Modular Signal Recorder

User manual

MSR 145

MSR® operating instructions

MSR® PC software

Setup

Reader

Viewer

Online

MSR® Utility programs

Additional software for PCs

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Important notes regarding this user manual

In this manual notes of particular importance are presented as follows:

WARNING	Indicates that equipment may suffer damage or that there is a risk of injury to the operator or user should the instructions not be followed correctly.
CAUTION	Indicates that equipment may suffer damage or that data loss may occur should the instructions not be followed correctly.

Conventions

Term / Symbol	Description	Example
MSR 145	In this manual the term "MSR 145" is used to mean both "MSR 145S", "MSR 145WS" and "MSR 145W"	
Commands, programs, menu items, functions, field names	Commands, programs, menu items, functions, field names are shown in bold.	**Record**
-> X	See page X	-> 5
	• Reference to further information • Further information	

Safety instructions and warnings

WARNING

- Read the operating instructions carefully before using the MSR 145 or the MSR software. This will protect you personally and avoid damage to the unit.
- The MSR 145 is a unit for recording and displaying measurement parameters and may not be used for safety-related applications.
- Before using the MSR 145 check the unit itself and all cables for visible signs of damage and never operate a damaged MSR 145. A damaged MSR 145 can endanger operator safety! Should the MSR 145 not function perfectly or appear to be damaged, send it to MSR Electronics GmbH for repair.
- Ensure that no fluids enter the MSR 145's casing. Fluids cause corrosion damage and short-circuits inside the MSR 145.
- The MSR 145 must never be opened or modified. The manufacturer cannot be held liable for damage resulting from use other than that for which the unit is intended, or from improper operation of the unit.
- Never use an MSR 145 with a leaking battery. Should a battery leak be detected ensure that the electrolyte does not come into contact with the skin, the eyes or the mouth. Should this occur, thoroughly rinse the affected area with water for at least 15 minutes. Consult a doctor. Do not breathe in any vapours emitted. Immediately clean the electrolyte from the MSR 145 using a soft cloth and dispose of the cloth subsequently.

CAUTION

- Ensure the proper disposal of an obsolete MSR 145 and USB connection cable ->14.

Operating Instructions

MSR 145S

MSR 145WS

MSR 145W

Overview

The MSR 145 is a miniaturised universal datalogger for measuring and recording different physical measurement parameters. It contains a temperature sensor, a humidity sensor with integrated temperature, a pressure sensor and a 3-axis accelerometer (X, Y and Z axes). The measurement parameters can be transferred to a PC either once data logging is completed or during the data logging process.

The MSR PC program enables users to customise the way in which the MSR 145 measures and records data according to their requirements. The integrated clock (RTC) allows data from as many MSR 145 units as required to be synchronised and merged into a single data record.

MSR 145S

MSR 145WS

USB connection cable

CD with MSR software

Controls

MSR 145W

Aperture for humidity sensor

Indicator LED's

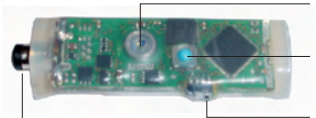
Blue: Record indicator ->27

Red: Alarm indicator ->26

Yellow: Battery charge indicator ->10

MSR 145WS

MSR 145S



Aperture for pressure sensor

Push-button

Aperture for humidity sensor

USB PC-Interface

Turning the unit on / saving measurement parameters

The storage properties of the MSR 145 are determined using the **Setup** program*.
Control of measurement parameter storage can be either time activated, value activated or by pushing the push button.

***Setup** is an MSR PC program (see **Setup** chapter ->23).

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Maintenance

User checks

- Check the MSR 145 before each use.
- Before using the MSR 145 check for visible signs of damage.
- Check the functions of the MSR 145.
- Never use an MSR 145 that is damaged or not functioning perfectly. Never use damaged accessories.
- Ensure that the battery is sufficiently charged for the required period of use.

Should the MSR 145 not function perfectly or should damage become apparent send the unit to MSR Electronics GmbH for repair. Repairs may only be carried out by MSR Electronics GmbH or an authorised dealer. Defective or damaged components may only be replaced with manufacturer's original parts.

Cleaning

CAUTION

- MSR 145S: Ensure that no fluids enter the MSR 145's casing. Fluids will cause corrosion damage and short circuits.
- Never use corrosive or abrasive cleaning agents or polishes.
- Cleaning agents containing additives such as alcohol will cause the case to become matt and/or brittle.

- Clean the MSR 145 when necessary.
- Always disconnect the MSR 145 from the PC before cleaning.
- Use a cleaning agent suitable for plastic or a cloth dampened with water and soap.

Charging the battery

Before first use: The battery is not fully charged on delivery and should be charged for approx. 3 hours before using the MSR 145 for the first time.

Charge the MSR 145:
- Before each use
- At least every six months

Method:

- Connect the MSR 145 and the PC using the USB connection cable.

Notes:
- Ensure that the PC remains switched on.
- The yellow LED illuminates during charging (continuously).
- Charging is completed after a maximum of 3 hours.
- Recorded data is non-volatile and remains in the unit's memory even when the battery is exhausted.
- Never store the MSR 145 with a discharged battery.
  See ->13 (storage conditions).

Meaning of the yellow lamp when a USB device is connected

	Yellow LED	Meaning
	Lights continuously	Charging in progress
	Off	Fully charged or no connection to PC or PC turned off
	Flashes	Fully charged The battery is recharged for a short time, e.g. during an online measurement or data recording

Specifications

Measured parameters:
- Temperature
- Relative humidity with integrated Temperature
- Pressure (e.g. altimeter, water level, barometer)
- 3-axis acceleration (e.g. determining position)
- 2 analog inputs (voltage range 0 to 3.0 V, 12 bit)

Working range:

Temperature:	-10 °C to +58 °C
	-55 °C to +125 °C (optional with external sensor)
Humidity:	0-100 % relative Humidity, -20 °C to +65 °C
Pressure:	0-2500 mbar absolute
	Optional: 0-14 000 mbar absolute
Acceleration:	±10 G / ±2 G selectable

Accuracy:

Temperature:	±0,1 °C (5 °C to 45 °C)
	±0,2 °C (-10 °C to +58 °C)
	Options with external sensor:
	±0,1 °C (5 °C to 45 °C)
	±0,5 °C (0 °C to +70 °C)
	±2 °C (-55 °C to +125 °C)
Humidity:	±2 % rel. humidity (10-85 % rel. humidity, 0 to 40 °C)
	±4 % rel. humidity (85-95 % rel. humidity, 0 °C to 40 °C)
	±0,5 °C (0 °C to 40 °C)
Pressure:	±2,5 mbar (750-1100 mbar absolute)
Acceleration:	±0,15 g (25 °C)

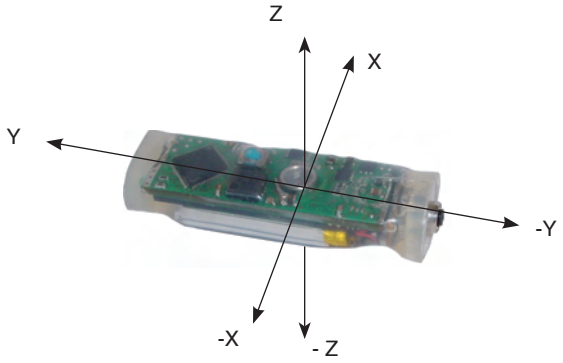
Storage rate:	Temperatur and humidity:	1/s	to every 12 h
	Pressure:	10/s	to every 12 h
	Acceleration, Analog input:	50/s	to every 12 h

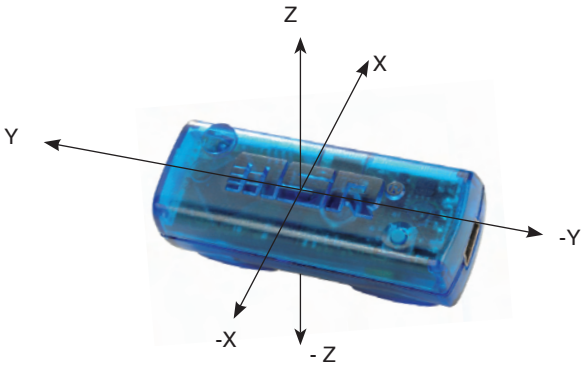
Memory capacity: Over 2 000 000 measurement parameters

Push-button: Set bookmark or start and stop the record

General	MSR 145S	MSR 145WS	MSR 145W
Size (mm):	20 x 15 x 52	20 x 15 x 61	18 x 14 x 62
Weight approx.:	16 g	23 g	18 g
Sheath material:	PC	PC	Silicon
Medium:	Air	Air, water	Air, water

Power supply:	• Rechargeable lithium polymer battery 170 mAh • The battery is charged via the USB connection. • One battery charge is sufficient for operation of the unit for several months (measurement rate 1 / minute)
Interface:	USB
USB connection cable:	Approx. 200 cm
Standards:	The MSR 145 complies with EU Directive RoHS / WEEE. MSR 145S: Protection Classification IP 60 MSR 145WS: Protection Classification IP 67 MSR 145W: Protection Classification IP 67





Operating, transport and storage conditions

- Protect the MSR 145 from excessive exposure to the sun and other sources of heat. Avoid heavy impacts.
- Do not place heavy objects on top of the MSR 145.
- Only store the MSR 145 in a dry, dust-free environment.

