mikromec®*multisens*

Instruction Manual

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mikromec®*multisens*: Illustration of the User Controls
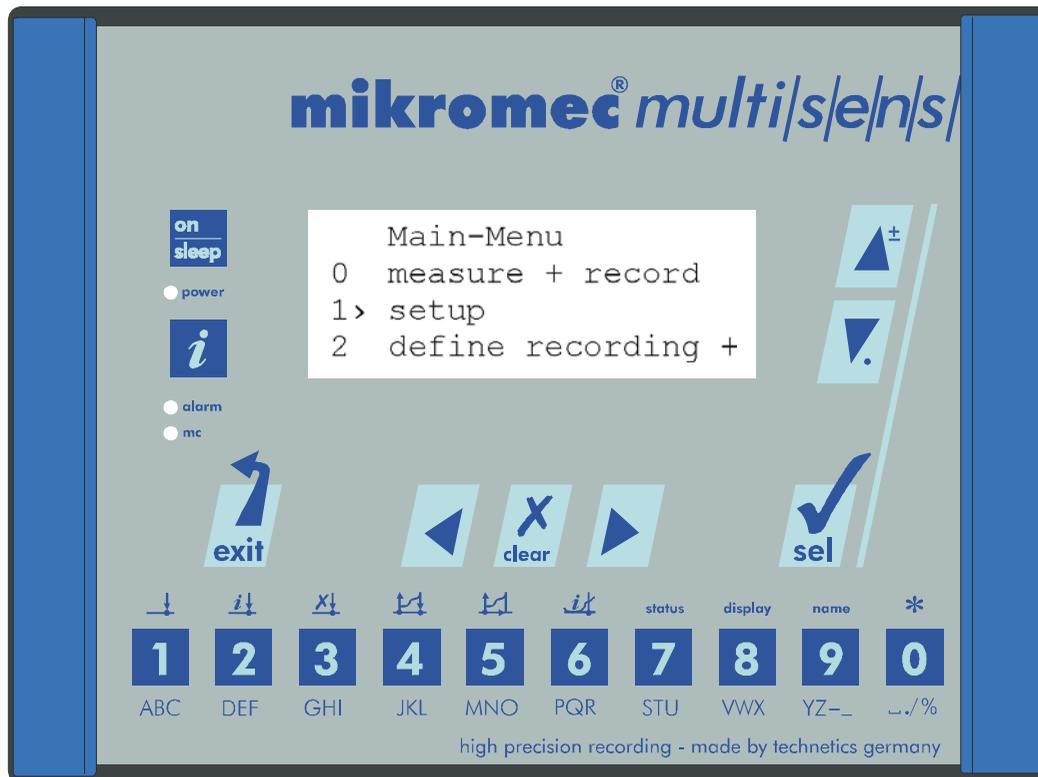
Warranty

The manufacturer's warranty extends for two years after delivery. This warranty applies to devices in the mikromec®*multisens* series. It covers production defects but does not cover inappropriate or negligent use. The device and accessories are not to be opened by the user. Charges for shipping, packaging, insurance and any relevant customs fees are the responsibility of the claimant. If the defects are found not be the fault of *TECHNETICS*, the costs for examination and possible repairs will be billed to the user, according to time.

The various individual manufacturers' warranties are valid for all accessories and merchandise.

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TECHNETICS-Meteo-station:
mikromec®*multisens* 5.0 with an analogue modem

Available 24 hours:
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Safety Tips

The devices are operated with a direct current under 40V and function under the heading of "functional low voltage." The user may not directly apply any higher voltage than 40V DC. To make measurements of higher voltages or with higher potentials, please use the *TECHNETICS* adapters, which provide secure isolation. The installed recharging and power supply components have own individual power ratings. Before putting the device into operation, it is important to ensure that the set voltage on the power unit corresponds to that of the external power supply.

Important: There are accessible conductive components which are connected to the device's ground and which therefore have a conductive connection to the measured signal. Therefore the user has to ensure that the inputs (currents, etc) connected to the datalogger do not pose any physical danger.

In all cases with all instruments, only voltages under 40V may be connected to the mikromec®*multisens*. That also applies to the relay contacts from the alarm relays (ALRS option).

If a mikromec®*multisens* is moved from a cold environment into a warm one, or vice versa, the device must be left turned off long enough for its internal temperature to adjust to the new environment. In extreme cases, not doing this can lead to equipment failure through internal condensation. All open input ports must be covered with protective caps, even if the device is being used in a dry area!

If there are any doubts about the operational safety of the device, it is to be labelled with the appropriate remarks and sent to *TECHNETICS* for repair.
Such cases are for instance:
Penetration of moisture
Water droplet buildup in the display window
Mechanical defects on the device housing due to violent contact or a fall
Loose components in the device (shake-test)
Improper interference, i.e. stuck or jammed leads
These defects and inappropriate interference can cause a fire through the inbuilt battery.
In the case of this type of defect, the battery is to be removed before shipping to prevent short-circuits.
If moisture is found in the device, it is to be shipped to repair as soon as possible to prevent further corrosion damage.
Adjustments and maintenance are only to be performed by professionals authorized by the manufacturer.

CONTENTS

Foreword

TECHNETICS has been producing and marketing dataloggers for a broad range of applications since 1986. The experience we have gained has flowed into the mik-romec®*multisens* series, with the goal to offer measurement evaluation and re-cording systems which can be universally employed. Most sensors require merely to be clicked into place and *TECHNETICS* supports the user with a wide array of available sensors. Don't worry if you have special or unusual sensors. We can find and set them up for you.

We are also available to help in the adjustment of existing sensors. Call us on our hotline. Our Windows PC-software package **„MM-grafix"** supports all data evaluation and graphical reproduction tasks. Our analysis program **„MMforEx-cel"** works straight out of Excel. Data can be easily and directly downloaded into tables. For larger amounts of data and for multiple remote dataloggers, *TECH-NETICS* has developed a Windows-based software package. With the help of automated phone calls this package archives the data automatically into a SQL-Database. This software is called **„MessNetz."** We offer drivers to connect to the datalogger from programs such as DIADEM, DasyLab and FLEXPRO. With all these packages you can quickly produce powerful graphic descriptions of the measured values.

You can count on us . . .

Walter Fischer and Reinhold Maier, Company Managers

mikromec®*multisens* Variants

mikromec®multisens *Standard datalogger: Front View*
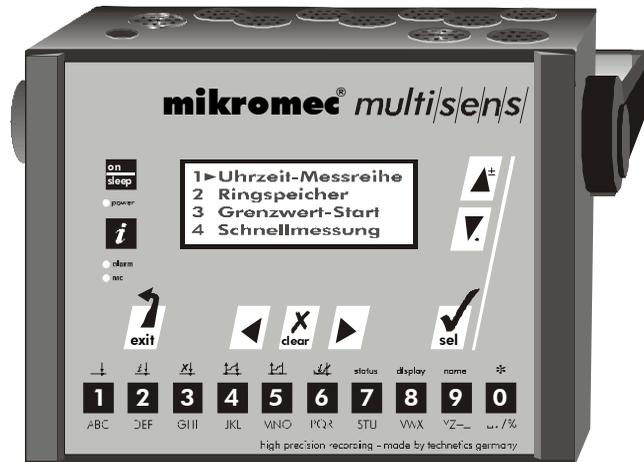
The mikromec®*multisens* display and keyboard are very user-friendly. All readings can be quickly viewed. It is a very flexible and multi-channelled hand-held measuring device for every possible measurement.

mikromec®Logbox *without User Interface: Front View*

The Logbox is intended to be used in situations where no commands need to be entered and where the measurements don't need to be read locally. The Logbox operates from an internal battery and the operation and readings are controlled remotely. This is usually achieved with help of a telephone or modem.

mikromec®multisens *multi*Logger *mL11: Front View*

The mL11 datalogger from the mikromec®*multisens* series can only be operated using exchangeable batteries. That means that it can't be operated without an external power supply in the form of the battery or the VNLB12 recharger. This special model is intended to be used in outlying stations that are either supplied from time to time with exchangeable batteriesor that are connected to a solar power supply.
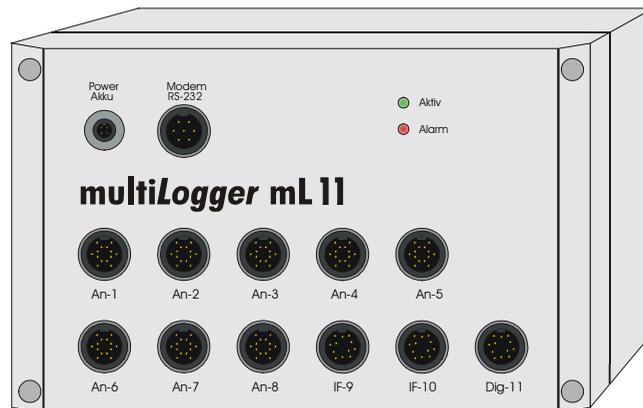
mikromec®rackLog *for Installation in 19" Systems*

This model is designed to be mounted in racks and is not water-proof.
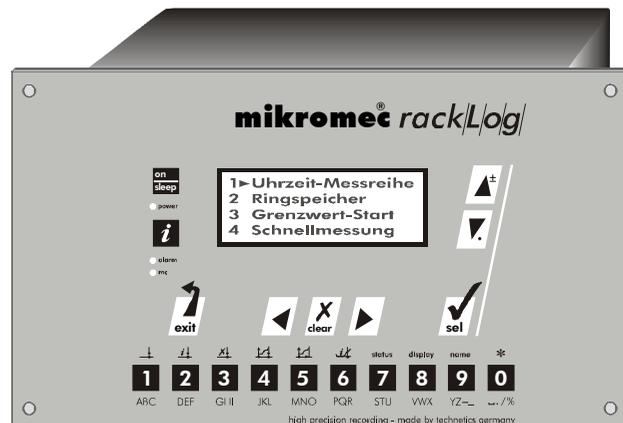
Introduction

What is the Datalogger Designed to do?

A datalogger is a device which collects measurements over a certain period of time. Depending on the model, the mikromec®*multisens* datalogger can simultaneously record on up to 19 different channels. Typically, the mikromec®*multisens* registers data in 1-second intervals. The device can store up to either 128,000 or 512,000 values. The mikromec® dataloggers are especially suited to making measurements independent from a network over longer timeframes – everything from minutes to months. The datalogger can register and save the current measurements from multiple channels. Either afterwards or simultaneously if required, the datalogger can reproduce the results on a PC or even send them straight onto a printer. Using these features and aids, it is possible to efficiently supervise and optimize all processes.

The mikromec®*logger* and mikromec®*rackLog* versions can be operated either through a control panel or through a PC. The *Logbox* and multi*Logger* versions do not have a display or control panel and are operated through a serial interface.

The devices are offered with between 4 and 19 channels. Each input-socket is assigned to its own channel.

How the mikromec®*multisens works:*

The modes of operation are as follows:
- Input-mode: the user chooses, for instance, a sensor.
- Measure and Record mode: the measured values are continually displayed.
- Fast measurement mode: all other activities are limited in order to assist the „fast measurement."
- Data-output: already registered data is transferred to a PC. During this time, no new measurements are made.

The multisens-concept

In order to allow the user to connect all different sorts of sensors to the system, the loggers are fitted with analogue input-sockets („An-ports") with 14 pins. Depending on the model chosen, the device comes equipped with 2, 3, 8 or 16 of these analogue channels. The mikromec®*multisens* provides a high degree of system accuracy and a high resolution.
There is a special type of port („IF") for impulses, frequencies and turbines. These ports have 12 pins.
The third type of standard port is intended as a digital port and each datalogger has one of these. It is labelled as „Dig" and also has 12 pins.
These three port-types (An, IF and Dig) are laid out on the datalogger so that the user can attach and supply the maximum number of sensors directly and without the need of special adaptors. For that reason it is called „*multisens.*" The ports also allow „exotic" sensors to be connected and they can supply power to modules

connected in series. The ports can also supply a voltage to support sensors or external signal transformer modules.

TECHNETICS supplies ready-to-fit, mass-produced sensors. The sensors have conventional plugs and are available directly from your preferred electronics dealer. This instruction booklet explains the different characteristics of the input-ports so that the user can connect sensors to the mikromec®*multisens* themselves.

Data Analysis

The datalogger can be read and configured over a serial port. The Windows-based *TECHNETICS* analysis software, „MM-grafix," performs this function. The *TECHNETICS* software „MessNetz" is able to perform continual and unbroken archiving of the results in a database. The EXCEL user can also have the results displayed directly in an EXCEL-spreadsheet table, where the results can be easily processed.

The serial connection commands are fully documented which allows the user to program in their own solutions. The available drivers for DIADEM, DasyLab and FLEXPRO allow the user to quickly and easily produce their own solutions. Further drivers for common analysis-packages are in production.

Improvements on the Previous Models 3.9 to 4.1

The versions 5.0 and up of the tried and tested mikromec®*loggers* have a number of new functions:

The user controls have been newly designed: The new menu-based user interface makes using the device considerably easier. For instance, the user no longer has to scroll through the full list of channels when they just want to select another one. The user can now keep track of recordings in an instant. The „running menu" has been replaced by a „main menu."

The display is now larger: it now presents 4 lines, each with 20 characters.

The sensor sockets have been designed more flexibly. *TECHNETICS* supplies adaptors for datalogger sensors which were produced up to revision 4.1:

Ud-adaptors for RTD-100, pressure measurement bridges

Us/I-adaptors for 20mA, combination probes for temperature and humidity

IF-adaptors for impulse-pickups

Each socket is now specifically assigned to a channel. There is no longer any overlapping between Us/I- and Ud-sockets or counter-channels. The sockets can no longer be mistaken for others.

The possible number of channels is now higher: there are now up to 16 analogue channels plus counter and status-registration-ports. The advantage is that an analogue channel is not forfeited when a counter channel is being used.

The datalogger's temperature and batteryvoltage can now be noted without losing any other channels and no longer block any input-sockets. These sorts of „internal" channels have no input sockets.

The registration of status-signals (digital ports) has been newly added. This includes a new type of recording: „Record all values on status change."

The serial interface is now, as a rule, electrically isolated so that the measurements are not interfered with by crossed currents when simultaneously operating with a PC.
All models now offer RTD100readings with a resolution of 1/100°C.

The Windows-software MM-grafix V7.0 (and higher) not only handles the current device versions from mikromec 5.0 but also supports the previous models versions 3.9 to 4.1c. The Windows-based programs MessNetz and MMforExcel only support the mikromec products from V5.0. Since the programs are 32-bit, the software is only suitable for Windows 95/98/NT and does not operate on Windows 3.11 or previous versions.

Setting-up the Datalogger Models (to 4.1c and *multisens* 5.0 and higher)

MM-grafix works with dataloggers from the "mikromec®*logger*" series (versions 3.9 to 4.1c) and also with the current mikromec®*multisens* model (from version 5.0).
Before a function that involves communication with the datalogger can be performed, the datalogger model must be set-up. You can do this either by clicking on the datalogger symbol in the main menu or by choosing the menu option: „Setup" – „System Setup" – „mikromec."

mikromec®*multisens* Dataloggers with the Software Package MM-grafix V5.0 and higher

The mikromec®*multisens* dataloggers can perform all the functions of their mikromec®*logger* predecessors. The new dataloggers offer both brand new functions and improvements to older functions. These improvements are reflected in the analysis software MM-grafix, version 5.0 and higher.
The most important of these functions are:
- Use of the command languageto communicate (Bus-commands)
- Clear operation of the dataloggers in the „remote mode " with the reproduction of the datalogger as a „virtual instrument" on the PC-display.
- Up to 24 channels on the datalogger– up to 30 when using MM-grafix.
- Can make up to 512,000 readings per recording.
- Processing of status-inputs
- Measurements triggered by changes in the status-inputs.

mikromec®*multisens Model Updates, V5.0 and higher*

Over time, new functions are incorporated into the mikromec®*multisens* datalogger's firmware. The firmware is the software inside the datalogger and can be updated by replacing the EPROM. You can determine which firmware version your device has by using the *iq3-command over a serial interface. You could receive a response such as: „Version 5.0.0033." In the future, it is planned that the version number will be displayed during the boot sequence so that the user will no longer have to use the *iq3-command.

