SF$_6$ Analyzer 973

Operation Manual
Version 973-SF$_6$
V1.5

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SPECIFICATIONS ................................................................................................................ 39
This manual explains the function of the SF₆ Analyzers 973, Version 973-SF₆. In this manual the instrument will be called 973.

**Vol SF₆ %**

All descriptions in **bold** and *italic* are related to the text on the front panel, the display and the back panel of the 973.

If you wish to use the instrument as quickly as possible, we recommend reading the chapters **Initial Setup** (page 9) and **Measurement** (page 15). Standard use of the instrument is explained in these two chapters.
Reliable SF₆ Measurement

The 973 was specifically designed for measurement of Humidity and SF₆ Purity in gas insulated switchgear systems. Humidity Measurement data is displayed in ppmᵥ, ppmₘ, and Dew/Frost Point. Purity Measurement is displayed directly in % Volume SF₆. Both the Humidity and Purity measurements utilize accurate and reliable condensation techniques.

Gas Recovery and Pressure Measurement

The 973 is equipped with a gas recovery system that stores the sampled gas during the measurement process in its internal storage tank. After completion of the measurement, the stored gas is automatically pumped back into the original compartment or into another vessel. The compartment pressure is also measured.

Easy, Automated Measurement

The 973 is equipped with a user configurable full color active matrix LCD with integrated touch screen. The 973 may be configured for measurement of Humidity and % Volume SF₆ with either automatic or manually initiated Pump Back. In addition the 973 measures the pressure of the connected gas compartment. Using the bi-directional RS 232 communications port, all measurement data may be easily transferred into a computer.

Calibration

Easily check the calibration at any time using the built-in Ice Test function, providing instant proof of system accuracy and integrity.

Connect and Go

The system is supplied ready for immediate use.

973-SF₆ with Standard Accessories

Transport Case
6m Stainless Steel armored PTFE tubing
DILO coupling DN20 and DN8
3 m RS 232 cable incl. USB adapter with USB cable
3 m power cable
Operation Manual
CD-ROM
Operation

Front Panel

LCD Display with Touch Panel

The 973 utilizes a full color active matrix liquid crystal display with an integral touch panel. It has a high contrast ratio and a wide viewing angle for easy readability. Data is displayed in large easy to read fonts. Using the on screen function and menu keys, you can easily configure each line of the display and navigate the menus.
Data Lines

The first four lines of the display are for numeric or graphic representation of the measured data. We refer to those first four lines as Data Lines. Numeric data lines contain the value to the left, with the parameter description and units to the right. The displayed parameters and units can be changed, but after a restart of the instrument the values will be reset to the stored standard configuration.

1. Data Line
This line displays the measured Dew/Frost Point. The unit is °C related to atmospheric pressure.

2. Data Line
This line displays the humidity content in ppm\(_w\) (parts per million weight). This unit is pressure independent.

3. Data Line
This line displays the SF\(_6\) purity in % Volume.

4. Data Line
This line indicates the current pressure of the gas compartment. The unit is kilo pascal absolute pressure.

The data lines indicating the measured Humidity as well as the % Volume SF\(_6\) will only be displayed after completion of the measurement. During the measurement only the current gas pressure of the measured compartment is indicated.

Fixed Function Keys and Status Line

The bottom line of the display contains two fixed function keys. By pressing the Start button the measuring process will be started. With the Pump button the pump back of the stored gas in the internal tank can be activated manually. These function keys are not changeable and are always available. Additionally this line contains the status indication, which indicates the current operation mode. The level indicator of the internal tank indicates the current storage capacity.

Menu Keys

To the right side of the display is a column of menu keys. Each of these keys changes function as needed.

Notice that the bottom key in this column is different from the rest. The bottom key is used to cycle the upper keys through the various menu options. The text on the bottom key changes to indicate the currently selected menu option. The text of the upper keys change based on the functions available in the menu.
Keypad

The keypad is used for entering data into the 973. For normal operation it is rarely used.