Operating conditions:

Temperature:	-20°C to +65°C
Pressure:	500 mbar to 2500 mbar absolute

Optimal storage and transportation conditions:

Temperature:	0°C to 45°C (ideal storage condition for the battery)
Humidity:	10-95% relative humidity, non-condensing
Battery charge level:	Never store the MSR 145 with a discharged battery. The ideal charge level is a 2/3 charge (a discharged battery achieves this charge level after approx. 2 hours' charging).
• MSR 145S:	Avoid contact with water and humidity.
• MSR 145WS:	Relative humidity: 30% to 95% max. (storage and transport 10-95%)
• MSR 145W:	Relative humidity: 30% to 95% max. (storage and transport 10-95%)

Troubleshooting

Problem	Possible cause	Possible solution
The temperature increases continuously when the MSR 145 is connected to the PC	The battery warms up because charging commences when the MSR 145 is connected to the PC.	When making temperature measurements disconnect the MSR 145 from the PC.
The MSR PC programs do not recognise the connected MSR 12	The COM port driver is not installed correctly.	Observe the manufacturer's installation instructions http://www.ftdichip.com/

Packing list

- MSR145S, MSR 145WS or MSR145W
- CD including:
  - User manual
  - MSR PC software
- MSR145 USB connection cable
- Warranty card

Options:

- Additional sensors
- Adapter for connecting further sensors

Warranty

See warranty card.

Disposal

Take the MSR 145 to a municipal waste disposal centre or return it to MSR Electronics GmbH. The MSR 145 must not be disposed of in normal domestic waste.

Declaration of conformity

CE

QUINEL
QUALITY IN ELECTRONICS

TEST REPORT

EN 61326-1

Electrical equipment for measurement, control and laboratory use

EN 61000-6-2 and EN 61000-6-3

Part 6-2: Immunity for industrial environments

Part 6-3: Emission standard for residential, commercial and light-industrial environments

Report reference No:	**E971-05-6 b**
Tested by test engineer:	L.Monnin
Approved by management:	Dr. F. Stucki
Date of issue:	5 September 2006
Number of pages:	14 pages
Testing laboratory:	QUINEL
Address:	Feldstrasse 6 CH-6300 Zug
Testing location:	Zug Tel. 041-724 27 54
	STS 037
Applicant's Name:	**MSR Electronics GmbH**
Address:	Hr. W. Belz, Oberwilerstrasse 16 ,CH-8444 Henggart
Manufacturer:	**MSR Electronics GmbH**
Address:	Oberwilerstrasse 16 ,CH-8444 Henggart
Test specification:	
Standards:	IEC 61000-6-2:1999, mod. EN 61000-6-2:2001 IEC 61000-6-3:1996, mod. EN 61000-6-3:2001 EN 61326-1:2006
Test procedure:	Type testing for Swiss and EU legal requirements
Procedure deviation:	None
Non-standard test method:	None
Test-specification:	The used test setup fulfils the specification described in the relevant standards
Test item description:	
Trademark:	
Model and/or type reference:	MSR 145 / Nr.20022
Ratings:	230 V / 50 HZ
Date of receipt of the test item(s):	5 September 2006
Summary of testing:	**Passed**

Applied standards:

No	Title	Standard (up dated)	pages	Verdict
E971226-b	RF disturbances	CISPR 22(2003), EN 55022(2003)	5	P
E971036-b	Radiated electromagnetic field	IEC/EN 61000-4-3(2001)	4	P
E971026-b	Electrostatic discharge	IEC/EN 61000-4-2(2000)	3	P

Verdicts: P = passed, F = failed, NA = not applicable, NT = not tested

MSR® PC software

Setup

Reader

Viewer

Online

MSR® PC software

Overview

External processing of MSR 145 data is carried out using the MSR PC software programs **Setup**, **Reader**, **Viewer** and **Online**. The MSR PC programs can be used for all MSR types.

The **Setup** enables the properties of the MSR 145 to be customised to user's requirements.

The **Reader** allows the user to transfer measurement parameters to a Windows PC. The **Viewer** is used to display data graphically or in table form or to export it as a text file (*.csv).

With the help of **Online** users can view measurement parameters and curves "live" on a PC.

Installation of the MSR PC software on a PC

For installation you will require Windows administrator rights.

Insert the CD containing the MSR PC software into the computer's CD-ROM drive. The installation procedure starts automatically*.
During installation select: **Run MSR Modular Signal Recorder now**.

Completing installation

Initial installation: Select **Install USB driver**.

Click on **Finish**.

The MSR symbol appears on screen.

If the PC is not set up for automatic installation, proceed as follows:

1. Click **Start > Run**
2. Click **Find** > **Look in**: (set to CD drive).
3. Select the file **Install_MSR.exe** and **Open**.
4. In the **Run dialog box** click **OK**.
5. The installation process will begin.
6. Follow the instructions and select: Run **MSR Modular Signal Recorder now**.
7. During the initial installation select Install USB driver. See above, **Completing installation**.

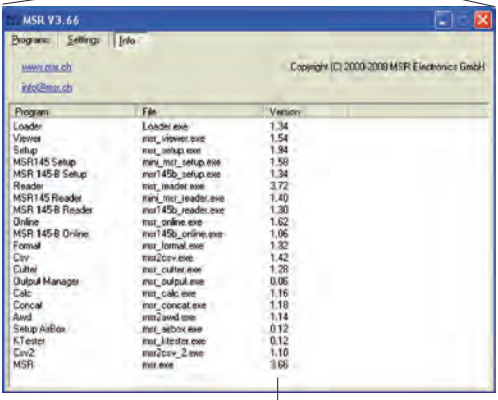
* The program "Inno Setup" for installing the MSR PC programs was written by Jordan Russell (www.jrsoftware.org, copyright Jordan Russell).

Starting the MSR Software

The MSR software may be started by clicking on the MSR symbol or via **Start** > **Programs** > **MSR** > **MSR**.

Version number of MSR CD

MSR program window



Version numbers of MSR PC programs

Uninstalling

The software is uninstalled via the computer's operating system (Programs > MSR > Uninstall MSR).

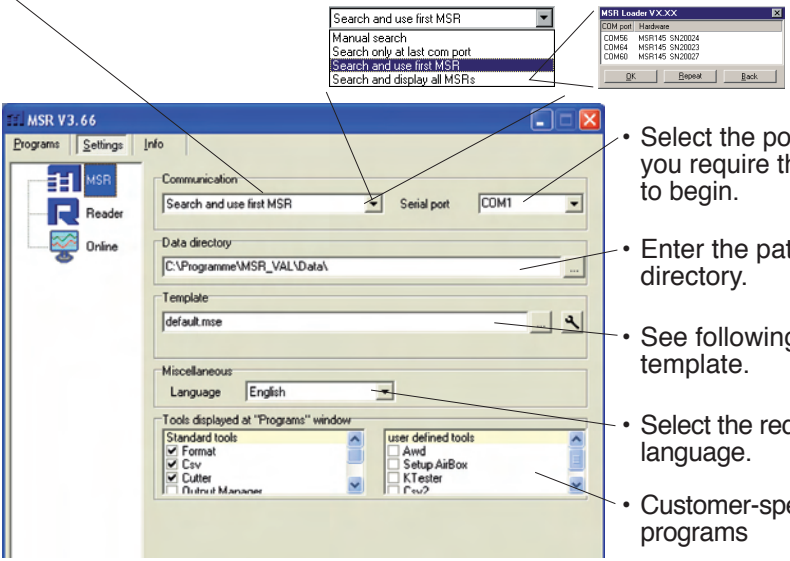
System Requirements

- Windows 95 or higher
- USB port

Preparation

Before using the MSR PC programs **Setup, Reader** and **Online**, the following preparations must be completed:

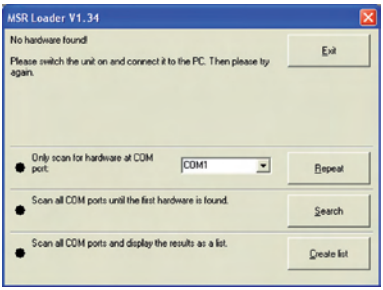
- Use the USB connecting cable to connect the MSR 145 with the PC.
- Before first use: Using open the **MSR program window**, select **Settings > MSR**.
- Select the rule by which the **Setup, Reader** and **Online** programs are to search for the required MSR*.