The following list indicates which functions were improved with each update:

Version	Description
5.0.0015	All functions of the old model 4.1c. Status measurement from 20 digital ports. Alarm outputs realized.
5.0.0020	Individual measurements can now be performed using numerical markings. Variable warm-up time for slower sensors. Dutch language now available.
5.0.0025	Longer recordings (up to 380 days) and longer intervals (up to daily). Expansion to support 4 languages: German, French, English and Dutch. Modem-callback in case of alarm, also channel-dependent.
5.0.0031	Offsetadjustment for sensors which were previously not variable, i.e. for RTD100temperature sensors. Sensors can now also be assigned individual names, for example 125.4° TIN 76.1 ° TOU for a incoming and outgoing temperature.
5.0.0033	Different locking-functions. On top of the keyboard lock there are now extended barring possibilities so that fixed stations cannot be inadvertently reconfigured. Croatian language now optional.
5.0.0035	New alarm-callback method. A callback is now triggered every time an alarm occurs, not just sent through all channels. Big-offset introduced: displayed values >10000 now possible on customer- or application-specific scales.
5.0.0039	The method for recording starting limits is completely updated: only the final interesting result is recorded.
5.0.0044	Special recording method: pressure drop test now with automatic protocol printout. High-resolution scales for 20-bar probes. High-resolution differential scale. Scale-range widened: greater offsets now possible: i.e. 65000 to 75000 display values. Slovene languagenow optional. Newstart with button "5." Printout of the current values with the button "0."
Planned!	Time-switching relays in the logger: Modem wakes up for 1 hour every day. Expansion of the mcl-command: block-oriented, line-based selection for self-adjusting, error-tolerant transfer over S232. Back-readings of all settings, including those of the PD-command.

Starting Up – First Steps

The mikromec®*multisens* is connected to the power supply with the battery charger component VNLB12. This component is connected to the socket labelled "Power Supply VNLB12" or "Power/Battery."
Use the on/sleep-key to turn the device on.
If the datalogger has at some stage already been informed what sort of sensors are connected to it (from now on referred to as "preselection"), the datalogger displays the current reading directly on the LC-display. If this is not the case, the datalogger reverts to the main menu. Use the SEL (select) key to switch back and forth between the main menu and the currently measured values. If no scales or sensors have been selected and you attempt to directly view the measured values with "`0 read and save`" instead of a measurement, you will receive the error message "`no sensors selected`."

The procedure is then as follows:
- Firstly, perform the sensor selection to inform the datalogger what each channel should measure.
- Then the values will be displayed.
- Then, if desired, enter a so-called "recording" in order to record the values over a predetermined time.

The sequence in which the channels are displayed is as follows:

```
Chan 1  Chan 2
Chan 3  Chan 4
Chan 5  Chan 6
Chan 7  Chan 8
```

First Steps

For the time being the power supply for the logger will come from the supplied battery charger (VNLB12). The mains voltage indicated on the battery charger must correspond to that of the mains power supply. This component then supplies power to the datalogger and at the same time charges the internal battery.
When this occurs, the yellow light-diode on the front-plate will light up.
The datalogger should be left connected to the power supply for 2 days before its first application away from the mains power supply.
Immediately after plugging in the battery charger, the device can be turned on with the on/sleep-key. Either the currently measured value or the main menu will appear.

The First Measurement

The first practical measurement will be a temperature reading using an RTD100 on channel 2.

In order to do this, attach a resistance type detector RTD100 thermal probe to the second channel and the temperature will appear in the display. The RTD100 probes require a 14-contact plug which is inserted into the second channel (An-2). You now have to inform the datalogger that the configuration has changed.

To do this, press EXIT and you will find yourself in the main menu. If nothing is entered for five minutes, the datalogger will automatically revert to the measurement display.

```
     Main-Menu
0  measure+record
1▶ setup
2  define recording +
```

Use the up and down arrows to the right of the display to select a menu option and then press SEL (select) to activate it. The list of menu options is usually longer than 4 lines so use the down arrow to scroll down to the further options. The small plus sign in the bottom right-hand corner indicates that there are further options.
We will select "1▶ setup" and press SEL.

```
      setup
1▶ sensor selection
2  scale sensors
3  clock          +
```

Since we want to select an RTD100 sensor for channel 2, press SEL in the setup menu on the option "select sensors."

```
   Sensor selection
1▶ chan1      on
2  chan2      on
3  chan3      on  +
```

Here, each channel is assigned to an input port and told how to interpret the signals. It is not always enough just to say what kind of sensor has been connected. It also has to be made clear in what measuring range (i.e. –30oC to +70°C) and in what resolution (i.e. 0.01°C) the signals are to be measured. All of these entries are described as being either sensors or sensor-scales.

Using the down arrow, move down to "2 chan2" and press SEL.

```
   Select chan 2:
1  on (U_1.25V_)
2 ■off
3  change
```

Under this first menu option you can see the last selected sensor or sensor-scale that was connected to channel 2. Therefore, there could be something else in brackets besides "U_1.25V_" – or there could even be nothing there at all.

Instead of the 1.25V scale, we want to select an RTD100so go down to option 3 and select "change."

```
Sensor set ch1
1▶voltage
2 current
3 modules        +
```

Here you can select what is to be measured on channel 2. Because this is a very long list (approx. 125 entries) it is divided into groups. The RTD100 belongs to the "temp.resistor" group.
You can view the different group names by using the arrow keys.
We will choose "7 temp.resistance."

```
31 R_2kOhm
32 Rp25kOh
33 TPt100<
34 Tpt100>       +
```

We will choose "RTD100<." It is the -30oC to +69.99oC scale for RTD100 probes.
Now the datalogger shows the changed sensor selection. If you want to change other channels, you can do that here as well.

```
   Select sensors
1  chan1     on
2▶ chan2   TPt100<
3  chan3     on  +
```

The EXIT key takes you back one level into the setup menu and pressing it a second time takes you back to the main menu.
The third time you press EXIT (or "0 measure and record") you will be taken to the measurement display.
The display looks like the following:

```
              22.56°C_


           10:37:44
```

Note:
If at least one channel is not being used at this time, that is to say deselected, the time will be shown in the position of a measurement. If multiple channels are free, the time will be displayed in the position of the highest channel number.

If you are in the measurement display, you can use the special options that are printed above the number keys.
Numbers 1-6 have symbols which relate to saving measurements.
Number 7 gives the momentary status of the recording.

The up and down arrows ▲▼ scroll through the available channels.
Number 9, or "name," gives the channel number and the name of the currently selected sensor or scale.

After pressing key 9 ("name") you will get the following result:

```
01          TPt100<
03
05
07
```

In this example, there is an RTD100 connected to channel 2. All other channels are unoccupied.

First Measurement Readings

The datalogger only records values when it is informed what sort of data it should record.
Enter this information through "Main Menu," then "define recording."

```
   Main Menu
0  measure+record
1  setup
2▶ define recording+
```

```
   define recording
1▶ define
2  restart
3  abort
```

```
P1 definition
free: 130431
1▶time starts reco.
2 loop memory reco.+
3 limit starts reco.
4 fast recording
5 limit st. Fast rec
6 sgl. meas status
```

"r1" means recording 1 (you can enter up to 9 different recordings).
"free" gives the amount of remaining memory which you can use to store measurements.

The simplest recording is time recording. Measurements are made over a certain timeframe, at a defined interval and the results are then saved.

Task:
Here we are going to record the temperature on channel 2 (RTD100) once per second for 4 hours.

After selecting "time starts record," the following information will be displayed:

```
r1 values.:  00002
not used: 130431
1▶ch:  2_____
2 Start 11:32 24.10+
```

Where:
"r1 values" always shows the amount of necessary measurement values for the selected recording. If you change the task, the required memory will change accordingly.
"ch" stands for the channels and is a compact form of the list of displayed channels. If you choose this option (with SEL), the entire list will be displayed.

As start time we will enter the current time. The time and then the date are displayed.

The plus-sign in the bottom-right indicates that there are more lines of information that do not fit on the display. Use the down arrow ▼ to scroll down and expose these lines.

```
2 Start 11:32 24.10.
3 Durat 0d  0h  1m
4▶Interval:    1min
5 kind: actual values
```

The duration of the recording is indicated in the form of days (d), hours (h) and minutes (m).

The interval can be given in either minutes or seconds and are given in two-digit form. There are seven possible second-intervals offered: 1, 2, 3, 6, 10, 15 and 30 sec.

The minute value can be given in two-digit form from 00 to 99 minutes.

The recording we have prepared requires roughly the following:
4 hours * 3600 seconds * 1 channel = 14400 measured values.

You can now check (and also adjust) what you have entered under "r1." You can use the up and down arrows to verify the entries.

```
r1 values.: 14460
not used: 130431
1▶ch: _2_____
2 Start 11:32 24.10+
```

In the top row you can see the amount of reserved memory space for the planned readings. It will actually be 60 seconds more, because the first and last minutes are recorded in their entirety.

Use EXIT to leave this window and last of all, use SEL to confirm that the entered information should actually be activated.

The blinking explanation mark (!) in the top-left corner (or in the time display) indicates that (at least) one current recording is in progress. This explanation mark will continue to blink for as long as the recording is in progress.

To produce a nice temperature curve, you can warm the RTD100 probe up in your hands or put it on the heater or in the refrigerator.

First Evaluation

You do not have to wait until the recording is finished to look at the resulting curve. In the main menu under data output, recording, define, display, r1, you can view the recording and the measured results one after the other. No new values will be recorded as long as the user adjusts the setup or lists out values outside of the measurement operation.

If you have the *TECHNETICS* analysis software MM-grafix version 5.0 or higher, you can now start the program and have the temperature curve displayed on a PC.

To do this, connect the "data transfer cable DKR9/25" to the "RS232/Modem" socket and to a free serial port on the PC. In the datalogger, use the options "setup" "RS232" "9600 Baud" to set up the serial interface to the standard transfer speed.

Then start MM-grafix.

Under "Control Panel"/ "COM-port" enter the relevant port number. This is usually 1 or 2 for COM1 or COM2. Then set the baud-rate to 9600 to match the datalogger.

Under "Control Panel" / "mikromec" the "mikromec 5.0" must be entered as the current model and then the procedure can begin. The program MM-grafix will then utilize all of these settings.

Under "Remote Control," the datalogger is reproduced one-to-one as a device on the monitor. If you click your way back to the main menu, you receive the option "Recording from logger." Here there should be at least one defined reading available that you can click on and transfer. The datalogger will then begin to import the data and will display it immediately in a list. With the option "as graph," the results will be displayed as a curve. All further functions are described in the MM-grafix user manual.

Operation

How to operate the mikromec®multisens: General Instructions

Introduction

The mikromec®*multisens* systems can be used in a multitude of different situations. The user can modify measurement tasks and change the channel-setup and recording tasks directly with the keyboard, with results shown on an easy-to-read display. If you can reach the device with a modem, on the other hand, the configuration and communication tasks can be performed using the purpose-built PC-software. And if the user wishes to use the mikromec®*multisens* in conjunction with their own software programs, the operation through the serial interface is possible with special commands. To be able to cope with these many and varied situations, the mikromec®*multisens* system is fitted out with up to three different communication interfaces:

1. Keyboard and display

2. Analysis and communication software: "MM-grafix," "MMforExcel" or "Mess-Netz"

3. Command language "mcl"

Configuration and Operation with the Keyboard and Display

All settings and functions can be entered into the mikromec®*multisens* device directly through the keyboard and display. In order to make it easier to learn the ropes of the mikromec®-system and to provide optimum support to the user, a new operator-keyboard, menu options and a new menu structure have all been developed for the mikromec®*multisens* system. The goal has been to allow the user to navigate easily through a concise series clearly understandable menu keys. This allows the menus to be clearly arranged and allows to the user to assign measurement parameters simply, safely and quickly. In order to do this, it is important to be able to enter numbers and letters – a task performed by the additional keys. On top of that, when in the measurement mode, the user must be able to directly call up all the important functions.

To be able to fulfil these demands, a new concept of operation has been developed with a special format, which through form, shape, colour and order makes the operation of the device simple and easy. Navigation through the menu and entry screens is achieved with specialized dialogue elements, which use a 4-line display to guide the user through selection and entry tasks.

The user surface consists of the following:
- Keyboard and key-arrangement
- Dialogue elements within the display
- Menu system

The way in which the display and keyboard can be used to operate the mikro-mec®*multisens* will now be examined. The sections "Configuration with MM-confix" and "Operation with MM-grafix" will then cover the operational possibilities with a PC.

The Menu-control Keys

4 keys are used to navigate through the menu. The purpose of these keys is easily identifiable by the symbols, markings, form and positions.
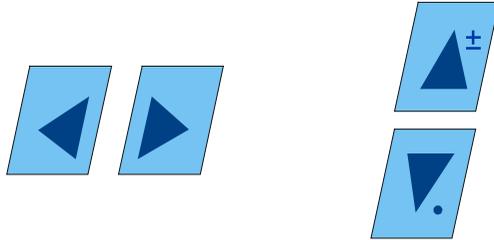
The cursor keys are used to position the cursor within the menus and to move the cursor while making selections or setting parameters. These keys are also used while entering numbers to change signs and move the decimal point.

The "select" key is used to select menu options and to adopt parameters.

The "exit" key is used to "go up a level" in menus, to drop functions and to leave parameter screens. Often, pressing the "exit" button will return the previous values to the menu and pressing it again will leave the setup screen with the original settings still in place.

The Number and Letter Keys with Symbols

↓	i↓	X↓	⊔	⊔	i↗	status	display	name	*
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0**
ABC	DEF	GHI	JKL	MNO	PQR	STU	VWX	YZ–_	⊔./%

The numbers 1 to 9 can be directly entered; letters are entered by pressing the appropriate key the relevant number of times (see the section entitled "Text Entry Screen"). Special symbols can be found on the last two number keys. While in the measurement mode, these symbols and shortcuts can be used to call up particular functions (see the section entitled "Direct Functions" page 70).

The Edit Keys

The entry of numbers and letters is also supported by the edit keys.
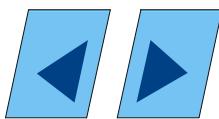
The positioning keys allow the user to position the cursor while entering numbers and letters.

The "clear" key allows the user to delete the contents of an entry field – i.e. to change a suggested entry or an incorrect one.

The Info Key

The info key informs the user about the current options (in the relevant condition) and explains any possible entries of functions. This function is initially limited and will be expanded in future models.

The Continuous Operation and Sleep Key

This key is used to turn the mikromec®multisens on and off and to put the machine in the sleep mode. If a recording has been entered, at the appropriate time the device will "wake up" automatically.

The Dialogue-Elements for Menu-Navigation and Entries

Introduction

The calling-up of functions, the setup of parameters and the entry of parameters, numbers and text are all achieved through the mikromec®*multisens* menu. Navigation through the menus and entry options is made possible by a 4-line display, which boasts a small number of clear elements. The user can tell which dialogue element is open through the shape and form of the headers and cursor, etc. A dialogue element can cover numerous display lines. The relevant keys function in their respective elements.

The dialogue elements are as follows:

- Measured value display screen: displays the currently measured value and the time (if there are free channels).

- Branching screen: used for menu navigation and function selection

- Selection screen: selects exactly one of the available setup alternatives.

- Multiple settings screen: must be selected for a function from multiple lists of the same kind.

- Multiple parameter screen: setup or entry of multiple different and relevant parameters for a function.