Carrying Handle

To adjust the position of the carrying handles press the buttons on both sides to unlock the handle. Release the buttons when the desired position is found.
The mains power cord is connected to the power plug on the instrument back panel. The power socket also includes the power switch. The power supply voltage is 100-120VAC/200-240VAC at 50 to 60Hz. The power supply is internally fused and will automatically be switched off in case of an overload. To restart the power supply the instrument main switch must be switched to 0 and I again.

The sampling line is connected to the sample gas inlet. If the instrument is not in use the inlet should be protected with the blue cover.

The RS 232 connector is used when connecting the 973 to a computer. Use a 9 pin 1:1 cable to connect the 973 to a desktop or laptop computer. This cable has a male connector on one end and a female connector on the other end. It is most often referred to as a serial extension cable.

When the 973 is switched on the cooling fan is always running independent of the ambient and the instrument temperature.
Initial Setup

Preparation

The 973 needs a source of normal AC power. The label on the back panel indicates the mains voltage. The instrument has been designed to work with a power range between 100-120VAC/200-240VAC at 50 to 60Hz. This normally covers all usual mains voltages.

Electrical Connection

The power socket and the 973 main power switch are on the back panel of the instrument. Use the provided power cable to connect the instrument to the mains power.

By pressing the power switch the instrument is started. The display of the 973 comes up immediately following the processor’s boot phase. The boot phase may take several seconds to complete.

Connection of the Serial Interface

If you intend to transfer the measured data via the serial interface to a computer, the provided serial cable must be connected to the RS 232 port on the 973 and to the serial interface of the computer.

If your computer is equipped with a USB interface, you can use the provided RS 232/USB converter. You will find the drivers on the CD. The installation will be explained in the following chapter.
RS 232 – USB Converter / MSCOMM32 Driver Installation

On the CD-ROM 973-SF6 you will find the drivers for the Keyspan RS 232 / USB Adapter.

Double click on:

**KeyspanUSA19hsWinV34.exe**

and follow the installations instructions. The program is stored (default) in the folder

*C:\Program\Keyspan\USB Serial Adapter*.

After the installation (default) you will find in the folder *C:\Program\Keyspan\USB Serial Adapter* the assistant for the Keyspan RS 232 / USB Adapter.

Double click on:

**K19hasst.exe**

In the **Adapter Status** tab, the assistant will show you which COM Port the USB Adapter will use. You will need this COM Port number later since it will need to be entered into the Excel Protocol in the cell **Read Data From COM**.

After the installation according to standard (default) you will find further information in the pdf operating instructions in the following folder :

*C:\Program\Keyspan\USB Serial Adapter\docs*

On the CD-ROM 973-SF6 in the folder **973INSTALL** you will find the driver **MSCOMM32**.

Double click on:

**Install.bat**

and follow the installation instructions. The driver will be installed and registered.
SF$_6$ Gas Connection

The quick coupling on the instrument side of the sampling tube must be connected to the \textit{SAMPLE GAS} inlet.

Note:
To prevent contamination the blue cover caps of the instrument and sampling tube should always be installed when the instrument is not in use.

The standard accessories of the 973 include a DN8 and a DN20 DILO coupling.

The sampling tube must always be stored with an installed DILO coupling in order to avoid exposure to air. Also protect the coupling from dust with the yellow screw cover.

After changing the DILO coupling the sampling tube must be evacuated.
Evacuate the Sampling Tube

The sampling tube must be evacuated before the first initial measurement is started. Once initially evacuated, there is no need to re-evacuate the hose, even when moving the connection to the next compartment.

Press the lower right key in order to select the **Control Setup** menu. **Control Setup** appears on the key, while on the upper keys the available menu options are indicated.

Press the key **Evacuate Hose**.

Make sure that a DILO coupling DN8 or DN20 is properly installed on the sampling tube, but do not connect the DILO coupling to anything else at this time. Since the DILO couplings are self-sealing, the sampling tube is sealed.

Ensure that the other end of the sampling tube is properly connected to the 973.

With the sampling tube correctly connected, press the **Ok** key in order to start the evacuation process.