- Select the port at which you require the search to begin.
- Enter the path to the directory.
- See following page for template.
- Select the required language.
- Customer-specific programs

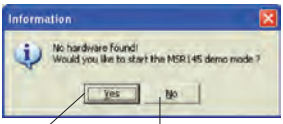
MSR program window

* One of the following windows will appear if a connection to an MSR cannot be established using the current rule.



Loader Dialog

Im Setup:



Starts the Loader dialog (see screenshot left)

Starts the Setup demo mode

Template

The template, selected via **Setting** > **MSR** (*.mse), defines which sensors the **Reader** reads out as standard or are displayed in **Online**. The template sets the colour of the trace, the positioning of its axis (left, right) and gives the sensors a name (“HUM, T1” is required to be displayed as “outside temperature”, for example). Templates can be produced on the basis of examples contained in **Viewer** (->34).

Example

The temperature curves are required to be blue and oriented on the right hand axis in all display modes.

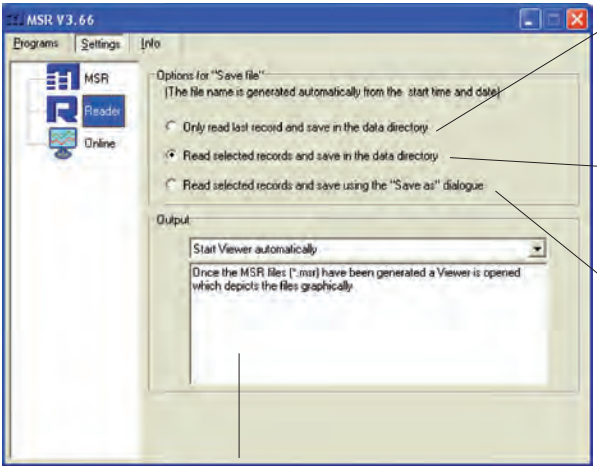
1. Assign right hand axis and blue colour shades to temperature in **Viewer**.
2. Save as template (Bluetemp.mse).
3. Generate new templates for **Reader** and **Online**: Select MSR program window, **Settings MSR** > **Template** ... , enter new name and path (Temperature.mse), then **Open**.
4. Open the still blank template (Temperature.mse) using .
5. **Import** the template that was created in **Viewer** (Bluetemp.mse). Select the required sensors (tick in checkbox) in the **Module** column and confirm with **Accept**.
6. Edit the displayed list: First select a sensor in the **Module** column and then choose **Edit**.
7. Change the name “HUM, T1” to “Outside temperature”, and **Accept**.
8. Continue to make the necessary adjustments and confirm them with **Accept**.

Pre-adjustments - Reader

Enter the required options for the **Reader**** via **Settings** > **Reader**.

Data records are transferred from the MSR 145 to a PC using the **Reader.

Once data transfer is complete the **Reader** creates a data record (*.msr) from each logged record, names it and saves it in the corresponding directory. The bottom-most option allows the user to alter the suggested filename and location.



Transfer only the most recent data record logged with the MSR 145 to the PC.

User defines which records are transferred to the PC.

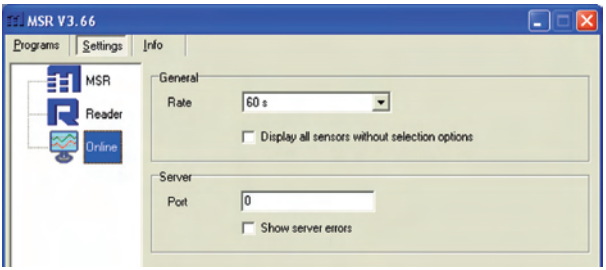
User defines which records are transferred to the PC, their filenames and their location.

Once the data has been transferred to the PC various options are available to the user. Details may be found in the text window.

Example: "Automatically generate a text file"
In addition to the MSR format file, the **Reader** creates a text file (*.csv), which can be opened with programs such as e.g. Microsoft Word or Excel.

Pre-adjustments - Online

The functions described on this page are currently not available with the MSR 145.



Completion of the preparatory measures

Upon exiting **Settings** the PC saves the settings that were last entered. The default settings can be reinstated by selecting **Settings** > **MSR** > **Default**.

Once entry of the settings is complete, select **Programs** and start the required program.

Note: The following instructions assume that the preparations for using the MSR PC programs have been completed.

Setup

Setup is used to select the sensors for which the MSR 145 is required to save measurement parameters, to enter the measurement frequency and to set the behaviour of the MSR's memory. In **Setup** you can also define the start time for data recording and stop data recording.

The following subjects are dealt with in the **Setup** chapter:

Basic settings 24
Prediction 25
Shock Assistant 25
Reducing the volume of data 26
Conditional recording of measurement parameters (limits) 26
Setting the alarm 26
LED behaviour 27
Transferring basic settings to several MSR 145s 27

Enter the name of the MSR 145 28
Setting the measure range of the accelerometers 28
Setting up the analogue inputs 29
Calibrating the acceleration sensors 30
Calibrating the humidity and temperature sensors 31

Formatting the memory 32

Basic settings

Note: This page describes the most commonly used settings – the **Basic settings**. Information on further settings can be found on the following pages.

- Complete the preparations (->19).
- Start **Setup** (Setup symbol).
- Under **Read basic settings**, read the configuration saved in the MSR 145.
- Edit the **Basic settings** according to your requirements.
- Transfer the new configuration and the start conditions to the MSR 145 with **Write basic settings**.

Name of the MSR 145 ->28

Currently no data is being recorded (inactive)
(active: data recording in progress)

Exit setup

Read the information and measurement parameters

Freezes the selected options in the **Basic settings** and **Limits tabs** so that these can be transferred to other MSR 145 units ->27

->32
->26
->28

Enter the main storage rates

Conditional recording of measurement parameters ->26

->25

Overwrite oldest measurement parameters when memory is full

Marker function on/off

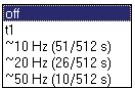
Stop data recording

Transfers the configuration, the start conditions and the PC time to the MSR 145

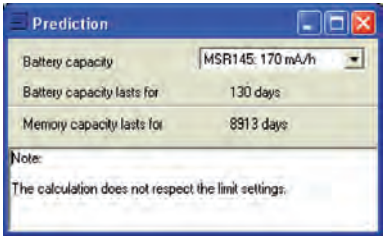
If the measurement parameter exceeds the alarm limit the LED flashes. When **Stop alarm** is selected the alarm can be stopped by clicking the button.

Blue LED flashes during data recording (🔍 ->27)

Define the sensors from which the MSR 145 should record data, together with the storage rate Define the sensors from which the MSR 145 should record data, together with the storage rate



Prediction



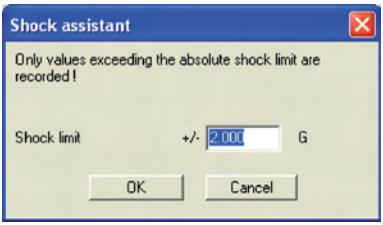
The maximum amount of data that can be recorded is influenced by:
- The number of sensors
- The measurement rate
- The battery capacity

With each click on **Prediction** (**Basic settings**) the program generates an approximate prediction using the selected basic settings.

Note: The Limit settings are not taken into account here.

Setup

Shock Assistant



Using the Shock assistant you can rapidly configure the MSR 145 for a shock measurement (conditional recording of accelerations).

Menu access via **Basic settings** > **Shock assistant**.

Only those acceleration values are recorded that exceed the value set for the threshold limit. Acceleration due to gravity over and above the measurement is not taken into account.
The figure input for the threshold value is set as the limit for the X, Y and Z axes of the accelerometer. The accelerometer and limits are activated, 50Hz is used as the measurement rate.

Note: Other settings are not affected.

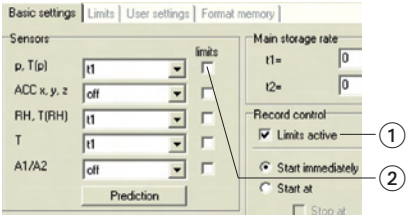
Reducing the volume of data

When making extensive recordings it is recommended that all sensors that are not required be “turned off”. This prevents unrequired measurement parameters from being saved.