- Number entry screen: used to enter numerical values

- Text entry screen: used to enter text or information

Measured Value Display Screen

When the mikromec®*multisens* is turned on or if it is left alone for a certain period of time (>5 mins), it reverts to the measured value display screen and displays the current measured values. In order to be able to display the maximum number of values, no menu management or titles are displayed. You can access the main menu by pressing either "exit" or "select." Any measurements and recordings will then be interrupted.

```
36.48C_      48.6%rF
 122.7bar

  12.5 V      16:14:11
```
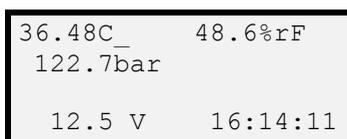
There is a symbol indicated above each number key. The symbol stands for a direct function, and the relevant direct function is called up when you press the appropriate key (see the chapter: "Direct Functions while Displaying Values"). If you now press the "info" key, you will be presented with information about the possible direct functions.

The direct function key "name" (number 9) displays the value that corresponds to the relevant sensor name.

If the device is fitted with more that 8 measuring channels, you can use the arrow keys ▼▲ (located next to the display) to scroll to the remaining channels. If you hold down the cursor key, the channel names will be displayed. If no channels have been selected, holding down the cursor key will just display the channel numbers. When you let go, you will then see the time.

Notes:
- If the last channel has not been selected, the time will be displayed in the place of a reading.
- If a >>> appears instead of a reading, either the reading has exceeded the permissible range or no sensor is connected.
- A blinking "F" in the top-left corner indicates that an error message has been recorded. Under the menu option "data output" / "error messages" you can view the error message and you can delete it under "clear" / "error messages."
- An "!" (exclamation mark) indicates that readings are being saved. If the exclamation mark turns into an "M," the mean value will be calculated and recorded.
- A blinking "S" indicates that the status inputs are being monitored and if a change occurs, a series of readings will be registered as a single measurement.

Branching Screen

The branching screen allows the user to choose between the different functions and menu options that the device offers. This screen is used to navigate through the menus. Using this option, you can navigate from the main menu to all of the mikromec®*multisens'* menu options (see the chapter: "Menu Overview Pictures"). All other screen types are used to set up or enter parameters or text.

Elements of the branching screen:
- Title: indicates the selections in the menu-surface
- Branching lines: indicate possibilities
- Cursor: acts as pointer to the selected option
- Line number: acts as an overview and allows you to jump straight to certain options
- Number: shows the entered line-number

```
Title         Number
1  Possibility 1
2▶ Possibility 2
3  Possibility 3  +
4  Possibility 4
5  Possibility 5
6  Possibility 6
```

Operation within the branching screen:

Position the cursor:
Use the arrow keys ▼▲ to position the cursor over the desired menu option. The options are numbered to make it easier to orientate yourself in a very long branching screen. A plus-sign (+) to the right of the last line indicates that there are further lines. Instead of using the cursor, you can also press the corresponding number-key and then finally "select." The entered number is shown on the top-right of the screen. This number can then be deleted with the "clear" key.

Select a function:
Using the "select" key calls up the relevant function and takes you one level "lower" into the menu.

Leave the branching screen:
Use the "exit" key to go "up" one level in the menu. If you keep pressing the "exit" key, you will find yourself back in the main menu.

Branching screen examples:
Main Menu, Select Reading Type, Choose Sensor Group.

Selection Screen

The selection screen allows you to select one of the previously entered settings or parameters.

```
Parameter selec.
1 □setting 1
2  setting 2
3 ■setting 3
```

Elements of the selection screen:
- Title: indicates the type of selection
- Selection lines: name the possibilities
- Selection cursor ■ acts as a pointer to the desired line
- The symbol □ shows the already entered settings. This will by definition change when a new setting is entered.

Operating the selection screen

    Cursor element:
    The selection cursor ■ indicates the desired line.

    Choose settings:
    Pressing the "select" key chooses the option highlighted with the ■ cursor and you are then taken one menu level higher.

    Leaving the selection screen with "exit"
    Pressing the "exit" key makes the ■ cursor jump back to the original setting (which is indicated with the □ symbol) and pressing "exit" once again will leave the selection screen and the original setting will be maintained.

Multiple Settings Screen

If multiple similar parameters must be activated or deactivated for a setting, the mikromec®*multisens* offers a special selection process:

```
Multiple parameters
1◆ parameter list 1
2  parameter list 2
3  parameter list 3
+
```

Elements of the multiple settings screen:
- Title: indicates the settings
- Selection lines: name the parameters
- Cursor ◆ used to indicate changes

Operating the multiple settings screen:

    Cursor element:
    The selection cursor ◆ is used to mark the desired line.

    Change settings:
    Pressing the "select" key will change the settings to the selected option.

    Leaving the multiple selection screen:
    Pressing the "exit" key will leave the screen and retain the original settings.

    Example of the multiple selection screen:
    Which channel to record

The Multiple Parameters Screen

Many of the mikromec®*multisens'* settings and functions (i.e. channel reservation or the execution of time recording) are performed using multiple parameters. An overview of these parameters is displayed in the "multiple parameter screen," which shows the parameter names and current settings. In order to make an entry, select the relevant parameter with the cursor. You are then taken into the entry screen with the relevant query for this parameter (i.e. numerical or text entries) and after the entry has been made, you are taken back to the multiple parameter screen where the new settings are displayed. In this way, you can enter all of the new settings one after the other while maintaining an overview of all of the parameters. After pressing the "exit" key, you leave the multiple parameter screen and all current settings are saved.

```
Function name  Number
1  Parameter1:current
2▶ Parameter2:current
3  Parameter3:current
```

Elements of the multiple parameter screen:
- Title: names the function which the parameter belongs to
- Selection lines: name the possibilities
- Cursor ▶ acts as a pointer to the desired line

Operating the multiple parameter screen:

Marking parameters with the cursor:
Use the up and down arrow keys ▼▲ to mark out the parameters where an entry or a change should be made. This selection can also be made by entering the number and then pressing the "select" key.

Input:
When the desired parameter has been marked with the cursor ▶, pressing the "select" key will take you into the parameter entry screen. After entering the parameter, you are taken back into the multiple parameter screen.

Leaving the multiple parameter screen:
Pressing "exit" leaves the multiple parameter screen and saves the current settings.

Examples for the multiple parameter screen:
- Channel settings
- Sensor definitions
- Parameters for the type of readings

Number Entry Screen

A comfortable and secure number entry is important for simple and quick operation. The number and editing keys along with the keys for changing the decimal point and ± are all easily accessible on the front panel.

Numbers are entered in the number entry screen.

```
Parameter descript.

    [value ▮ ]
```

Elements of the number entry screen:
• Title: describes the parameter
• Entry field: [. . .]
• Blinking cursor ▮ indicates the current entry position

Operating the number entry screen:

Number entry and correction:
- Number entry in the insert-mode: the desired number is simply entered. The last number to be entered is shifted to the left. By pressing the decimal point "▼." you are taken to the right of the decimal point – that is to say to the "tenths." When you initially enter the number-entry screen, you are always in the insert-mode. You can then go into the edit-mode by pressing the edit keys ◀▶.
- Number entry in the edit-mode: this mode can be used to enter and to edit numbers. Place the entry cursor in the desired position and insert the desired number. The cursor will then automatically move one position to the right.

Delete number entry: pressing the "clear" key will delete the contents of the entry field.

Changing the number prefix (±): the plus/minus key ▲± changes the symbol.

Leaving the number entry: pressing the "select" key will leave the entry menu and save the new settings.

Notes:
- The comma position in the number entry is often predetermined. If you wish to specially place a comma, use the ▼. key (not the 0 key!).
- If you exceed the permissible range while entering the number, the entry will not be accepted and the error message "ERR" (error) will appear for a moment.

Introduction

Text Entry Screen

Alphanumeric entries are used to name sensors, enter the dimensions of a value or to enter additional information. Both text entries and special symbols can be entered using the text/number keys.

⊥	i↓	X↓	⊔	⊔	i↓	status	display	name	✳
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0**
ABC	DEF	GHI	JKL	MNO	PQR	STU	VWX	YZ–_	⊔./%

```
Text description:
TEXT █
```

Elements of the text entry screen:
• Title: description of the text
• "TEXT": text field
• Blinking entry cursor █

Operating the text entry screen:

Number entry: pressing the number key once enters the relevant number. The cursors stays in the same position to make text entry possible. If another number key is pressed once (indicating that the user wants to continue to enter numbers) the cursor will automatically jump one position to the right and this number will be entered.

Letter entry: Pressing the number/letter keys multiple times makes the letters appear in turn. Initially the uppercase letters will be shown, then the lowercase letters.

Special symbols: special symbols can be entered using keys 9 and 0. The 0 key actually contains more special symbols than those printed on the front panel. These include:

Minus: "-" Plus: "+" Multiply: "*" Colon: ":"
Slash: "/" Dot/Full stop: "." Comma: "," Semicolon: ";" Roof: "^"
Underscore: "_" Space: " " Exclamation mark: "!" Question mark: "?"
Procent sign: "%" Open brackets: "(" Close brackets: ")"
Open square brackets: "[" Close square brackets: "]"
Apostrophe: " ' "
Equal sign: "=" Less than sign: "<" More than sign: ">"
Inverted commas " " " Hash: "#" Dollar sign: "$"
Abbreviated And: "&" Degrees: "°" Omega: "Ω" Micro: "μ"

Edit keys ◀▶: these keys are used to move the cursor into the correct position for the entry.

"clear" key: this key deletes the entire entry field.

"exit" key: pressing the "exit" key once restores the original settings and pressing it again takes you back up one level (again leaving the original settings intact).

"sel" key: the new entry is adopted and the text-entry screen closed.

Configuring the mikromec® Logger

Setting the Language

The logger supports four languages: German, French, English and Dutch. Croatian and Slovene are available as optional extras on the *multisens*. The operating software MM-grafix supports numerous other languages (but these are only supported in the software itself).

```
     Main Menu
0   measure+record
1▶  setup              Setup
2   define recording+ 1  select sensors
                       2  scale sensors
                       3  offset adjust   +      language
                       4  clock                 1■ German
                       5  RS232                 2  French
                       6  alarms                3  English
                       7▶ language              4  Dutch
                       8  lock keyboard
                       9  time to wait
```
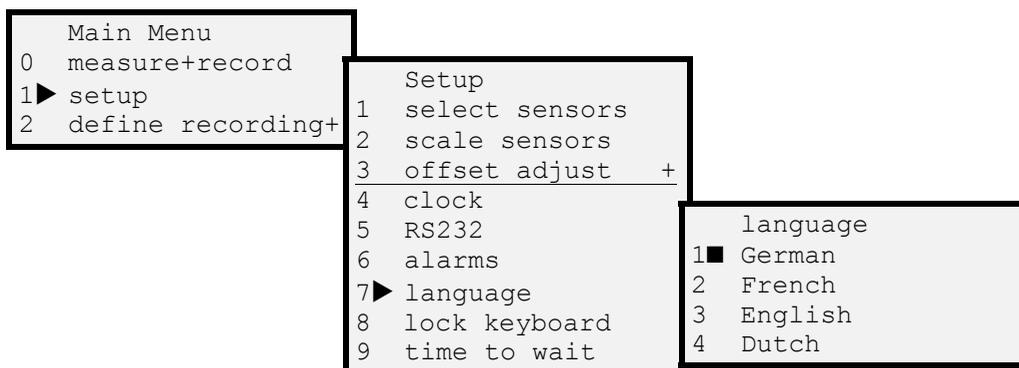
The new setting is then saved and maintained until the next language adjustment. The default language is German.

Setting the Internal Clock

Under "setup" in the main menu, you can find the "clock" option. Before changing the clock settings, it is important to end all running recordings. This is because adjusting the time management could impact on the recordings. If recordings are still running, the logger reports "Warning: recordings."
The logger automatically suggests the current time as the new value and the user can either enter a new time or accept the original one. In order to set the clock to the exact second, it is important to enter the last value (the month) at the precise moment when the minute changes. After setting the clock, you have to wait until the next minute change: from this point on you can perform the clock synchronisation (for instance with other loggers).

Limitations of the clock:
Clock change and leap year adjustment are not performed automatically. After switching the settings, the second counter starts from 00. The second display is only properly synchronised after the first minute has elapsed.
Please note: After an intercalary day (29th February), therefore the 1st March of a leap year, the mikromec®*multisens* internal clock has to be reset! Beforehand, all current recordings should be exported and deleted from the logger. After the date has been changed to the 1st March, the recordings can be re-entered and re-started.

```
    Main-Menu
0   measure+record
1▶  setup
2   define recordi
```
```
        Setup
1   select sensors
2   scale sensors
3   offset adjust   +
4▶  clock
5   RS232          time10:34 15.10.
6   alarms         new 10:     .  .
7   language
8   lock keyboard
9   time to wait
```
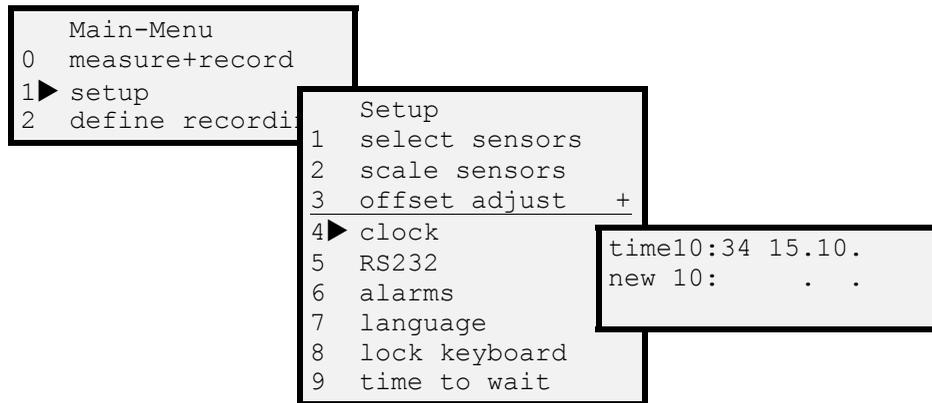
Summer Time, Winter Time and Leap-years

If the time has to be adjusted to suit winter or summer time, all recordings have to be stopped and exported. Then the new time can be entered and all recordings deleted and re-entered. The same applies to the 29th February because the logger doesn't recognise leap years.

Lock-out Functions

There are in all four different lock-out levels that will be described in the following chapters.

All lock-outs that prevent access (completely or partially) over a serial interface are described under the "mcl" bus-commands LK and UL.
All lock-out levels above 1 can only be activated with an LK-command and can only be removed with the UL-command. Only level 1 can be locally activated and deactivated with the keyboard.

A level can only be changed when the logger is completely unlocked, i.e.:

*LK 2   barring in level 2!
*LK 3   is not allowed, since LK2 has already been activated (-> error 54)

correct is:
*LK 2   barring in level 2!
*UL <password>   unlock again before changing the barring option
*LK 3   can now change the barring to level 3.

After a reset (reboot, MEM system error), the password is set to 0000.

The password can be changed with the SP command.

The bus-commands that have lock-out functions are:
LL, LO, LK, UL, SP

Error codes which are related to the lock-out functions are:
54 = logger is barred from this function
55 = two different passwords have been entered with the SP function

Level 1: Locking the Keyboard

A level 1 lock-out is a keyboard lock. It prevents accidental or unauthorised use of the device. As an example: an accessible device should not be able to be adjusted by unauthorised persons. The goal is to prevent any settings from being accidentally changed. The device should make a continuous measurement.

The ON/sleep key and the optional lighting key cannot be locked. You can activate this keyboard lock under "setup" / "keyboard lock." You can deactivate the keyboard lock by entering the 4-digit logger serial number (without the production year, so if the serial number was 2254-97, you would only enter 2254) or by using the UL-command over the serial interface.