After the evacuation has started the next window indicates the decreasing pressure of the sampling gas tube while evacuating.

After reaching the set residual pressure of 20 kPa the evacuation process is stopped automatically and the window is closed. The instrument and the sampling tube are now ready for the measurement.

By pressing the **Cancel** key during evacuation the process can be manually stopped.
Evacuation of the Internal Storage Tank

If the content of the storage tank is unknown or bad SF\textsubscript{6} gas is in the storage tank, the internal storage cylinder can be evacuated.

Press the **Evacuate Internal Cylinder** key in the **Control Setup** menu.

The dialogue box requests you to remove the sampling gas tube or connect a SF\textsubscript{6} reclaimer to the 973.

Disconnect the quick coupling from the **SAMPLE GAS** inlet or connect the instrument to a SF\textsubscript{6} reclaimer.

Press the **Ok** button to start the internal tank evacuation.

The dialogue box indicates the current storage tank pressure during evacuation. After evacuating below 20 kPa residual pressure the internal pump automatically stops. The evacuation process can be stopped by pressing the **Ok** button.

If the 973 is connected to a reclaimer, the evacuation can be continued with the external reclaimer, until the desired residual pressure is reached. By pressing the **Ok** button the evacuation can be stopped.
**SF₆ Gas Connection to the Compartment**

If the sampling tube was properly evacuated before the first measurement, it is now ready to connect to the gas compartment. When moving the connection from compartment to compartment, there is no need to re-evacuate.
Measurement

Measurement Start
Before the start of a measurement make sure that the selected parameters of the Excel Protocol are identical with the parameters of the 973.

As soon as the 973 is connected to the gas compartment the current vessel pressure is indicated. The SF₆ standard configuration for the pressure unit is kPa absolute. The input pressure range is 0.1 – 1MPa abs.

When the instrument is switched on the standard SF₆ measuring mode with Humidity Measurement, % Volume SF₆ Measurement and Pump Back After Measurement is activated.

Press the Start button. The Start button and the Pump button turn green. The pump starts and the humidity clock, located next to the Start button, begins to spin. During the measurement, SF₆ gas flows from the gas compartment, through the hose, through the measuring head, and into the internal storage tank.

After the completion of the Humidity Measurement the spinning clock stops and the measured Dew/Frost Point as well as the calculated humidity content in ppmw is displayed.

Now the % Volume SF₆ measurement starts and the corresponding clock begins to spin.

The internal cylinder level indicator shows the rising pressure in the internal storage tank.

After the completion of the % Volume SF₆ measurement the spinning clock stops and the measured % Volume SF₆ is displayed.

Now the pump back starts and the corresponding clock begins to spin. The level indicator shows the decreasing pressure in the internal storage cylinder. At the same time the mirror is heated. This is indicated by the red Start key. During the heating phase the Start key is locked.
After completion of the pump back into the gas compartment, the measuring head pressure is released to 100 kPa abs. After stabilization of the gas compartment pressure display (approx. 5 seconds) the measurement results are now available on the data lines as well as on the serial interface for a data transfer to the excel protocol (see page 19).

The measurement data for Humidity and % Volume SF$_6$ remain stored and displayed until the next measurement is started by pressing the Start button. The vessel pressure measurement always indicates the current pressure at the 973 sample gas input. After completion of the measurement the gas compartment pressure remains indicated as long as the sampling tube is connected to the gas compartment.

After connection of the sampling tube to the next gas compartment, the next measurement can be started by pressing the Start button.

**Termination of Measurement**

After completion of the measurements, disconnect the DILO coupling from the gas compartment and close it with the yellow screw cover. Then disconnect the quick coupling from the 973 and cover the gas inlet as well as the coupling of the tube with the blue caps. The last measured SF$_6$ remains in the sampling tube. A correctly closed sampling tube is protected from dust and ambient air.