- Under **Basic settings** turn "**off**" all unused sensor groups (see next section).
- To turn off individual sensors within one sensor group proceed as follows: Set the cut-in condition such that they are not activated during the planned recording (e.g. > 200 °C) (see next section).

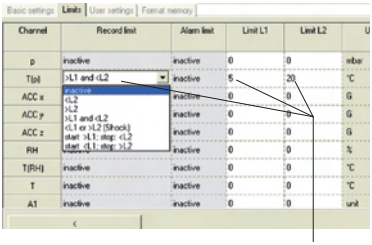
Conditional recording of measurement parameters (limits)

If for example, you require only to record temperatures above 5°C and less than 20 °C, use the following procedure



- Activate Limits active ① and the corresponding temperature sensor ②.

  The **Limits** tab opens.



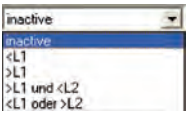
The MSR 145 only records measurement parameters from the sensor T(p) above 5°C and less than 20 °C

- In the columns **Record Limit**, **Limit L1** and **Limit L2** enter the cut-in conditions for the sensor.

- Return to the **Basic settings** with [<] and click **Write basic settings**. The limits will only be transferred to the MSR with **Write basic settings**.

Setting the alarm limit

The MSR 145 can display an alarm if a certain measurement parameter drops below or exceeds a certain value. When the alarm condition occurs the red LED flashes once per second until the data recording is stopped or the alarm function is exited (->24).



Inputting the alarm condition is carried out in the same way as setting the cut-in conditions (see section **Conditional recording of measurement parameters**). In the **Alarm Limit**, **Limit L1** and **Limit L2** columns enter the alarm conditions. The alarm limits can be displayed in **Viewer**.

LED behaviour

The behaviour of the blue LED is defined via **Setup** > **Basic settings**.

		Options during record ☒ blue LED flashes with t1	Options during record ☐ blue LED flashes with t1
Situation		**Behaviour of the blue LED**	
Start time has been transferred to the MSR 145 (nonfuzzy)	First 5 seconds	Double-flashes 5 times at 1-second intervals	
	Warten auf Start (scharf)	Double-flashes at 5-second intervals	
Datenaufzeich-nung läuft	First 5 seconds	Flashes 5 times at 1-second intervals	
	After 5 sec-onds	LED flashes with main storage rate t1	LED does not flash

Transferring basic settings to several MSR 145s

Use the following procedure to transfer basic settings that have already been input to several MSR 145s:

- Start **Setup**.
- Connect the MSR 145 to the PC. (If several MSR 145s are connected to the PC, select the COM port of the required MSR 145).
- Enter the required values in the **Basic settings tab**.
- Set the cut-in and alarm conditions in the **Limits** tab.
- Use **Write basic settings** to transfer the basic settings to the MSR 145.
- Disconnect the MSR 145 just configured and connect the next MSR 145 to the PC.
- Select the new MSR 145 via COM Port.
- **Caution!** If you wish to import the information and measurement para-meters of the newly connected MSR 145, you must first select the option **Freeze** ->24, so that the settings in the **Basic settings** and **Limits** tabs are not overwritten!
- Transfer the basic settings to the MSR 145 with **Write basic settings**.

Note: It is also possible to configure differently equipped MSR 145s with a single basic setting. One MSR 145 may for example, not be equipped with any analogue inputs. The setup program then simply does not write any data to the settings saved in the MSR 145 for those analogue inputs.

- If a connected MSR deviates too greatly from the first MSR, this message appears:

Setup

User settings

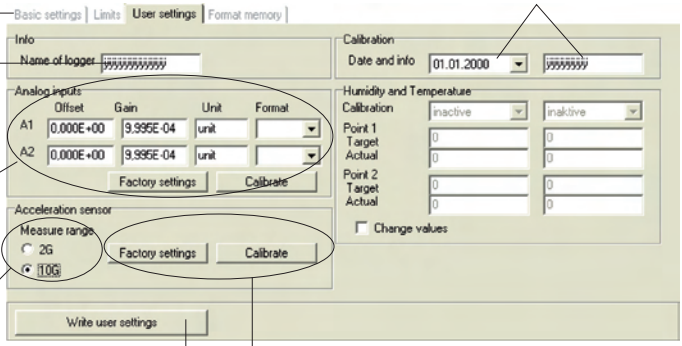
To display the configuration saved in the MSR 145 select the **Basic settings** tab ① and click **Read basic settings**. The settings are now displayed in the **User settings** tab.

CAUTION	The changes made in the User settings tab and its sub-menus will only be transferred to the MSR 145 after clicking Write user settings ②.

Enter date of last calibration and comment

①

Enter the name of the MSR 145



②

Select the measure range of the acceleration sensors.

Calibrate analogue inputs
Here you can enter the offset (zero point) and gain, calculate them via **Calibrate** ->29 with the help of an assistant or you can reset them to the **factory settings**.
.

Calibrate acceleration sensors
Calibrate the acceleration sensors as required manually via **Calibrate** ->30 or activate the **factory settings**.

Note: The fields available for input are dependent upon the respective MSR 145.

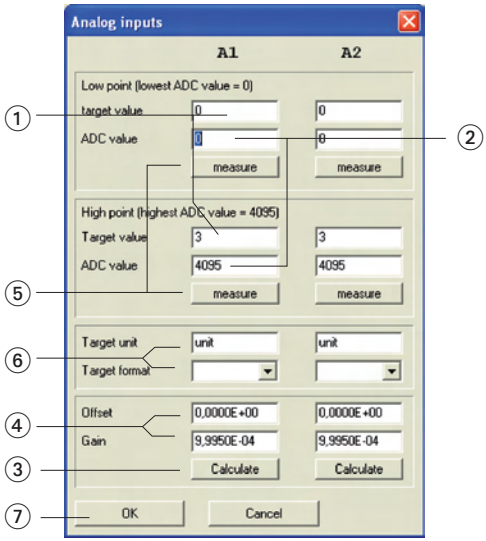
Calibrating the analog inputs

The analogue digital converter (ADC) of the MSR 145 converts an external voltage U between 0.0 V to 3.1 V into an internal digital signal D between 0 and 4095. This signal D is converted to the value displayed A using the linear equation A = m*D+n. Here m represents the gain and n the offset (zero point).

Two options are available for calibration:

a) For the high and low point the required target values ① and the corresponding ADC values ② are entered manually. Then the offset (zero point) and the gain ④ are automatically calculated by clicking on **Calculate** ③.

b) For the high and low point the required target values ① are entered manually. Then the voltages applied to the MSR 145 for the high and low points are measured by clicking on **Measure** ⑤. Clicking now on **Calculate** ③ allows the offset (zero point) and the gain ④ to be calculated.

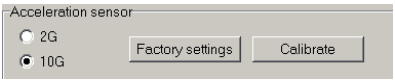


The appearance of the displayed value is set by entering the target unit and format ⑥ (number of decimal places).

- Complete calibration by clicking **OK** ⑦.
- Transfer the new calibration settings to the MSR 145 by clicking on **Write user settings.**

Calibrating the acceleration sensors

Depending upon requirements, the acceleration sensors may either be manually calibrated or the **Factory settings** may be activated from the **User settings** tab. Transfer the new calibration settings to the MSR 145 using **Write user settings**.

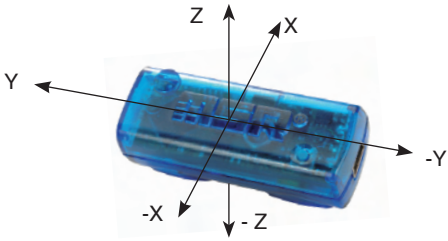


Resetting calibration to factory settings

- Select the **User settings** tab and click on **Factory settings**.
- Transfer the factory settings to the MSR 145 with **Write user settings**.

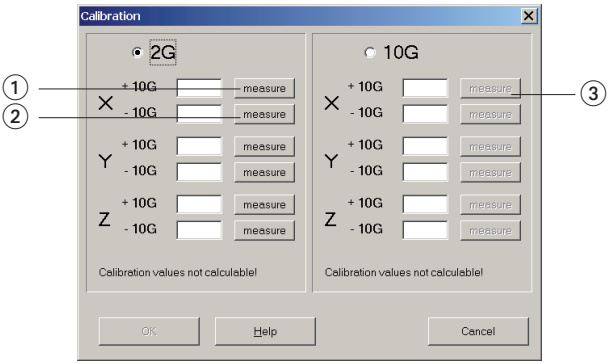
Manual calibration

- Select the **User settings** tab and click **Calibrate**.
  Click on **Help** to display the Position of the axes.