The LK1 command locks the keyboard in level 1.

```
     Main-Menu
0   measure+record       Setup
1▶setup              1   select sensors
2   define recording 2   scale sensors
                     3   offset adjust    +
                     4   clock
                     5   RS232
                     6   alarms
                     7   language
                     8▶ lock keyboard   (un)lockID:      2053
                     9   time to wait   SEL=lock keyboard
                                        EXIT=abort
```
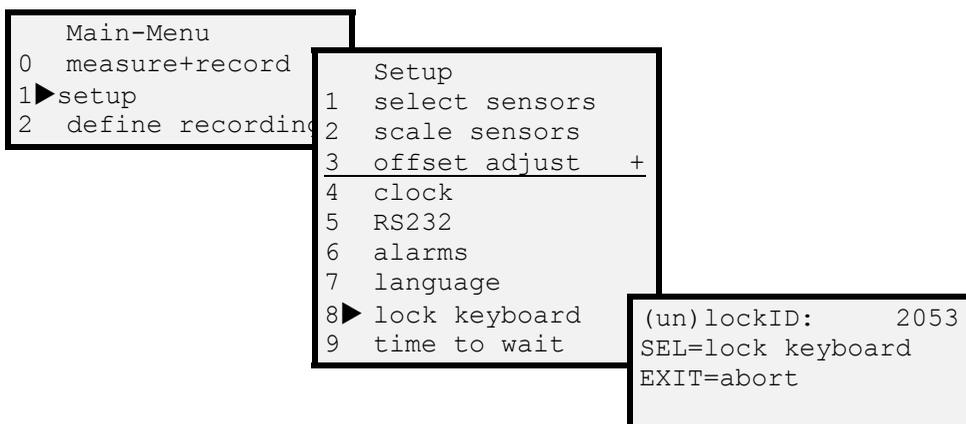
The serial number is displayed as the lock-out code and cannot be changed. This number can also be found on the underside of the device.

If the keyboard is locked, each time a key is pressed the message "keyboard locked!" will appear. This lock-out will not hinder operation with "mcl"-commands over a serial interface, but will effect the remote control.

If the keyboard lock is activated over the serial interface (the so-called remote control), you can't use this same method to deactivate the keyboard lock.

There are also numerous other barring-possibilities. For example, you can lock the keyboard over a serial interface (with the LL and LO commands) but when the machine is turned off/on, the keyboard lock is lifted.

Lifting the Keyboard Lock (Level 1)

You need the 4-digit serial number (remember without the year) to lift the keyboard lock.

The serial number is printed on the underside of the device. As well as that, this number is shown on the display as the so-called "lockID" in the keyboard lock menu. This number cannot be changed.

In order to lift the keyboard-lock, the 4-digit serial number (minus the year number!) must be entered. After entering the 4 digits, wait a second and then press SEL. Each time a key is pressed, the message "keyboard locked!" appears. That is intended.

Further methods to either partially or totally lock the keyboard are listed under the mcl-commands.

If the attempt to remove the keyboard lock doesn't work, you can still use the so-called "reboot (Cntl + Alt + Del)." See the separate chapter entitled "Recognise and Fix errors."

Level 2: Lock Only Setup

The settings are locked but the readings are freely accessible. The device can be used as normal, except that the "setup" menu is protected by a password. All bus-commands can be used. Example: the user should not be able to readjust sensors (and their corresponding scales), the interface parameters or the language. This effectively limits the errors that can occur while collecting readings.

The password must be entered locally to gain access to the "setup" menu.

Level 3: Lock Recordings and Setup

The password must be entered to gain access to "setup," "recordings" and "delete." All bus-commands with the exception of RS, IQ, RE, RH, RD and UL are blocked. The blocked commands return error message 54. Example: demonstration devices for a particular application, mikromec®*multisens* at exhibitions, a *TECHNETICS* demo weather station.

Level 4: Protect Against Remote Access

All bus-commands with the exception of RS and UL are blocked in level 4.

All local activity is allowed.

Example: Remote measuring stations should be protected from the inquisitive eyes of the competition. All access is protected by a password. The stations are called, opened with the password, the data downloaded and then locked again.

Setting the Baud-Rate

The logger is equipped with a serial interface. The interface baud rate has to correspond to the baud rate of the connected device. Baud rate settings are covered in detail in the chapter "Serial Interfaces." The set baud rate has to be the same as that of the PC. If you are using the *TECHNETICS* analysis software "MM-grafix," the baud rate settings can be found under "System Setup" / "BAUD-Rate." The

baud rate cannot be adjusted with the so-called remote control. Use instead the "sb"-command.

Configuration Process for Sensors

The logger has to be informed how it is supposed to interpret and display the electrical signals from the sensors. You can inform the logger which sensors are connected to which channels by using the relevant prefixes. This is described in detail in the chapter entitled "Configuring the Input Ports" from page 54.

Configuration Process for Recording Tasks

If you want the logger to save a series of readings, you have to inform the logger which of the channels it should record and also indicate a time frame in which the measurements should be made. A detailed description of this can be found in the chapter entitled "Recording."

Operation over a Serial Interface and with the Software MM-grafix

MM-grafix is a software package which is able to graphically analyse data. It also facilitates the remote control of the logger over a serial interface. The device is represented as an illustration on the monitor and you can perform key-presses per mouse click. There is a wide selection of commands and functions supplied to help you work with the data. The program supports modem connections.

Reading Data Directly in Excel with the MMforExcel Software

MMforExcel is a 32-bit Windows 95/98/NT software program, designed by *TECHNETICS* to view logger data directly in Excel tables. The software reads the data from a logger, which is connected over a serial interface to a PC, and displays the data graphically. MMforExcel binds itself to the Excel-surface with its own button. The actual data transfer is performed using DDE so that experienced users can set up MMforExcel to work with other programs.

At this stage, this software cannot be used to establish a modem connection. This program only allows the reading of data, not the configuration of the mikromec®*multisens* device itself. The MMforExcel program is explained in detail in its own manual.

Reading and Archiving in an SQL-database with "MessNetz"

The *TECHNETICS* software "MessNetz" allows the user to collect and archive currently running recordings without any gaps or overlapping. The data is collected from varied measuring locations, either directly, over telephone or over an ISDN line, and incorporated into an SQL-database (for instance MS-ACCESS®, PARADOX® or ORACLE®) and processed according to the user's specific wishes and analysis modules. The SQL-commands can be used at all times to access data. The collection of data is performed using so-called calling-plans. The software can use CAPI2.0 on an ISDN-line within a computer network, but can also directly read the data from a COM-port or use an analogue modem to collect the data. The analysis is suited for utilities in smaller to medium cities where other long-range transfer technology would be too expensive or inappropriate. The software can be used on Windows 95/98 and Windows NT4.0 platforms.

Configuration and Operation through a PC with the "MM-confix" Software

MM-confix is a simple, Windows-based (95/98/NT) software package from *TECHNETICS*. This software is used to configure the mikromec®*multisens* from a PC. It also uses configuration files to make it easier to administer changing tasks. The program utilizes the possibilities of representing the logger-configuration in large-format on a PC. At this point, it only works in the direction from PC to logger, not vice versa. That means that MM-confix cannot read data from the logger. MM-confix is described in detail in its own instruction manual.

Operation over Telephone and Modem

The operation over telephone and modem is identical to that over a serial interface. The difference is that the connection must be established and then terminated (hung up). This is performed using the modem's AT-commands. The analysis and operating software MM-grafix takes care of all of this.
If you have a modem, you can try out the extended operational possibilities on the *TECHNETICS* weather station on Tel. ++49 (0)761 45219-30.
In order to show how this process actually functions, here is a description of the procedure to connect to a logger over a modem "by hand:"
Prerequisites:
A modem is connected to a PC where a terminal program is installed and operational. Type AT&F <ENTER> and you receive the answer "OK." That means that the modem understands your commands. Now phone the number of our weather station. If you are calling over an extension, type ATX3 <ENTER> first and the modem replies with "OK."
Now the number is called: ATDP0W07614521930 <ENTER>. If that doesn't work, ensure that the extension operates with pulse dial and if the phone terminal you are using is actually allowed to make long-distance calls. If you don't have

this privilege, we cannot do anything to help, but in order to call using the more modern pulse-dial, replace the P in the above mentioned call-command with a T.

If the connection is successful, within 30 seconds a connection-message will appear and the carrier detect LED (=DCD) will light up.

Now you can use the symbol <CTRL A> (=<ALT 01>) to control the logger remotely. Values will appear every second. The connection is successful. You can now hang up by simply pressing <ALT H> or by turning off the modem. It is simpler with MM-grafix.

Communication and Configuration over a PC with the Command Language "mcl"

The "mcl" (*multisens* command language) was developed to allow the user to operate the mikromec®*multisens* safely and easily over a serial interface. You can use it to perform all logger functions, change the configuration, request the status and read measurements – and all this over the serial interface. When using these commands, the mikromec® is operated with the MM-confix software but the user can also use their own programs to communicate with the mikromec®. Simple drivers can be easily produced for programs such as LabView, Measure for Windows, DIA-PC or other similar programs. Some drivers are already available from *TECHNETICS*, for instance for DIADEM, DasyLab and FLEXPRO.

Each command consists of two mnemonic, command descriptive symbols, which supply the necessary parameters or an optional test-number to check the security of the transfer.

A description of the commands is in the chapter entitled "The Logger's Command Language," starting page 148.

Operating the mikromec®multisens *Logbox*

The Logbox does not have a display or a keyboard. It is a network-independent device, used to record readings. It operates by default in the sleep mode and does not have an on/sleep switch as such. The Logbox has its own internal battery but can also be connected (as can all mikromec®*multisens* loggers) to an exchangeable battery.

In order to select channels or program in recordings, a PC must be connected to the device. The Logbox is switched on by a voltage gauge from the PC as soon as MM-grafix is launched (over an RS232-socket, pin 7 = DCD). Then a virtual device is presented on the PC, which can be operated in exactly the same way as the version with keyboard and display.

There is a green light-diode on the front-plate, which is labelled with "active." As soon as the logger goes active, this light turns on. This happens every time the logger wakes up to make a measurement and when it is activated by a PC. Just like the other mikromec®*multisens* loggers, the Logbox can be switched on with a bridge in the Dig-socket between pin M and pin K. However, this is just an addi-

tional method to turn on the device and is just as good as turning it on using the RS232-socket. In both cases, the "active" light turns on.

Operation of mikromec® multiLogger Exchangeable Battery Devices

The multi*Loggers* mL4, mL7, mL11 and mL19 do not have an internal battery. This device is connected to an external battery and the batteries either exchanged or recharged (for instance by a solar cell). While the battery is being changed, the multi*Logger* cannot make any measurements. The configuration and data-readings are performed in exactly the way as for the previously described Logbox since the multi*Logger* doesn't have a display or a keyboard either. If the multi-*Logger* isn't being used at all, it must remain continually connected to a VNLB12 charging-device or an exchangeable battery, otherwise the Li-buffer zone will lose its charge in a matter of months.

Menu-Overview-Pictures

This illustration shows an overview of the operation menus. Use the arrow keys to scroll up and down and use the SEL key to select an option. That is how you move one level to the right. If you want to go back a step, (that is to say one step left) press the "exit" key.

Menu-Overview: Important Menus in their Activated Form

```
    Main-Menu
1   measure+record
2▶  setup
3   define recording+
4   clear
5   data output
6   maintenance
```

```
      Setup
1▶  select sensors
2   scale sensors
3   offset adjust   +
4   clock
5   RS232
6   alarms
7   langua
8   keyboa
9   time
```

```
      Select sensors
1▶  chan1        off
2   chan2        off
3   chan3        off
4   chan4
5   chan5
6   chan6
7   chan7
8   chan8        off
9   chan9        off
...
19  chan19       off
```

```
Select chan. 1:
1  on (U__25mV)
2  off
3■ change
```

```
Sensor set ch1
1▶  voltage
2   current
3   modules         +
4   count / frequency
5   status
6   resistor
7   temp. resistor
8   temp. Thermocoup.
9   rel.hum. / temp.
10  pressure
11  flow
12  heavy current
13  hydro
14  meteo
15  other
16  special group
17  scale position
```

```
Sel sensor ch1
  0■U___25mV
  1 U___50mV
  2 U_100mV         +
  3 U_200mV
  4 U_1.25V
  5 U__2.5V
  6 U____5V
  7 U___10V
  8 UIso_2V
  9 Uiso10V
 10
 11 Is_20mA
 12
 13 MIso_2V
 14 MIso10V
 15 MIs20mA
 16 MAP20mA
 17 MUp_10V
 18 MUp_25V

etc.

117 _UVB___
118 T_innen
119 U_Bat
124
125
126
```

Measuring and Displaying

How the mikromec®*multisens Measures*

The mikromec®*multisens* measures one channel after the other. The time-scale that the mikromec®*multisens* uses is exactly one second. The way it interprets the signals and how it measures the boosting must be entered in the sensor selection menu before measuring. You also use this menu to select a scale from the extensive list. If a channel is completely deselected, no values will be measured through it. The mikromec®*multisens* measures each channel, one after the other, starting with channel 1. If a recording has been entered, the results from at least one of these channels must be recorded. The first result from this scanning sequence is saved every second. The mikromec®*multisens* can measure roughly 12 channels per second. That means that if you are using a model with 16 channels and more than 12 are activated, the device can only perform the measurements once every two seconds. Even in this extreme case, the mikromec®*multisens* ensures that the recordings on all selected channels are carried out, but they are only then registered (saved) every two seconds.

A constant current of approx. 1mA is applied to active channels measuring RTD100 and resistances for the duration of the measurement. It takes approx. 65ms to measure one channel.

Apart from these "visible" measurements, the mikromec®*multisens* performs a series of internal measurements (for instance cold conjunction compensation and automatic calibration measurements) every second. In this way, the device is constantly monitoring its own measurement electronics. The mikromec®*multisens* reports errors that exceed the tolerated (and that exceed the automatically-compensated) ranges of the particular component. This self-calibration process limits the drift on the signal path.

The mikromec®*multisens* is only making measurements when you can see them on the display. The device can only record measurements that it is able to display. If the mikromec®*multisens* is interrupted (for instance by navigating through the user menus), any running recordings also have to be paused. So as not to forfeit complete recordings in this way, after 5 minutes of inactivity, the mikromec®*multisens* automatically reverts to the measuring mode. Any gaps in the recorded data are always correctly administered by the logger: missing readings are shown as dashes in the record. These sorts of gaps are also caused by activities such as reading saved recordings and by intensive use of interface commands.

The actual measurements inside the device are performed with the help of a continual A/D transformer-procedure, which is extremely good at filtering out 50Hz disturbances. This is extremely important for the sensor installation because it provides for a stable measurement display in high resolution.

The multisens Measuring-Concept

Introduction

The loggers in the mikromec®*multisens* series have an in-built signal processor which allows the direct connection of most types of excitation-requiring sensors. Some sensors require a power supply, other require a reference voltage. Others have to be supplied with a constant-current. In order to be able to fulfil all these demands, the sensor-sockets are able to supply these excitations. This is why the An-sockets have 14 pins. This may seem unnecessary because only 2 pins are actually used, but this system has the advantage that you do not need to use special serial modules or special sockets for these sensors. This makes the devices much more flexible. The circuitry is provided for numerous standard sensors and measurement principals. All pins are of course clearly documented, which allows individual settings to be adjusted. If in doubt, please contact the technical support. The Hotline-number is listed in the beginning of this book.

The Signal-Ports on the datalogger mikromec®: *multisens*

Port types: An, Anp, Ani, IF, Dig, Iso

The mikromec®*multisens'* signal input-ports can be divided into four groups:

1. **"An":** These are the ports for analogue signals.
   These ports are not electrically isolated.
   The An-ports differentiate themselves through their 20mA-ports and are offered as alternative options:
   • An: 20mA standard, grounded, single-ended, 0.5V load
   • Anp: 20mA in loops, "potential-free" up to 30V, 0.5V load, rest: like "An"!
   • Ani: 20mA electrically isolated, load of 2V, rest: same as "An"!
   All mikromec®*multisens* An-input-ports have 14 pins.