If the measurement was stopped with a normal pump back sequence, 200 kPa abs. pressure (100 kPa gauge) will remain in the internal storage cylinder. The instrument can now be correctly transported.
Measuring Range Limitations

The lower measuring limit of the 973 is 5 ppm for Humidity and 80% for Volume SF₆ Measurement. If the measured value for Humidity or % Volume SF₆ is below this measuring limit the instrument indicates this condition as follows:

If the measured value of the Humidity is below the measuring limit of the 973, the display shows ‘smaller than’ < and the value in °C Frost Point and ppmw.

This indicates that the actual humidity is below the displayed value.

If the measured value of the % Volume SF₆ measurement is below the measuring limit of the 973, the display shows ‘smaller than’ < 80%.

This indicates that the actual % Volume SF₆ value is below 80%.

Alarm Messages

If the gas compartment pressure is too low or if the DILO coupling is not correctly connected to the gas compartment an underpressure occurs in the sampling tube and the 973 turns off automatically. The 973 displays that the pressure is too low.

Make sure the sampling tube is correctly connected on both sides and the minimal gas pressure of 100kPa is available.

If the gas compartment pressure is too high to allow the pump back, the 973 turns the pump off automatically and indicates that the compartment pressure is too high. The maximum pump back pressure is 900 kPa.

Connect the 973 to a gas compartment with a lower pressure to pump back the stored SF₆.

Measurement Aborted

If the measurement is aborted due to low or high pressure conditions, the 973 will heat up the mirror and release the measuring head pressure to 100 kPa abs. Pump back of the stored gas in the internal tank can be started by pressing the Pump key.
Measurement of Nitrogen (N₂)

The 973 is equipped with a measuring mode for nitrogen. The measured nitrogen is not stored in the internal tank and will be pumped to atmosphere.

For this example, select **Humidity Measurement** and **Air/N₂ Mode**.

Press the **Ok** key.

In this measuring mode, only the Humidity Measurement is performed, without storing the gas in the internal cylinder.
Data Collection over RS 232 with Protocol

When the 973 is connected to a computer via the RS 232 connection, the measuring results may be transferred directly into the Excel Protocol.

On the CD-ROM 973-SF6 you will find the 973-SF6 protocol.

Double click on:

973-SF6 Protocol V10

After opening the 973-SF6 protocol the safety warning appears. Please select Enable Macros.

All changes of the COM Port Number and unit attitudes must be made on the 1. Table (Feeder 1).

Click on the cell below the field Read Data from COM. An arrow appears on the right side. By clicking on the arrow the window for the input selections of the COM Port Number opens. If you use the Keyspan USB Adapter, you find the COM Port Number in the Keyspan USB Serial Adapter Assistant (see page 10).

After input of the COM Port Number the window Parameter Selection opens, with which you can confirm that your selection has validity for all tables (Feeder 1... 30). All in the following explained changes of the parameter are copied with the same confirmation on all tables.
In order to change the different units, you click on the respective unit field. On the right side an arrow appears. By clicking on this arrow a selection window with the possible units opens. The selections of the units of the Excel Protocol are independent of the display of the 973.

Enter the gas compartment identification in the appropriate fields.

The data communication can be released only after completion of the measuring cycle. If the Read-button is pressed during the measurement, appears the message to the left, which requests you to wait for the completion of the measuring cycle.

After completion of the measurement, the stored measuring results for Humidity and % SF₆ are available on the display and on the serial port. The pressure value on the display indicates the current gas compartment pressure as long as the sampling tube is connected to the corresponding gas compartment. These data are now ready for the transfer.

The measurement is finished, if all selected modes are confirmed with a check mark and the red light of the start button expires after the end of the mirror heating phase.

By clicking the Read button the measured values for Dew/Frost Point, Moisture Content, SF₆ Vol and Pressure are transferred to the corresponding line. Additionally the Date is registered. The value for the pressure measurement corresponds with the measured value at the moment when the Read button is pressed. The stored data for Dew/Frost Point, Moisture Content and SF₆ Vol remain stored in the 973 until the next measurement is started.