- Select the **2 G measure range**.
- Hold the MSR 145 so that the + X axis is oriented vertically - bottom-to-top.
- Click on **measure** ①.
- Turn the MSR 145 over. Now the -X axis is oriented vertically - bottom-to-top.
- Click on **measure** ②.
- Repeat the procedure for the +Y, -Y, +Z and -Z axes.

- Select the **10 G measure range**.
- Hold the MSR 145 so that the + X axis is oriented vertically - bottom-to-top.
- Click on **measure** ③.
- Repeat the procedure correspondingly for the +X, +Y, -Y, +Z and -Z axes.
- Complete calibration by clicking **OK**.
- Transfer the new calibration to the MSR 145 with **Write user settings**.



Setup

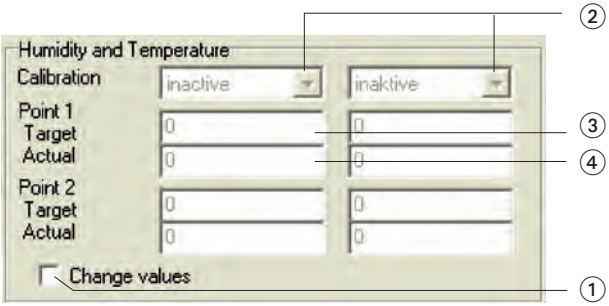
Calibrating the humidity and temperature sensors

For humidity and temperature the two point calibration procedure can be carried out.

Preparation
Before measurement of the actual values is carried out any existing two point calibration should be removed:

1. **Check Change values** ①
2. Deactivate the parameters to be calibrated ② (inactive)
3. Transfer these settings to the MSR 145 via Write user settings. Now the current measurement parameters may be used as actual values.

Carrying out calibration
1. Check **Change values** ①
2. Activate the parameters to be calibrated ②
3. Enter the target ③ and actual values ④ for both points.
4. Transfer these settings to the MSR 145 via **Write user settings**.



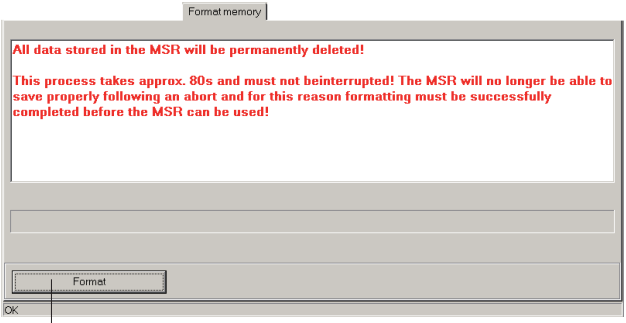
Setup

Formatting the memory

CAUTION	**Formatting** will erase all measurement parameters saved in the MSR 145!

Formatting is used to delete all the measurement parameters saved in the MSR 145.

Formatting the MSR 145 is carried out from the **Format memory** tab.



Deletes all measurement parameters saved in the MSR 145

Reader

With the **Reader** users can selectively transfer data records logged with the MSR 145 to a PC. It does however free measurement records that have already been read out for overwriting.

Transferring data records to a PC

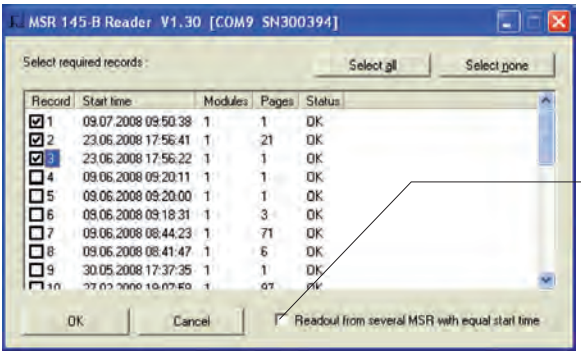
- Complete the preparations (->19).
- Start the **Reader** (Reader symbol)

CAUTION	Once data transfer has started (**Start**) all data records saved on the MSR 145 can be overwritten if required, even if the circular buffer is deactivated in Setup.

- Begin data transfer with **Start**.

The options selected under **Settings** > **Reader** (->21) influence the next steps:

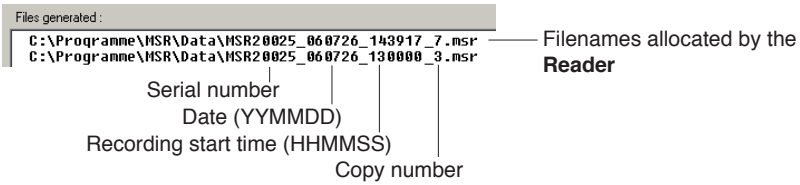
- Under the option **Read selected records** the following data entry dialog box appears:



- Select the data records to be transferred.
- Click **OK.**
- Data records having the same start time are written together to one file.

- With the option **Read selected records and save with "Save dialog as"** under **Settings** > **Reader** (->21) the filenames and locations suggested by **Reader** can be overwritten.

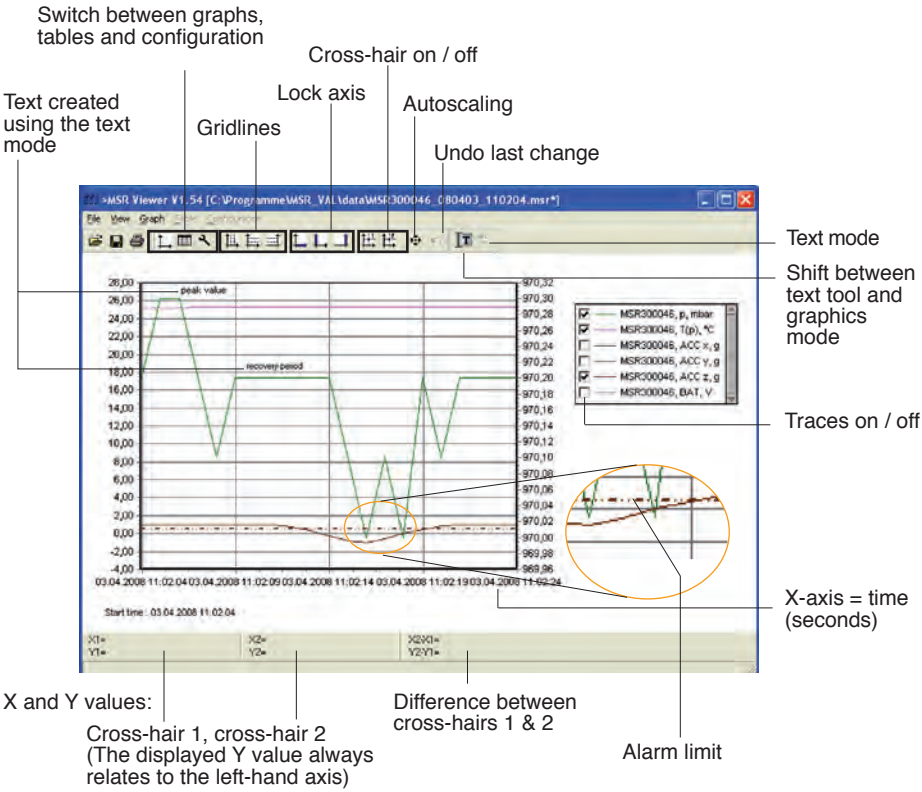
Once the data records have been saved on the PC a list of files created appears.

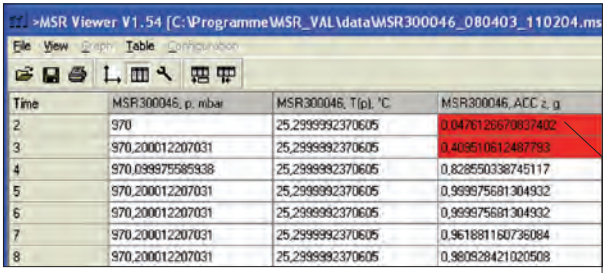


Viewer

Records created in **Reader** or **Online** may be viewed and edited on a PC with the **Viewer**. The measurement parameters may be displayed either in graph or in table form.

- Start the **Viewer** (Viewer symbol).
- Open a record (*.msr) via **File** > **Open**.