2. **"IF"**: These are the ports for impulses and frequencies
   All mikromec®*multisens* IF-input-ports have 12 pins

3. **"Dig"**: These are the ports for the 4 digital status-signals.
   External modules to expand this to 4, 12 or 20 electrically isolated status input-signals can be delivered: Article numbers MStaAb4, MStaAb12 and MStaAb20.
   All mikromec®*multisens* Dig-input ports have 12 pins. The device is specially designed so that no damage is caused by accidentally connecting an IF-plug to a Dig-port.

4. **"Iso"**: This is the completely electrically isolated port-type.
   multisens® loggers can be fitted with fully electrically isolated **"Iso"** ports instead of **"An"** ports. Signals of 2.000V, 10.00V or 20.00mA can be alternatively recorded.
   The mikromec®*multisens* Iso-ports have 5 pins.

The ports are also labelled with these abbreviations. Each of the (for example 11) channels is strictly assigned to a port. Example: **"An-4"** is the 4th channel and is a port for analogue signals.

Usually, there are 8 analogue channels, 2 IF-frequency channels (for example channels 9 and 10) and one port for digital signals (for instance channel 11). The other channels, which are not assigned to ports, have other functions. They act, for example, as calculation channels or note down the device temperature or the supplied voltage and do not occupy any of the standard channels in the process.

From Signal to Display

In fact, the mikromec®*multisens* can only measure voltages. Since these voltages can lie in extremely varied ranges, the mikromec®*multisens* has to boost the voltage into a suitable range. This is just like the rotary switch on a multimeter. You also use the multimeter's rotary switch to adjust the unit and the conversion factor. To do this with the mikromec®*multisens*, use the "select sensors" option.

Since the mikromec®*multisens* works like up to 24 parallel multimeters, the boosting and analysis part of the mikromec®*multisens* must be adjusted to the channels one after the other – that is to say in a time-multiplex. Each individual multimeter is then set to exactly one of the logger's "channels." Every possible position for the rotary switch on a multimeter is an entry in the "sensor list" (= scale) in the logger. The current setting in the sensor selection is equivalent to the rotary switch's position on the multimeter. This is why it is possible to separately assign sensors to each channel.

The readings are displayed in a strict channel order from left to right and two values are displayed on each line. If the device has more than 8 channels, use the arrow keys ▲ and ▼ to scroll up and down the list. You can achieve a degree of clarity by pressing the "name" key. The sensor types will then be displayed. A measurement that cannot be shown in this display cannot be recorded either.

Block diagram mikromec *multisens*

Dig 11
- Sta4
- Sta3
- Sta2
- Sta1

Status Input Port

IF 10

IF 9
- HC/TTL
- Turbine
- NAMUR

Counter

Memory Readings

Prog.1

Prog.9

P0: Single meas.

An 8

An 1
- A
- L
- J C

U

I

Function Selection

Channel Selection

Cold Junction Measurement

Programmable-gain Amplifier

A/D

Self calibration

Precision Voltage

µProcessor

LCD

54.32°C 42.1%rF
22.9KW 3.82m/s

sel

Keys

(optically isolated)

RS232
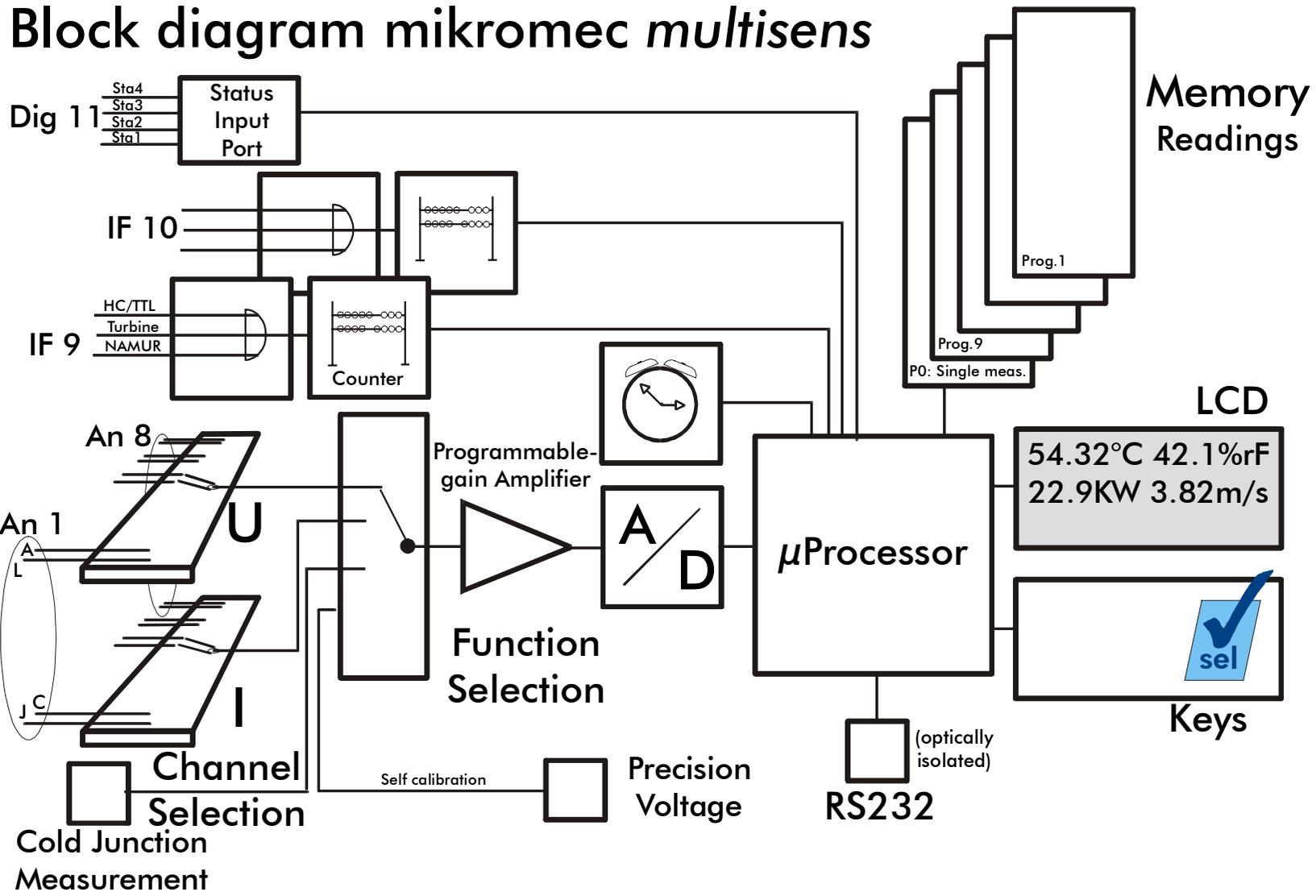
Giving Individual Names to Sensors and Locations

In order to be able to easily keep track of different measurement ranges, the mikromec®multisens displays the measurement's dimension (unit of measure) for every channel directly after the value. For example: 23.10 °C.

If you have a number of similar ranges on the different channels, it makes sense to rename and use the 3-digit <u>dimension</u> as a short description of the measuring <u>location</u>.

The advantage of this method is that the location is displayed next to every value. The disadvantage is the limitation to 3 digits.

If you need more than 3 digits, you can also edit the so-called <u>sensor name</u>. It appears in the processing and analysis over the measuring channel columns.

You can use both methods on each channel completely independently.

Both the dimensions and the sensor names are reached through the mikromec®multisens adjustment functions: that is to say, "offset adjust" and "scale sensors." Both are described at length in the following chapters. If you merely wish to change the dimension or the sensor name, enter a one-to-one scale: X1=Y1 and X2=Y2. This prevents the numerical results of the measurements from being changed. Since these functions are located under "offset adjust" and "scale sensors," you can only readjust the names of sensors that are able to be scaled or have their offset adjusted. You can see which scales this applies to by consulting the sensor list.

You can see the sensor names during the measurement process by pressing the "9" ("name") key.

Assigning Names to Measured Values: Markers and Recording Names

In order to administrate and separate individual measurements, the mikromec®multisens offers you three methods in which to give measurements names.

- To make a spot check (therefore an individual measurement) and give that check a name, use key 2 in the direct functions. More information on this is located under "Direct Functions."
- A number of this type of markings can be assigned to a running recording. The identification is made at the relevant moment during the recording. This is also described in detail under "Direct Functions."
- On top of this, you can also assign individual names to the recordings. These names are indicated in the headers of the recordings to make sorting them easier. You can only assign these names using the mcl-command ***DP.**

Calculation Channels

During measurements, the mikromec®multisens can simultaneously perform tasks such as converting and displaying mV as pressure. This happens lineally and it is very easy for the user to reach these functions by using "scale sensors" and "offset

adjust." A number of these sorts of magnitude-related display scales are already directly accessible in the mikromec®*multisens*.

However, there are cases where you can only achieve the desired magnitude by using more complicated (non-linear) formulas, or where the desired value is made up of multiple electrical signals. In these cases, you have to fall back on the subsequent (later) analysis because the mikromec®*multisens* only has a limited amount of calculation time.

Many of these difficulties can be overcome by using customer-specific scales, which *TECHNETICS* can program into the device.

The current calculation functions are as follows:

- Scale sensors: linear 2-point figure which the mikromec®*multisens* can easily control. This is only possible with sensors with a linear reference line.
- The "offset adjust" is the 1-point calibration. Only one value is added or subtracted to the previous value. This procedure works for non-linear scales, particularly RTD-100 temperature probes.
- The mean value formation for saving measured values: this can be reached under "define recording" / "define" / "kind" / "mean values."
- Wind direction recording around 360° as a vector, using scale 110.
- Integrated temperature compensation from the cold compensation value for thermo-couples.
- The difference of two channels of the same kind, 1 and 2, using scale no. 120.
- Scales with different valences for a single measurement range, i.e. impulses.
- Customer-specific scales over and above the sensor scaling entry can only be produced by *TECHNETICS*.
- The only way to derive multiple results from a single measuring channel is to run the electrical signal through two ports in parallel and then run the results through two different scales.

Which Channel is Displayed Where?

Up to 8 channels can be displayed on the 4-lined LCD display.

The display is not large enough to be able to display all the results for devices with more than 8 channels. For that reason, there are a number of measurement-pages. Since there is only enough room to display the measurement and its unit of measure, the channel names cannot be displayed along side.

There are a number of conventions that help to clarify the display. When you enter the measuring function (be that through turning on the device, the device waking up to make a reading or by pressing a key in the main menu), the display will always show the first 8 channels.

You can scroll through the pages using the up and down arrows. The channel display then changes page by page:

1. page:	Channels 1 to 8
2. page:	Channels 9 to 16
3. page:	Channels 17 to 24

If at least one channel hasn't been selected, the time will be displayed in the place of a measurement. If a number of channels on this page have been deselected, the time will be displayed in the place of the last channel.

01	09	17
03	11	19
05	13	21
07	15	23

As long as you hold down the arrow key, the new channel allocation and the selected sensor scales will be displayed. If you would like to see this allocation for the current page, press the "name" key (key 9).

If you try to scroll past the last page, you will be taken back to the first, and vice versa. Devices with fewer channels have less of these measurement screens.

A further possibility to differentiate between the measurements is to (only) change the sensor name or the unit of measure by using the "scale sensors" function. After this has been done, either the changed unit of measure will always be displayed or the changed name will be displayed by pressing the "name" key (key 9).

Scaled Displays: Scaling, Calibrating and Offset-Adjusting

What does "scaling" mean?

In its capacity as an electronic measuring device, the logger can only measure and display electrical magnitudes. Quite often, however, the electrical voltage is of little interest – the important information is the physical magnitude that the sensor is actually measuring, for instance the temperature. The guide that the logger uses to interpret and display the attached voltage is known as a scale. "Scaling Sensors" is therefore the changing or new entry of a scale. "Adjusting Offset" is a more limited way in which to set a scale and will be described at the end of this section.

Example of scaling: A temperature sensor supplies an output resistance of 0.000 volts at 0°C and 1.000V at 100°C. The logger has to know which voltage range it has to choose – in this case the base-scale U_1.25V. Apart from that, it also has to know that it has to measure in °C and also how to convert the supplied voltage into °C. An appropriate scale for this is already available: Scale No. 48 "1V = 100C"

The mikromec®*multisens* offers a series of pre-supplied display scales for each channel. These scales cover the different measuring ranges (boosts) or the already-known sensors. These lists are known as sensor lists and are located in this booklet, starting page 56.

The user also has the possibility, through "scaling" and "calibrating," to define a further display scale to each channel. The user then adapts their own sensor or justifies the sensor's values in case its signal output changes over time.

The newly activated display scale is handled in the same way as the previously activated scales during the entire procedure. This applies to displaying measurements, saving recordings, monitoring limits and processing recordings on a PC. Each channel has one of these independent scaling positions in the sensor list. That means that an 8-channel device can have 8 of these different scales.

Examples of Applying Scaling

1. A transmitter for temperature measurement supplies 4mA to 20mA for a measured temperature in the range from –20°C to +80°C.
2. A humidity probe should be calibrated in two basins with a constant relative humidity of 33% and 75%.
3. A pressure-probe with manufacturer-set divergence from the freezing point and sensitivity should be adjusted.
4. An already activated scale for pressure measurement that is currently reading in hP (hecto-Pascals) should be converted to mwl (meter water level).

5. Changing names: temperatures are being measured on multiple channels. In order to indicate the measurement locations, the sensor names can be changed to "T_air," "T_oven," "T_outside" etc.

6. Changing names: The unit of measurement is used to indicate the measuring location. Instead of letting 4 channels measure the pressure in "bar," use to "scale sensors" function to change the 4 "bars" in text: i.e. "p1" to "p4."

Organization of the Display Scales

The datalogger offers a number of fixed display scales in a preset order for every processing channel. The order of the set scales begins, for instance, in the model MLm824n on channel 1 with the scales "U_25mV," "U_50mV . . . " "U_50mV . . . " You can select the display scale under "setup" / "select sensors." See that section for more information. When switching on the machine, no further scales are available.

After entering a scaling adjustment, that is to say setting up an additional display scale, it will be stated at the end of the list of the preset scales, i.e. " . . . rel.Hum."

If a new scale is applied to this channel at a later time, the previous scale will be overwritten and can no longer be selected. There is exactly one "scaling position" per channel in the sensor list.

Setting the Scaling Data

Before entering a scale, the necessary parameters have to be carefully entered. This is best done in the following order:

1. Selecting a suitable input measurement range and a suitable basis scale:
The datalogger offers multiple measuring ranges for voltage measurements of 25mV, 50mV, … to 10V, for resistance readings, current readings, etc, as well as "basis scales" (for example "FR_Temp" or "FR_relF") which are derived from these measurement ranges through a linear relationship.

The basis scale has to be set so that the sensor's output-signal range fits safely in the range of the basis scale. A pressure sensor with an output voltage of 0 to 60V should be scaled using a basis scale of 100V. If the 50V scale is used, the port could be overmodulated which will lead to the display being overrun.

Two scales are well-suited as basis scales for humidity probes with an output voltage of 0 to 1 V: the basis scale "U_1.25V" which displays the voltage in volts, the basis scale "FR_relF" which operates based on a fixed relationship (0V equals 0% relative humidity and 1V equals 100% relative humidity!) and the user-installed scale "rel.Hum" which is derived from the "U1.25V" scale.

Fixed scales, which do not have a linear relationship to a measuring range, cannot be used as basis scales. This includes, for instance, the scales "TPt100<" and "TK_700C" which are linearised. These scales can only be "offset adjusted" and have new names assigned.

To test if the basis scale is actually suited to the desired task, it is a good idea to preselect the datalogger's scale, connect the sensor and compare the display. The

datalogger should be able to display all possible measurements within the ranges of the scale.