The instrument type and serial number are automatically stored in the last line at the bottom of the page.
Measurement Options

Navigating the Menus

The various menus of the right column of keys are navigated by using the key in the lower right corner of the touch screen. Each time you press the lower right key, a new menu appears on the keys directly above it. The menu is circular, meaning that once you go past the last menu, the first one appears again and the process starts over. You can use the +/- key on the keypad to move backward through the menus. Use the Enter key to clear the menu.

Selecting the Measurement Options

With the measuring options you can select the Humidity Measurement, % Volume SF₆ measurement only, or both. In addition you can select Automatic Pump Back of the stored gas after the termination of the measurement. With the standard 973-SF₆ configuration Humidity Measurement and % Volume SF₆ measurement with Automatic Pump Back are selected. This configuration can be changed, however, after restarting the instrument it will be set back to the standard configuration.

Press the lower right menu key once to select the Control Setup menu. Control Setup appears on the key while the keys above change to available menu options. Notice that the top key indicates Measuring Options.

Press the Measuring Options menu key at the top right corner of the screen. The Measurement Control Setup window appears.

Humidity Measurement, % Vol SF₆ Measurement, and Pump Back After Measurement are selected. This is the standard SF₆ configuration.

With the buttons Humidity Measurement, % Vol SF₆ Measurement, Pump Back After Measurement and Air/N2 Mode the desired measuring mode can be activated. The small green indicator to the left of the buttons indicates that this mode is activated. Pressing the button toggles the activation mode on and off.
Measuring Mode examples

For purposes of this example, select only **Humidity Measurement**, and disable **% Vol SF6 Measurement** and **Pump Back After Measurement**.

Now press the **Ok** button.

With this configuration only Humidity Measurement is selected.

For purposes of this example, select only the **% Vol SF6 Measurement**, and disable **Humidity Measurement** and **Pump Back After Measurement**.

Now press the **Ok** button.

With this configuration only the % Volume SF₆ Measurement is selected.

For purposes of this example, select only the **Humidity Measurement** and **% Vol SF6 Measurement**, and disable the **Pump Back After Measurement**.

Now press the **Ok** button.

With this configuration Humidity Measurement and % Volume SF₆ Measurement will be selected, without Automatic Pump Back.

For purposes of this example, select the **Humidity Measurement**, **% Vol SF6 Measurement** and **Pump Back After Measurement**.

Now press the **Ok** button.

With this configuration both measurements will be selected, with Automatic Pump Back (SF₆ Standard).

For purposes of this example, select the **Humidity Measurement** and **Air/N2 Mode**.

Now press the **Ok** button.

With this configuration only the Humidity Measurement is selected, without storage in the internal cylinder. The measured gas will be pumped to atmosphere. This mode is only used for the measurement for air or nitrogen (N₂).
**SO₂ Module**

The SO₂ Module is a separate measuring unit which can be installed at the back panel of the 973. When installed and properly connected, the module changes the functionality of the 973, allowing it to make measurements of SO₂ concentration.

The SO₂ Module is installed at the back panel of your instrument with the supplied socket head screws (1). The measuring gas outlet (2) will be connected at the Sample Gas Input of the 973. The electrical connection of the SO₂ Module is connected to the RS-232 connection (3) of the 973. The gas tube from the GIE to be measured is connected to the gas inlet quick connect of the SO₂ Module (4).
As soon as the SO₂ Module is electrically connected to the RS-232 connection at the back panel of the 973, the unit is switched into the SO₂ mode. Instead of the three standard status lines, the SO₂ status is indicated.

Press the **Start** button. The **Start** button and the **Pump** button turn green. The pump starts and the small clock on the SO₂ status line, located next to the **Start** button, begins to spin. During the measurement, SF₆ gas flows from the gas compartment, through the hose, through the SO₂ Module, and into the internal storage tank of the 973.

After completion of the SO₂ measurement, the spinning clock stops, a checkmark is displayed in its place, and the measured SO₂ content in ppm, is displayed.

The measured SO₂ value remains indicated until a new SO₂ measurement is started. By pressing the **Start** button, further SO₂ measurements can be accomplished, until the internal storage tank is full.