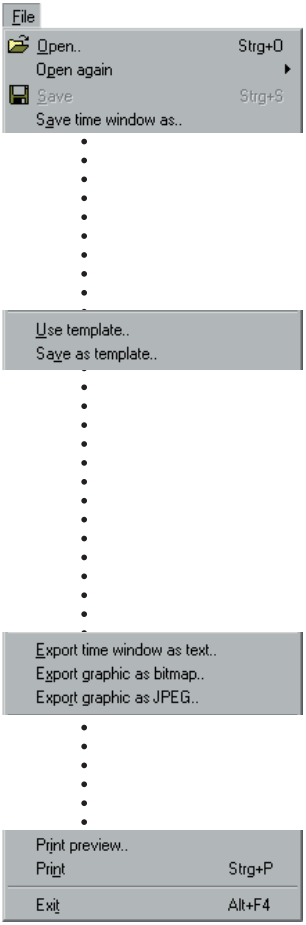


Time	MSR300046, p, mbar	MSR300046, T(p), °C	MSR300046, ACC z, g
2	970	25,2999992370605	0,0476126670837402
3	970,200012207031	25,2999992370605	0,409510612487793
4	970,099975585938	25,2999992370605	0,828550338745117
5	970,200012207031	25,2999992370605	0,999975681304932
6	970,200012207031	25,2999992370605	0,999975681304932
7	970,200012207031	25,2999992370605	0,961881160736084
8	970,200012207031	25,2999992370605	0,980828421020508

Displayed as a table

Alarm limit exceed

Move traces		With right mouse button held down.
Enlarge section		Mark the required section with the left mouse button held down. See also **Graphics** > **Fixed axis**.
Cross-hair	Move axis:	Grab the axis, move with left mouse button.
	Move centre:	Grab the centre, move with left mouse button.



File

The **File** menu is used to **Open** records, to Reopen (**Open again**) the most recently used records and to **Save** the currently open record as displayed.

With **Save time window as** the measurement parameters of the displayed time window are saved. (The measurement parameters of the hidden traces are also saved). For further options see **Cutter** ->44.

Templates help to standardise the displays, enable easy repetition when reselecting the same sensors and the same printing format.

Creating templates: Adjust the display with **Graph** and **Configuration** and save via **File** > **Save as template** (file type: *.mse).

Apply a template to the displayed record:
File > **Use template** then select the required template (*mse).

Export Time window as text exports the measurement parameters of the displayed time window in *.csv format. The measurement parameters of the hidden traces are also exported.

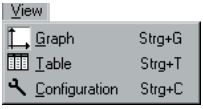
The trace can be exported in **Bitmap** (*. bmp) or as **JPEG** format.

Print preview opens a preview of the trace/graph.

Print opens the print dialog box.

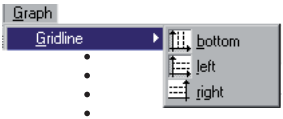
Exit closes the **Viewer**. If changes were made the user is asked whether the changes should be saved.

Note:
The program saves changes as “Template” (*. mse). The template is automatically saved in the record’s directory. Template (*. mse) and record (*. msr) have the same name.
Upon **Open**ing a record the **Viewer** searches for the template associated with that record. Should the template not be located in the same directory as the record then the standard format will be opened.



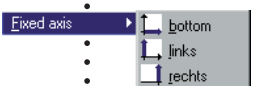
View

The **View** menu allows measurement parameters to be displayed as a **Graph** or **Table**. Alternatively, using **Configuration** the display method can be customised to the user's requirements.



Graph

Gridlines can be shown for each axis (bottom, left, right).

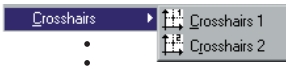


Fixed axis simplifies the amount of detail shown within a time window or range of values.

- Select the required section with the left mouse button held down. The section is displayed enlarged.
- For closer viewing, lock the time window ( ) or range of values to the left or right axis (/). Several axes can be locked.
- With the left mouse button held down, select the required detail. The enlargement is displayed without altering the time segment or range of values of the locked axes.

A further click releases the lock.
Auto scal clears all locked axes.

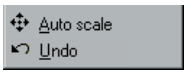
Calculation functions



Using the two **Crosshairs** values can be measured on the X and Y traces. X and Y differences can be evaluated with the second cross-hair. The Y values displayed are always associated with the left axis.

With **Detailed legend** traces can be turned on and off in the list of sensors.

If available: Display of the alarm limits (see ->34).



The complete record is displayed by selecting **Auto scale**.
Auto scale clears all locked axes.

Undo undoes the last enlargement. As long as the **Configuration** dialog is not quitted, **Undo** allows the last changes made to the displayed configuration screen to be undone.

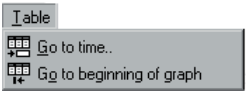


Table (Tabelle)
Go to time allows users to jump straight to the line in the table with the required time.

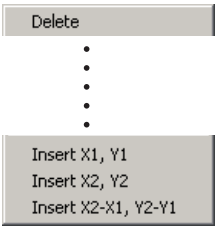
Jump to beginning of graph causes the table to jump to the first measurement values displayed in the graph.

Configuration
As long as the **Configuration** dialog is not quitted, **Undo** allows the last changes made to the configuration screen to be undone.

Text mode
Using the text mode you can insert texts at any place.
By clicking on you can activate and deactivate the text mode.

Insert text:

- Click on . The viewer displays "Text 1" in the upper left corner.
- Drag the text field to the desired place.
- Double click on the text field and enter your required text.



Delete text:

- Click with the right mouse button on the text field and select **Delete**.

Text field with X and Y values:

- place the crosshairs (->37) on your chosen position to adoddopt the X and Y values you would like to use in the text field.
- Create a text field (see above) and click on the right mouse button. Select the desired representation.

Configuration Strg+C

Configuration allows the display method of the measurement parameters to be set with the help of the configuration screens.

General | Curves | Time axis X | left Y axis | right Y axis | Crosshairs

General

Entering title and footer information is achieved via **Configuration** > **General**.

Curves

The associated sensor name, assignment to the left or right axis, the colour, line weight and style can be set for each curve.

Axis > **inactive** allows the graph curve to be shown or hidden as required.

CAUTION

Depiction of the curves using dots (**Configuration** > **Curves** > **Dot**: **Yes**) requires more computing power, possibly leading to problems.

Time axis X
left Y axis
right Y axis

Using **Configuration** >**Time axis X**, the time axis can be annotated, the time segment to be displayed can be set, and the **Increment** for the lettering and ruled lines, together with the **Format** for numbers can be entered.
Automatic axis annotation with an **Increment** of 0 (zero).

Crosshairs

The number **Format** for the displayed X and Y values is entered via **Configuration** > **Crosshairs**. The displayed Y value always relates to the left axis.

Undo the last changes

As long as **Configuration** is not quitted, users can undo the last changes made to the displayed configuration screen with .

Quit **Configuration**

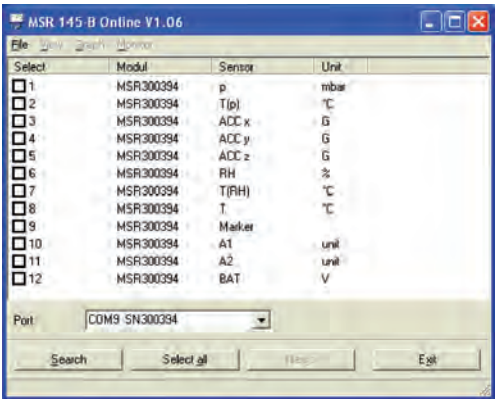
Quit **Configuration** via **Graph** or **Table** . Upon quitting, the **Viewer** saves the configuration.

Online

Online allows users to view the progress of the measurement parameters directly on-screen.

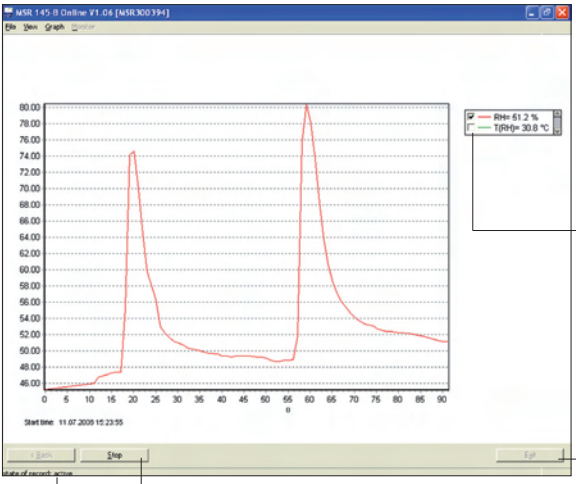
Procedure:

- Complete the preparations ->19.
- Start **Online** (Online symbol).



- Select the sensors that you wish to display.
- Click on **Next**.

- Online displays the measurement parameters graphically and numerically.