2. Selecting the display range:
The datalogger reserves nine symbols to display a measurement, i.e. "-22.34mV". 4 of these symbols are used for the actual value (2234), one symbol each for the prefix (±) and the decimal point and three positions for the dimension/unit of measure.
The raw numerical value and the prefix cover a range from –5000 to +4999, therefore a range of 10000 values. Different basis scales shift this range. The scale "PS_7bar" displays pressures of –1000 to +8999hP and the "frequencies" scale displays frequencies from 0000 to 9999Hz.
The same numerical range of –5000 to 4999 is also valid for the newly built "target-scale." Apart from that, there are only 4 possible positions for the decimal point. This then allows the following numerical ranges:
-5000 … 4999
-500.0 … 499.9
-50.00 … 49.99
-5.000 … 4.999

Examples:

0 to 100% should be displayed:
The display range 0.0 to 100.0% is contained within the –500.0 . . . 499.9 range; a display of 0.00 to 100.00 is not possible because it requires 5 digits.
-1 to +7 bar should be displayed:
The display range –1.00 to 7.000 lies within the –50.00 to 49.99 range. The display of –1.000 to 7.000 is not contained within any of the previously indicated ranges but these values can be scaled using the basis scale "PS_7bar" because the values lie within the adjusted range of –1000 to 8999.
The display range 0 to 20000mm is not possible. Use the range 0.00 to 20.00m in this case.

3. Selecting the dimension and sensor name
3 symbols are reserved to display a measurement's dimension, which are displayed on the depiction of the curve on a PC. The logger's display is able to show the first two of these three symbols.
7 symbols are reserved for the sensor name.
When entering a sensor name, the name of the sensor or the measurement range is passed onto the original scale. It is a good idea to change these names anyway because it can be confusing to have the same names for both the original and the scaled sensors. "Sensor" and "scale" in this case are one in the same. The difference is that the input voltage is known as a scale but the user asks themselves, what sensor should be connected. The answer can be found in the "sensor list," which is nothing more than a list of sensors and scales.

4. Selecting the scaling point
The scaling, that is to say the conversion from the original scale (X-value) to the new target scale (Y-value), is achieved by assigning two reference points ("1" and "2"). Both of these points are made up of an X- and Y- value. "X" stands for the

original value of the original scale and "Y" stands for the value which will be displayed. Said otherwise, "X" stands for "from" and "Y" stands for "to." You only have to enter two of these pairs, because straight lines are defined by two points (the two value-pairs X1/Y1 and X2/Y2).

To scale the previously mentioned transmitter (0 … 20mA to cover –20°C … +80°C) use the following:

Scaling points: Point 1: X1 = 0.00mA original, Y1 = -20°C displayed value
                         Point 2: X2 = 20.00mA original, Y2 = +80°C displayed value

In this case, there is an important distinction between "scaling" and "calibrating." During "scaling," the scaling points are known before entry and during "calibration," the Y-points are chosen and during the calibration procedure the X-values are measured and adopted by the logger as readings.

Example of scaling:

A pressure sensor with the range of 0 to 1bar has an offset-value at 0bar of 0.12mV and a sensitivity of 0.0475mV per mbar. Assigning 0bar = 0.12mV gives the scaling point and the second point is achieved by calculating the offset and the sensitivity: 1bar = 47.62mV. The scaling points are:

          Point 1: X1 = 0.12mV, Y1 = 0.00bar
          Point 2: X2 = 47.62mV, Y2 = 1.00bar

Example of calibration:

A pH-probe with a measuring range of 7pH to 12 pH with a buffer at 7pH and 10pH should be calibrated:

          The display range is 7.00pH … 12.00pH
          The calibration points are: Point 1: X1 (measured, in mV), Y1 = 7.00pH
                                      Point 2: X2 (measured, in mV), Y2 = 10.00pH

We recommend that you document the scaling data. The form shown below is suitable for this task.

The recording of the previously named examples would look like the following:

Type	Dim.	Sensor	Basis scale	Y1-value	X1-value	Y2-value	X2-value
scal	°C	Temp.	Is_20mA	-20.0°C	4.00mA	80.0°C	20.00mA
scal	%_	rel.hum	U_1.25V	33.0%_	0.33V-	75.0%_	-0.75V
scal	bar	Pres.	U_50mV	0.00bar	0.12mV	1.00bar	47.62mV
scal	mWS	Pres.	PS_1bar	0.00mWS	0hP	10.20mWS	1000hP
scal	°C	T_air	FR_Temp	0.0°C	0.0_C	100.0°C	100.0_C

Limits and Restrictions of Scaling

Due to a combination of limited memory and a limited display, the logger can only display and save 4 decimal places plus comma and sign: in all, 10000 parts. These restrictions are valid for all scales which are modified using the "scale sensors" function. Internally however, the logger performs many more steps, namely more than 34000 scale parts. If you scale upwards by a factor of 2, all of the individual steps will still be resolved but the full input range will not be able to be dis-

played. The logger works with a set comma format: 4 positions plus a "comma position." In order to achieve the maximum possible gradient, the comma is ignored. The scaling possibilities are limited by the maximum factor that an original scale converts into a the new scale:

Or.-Scale	max. factor (figure!)
25.00mV	5.00
50.00mV	2.50
100.0mV	12.50
200.0mV	6.20
1.250V	10.00
2.500V	5.00
5.000V	2.50
10.00V	12.50

You can find a complete listing under the "Sensor Lists," page 56.

The gradient is not entered directly. It is formed using the two scaling points. These two points (x1;y1) and (x2;y2) must not lie too close to each other because this could cause errors in the gradient. It is recommended to set x1 and x2 at least one quarter of the range of the original scale apart. The logger only conditionally accepts entries less than 10% apart.

Example: The original scale is the built-in 50.0mV scale. The two X-values (x1 and x2) should be laid as close as possible to 0mV and to the top-limit of 50.0mV. Setting the points at 10.0mV and 11.0mV would be a bad idea. You therefore have to know the two target values for x1 = ca. 0mV and x2 = ca. 50mV. The two target values (at x1 = 0.12mV y1 = 0.000bar and at x2 = 47.62mV y2 = 1.000bar) will be displayed. You can see from the afore-mentioned table that the maximum gradient can be 2.56. In this case, the gradient is only (ignoring commas!): (y2-y1)/(x2-x2) = (1000-0000)/(4762-0012) = 0.21 and is therefore uncritical.

A scale cannot exceed the 10000 values, or an overflow will be displayed. It is independent from the fact (among other things) that the results still lie within the original scale's allowed display range.

Asymmetrical scales, for instance –1000 to +8999 (with any comma position) cannot be entered. In this case, you have to come to terms with a more limited resolution (-0100 to + 0899) because of the restriction to 10000 parts, or you can order a customer-specific scale.

Setting a Scale

```
  Main-Menu
0  measure+record
1▶ setup
2  define recordi┌──────────────────┐
               │    setup         │
             1 │ select sensors   │
             2▶│ scale sensors  ┌──────────────────┐
             3 │ clock          │  scale sensors   │
               │              1▶│ chan1    U  50mV │
               └──────────────┌──────────────────────┐
                            2 │ chan2 │ scal: K1 U__50mV   │
                            3 │ chan3 │ 1▶name      xU__50m │
                            +         │ 2 dimension    xxx  │
                                      │ 3 dec.point:0.00xxx+│
                                      │ 4 X1=  0.00mV_      │
                                      │ 5 Y1=  0.00mV_      │
                                      │ 6 X2= 40.00mV_      │
                                      │ 7 Y2=  0.00mV_      │
                                      └──────────────────────┘
```
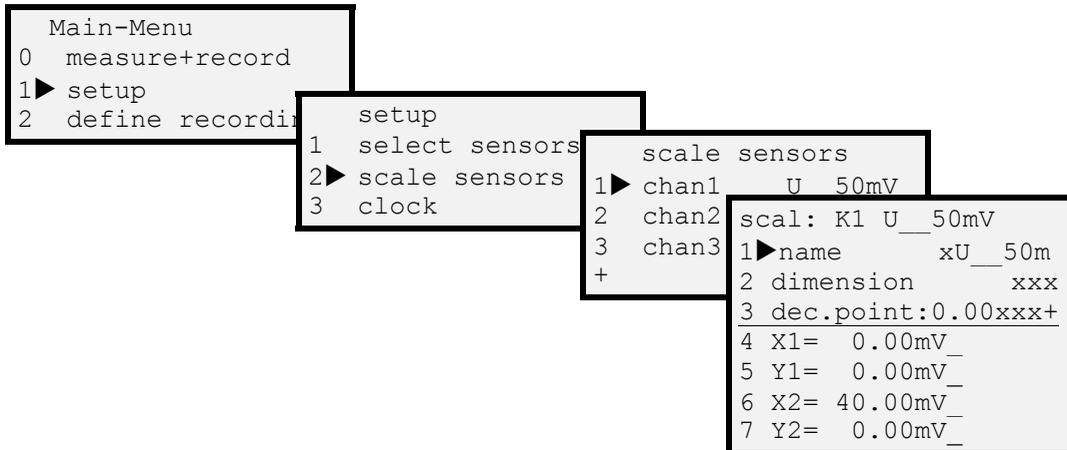
First of all, you have to have already selected a basis scale under "Setup" and "Select Sensors." Under "Setup" / "Scale Sensors" these selected basis-scales can be changed at will. The display shows the name of the scale assigned to channel 1. This scale will now be turned into a new pressure-display-scale in "bar." Therefore, insert "bar" under "dimension" ("dim"). You can do this by using the letter keys. You can find the lowercase "b" by pressing the "1" key numerous times. You can move the text entry back and forth with the left/right arrow-keys. Use the SEL key to confirm the entry. More information on this can be found under "Text Entry Screen."

```
scal: K1 U__50mV
1 name      xU__50m
2▶dimension    xxx
3dec.point:00.00xxx+
4 X1=  0.00mV_          ┌──────────────────┐
5 Y1=  0.00mV_          │ dim:     bar     │
6 X2= 40.00mV_          │                  │
7 Y2= 40.00mV_          └──────────────────┘
```
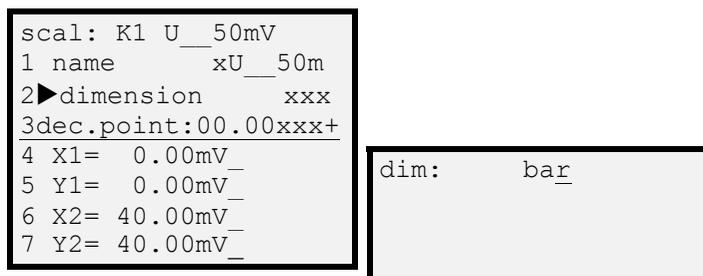
Pressing the SEL key confirms the dimension and exits the menu.
You can now see that the target unit of "bar" has replaced the original "mV_" next to the Y1 and Y2 values:

```
scal: K1 U__50mV
1 name      xU__50m
2▶dimension    xxx
3 dec.point:0.00xxx+
4 X1=  0.00mV_
5 Y1=  0.00bar
6 X2= 40.00mV_
7 Y2= 40.00bar
```
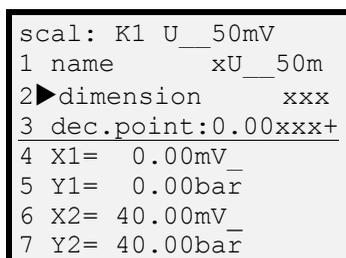
The comma position is not changed here. If you call up the comma position entry, the comma can be put into position with the left/right arrow-keys.
Now it is time to enter the two scaling points:
X1 = 0.12mV should indicate Y1 = 0.00 bar, and
X2 = 47.62mV should indicate Y2 = 1.00 bar:

```
scal: K1 U__50mV
1 name       xU  50m
2 dimension      xxx
3dec.point :0.00xxx+
4▶X1=  0.00mV_
5 Y1=  0.00bar
6 X2= 40.00mV_      signal value X1
7 Y2= 40.00bar      1▶type
                    2 measure      signal value X1
                                          [_0.00]mV_
```
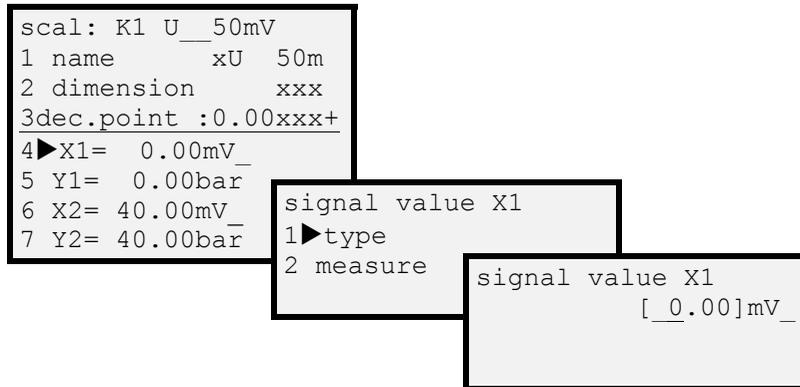
Now enter the follow one after another:
X1 = 0.12mV
Y1 = 0.00bar
X2 = 47.62mV
Y2 = 1.00 bar
An alternative possibility to acquire the two X-values is to measure the original signal, as opposed to keying it in. In this example, you would choose "define recording," make sure that the sensor is reading 0.00bar and then adopt the measured value as X1 with SELect. Use the same process to find the X2 value, except this time apply 1.00bar. This method is also useful when recalibrating an already scaled sensor, for instance to make fine adjustments.

Notes:
If you wait in the entry screen for too long (>5 min) so that the scaling process is interrupted by a time-out, the original scale is also deselected from the channel. You then first have to reselect the scale under "Setup" / "Select Sensors" and only then can you go back to the "Scale Sensors" screen.

Which Scales and Sensors can be used as the "Origin" when Scaling?

You can see if a scale or a sensor is suitable to be used as an origin when scaling by consulting the sensor list in the chapter "Sensor List" page 56. Non-scalable scales are listed there as "non-scalable."
The original scales always remain unchanged, even if they have been used to derive a new scale for the display. The newly created scale is entered in the end of the sensor list (No. 126). This is the so-called scaling position. There is exactly one of these scaling positions per channel! If you use an already modified scale as the original scale, the X-values from the "old" original scale will be used. What

that in effect means, is that you can further modify scales that have already been changed.

The entry on the scaling position can also be left blank. Once a scale has been produced, it remains in the device until it is overwritten. In the meantime, you can also use another (non-adjusted) scale and then go back to the previous scale in the scaling position.

The scaling is not lost by pressing the "delete" key.

It is not possible to select scaled sensors on neighbouring channels. Scales can only be applied to channels individually. The process has to be repeated for each channel in which the scale is to be used.

Correcting an Offset: "Offset Adjust"

A special form of the scaling function is the entry of an offset-value. This can be used, for instance, to align different temperature probes to a set value. The "offset adjust" only works on non-linear sensors, for instance the Pt100 and Pt1000 scales. Linear scales, like the voltage and current-measuring ranges can be assigned an offset with the help of a scaling operation. You just have to add exactly the same offset value to both the set points Y1 and Y2.

The "offset adjust" is a one-point scaling. As a result, only X1 and Y1 are queried as entry values.

Since the offset change also alters the scale, the unit and the name of the sensor are shown with an X. You can also freely assign names and units, exactly as with scaling. This is particularly useful for differentiating between measuring locations on the display and also in the analysis process, for instance differentiating between incoming and outgoing water temperature.

Examples:
1. Instead of 25.35°C, 25.00°C should be displayed:
        Signal value: X1 = 25.35°C
        Rated value: Y1 = 25.00°C
2. The display should show 0.45°C less:
        Signal value: X1 = 00.00°C
        Rated value: Y1 = -00.45°C

Whereas these offsets are quite small, if a very large offset is necessary to reach the desired range, it is recommended that you have *TECHNETICS* create a special scale. This is described later.

What to do, when no useful display can be reached

The previous chapters have described various restrictions on scaling and adjusting offsets. If no reason can be found why the expected readings aren't appearing (instead incorrect numbers or overflow), you can use the following method: on a free neighbouring channel, select the electrical basis scale that is able to display the unchanged values. For instance Is_20mA for a sensor that should supply 0…20mA. Now, by switching the sensor between ports, you can see if any rea-

sonable values are coming out of the sensor at all. You can also then very quickly figure out which input value should be converted to which in the scaling process.

