graphic settings and table settings will not be reset.

An alternative to pressing the **ENTER** key is to press the "edit" software key. Changes will only be saved if the menu is exited by pressing the middle software key ("save"). All changes will be lost if the **ESC** key or the "exit" software key is pressed.

13.3 Device Info

Device infos and diagnosis of an error will be given under **menu - info/test - warnings...** , as far as the device is capable of detecting the kind of error:

warnings... : device errors

A device error is indicated by a little flashing 'w' in the title line of the display (at the upper right corner).

serial bus sensor:	EEPROM of the sensor cannot be activated
pressure pump:	Pump is giving too little pressure
sensor ventil low:	Air throughput too low
sensor capil. low:	Pressure in capillary too low
sensor capil. high:	Pressure in capillary too high
voltage low:	Supply voltage too low
current high:	Current consumption of device too high
battery low:	Battery low
temp. device low:	Device temperature below 0 °C
temp. device high:	Device temperature above 50 °C
temp. sensor low:	Temperature sensor head below 0 °C
temp. sensor high:	Temperature sensor head above 50 °C
temp. medium low:	Temperature of sample below -100 °C
temp. medium high:	Temperature of sample over 150 °C
trigger lost:	No trigger signal (due to shock or dirty / leaky capillary)
no warnings - device ok:	+++

serial number... : Serial number of the sensor head, main device and software version

Device health... : Displays important internal data (temperature, voltages and currents)

manufacturer : support adress

Symbols that indicate a low battery or temperatures which are too high or too low will also be shown in the status line of the display alternating with the measuring mode. That results in a flashing status line.

14 PC-Software

IMPORTANT:

Please read the software licence agreement prior to opening the software package(s) or using the software. The licence agreement is contained in this manual or is attached to the software package. By opening the sealed package you acknowledge that you have read, understood and agree to abide by the terms and conditions of the agreement.

Using the software requires the instalment of a hardware lock (HASP®-KEY) on your computer. Please plug the enclosed HASP®-KEY into the parallel port of your computer. Peripheral devices, such as printers, can be connected to the HASP®-KEY using the same parallel port.

(Some printers need to be switched on to power up the HASP®-KEY.)

With the program **SITA-online V2.0** you can display the readings of the tensiometer on your computer. This program requires a 32-Bit Windows Operating System.

Connect the tensiometer to the serial port of your PC using the interface cable.

The program automatically detects connected and powered up (i.e. switched on) devices. You can control the tensiometer either from the PC or directly with the device.

The Program is capable of:

a. recording all data on-line (surface tension, temperature and lifetime of bubbles,
b. plotting the readings versus the elapsed time, current time, number of readings, temperature, bubble frequency or lifetime of bubbles,
c. saving all data,
d. exporting the data to ASCII-format *(*.txt - for import in Excel, Origin, ...)*,
e. controlling the device,
f. recording data from up to 8 devices simultaneously.

The program **SITA-offline** aids in comparing and analysing the on-line measurements.

The program is capable of:

a. plotting the measured surface tension (maximum of 128 measurements) in one window, plotting the measurements versus time, number of measurements, temperature, bubble frequency or bubble lifetime,
b. saving the plots,
   Note: The sources (.dat) will not be saved in the plot again.*
c. printing the plots.

The use of the **SITA-online** and **SITA-offline** program is explained in a comprehensive Help function. *For embedding plots in presentation software use the ALT+PRINT funktion for copying the active window in the clipbord.*

For installing the program, insert the installation disk in the disk drive and start **setup.exe**.

System requirements

Intel compatible PC 586 / 133MHz or better, 32MB RAM or more, mouse,

operating system: Windows 32-Bit,

free serial port (RS232) for connecting the device (FIFO activated!).

15 Surface Tension of Water

The surface tension [mN/m] of water as a function of temperature [°C], according to

Teitelbaum: $\sigma = 75{,}69 - 0{,}1413 * T - 0{,}0002985 * T^2$

°C	mN/m	°C	mN/m	°C	mN/m	°C	mN/m
0	75,69	25	71,97	50	67,88	75	63,41
1	75,55	26	71,81	51	67,71	76	63,23
2	75,41	27	71,66	52	67,54	77	63,04
3	75,26	28	71,50	53	67,36	78	62,85
4	75,12	29	71,34	54	67,19	79	62,66
5	74,98	30	71,18	55	67,02	80	62,48
6	74,83	31	71,02	56	66,84	81	62,29
7	74,69	32	70,86	57	66,67	82	62,10
8	74,54	33	70,70	58	66,49	83	61,91
9	74,39	34	70,54	59	66,31	84	61,71
10	74,25	35	70,38	60	66,14	85	61,52
11	74,10	36	70,22	61	65,96	86	61,33
12	73,95	37	70,05	62	65,78	87	61,14
13	73,80	38	69,89	63	65,60	88	60,94
14	73,65	39	69,73	64	65,42	89	60,75
15	73,50	40	69,56	65	65,24	90	60,56
16	73,35	41	69,39	66	65,06	91	60,36
17	73,20	42	69,23	67	64,88	92	60,16
18	73,05	43	69,06	68	64,70	93	59,97
19	72,90	44	68,89	69	64,52	94	59,77
20	72,74	45	68,73	70	64,34	95	59,57
21	72,59	46	68,56	71	64,15	96	59,37
22	72,44	47	68,39	72	63,97	97	59,18
23	72,28	48	68,22	73	63,78	98	58,98
24	72,13	49	68,05	74	63,60	99	58,78

16 Software Licence Agreement

IMPORTANT: Prior to opening or using the Software package(s), please read the licence agreement thoroughly. By opening the sealed package(s) or by installing this software you acknowledge that you have read, understood and agree to abide by the terms and conditions of this Agreement.

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EG-Certificate of Conformity

This is to certify that the following product:

SITA science line t60

is complying with the relevant regulations of protection as stated in the directions of the Jury for Harmonisation of Laws of the Member States for electromagnetic compliance (89/336/EWG).

This certificate covers all instruments of serial number 200501 and higher which were manufactured in accordance with the technical documentation.

For assessing the product for electromagnetic compliance (EMV-Gutachten 99-06-02) the following standards were considered:

- EN 50 081 - 1 (standard of emissions in domestic and small businesses)
  - EN 55022 (radiated emission)
  - EN 55022 (power related emission)
- EN 50 082 - 2 (standard of interference robustness in industrial use)
  - EN 61000 - 4 - 2 (interference robustness, ESD)
  - EN 61000 - 4 - 3 (interference robustness, radiated high frequency fields)
  - EN 61000 - 4 - 4 (interference robustness, fast transients / Burst)
  - EN 61000 - 4 - 5 (interference robustness, high energy transients / Surge)
  - EN 61000 - 4 - 6 (interference robustness, high frequency currents)
  - EN 61000 - 4 -11 (interference robustness, power drop, short black outs)

In behalf of the manufacturer

SITA Messtechnik GmbH
Gostritzer Str. 61 - 63
D – 01217 Dresden, Germany

this certificate is given by Dr.-Ing. Lothar Schulze, CEO

Dresden, 99-07-08

SITA
MESSTECHNIK GmbH
Gostritzer Straße 61-63
01217 DRESDEN

Rev 5 engl. (09/2012)