Turn trace on and off

Exits **Online**

Stop: Stop display
Continue: Continue

The MSR is currently recording measurement parameters

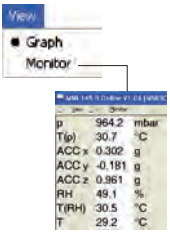
Online

For recurring applications in **Online**, **Templates** assist in selecting the required sensors and adjusting the display to suit.

Create template: Start **Online** and select the required sensors. Select **Next>**. Use
Graph > **Properties**,
Graph > **Grid line**,
Graph > **Legend** and
Graph > **Start time to change the way the curve is displayed**. Via **Back** return to the trace display. Interrupt recording with **Stop**. Save the template via **File** > **Save as template**.

Apply the template to Online: File > **Use template** and select the required template (*mse).

Once recording has finished by clicking on **Stop**, the recorded measurement parameters can be saved via **File** > **Save as**.



In the menu **View** the measurement parameters can be displayed as curves with **Graph** or as numerical values with **Monitor**. The font displayed on the monitor can be selected via the menu **Monitor** > **Font**.

Once recording has finished by clicking on **Stop**, the recorded measurement parameters and traces can be deleted via **Clear**.

The display can be changed via **Properties**, **Gridlines**, **Legend** and **Start time**.

Select the frequency (**Refresh rate**) with which measurement parameters are to be transferred to the PC.

In the **Time window** you can define the time period represented by the time axis.

MSR® Utility programs

CSV

Cutter

Calc

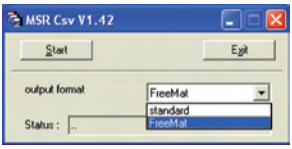
Concat

CSV

The **CSV** utility creates text files (*.csv or * .fmc) from data records (*.msr). Files saved in *.csv format can subsequently be opened and edited in a word processing or spreadsheet application. The *.fmc files can be transferred to FreeMat[1].

Creating a text file

- Start CSV (**MSR Program window** > **Tools** > **Csv**).



- Select the output format (standard *.csv or FreeMat * .fmc)
- Click on **Start** and select the data record from which the text file is to be created. **CSV** creates a text file (*.csv) and saves it in the corresponding directory for that data record. Text file (*.csv) and data record (*.msr) have the same name.

Note on creating *.csv files: If a template (*.mse) exists for the data record in question, **CSV** takes this into account when creating the text file (*.csv).

Example: Opening a CSV text file with Excel

- Start the word-processing or spreadsheet program.
- Open the CSV file via **File** > **Open**.
- Under **File type**, select **Text Files**.

	A	B	C	D	E	F
1	*CREATOR					
2	msr_cutter.e>	[V1.20]				
3	msr2csv.exe	[V1.28]				
4						
5	*MSR					
6	Name	Pilatus				
7	SN	20025				
8	Revision	0				
9						
10	*STARTTIME					
11	31.07.2006	17:14:00				
12						
13	*MODUL					
14	NAME	MSR20025	MSR20025	MSR20025	MSR20025	MSR20025
15	ID	[C102 V1.22]	[C102 V1.22]	[C102 V1.22]	[C102 V1.22]	[C102 V1.22]
16						
17	*TIMEDELAY					
18	s	0.3	0.3	0.3	0.3	0.3
19						
20	*CHANNEL					
21	TIME	T	RH	T(RH)	ACC x	ACC y
22						
23	*UNIT					
24	s	°C	%	°C	g	g
25						
26	*DATA					
27	31.07.2006 1;	28.875	48.8699989	28.3799992	-1.01199996	0.27599999
28	31.07.2006 1;	28.875	48.9300003	28.3899994	-1.01199996	0.27599999
29	31.07.2006 1;	28.875	48.9300003	28.3899994	-1.01199996	0.26800001
30	31.07.2006 1;	28.875	48.9700012	28.4099998	-1.01199996	0.26800001

Excel file with measured data

Data source

MSR 145 name

Serial number

MSR revision number

Record start time:
Date (Day.Month.Year) and time of day (Hr:Min:Sec)

Modules for which measurement parameters were recorded

Module version

Time difference between PC time and MSR 145 time (readout time)

Channel and sensor names

Unit for the displayed value

Measured parameters (data) in chronological order

Time of recording

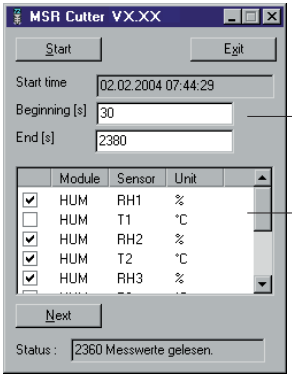
[1] Further details on FreeMat can be found in the section **FreeMat** ->52

Cutter

The **Cutter** utility creates an extract from a data record (*.msr).

Creating an extract from a data record

- Start the **Cutter** utility (**MSR Program window** > **Tool** > **Cutter**).



- Click on **Start** and select the data record from which the extract is to be created.
- Select the time window. **Beginning** / **End**.
- Select the sensors for which the measurement parameters are to be exported to a new data record and click **Next**.
- Enter the name and directory for the new data record. Click on **Save**.

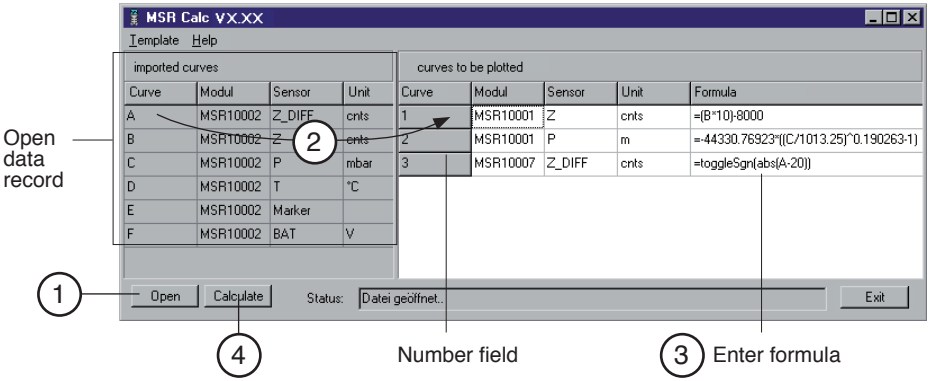
Calc

With **Calc** curves from existing data records can be linked to each other using formulae and saved as a data record (*.msr). The saved data record can be displayed and processed in the form of curves or as a table using the **Viewer**. Templates simplify the processing of recurring tasks.

Note: For making comprehensive calculations the FreeMat math software is available (see ->52).

Computing new curves

- Start **Calc** (**MSR program window** > **Tools** > **Calc**)



(1) **Open data record (data origin)**
Click on **Open** to open the data record for which you want to perform calculations on the curve. It is possible to open multiple data records.

(2) **Create new curves**
From **imported curves** select the curve that you want to use for your calculations and drag it – with the left mouse button pressed – to the right into the field for curves to be plotted. Repeat this procedure until the required number of curves is shown on the right.

(3) **Enter formula**
Enter the formula to be used for the new curve into the **Formula** column. For this, use the capital letters on the left.
Example for a subtraction: A-C

You will find a list of the available functions at the end of this section or under **Help**.

Modify the text for the new curves
The entries in the columns **Module**, **Sensor** and **Unit** can be modified.

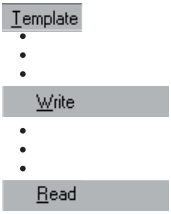
Modify the order of the new curves
With the left mouse button pressed, drag the number field to the required position.

Delete new curves
Click inside the number field of the curve to be deleted and then press the delete key. Via **Template** > **Delete plotted curve**, all new curves can be simultaneously deleted.

4

Calculating and saving the new curves
Click on **Calculate** then enter the name and set the directory for the new data record. Click on **Save**.

Note: The curves are saved as data records (*.mrs). The saved measurement parameters can be displayed and processed as a curve or as a table by the Viewer. Intermediate values are interpolated.
Only curves that overlap timewise can be calculated.



Creating a template for processing recurring tasks
Once you have created the new curves you can save their labels and formulae as a template (*.mse). (**Template** > **Write**).

Creating new curves using templates
Open the required template (*mse) via **Template** > **Read**. This will automatically generate a number of new curves.
Multiple templates may be used to generate new curves. Each template generates a number of new curves.