While the module is installed, the pump back function is disabled. Removal of the SO₂ Module connections from the back panel restores normal operation of the 973. The pump back can then be accomplished only if the measuring gas line again is connected directly to the Sample Gas Input of the 973 and the RS-232 cable of the SO₂ Module is removed from the RS-232 connection on the back panel of the instrument.

After connection of the measuring gas line at the standard input of the 973 back panel, the Humidity and % Volume SF₆ measurement can be started directly.

After conclusion of the pump back into the gas compartment all measuring results are available on the display, including the most recent SO₂ measurement.
Ice Test

The measuring accuracy can be checked with a simple test. This is important, if the results of the measurement do not correspond to expectations and the error is assumed with the instrument.

Press the lower right menu key once to select the Control Setup menu. Control Setup appears on the key while the keys above change to the available menu options. Notice that the second key from the top indicates Ice Test.

Press the Ice Test menu key. The first window requests you to open the measuring head.

The measuring head of the 973 is located on the right side of the front plate. To gain access to the mirror you first must remove the screw cover.

The cover should appear like a large tan colored knurled knob, simply twist it counterclockwise. It requires approximately 3 full turns to completely unscrew, allowing you to remove it.

Once the screw cover has been removed, the black optical assembly (optical head) is now removed by pulling it straight toward you.
Confirm by pressing the Ok button, that you opened the measuring head and that you are ready for the Ice Test.

Immediately after pressing the Ok button the test starts.

After the start of the Ice Test the mirror will be cooled down to -30°C and because the measuring head is open, the humidity from the ambient air starts to condensate on the mirror. It forms a frost layer on the mirror, which, if necessary, can be strengthened by blowing on it. After reaching -30°C the mirror will be heated and as soon as the mirror temperature approaches the 0°C border you hear a beep which becomes faster, the closer the temperature gets to 0°C.

Observe the mirror. As soon as the mirror temperature crosses 0°C, the ice will melt and the frost changes into liquid water drops.

In the moment you observe the phase transition on the mirror, you must press the Ok button, in order to store the measured mirror temperature at this moment.

It now shows a dialogue box with the information, if the Ice Test was successful or not. The box also indicates the temperature at which the ice melted.

If the stored temperature is in the range of +/- 0.2°C, the check is successful and will be indicated with the calibration status PASS.

If the stored temperature is outside the range of +/- 0.2°C, the check was not successful and it will be indicated with the calibration status FAIL. In this case the ice test should be repeated. If the FAIL status should be confirmed, the instrument must be sent to an authorized agent or the manufacturer.
Press the **Ok** button on the **PASS/FAIL** status windows. The next window will request you to clean the mirror.

Clean the mirror with a clean cotton bud or lint free tissue.

Install the optical head and close the measuring head with the screw cover.
Additional Functions

Selection of the Indicated Parameters

Selecting which parameter to display on the four data lines is easy. It is done with the Parameter menu.

Use the lower right menu key a couple of times to select the Parameter menu. The arrow indicates that each key corresponds to its data line.

Press the arrow key corresponding to the data line you wish to change. Notice that each time you press the arrow key, the parameter of the data line changes. The parameter selection is circular, meaning that once you reach beyond the last available parameter, the first one is again displayed and the cycle starts over. Change the parameters on any of the other three data lines with the same method.

If you like, you may clear the menu keys when finished by cycling through all the menus using the lower right key on the touch screen, or by pressing the Enter key once. Note that this is not required and nothing is wrong with leaving the Parameter menu (or any other menu) on the screen.

The changed selection of the Parameter menu remains displayed as long as the 973 is in operation. After restart of the 973 the display is set back to the standard configuration. Both the parameters of the instrument as well as those of the Excel Protocol are independent from each other and must separately be selected.
Selection of Units

The data may be viewed in any of the many available units.

Use the lower right menu key to select the **Units** menu. **Units** appears on the key and the keys above show the various units. Notice that each of the keys shows different types of units. Unlike the **Parameter** menu, the keys do not correspond to the data lines, but rather to different unit types.