Customer-Specific Special Scales

For sensors that the various capabilities of the mikromec®multisens are not able to adequately support, it is possible for the manufacturer to directly program special scales into the device. If a scale cannot be derived from the previous scales, because it is non-linear or for any other reason, it is possible for TECHNETICS to produce customer-specific scales. To do this, the mikromec®multisens must be sent back to TECHNETICS so that the firmware can be updated/replaced.
The sensor – including data form! – has to be sent back to TECHNETICS and will be sent back, ready for immediate use (and invoiced), in a matter of days.
This can only be done if a value-table is supplied. A comprehensive table with electrical core values and their corresponding desired displayed values have to be given. Almost all possible value-relationships can be produced. As well as that, the point of optimal display, desired resolution and desired minimum accuracy at the limits of the relevant range must be given.
These special scales can be ordered and then upgraded using the order-code "-NSK."

Scales with a 5-Digit Display, i.e. 800.0 to 1199.9 mbar

The logger (from rev. 5.0.0035) can process 5-digit readings in certain circumstances. The scales must be linear and the scale is then programmed into the individual device by the manufacturer. The coverable range has a maximum of 10000 parts in the range from –9999 to +99999. The comma position is free here as well. The scale has the advantage of producing a high resolution while simultaneously displaying relatively high values. An example would be atmospheric air pressure: the interesting range of approximately 800hPa to 1050hPa can only be displayed with a resolution of 1hPa without a special scale although the mikromec®multisens is capable of producing a much higher resolution. Using the special scale, the mikromec®multisens can display the following results with a resolution of 0.1hPa. All of these scales with the characteristic "Big-Offset" can be neither scaled further nor have further offset-calibrations.

Configuring the Input Ports, Necessary Settings

Selecting a Sensor from the Sensor List

The purpose of the sensor selection is to inform the logger how to interpret and display the electrical signal from each individual channel. The user is only presented with a list of sensors and scales that can actually be implemented on that particular special channel type. In order to allow readings to be displayed (and therefore saved), it is absolutely necessary to enter a suitable "sensor selection" in the "setup" menu.

The selection can be said to be globally valid: you cannot use a number of different scales on the same channel at the same time, for instance measuring temperature at different resolutions.

Once the preliminary selection has been made, the values can be checked for plausibility in the measuring procedure. You can document these readings (or a portion of them) with the help of recordings.

Note:

If you change the selection on a channel that is currently performing a recording, from that point on the channel will no longer be recorded. "-----" will be entered in the recording in the place of readings.
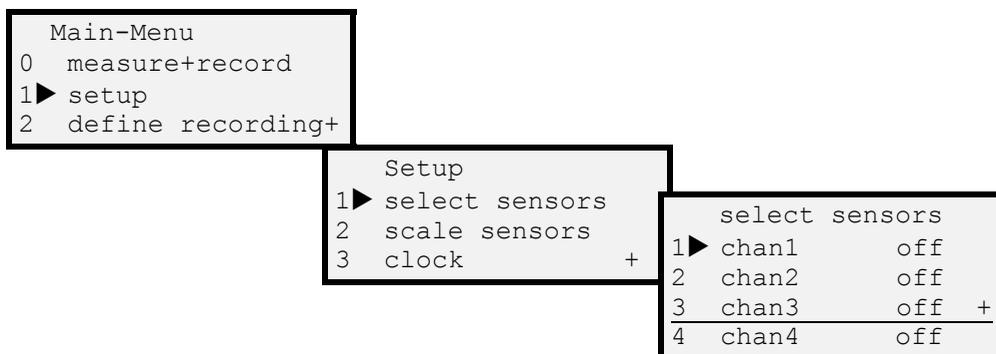
```
  Main-Menu
0  measure+record
1▶ setup
2  define recording+
```

```
      Setup
1▶ select sensors
2  scale sensors
3  clock          +
```

```
     select sensors
1▶ chan1       off
2  chan2       off
3  chan3       off  +
4  chan4       off
```

```
select chan. 1:
1  on (U__25mV)
2■ off
3  change
```

```
Sensor set ch1
1▶ voltage
2   current
3   modules          +
4   count / frequency
5   status
6   resistor
7   temp. resistor
8   temp. thermocoup.
9   rel.hum, temp.
10  pressure
11  flow
12  heavy current
13  hydro
14  meteo
15  other
16  special group
17  scale position
```

```
sensor set ch1
  0■U__25mV
  1 U__50mV
  2 U_100mV          +
  3 U_200mV
  4 U_1.25V
  5 U__2.5V
  6 U____5V
  7 U___10V
  8 UIso_2V
  9 Uiso10V
 10
 11 Is_20mA
 12
 13 MIso_2V
 14 MIso10V
 15 MIs20mA
 16 MAP20mA
 17 MUp_10V
 18 MUp_25V

etc.

117 _UVB___
118 T_innen
119 U_Bat
124
125
126
```

Measuring

You can see that the vast number of sensors/scales (127) are condensed into 17 groups. The sensors/scales are clearly numbered and these numbers are the same in the remote control commands (set-sensor [*ss]-command). The grouping is designed to make it easier to navigate around the list. You can use the up and down arrows to scroll through the entire list of scales. If a position in the list is empty, that means that this sensor(/scale) cannot be selected on this particular channel. The individual properties of the scales are shown in tabular form in the sensor list from page 56.

Selecting a Self-Defined Sensor

Per channel, there is precisely one free entry for user-defined sensors/scales. This entry is always in position 126 of the list. This so-called scaling-position cannot be deleted. It can either be left blank or overwritten. See the chapter, "What does "Scaling" Mean?" page 44.

Displaying the Current Channel Occupation/Sensor Selection

In order to find out which sensor or scale is currently selected on a channel, go to the measurement display and press the "name" key.

Nr	Sensor	Dim.	Meaning Meas. Princip.	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	Scale Data x1	x2	y1	y2 (ig. comma)	Num.-range Y max. Factor	Scale-limit

The sensor list in the device does not contain the sensors that connot be used on that channel!

Voltage 1

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	x1	x2	y1	y2	Num.-range Y	Scale-limit
0	**U__25mV**	mV_		0,01	-25,00	25,00	-30,00	30,00	An	25mV	Original				-5000..4999	5,00
1	**U__50mV**	mV_		0,01	-50,00	49,99	-50,00	49,99	An	50mV	Original				-5000..4999	2,50
2	**U_100mV**	mV_		0,1	-100,0	100,0	-120,0	120,0	An	100mV	Original				-2000..7999	12,50
3	**U_200mV**	mV_		0,1	-200,0	200,0	-240,0	240,0	An	200mV	Original				-5000..4999	6,20
4	**U_1.25V**	_V_		0,001	-1,250	1,250	-1,500	1,500	An	1,25V	Original				-5000..4999	10,00
5	**U__2.5V**	_V_		0,001	-2,500	2,500	-3,000	3,000	An	2,5V	Original				-5000..4999	5,00
6	**U____5V**	_V_		0,001	-5,000	4,999	-5,000	4,900	An	5V	Original				-5000..4999	2,50
7	**U___10V**	_V_		0,01	-10,00	10,00	-12,00	12,00	An	10V	Original				-5000..4999	12,50
8	**UIso_2V**	_V_	Option: ISO-	0,001	-2,000	2,000	-2,400	2,400		1,25V	Original				-5000..4999	6,20
9	**UIso10V**	_V_	input	0,01	-10,00	10,00	-12,00	12,00		1,25V	Original				-5000..4999	12,50

Current 2

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	x1	x2	y1	y2	Num.-range Y	Scale-limit
10	**Ip_20mA**	mA_		0,01	-20,00	20,00	-24,00	24,00	Anp	Ip/20mA	Original				-5000..4999	6,20
11	**Is_20mA**	mA_		0,01	-20,00	20,00	-24,00	24,00	An, Anp	Is/20mA	Original				-5000..4999	6,20
12	**Iso20mA**	mA_		0,01	-20,00	20,00	-24,00	24,00	Ani	Iso/20mA	Original				-5000..4999	6,20

Measurement Modules 3

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	x1	x2	y1	y2	Num.-range Y	Scale-limit
13	**MIso_2V**	_V_	ISO-Module	0,001	-2,000	2,000	-3,000	3,000	An+MISO	1,25V	0	1	0	2	-5000..4999	5,00
14	**MIso10V**	_V_		0,01	-10,00	10,00	-15,00	15,00	An+MISO	1,25V	0	1	0	10	-5000..4999	10,00
15	**MIs20mA**	mA_		0,01	-20,00	20,00	-30,00	30,00	An+MISO	1,25V	0	1	0	20	-5000..4999	5,00
16	**MAP20mA**	mA_	MAP20-Modul	0,01	-20,00	20,00	-30,00	30,00	An+MAP20mA	1,25V	0	1	0	20	-5000..4999	5,00
17	**MUp_10V**	V_p	UP-10V-Modul	0,01	-10,00	10,00	-15,00	15,00	An+MUp10V	1,25V	0	1	0	10	-5000..4999	10,00
18	**MUp_25V**	V_p	UP-25V-Modul	0,01	-25,00	25,00	-37,50	37,50	An+MUp25V	1,25V	0	1	0	25	-5000..4999	4,00
19	**MRMS_1V**	_V_	RMS-Modul	0,001	0,000	1,000	0,000	1,500	An+MRMS	1,25V	0	1	0	1	-5000..4999	10,00
20	**MRMS_1A**	_A_		0,001	0,000	1,000	0,000	1,500	An+MRMS	1,25V	0	1	0	1	-5000..4999	10,00
21	**MRMS.1V**	mV_		0,1	0,0	100,0	0,0	150,0	An+MRMS	1,25V	0	1	0	100	-5000..4999	10,00

Impulses, Frequencies 4

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	Scale Data				Num.-range Y	Scale-limit
22	**Frequency**	Hz_		1	0	9999			IF	Freq	Original				0..9999	99,00
23	**Impulse**	_i_		1	0	9999			IF	Impuls	Original				not scalable!	
24	**Imp-sum**	_i_		1	0	9999			IF	Impuls	calculated				not scalable!	

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	Scale Data x1	x2	y1	y2	Num.-range Y	Scale-limit
Status 5																
25	**Sta_1-4**	_D_	Status, intern	1	0	1111			Dig; Sta_Mod	Dig/int.	Original				not scaleable	
26	**Sta_5-8**	_D_	Status, Modul	1	0	1111			Dig+Sta_Mod	Dig/ext.	Original				or Offset-	
27	**Sta9-12**	_D_		1	0	1111			Dig+Sta_Mod	Dig/ext.	Original				adjustable!	
28	**Sta1316**	_D_		1	0	1111			Dig+Sta_Mod	Dig/ext.	Original					
29	**Sta1720**	_D_		1	0	1111			Dig+Sta_Mod	Dig/ext.	Original					
Resistance																
30	**R200Ohm**	_o_	4-wire	0,1	0,0	200,0		240,0	An	200mV	Resistance				-2000..7999	6,20
31	**R_8kOhm**	ko_	4-wire	0,001	0,000	7,999		7,999	An	10,0V	Resistance				-2000..7999	6,20
32	**Rp_100%**	_%_	potentiometric	0,01	0,0	100,0		120,0	An	5,0V	0	5,0	0	100,0	-1000..8999	12,50
Temp.-Resistance 6																
33	**TPt100<**	°C_	RTD100, 4-wire	0,01	-30,00	69,99	-30,00	69,99	An	25mV	Linearisation					
34	**TPt100>**	°C_	RTD100, 4-wire	0,1	-200,0	550,0		650,0	An	200mV	Linearisation				only offset	
35	**TPt1000**	°C_	RTD100, 4-wire	0,1	-200,0	300,0			An	2,5V	Linearisation				adjustable!	
36	**TNi100_**	°C_	Ni100, 4-wire	0,1	-50,0	150,0		180,0	An	100mV	Linearisation					
Temp.-Thermo 7																
37	**TK_700C**	°C_	Thermo, Typ K	0,1	-200,0	600,0		700,0	An	25mV	Linearisation				only offset	
38	**TK1300C**	°C_	Thermo, Typ K	1	-200	1300			An	50mV	Linearisation				adjustable!	
39	**TJ_500C**	°C_	Thermo, Typ J	0,1	-200,0	450,0		540,0	An	25mV	Linearisation					
40	**TJ1200C**	°C_	Thermo,Typ J	1	-200	1200			An	100mV	Linearisation					
41	**TL_500C**	°C_	Thermo, Typ L	0,1	-200,0	450,0		540,0	An	25mV	Linearisation					
42	**TT_400C**	°C_	Thermo, Typ T	0,1	-200,0	400,0			An	25mV	Linearisation					
43	**TU_400C**	°C_	Thermo, Typ U	0,1	-200,0	400,0			An	25mV	Linearisation					
44	**TS1700C**	°C_	Thermo, Typ S	1	0	1700			An	25mV	Linearisation					
45	**TB1800C**	°C_	Thermo, Typ B	1	200	1800			An	25mV	Linearisation					

Measuring

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	x1	x2	y1	y2	Num.-range Y	Scale-limit
Humidity, Temp. 8																
46	FR_Temp	°C_		0,1	0,0	100,0			An	1,25V	0	1	0	100	-5000..4999	12,50
47	FR_relF	_%_		0,1	0,0	100,0			An	1,25V	0	1	0	100	-5000..4999	12,50
48	T_kombi	°C_		0,1	0,0	100,0			An	1,25V	0	1	0	100	-5000..4999	12,50
49	F_kombi	_%_		0,1	0,0	100,0			An	1,25V	0	1	0	100	-5000..4999	12,50
50	1V=100C	°C_		0,1	0,0	100,0			An	1,25V	0	1	0	100	-5000..4999	12,50
51	1V=100%	_%_		0,1	0,0	100,0			An	1,25V	0	1	0	100	-5000..4999	12,50
52	20mA->C	°C_		0,1	0,0	100,0			An	Is/20mA	4	20	0	100	-5000..4999	12,50
53	A_3070C	°C_		0,1	-30,0	70,0			An	Is/20mA	4	20	-30	70	not scaleable	
54	A_0100%	_%_		0,1	0,0	100,0			An	Is/20mA	4	20	0	100	not scaleable	
Pressure 9																
55	PDCR_1_	bar	Bridge-	0,001	0,000	1,000		1,200	An	50mV	0	50	0	1	-5000..4999	12,50
56	PDCR_7_	bar	meas.	0,001	0,000	7,000		8,400	An	50mV	0	50	0	7	-1000..8999	1,75
57	PDCR_15	bar		0,01	0,00	15,00		18,00	An	50mV	0	50	0	15	-2000..7999	8,00
58	PDCR_20	bar		0,01	0,00	20,00		24,00	An	50mV	0	50	0	20	-2000..7999	6,20
59	PDCR_60	bar		0,01	0,00	60,00		72,00	An	50mV	0	50	0	60	-2000..7999	2,00
60	PS_10hP	hP_		0,01	-10,00	10,00	-12,00	12,00	An	50mV	0	16,7	0	9,96	-2000..7999	4,00
61	PS_70hP	hP_		0,1	-70,0	70,0	-84,0	84,0	An	50mV	0	7,5	0	68,9	-2000..7999	2,70
62	PS350hP	hP_		0,1	-350,0	350,0	-420,0	420,0	An	50mV	0	25	0	344,7	-2000..7999	1,80
63	PS_1bar	hP_		1	-1000	1000	-1200	1200	An	50mV	0	37,5	0	1034	-2000..7999	9,10
64	PS_2bar	hP_		1	-1000	2000	-2400	2400	An	50mV	0	37,5	0	2068	-1000..8999	4,50
65	PS_7bar	bar		0,001	-1,000	7,000		8,400	An	50mV	0	41,7	0	6,89	-1000..8999	1,50
66	PS10bar	bar		0,01	-1,00	10,00		12,00	An	50mV	0	37,5	0	10,34	-1000..8999	9,10
67	PFD_1hP	hP_		0,001	-1,000	1,000	-1,200	1,200	An	2,5V	0	2	0	1	-2000..7999	10,00
68	PFD_5hP	hP_		0,001	-5,000	4,999			An	2,5V	0	2	0	5	-5000..4999	2,00
69	PFD20hP	hP_		0,01	-20,00	20,00	-24,00	24,00	An	2,5V	0	2	0	20	-5000..4999	5,00
70	PLD_250	hP_		0,1	-250,0	250,0			An	Is/20mA	4	20	-250	250	-5000..4999	2,00

More pressure sensors next page!