Operators / brackets

+ - * / ^	Plus, minus, multiply, divide, to the power of
( )	Open brackets, close brackets

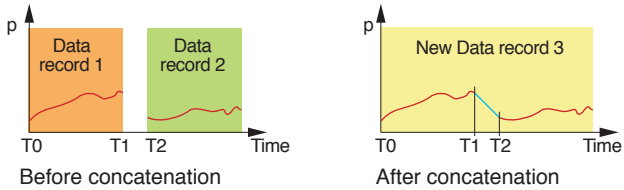
Functions

sqrt(no.)	Square root of the number
ln(no.)	Natural logarithm of the number (base e)
exp(no.)	Raise basis e to the power of the number
abs(no.)	Absolute value of the number
sgn(no.)	no. >0: sgn=1 no. =0: sgn=0 no. <0: sgn=-1
cos(no.)	Cosine of the number
sin(no.)	Sine of the number
tan(no.)	Tangent of the number
ctg(no.)	Cotangent of the number
arcsin(no.)	Arc sine of the number
arccos(no.)	Arc cosine of the number
arctan(no.)	Arc tangent of the number
arcctan(no.)	Arc cotangent of the number
sinh(no.)	Hyperbolic sine of the number
cosh(no.)	Hyperbolic cosine of the number
tangh(no.)	Hyperbolic tangent of the number
ctgh(no.)	Hyperbolic cotangent of the number
toggleSgn(no.)	Changes every second measurement parameter sign (plus/minus)

Further functions on request

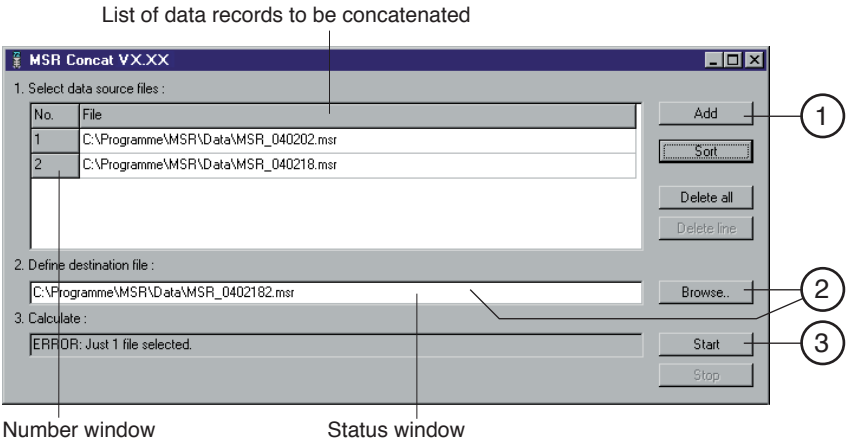
Concat

With **Concat** (concatenate = to link) data records can be linked together and saved as a new data record (*.msr). The newly created data record can be displayed and processed in the form of curves or as a table using the **Viewer**.



Concatenating several data records

Start **Concat** (**MSR program window** > **Tools** > **Concat**)



(1) **Select the data records to be concatenated**
Open the data records that you want to concatenate by clicking **Add**. Note that the list must be in chronological order such that the oldest data record is at the top. Therefore either open the oldest data record first or sort the list afterwards (see below).

Sort the list alphabetically
Use **Sort** to sort the list alphabetically.
Data records that have automatically generated filenames (->33) can be chronologically sorted using **Sort**.

Modify the data record order
With the left mouse button pressed, drag the number field to the required position.

Delete all data records from the list
Use **Delete all** to remove all data records from the list.

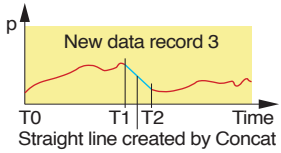
Delete one data record from the list
Select the data record to be deleted and click **Delete line**.

2 **Enter the name and directory for the new data record**
Set the path to the directory using **Browse** and enter the filename, or use the input window to do this.

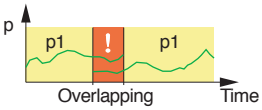
3 **Calculating the new data record**
Start the calculation process with **Start**. Cancel the calculation with **Stop**.

Note:

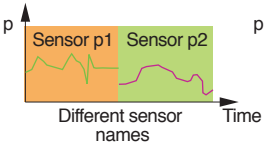
- Concat creates a straight line between the last data record of the first curve (T1) and the first data record of the second curve (T2).

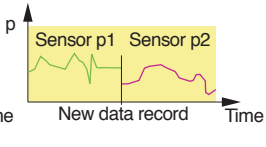


- If, for the data records to be concatenated, there are curves that overlap timewise and these have the same name (same module and sensor names with the same units), the calculation will be aborted and a corresponding message* will appear in the status window.

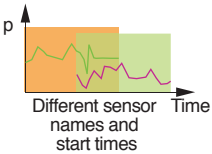


- If the module names, sensor names or units of the curves to be concatenated do not correspond Concat will be unable to join the curves and will create two curves.**

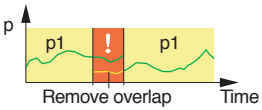




- With **Concat** you can superimpose curves with different module or sensor names.



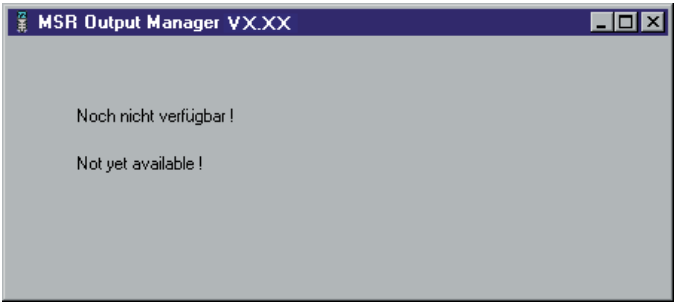
* **Remove overlap**
Use the **Cut** utility to create an excerpt from a data record that does not overlap timewise with the next data record.



** **Modify module names, sensor names and units**
Use the Calc utility to match the module names, sensor names and units for the curves.

Output Manager

The **Output Manager** is currently not available.



Additional software for PCs

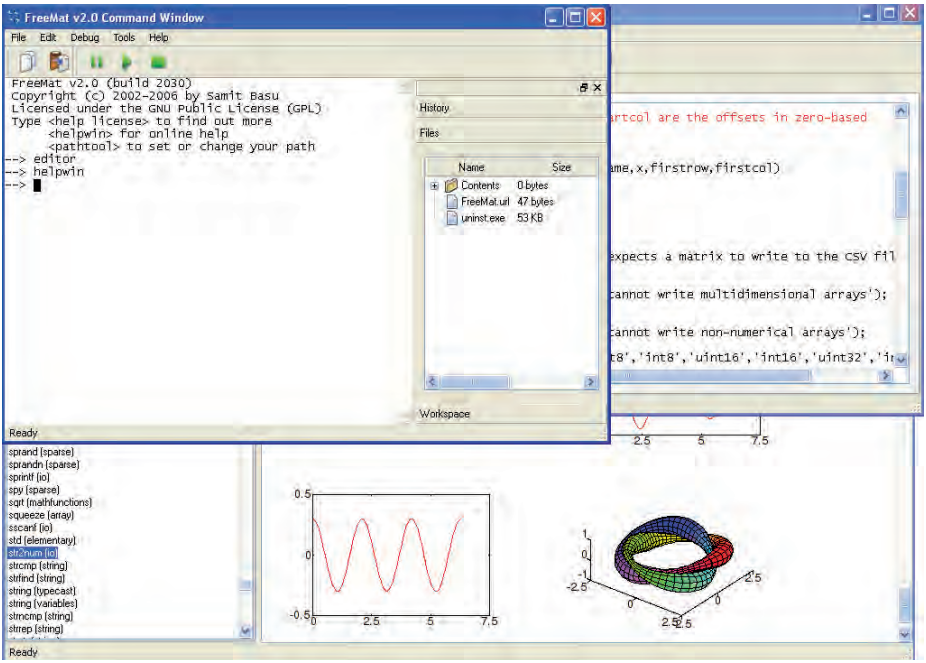
FreeMat

FreeMat

FreeMat is open source math software that can be installed from the MSR CD (ADDITIONAL\FREEMAT). FreeMat can be used to carry out a wide variety of calculations.

How are data records transferred to FreeMat?
The Reader transfers the data recorded with the MSR 145 (records) to the PC. From these data records (*.msr) CSV creates FreeMat files (*.fmc). Using the scripts included these can be opened and edited in FreeMat.

More information on FreeMat can be found at http://freemat.sourceforge.net/index.html.



The following FreeMat scripts can be found on the MSRCD under ADDITIONAL\FREEMAT\MSCRIPTS:

plotmsr.m	Imports *.fmc files into the FreeMat environment and presents the data records graphically.
loadmsr.m	Imports *.fmc files into the FreeMat environment.

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