To change temperature units, press the key labeled **Temp**. Notice that the corresponding unit changes each time the key is pressed. Also notice that any data line that is currently indicating temperature data also changes to the new unit.

Change other units such as **Pressure**, **Flow Rate**, etc. with the same method.

In addition to setting the **Pressure** units, the mode may be set to either absolute or relative mode.

Note: Relative mode is often referred to as ‘gauge mode’ or ‘over-pressure’.

If you like, you may clear the menu keys when finished by cycling through all the menus using the lower right key on the touch screen, or by pressing the **Enter** key once. Note that this is not required and nothing is wrong with leaving the **Units** menu (or any other menu) on the screen.

The changed units remain displayed as long as the instrument is in operation. After restart of the instrument the display is set back to the standard configuration.
Changing Color

You are free to change the foreground and/or background color of any data line with the **Fore Color** and **Back Color** menus. Access the **Fore Color** and **Back Color** menus with the menu selection key. To revert to the standard system default color scheme, press and hold the 9 key for a few seconds (see page 33).

**Fore Color**

Fore color affects the color of number and letters, and the plotting color of graphs. If you change the fore color of a data line that is displayed numerically, the graph attributes of that line are not affected. Likewise, if you change the fore color of a line displayed as a graph, the numeric display attributes of that line are unaffected. Which aspect of the data line that is affected is determined by whether that line is currently displayed as a number or as a graph when changing the fore color. To change a data line’s fore color:

Access the **Fore Color** menu. **Fore Color** appears on the key, and the keys above contain left pointing arrows. Notice that each key corresponds to the data line it points toward.

Press the arrow key corresponding to the data line you wish to change. Notice that the fore color of the data line changes with each press of the key.

Change the fore color on any of the other data lines with the same method.

**Back Color**

Back color affects the background color of number and letters, and the background color of graphs. If you change the back color of a data line that is displayed numerically, the graph attributes of that line are not affected. Likewise, if you change the back color of a line displayed as a graph, the numeric display attributes of that line are unaffected. Which aspect of the data line that is affected is determined by whether that line is currently displayed as a number or as a graph when changing the back color. To change a data line’s back color:

Access the **Back Color** menu. **Back Color** appears on the key, and the keys above contain left pointing arrows. Notice that each key corresponds to the data line it points toward.

Press the arrow key corresponding to the data line you wish to change. Notice that the back color of the data line changes with each press of the key.

Change the back color on any of the other data lines with the same method.

The changed selections of the **Fore Color** and **Back Color** menus remain displayed as long as the 973 is in operation. After restart of the 973 the display is set back to the standard configuration.
Storage of the Actual Settings

The 973 version SF₆ will be delivered with the SF₆ standard configuration. The configuration can be changed, but it will not be stored. After restart of the instrument all changes will be ignored and the instrument starts with the standard configuration. The standard configuration can be changed as follows:

Press and hold the number 1 on the keypad for about 5 seconds.

You hear a beep and a window will be opened.

By pressing the Ok button the actual settings will be stored as the standard configuration.

By pressing the Cancel button the window will be closed and the actual settings will not be stored.

The Standard Configuration Includes the Following Settings:

**Measurement Options**

The standard configuration includes the chosen measuring options.

**Units**

abs./rel. pressure mode

The standard configuration includes the units for all parameters as well as the absolute or relative pressure mode.
Parameters

The standard configuration includes the parameter selection of the data lines.

Colors

The standard configuration includes the front and background colors selection.

Restore Color Settings and Baud Rate

Press and hold the number 9 on the keypad for about 5 seconds.

You hear a beep and a window will be opened.

By pressing the Ok button the standard display color configuration and the baud rate 9600 are restored.

By pressing the Cancel button the window will be closed and without restoring the colors and the baud rate.
Maintenance

Touch Screen Calibration

The 973 utilizes a touch screen for user interaction. To activate a menu option or toggle a function on or off, simply touch the screen directly over the key or object desired.

For example left and right handed people have different points of pressure with such keypads. Before using the instrument for the first time, you may need to calibrate the touch screen to your finger positioning preference. Follow the instructions:

Press and hold the Enter key on the numeric keypad for 3 to 4 seconds. If you’ve done it correctly, you’ll hear two short beeps and a key in the upper right corner will turn yellow. If not, release the Enter key and try again.

With the tip of your finger, press the center of the yellow key in the upper right corner of the touch screen. It is labeled Touch This Key. Once you touch it, the yellow color goes away and another key turns yellow.

Now, touch the yellow key that’s in the lower left corner of the touch screen. Once you touch it, the yellow color goes away and you have successfully calibrated the touch screen.

Test your new touch screen calibration by pressing the bottom right menu selection key several times. If it seems not to work well, just repeat the calibration steps again from the beginning.

You may recalibrate the touch screen as often as needed, however, it is rarely required. If the touch screen does not seem to be working, please attempt to recalibrate it.
Mirror Cleaning

The heart of the 973 is the measuring head assembly. It is designed to be highly sensitive and accurate, yet rugged and easily accessible for periodic mirror cleaning. To ensure the high accuracy of the measurements the mirror should be cleaned before starting a series of measurement. After unscrewing the screw cover and the measuring head front part the mirror is easy accessible.

Request for Mirror Cleaning

If after completion of a measurement the 973 detects that a mirror cleaning is necessary, you will hear a beep and a window will open with the request to clean the mirror.

Removing the Head Cover

The measuring head is located on the right side of the 973 front panel. To gain access to the mirror and opto-electronic components, you must first remove the screw cover.

The cover looks like a large tan colored knurled knob. To remove it, simply twist it counterclockwise. It requires approximately three full turns to completely unscrew, allowing you to remove it.

Removing the Optical Assembly

Once the screw cover has been removed, the black optical assembly (optical head) is now removed by pulling it straight toward you.
Inspecting / Cleaning the Mirror

Clean the mirror with a clean cotton swab or lint free tissue.

Notice:

- Never attempt to polish the mirror.
- If needed, the mirror may also be cleaned with methanol or alcohol. Always follow the use of these cleaning chemicals with distilled water to ensure they are completely rinsed from the mirror surface.

Reassemble the Mirror Components

Reassemble the mirror components in the reverse order of disassembly.

1. Install the optical assembly, taking note of guide pin. Ensure that the arrow is pointing toward the top of the unit.
2. Replace the screw cover. Hand tighten until snug. Do not over tighten.

Exterior Cleaning

Front Panel

The 973 front panel is completely sealed and easily cleaned with liquid glass cleaner or other mild cleaning chemicals moistened on a cloth. Clean the front panel periodically as needed.
### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>973-SF&lt;sub&gt;6&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range:</td>
<td></td>
</tr>
<tr>
<td>Frost/Dew Point</td>
<td>-50…+20°C</td>
</tr>
<tr>
<td>Humidity content by volume</td>
<td>40…20'000 ppm&lt;sub&gt;v&lt;/sub&gt;</td>
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<tr>
<td>Humidity content by weight</td>
<td>5…2'500 ppm&lt;sub&gt;w&lt;/sub&gt;</td>
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<tr>
<td>Volume SF&lt;sub&gt;6&lt;/sub&gt;</td>
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<tr>
<td>Pressure</td>
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<tr>
<td>Accuracy:</td>
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<td>ppm&lt;sub&gt;v&lt;/sub&gt;/ppm&lt;sub&gt;w&lt;/sub&gt;</td>
<td>±5% of reading</td>
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<td>Volume SF&lt;sub&gt;6&lt;/sub&gt;</td>
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<tr>
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<td>Quick connect fitting</td>
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<tr>
<td>Power consumption:</td>
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</table>

<table>
<thead>
<tr>
<th>Instrument with Transport Case and Accessories</th>
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<tbody>
<tr>
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<tr>
<td>Height: 155 mm</td>
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<tr>
<td>Depth: 390 mm</td>
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<tr>
<td>Weight: 16.5 kg</td>
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