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	Scale Data x1	x2	y1	y2	Num.-range Y	Scale-limit
Cntd. Pressure 9																
71	PE_1bar	bar		0,001	0,000	1,000		1,200	An	1,25V	0	1	0	1	-2000..7999	10,00
72	PE_2bar	bar		0,001	0,000	2,000		2,400	An	1,25V	0	1	0	2	-2000..7999	5,00
73	PE_5bar	bar		0,001	0,000	5,000		6,000	An	1,25V	0	1	0	5	-2000..7999	2,00
74	PE_10ba	bar		0,01	0,00	10,00		12,00	An	1,25V	0	1	0	10	-2000..7999	10,00
75	PE_20ba	bar		0,01	0,00	20,00		24,00	An	1,25V	0	1	0	20	-2000..7999	5,00
76	PE_50ba	bar		0,01	0,00	50,00		60,00	An	1,25V	0	1	0	50	-2000..7999	2,00
77	PE100ba	bar		0,1	0,0	100,0		120,0	An	1,25V	0	1	0	100	-2000..7999	10,00
78	PE400ba	bar		0,1	0,0	400,0		480,0	An	1,25V	0	1	0	400	-2000..7999	2,50
79	PE600ba	bar		0,1	0,0	600,0		720,0	An	1,25V	0	1	0	600	-2000..7999	1,60
Flow 10																
80	STT01__	m/s		0,0	0,0	1,0	1,1		An	1,25V	Linearisation				only offset-adj.	
81	STSS20_	m/s		0,01	0,00	20,00			An	10V	Linearisation				only offset-adj.	
82	SPSta40	m/s	barrage, Sensor 10hP	0,01	0,00	45,00			An	2,5V	Linearisation				only offset-adj.	
83	S6Min20	m/s		0,01	0,00	20,00			An	2,5V	0	2	0	20	-2000..7999	5,00
84	S6Min40	m/s		0,01	0,00	40,00			An	2,5V	0	2	0	40	-2000..7999	2,50
85	S6Mik20	m/s		0,01	0,00	20,00			An	2,5V	0	2	0	20	-2000..7999	5,00
86	S6Mik40	m/s		0,01	0,00	40,00			An	2,5V	0	2	0	40	-2000..7999	2,50
87	S2min20	m/s		0,01	0,00	20,00			IF	Freq	6	1804	0,3	20	-2000..7999	10,00
88	S2min40	m/s		0,01	0,00	40,00			IF	Freq	10	1725	0,5	40	-2000..7999	10,00
89	S2mic20	m/s		0,01	0,00	20,00			IF	Freq	8	2926	0,5	20	-2000..7999	10,00
90	S2mic40	m/s		0,01	0,00	40,00			IF	Freq	8	2803	0,7	40	-2000..7999	10,00
91	S2Mac20	m/s		0,01	0,00	20,00			IF	Freq	4	960	0,2	20	-2000..7999	10,00
92	S2MnW05	m/s		0,01	0,00	5,00			IF	Freq	0	374	0	4	-2000..7999	10,00
93	S2McW05	m/s		0,01	0,00	5,00			IF	Freq	0	760	0	5	-2000..7999	10,00
94	Im=0.1l	_l_		0,1	0,0	999,0			IF	Impuls	0	1	0	0,1	not scaleable!	
95	Imp=1l_	_l_		1	0	9999			IF	Impuls	0	1	0	1		
96	Imp=10l	m3_		0,01	0,00	99,00			IF	Impuls	0	1	0	0,01		
97	Im=100l	m3_		0,1	0,0	999,0			IF	Impuls	0	1	0	0,1		
98	Imp=1m3	m3_		1	0	9999			IF	Impuls	0	1	0	1		

Measuring

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	x1	x2	y1	y2	Num.-range Y	Scale-limit
Heavy Current 11																
99	EZ_100A	AAC		0,1	0,0	100,0		120,0	An	1,25V	0	1	0	100	-5000..4999	10,00
100	EZ_500A	AAC		0,1	0,0	500,0		600,0	An	1,25V	0	1	0	500	-1000..8999	2,00
101	EU_400V	VAC		0,1	0,0	400,0		480,0	An	1,25V	0	1	0	400	-5000..4999	2,50
102	EP200kW	kW_		0,1	0,0	200,0		240,0	An	1,25V	0	1	0	200	-5000..4999	5,00
Hydro																
103	U_1V_pH	pH_	pH maes.	0,01	0,00	14,00			An	1,25V	0	0,06	7	6	-5000..4999	6,00
104	U_pH/T.	_V_	wi/ temp. omp.	0,001	0	14			An	1,25V	Temp-cal.				-5000..4999	5,00
105	Iso-pH_	pH_	pH, elec iso.	0,01	0,00	14,00			An+ISO_Mod	Iso/2V	0	0,06	7	6	-5000..4999	6,00
106	IsopH/T	_V_	w/ temp.comp.	0,001	0	14			An+ISO_Mod	Iso/2V	Temp-cal.				-5000..4999	5,00
107	PWS__7m	_m_		0,001	0	7		8	An	50mV	0	50	0	7,138	-1000..8999	1,75
108	PWS9.9m	_m_		0,001	0	9,9			An	50mV	0	25	0	5,098	-100..9899	1,20
109	PWS_20m	_m_		0,01	0,00	20,00			An	100mV	0	50	0	10,2	-5000..4999	12,20
Meteo 12																
110	_windr._	deg	1 Ohm→1deg Vector ave.	1	0	360	-1999	~6000	An	5,0V	Constant current: 1 Ohm Display for 1,03mV				-2000..7999	2,50
111	wind800	m/s		0,01	0,00	40,00			IF	Freq	0	800	0	40	0..9999	10,00
112	wind_48	m/s		0,1	0,0	40,0			IF	Freq	0	48	0	40	0..9999	10,00
113	Nieders	mm_		0,1	0,0	999,0			IF	Impuls	0	1	0	0,1	not scaleable!	
114	PAR	uml	umol/m2/sec	1	0	2500			An	25mV	0	25	0	2500	-5000..4999	5,00
115	Pyrano.	W/m		1	0	2500			An	25mV	0	25	0	2500	-5000..4999	5,00
116	UV-A	W/m		0,01	0,00	99,00			An	1,25V	0	0,99	0	99	-100..9899	1,00
117	UV-B	W/m		0,001	0	5			An	1,25V	0	1	0	5	-2000..7999	2,00

Nr	Sensor	Dim.	Meaning	Res.	Min.	Max.	Und.-flow	Over-flow	Socket	Input	Scale Data x1 x2 y1 y2	Num.-range Y	Scale-limit
Other sensors 13													
118	**T_innen**	°C_	cold conj. Comp., internal	0,1	-20,0	60,0	-110,0	110,0	internal		Original		not scaleable!
119	**U_Batt.**	V	batt. voltage, internal	0,01	0,00	16,00			internal		Original		not scaleable!
120	**_K1-K2_**	_d_	Difference: Channel 1-2	0,1					selectable		calculated quant.!		not scaleable!
Special group 14													
121	**reserved**												
122	**reserved**												
123	**reserved**												
124	**reserved**												
125	**reserved**												
Scale position: There is one of these in every channel! The new scaling is saved until it is specifically overwritten::													
126	**selectable**	selectable							selectable		x1,y1,x2,y2 editable		see basis-scale

Adapting Particular Sensors

A wide spectrum of ready-to-connect sensors is already provided by *TECHNETICS*. The following chapter will provide a number of hints and tips on connecting further sensors.
In addition to that, *TECHNETICS* offers the special service of configuring electrical sensors, as was previously described under "Customer-Specific Special Scales."

The signals in the standard input sockets An, Ani, Anp, VNLB12 and Dig are <u>not</u> electrically isolated and are all connected to a common ground potential. This ground potential corresponds to that of the device-housing. Due to safety reasons, voltages over 40V cannot be connected to the logger. *TECHNETICS* offers suitable serial modules for larger voltages, which provide isolation and protection from contact.

There are many useful aids for connecting particular sensors or signals, for instance connection boxes for every mikromec®*multisens* port-type. These boxes offer 4mm-sockets or screw-elements as cross-over points for the An, Ani, Anp, Dig, IF and Iso types.
If you want to connect a sensor directly to the mikromec®*multisens*, first assess which type of input-socket the sensor should be connected to and then procure the appropriate plug.

Supply Sources for Plugs for *multisens* Systems

You can acquire the necessary plugs for the mikromec®*multisens* system either directly from *TECHNETICS* or through mail order through the firm Binder:

For the analogue port-type **An**: 14-pinned BINDER coupling-plugs No. 423-14 (splash-water resistant): *TECHNETICS* article ZS14 (Binder No. 99-5451-15-14) or alternatively the Binder series 681-14, which are not water-resistant.

For **Dig**ital ports (status recording) and the **IF**-ports use BINDER 423-12 coupling-plugs: *TECHNETICS* article ZS12 or Binder No. 99-5129-15-12.

For the AMW alarm output and the time-controlled MOW output use BINDER plugs from the 712 series. Coupling-plugs 712-3 pins. *TECHNETICS* code ZS03, Binder No. 99-0405-00-03.

For serial interface plugs, use BINDER 723-7 7-poled coupling-plugs. These plugs are available from numerous manufacturers as DIN-plugs. The *TECHNETICS* code is ZS07, the Binder No. 99-0405-00-03.The power supply plugs are 4-poled and bear the *TECHNETICS* code ZS04. BINDER series 712-4 coupling-plugs. Binder No. 99-0405-00-03.

The Iso-ports are connected to BINDER 423-5 coupling-plugs. The *TECHNETICS* code is ZS05. Binder No. 99-5113-19-05.

The screw cap <u>set</u> for the logger input <u>sockets</u> has the *TECHNETICS* code ZV4m, ZV8m or ZV16m depending on the number of analogue channels that the particular mikromec®*multisens* logger has. To process a repeat order for the entire set, the *multisens* type and model have to be known. To do this, simply give the instrument's serial number when ordering.

Individual screw caps for the (large) An, IF, and Dig input sockets can be ordered from *TECHNETICS* with the code ZVBu423. The (smaller) screw caps for the power supply connector VNLB12 and the AMW-sockets are coded as ZVBu712.

Warning: Open input-sockets impede the logger's moisture resistance. For this reason it is extremely important to cover all open input sockets with the screw caps and to ensure that the sensor plugs are screwed in tightly so that the pins are not dirtied unnecessarily. This is not only important in humid operating environments but in all situations, since the air inside the device is supposed to remain dry for a long period of time. The screw caps are made out of plastic and it is easy to distort them while putting them on or to damage the thread. These caps should then be replaced.

There are also screw caps for the unused sensor <u>plugs.</u> While using the plugs it is important to make sure that no moisture of dirt finds its way into the sensor plugs. Therefore, when the device is being used in the field, all detached sensors must be covered with protective caps. *TECHNETICS* code: ZVSt423. Binder No. 08-1077-000-000.

The plugs and protective caps can be ordered from *TECHNETICS* or from various component dispatchers or alternatively from the Binder agencies:

evg Martens GmbH & Co KG
Trompeterallee 244-246
41189 Mönchengladbach
Tel. +49 / 2166 / 5508-0
Fax   -90
www.evg.de

Börsig GmbH
Richard-Wagner-Str. 21
74172 Neckarsulm
Tel. +49 / 7132 / 9393-0
Fax   -93

Adjusting Pickups: Procedure

Sensor-Signal Adjustment: Fundamentals

You will notice that the chain from the physical measurement location to the display demonstrates a continuously guaranteed accuracy. The accuracy of the individual links in this chain should be as comparable as possible. It is not desirable to have an extremely accurate coverage of very inaccurate sensors or vice versa.

The interesting physical magnitude is changed into an electrical signal. This signal is what can be recorded. The logger can work with an extremely wide range of signals – for example, it can measure from mV to 10V. Just like the rotating switch on a multimeter, you have to choose a range and thereby tell the logger which maximum electrical value needs to be considered. You then use the next larger scale. If the end value of the display scale and the maximum input signal are comparable, the datalogger's errors are minimized.

Once you have chosen which type of electrical output-signal a sensor delivers, you give preference to the differential voltage measurement over current and resistance measurement. A valid statement is: a more direct measurement, therefore a shorter chain, produces a more accurate result.

Resolution Versus Accuracy

A measurement is only worth something when in conjunction with a tolerance entry. The uncertainty of the displayed values should lie in the last position. It doesn't help anyone to display a value to 10 digits if the measurement error lies somewhere in the percent range. In this extreme case, the 10 digits are the resolution and the 3 places are the accuracy. You can see that they are not one in the same. Many measurement systems work with the high-resolution Sigma Delta A/D-converters and display with 16 to 22 Bit resolution. Unfortunately, you receive a high resolution but no appropriate accuracy, since the measured values are usually only stable to 12 Bit. The resultant curves are grainy. An analogue electrical signal with 16 Bit, therefore 2^{16} levels, can pass one plug or a few centimetres of wire unharmed. Thermo voltages, interference couplers and serial circuit drifts can ruin any accuracy very quickly.

The mikromec®*multisens* devices can internally process 15 Bit. The display can "only" show ± 5000 scaling parts. The result is a repeatable display with a standing value. The internal filtering can also achieve this with interfered measurement signals, particularly interference caused by 50 Hz network humming.

A further particularity of the mikromec®*multisens* devices is the low-drift construction. Drifts down to under 5ppm/K are practically achieved depending on scale and measurement magnitude. That is absolutely necessary, if you want to make RTD100 temperature measurements that work with 1/100°C resolution and better than 1/10°C accuracy, for example. The displayed value is only slightly influenced by the warmth or the coldness of the device during the measurement.

Connection Plans

Sensor Documentation

Connection Occupation

Power supply sockets: battery recharging and external supply
VNLB12
4 pins
The logger is recharged and supplied by a special lead-acid charging device. The device-type VNLB12 is connected to the corresponding socket: the yellow light-diode on the front plate lights up. The light diode on the recharging device also turns on and then turns off when the charging current falls under 60mA. That doesn't mean the battery is fully charged, but that it needs to be charged for approximately 8 more hours. *TECHNETICS* strongly recommend against connecting other recharging devices to the logger.

Pin 1: Positive of the charging device: current source with 400 to 600mA and a maximum voltage of 14.40Volts.

Pin 3: Negative of the charging device (or negative of the exchangeable battery). Its ground is connected internally to the common ground.

Pin 2: Positive of an external DC-power supply, for instance an external exchangeable battery. Lead-acid batteries with a nominal voltage of 12V and a capacity greater than 2Ah can be used as exchangeable batteries.

Pin 4 is reserved and does not need to be connected.

Serial Interface for Modem and PC: RS232
7 pins
This is the serial interface which you can use to configure and read from the logger. This can be done directly on a PC or through a modem. All signals are electrically isolated from the logger. In particular pin 3 (=GND isolated) has no electrical connection to the other sockets' ground or to the logger housing. The serial interface receives all its energy from the computer or modem, so that no logger signals can be measured on a disconnected interface.

Pin 1: TxD-Output
This pin is used to send the serial data from the logger at the predetermined baud rate. The levels conform to the RS232 – that means that both positive and negative signal levels are sent.

Pin 2: RxD-Input
The logger uses this pin to receive serial data from the computer or modem.

Pin 3: Isolated GND
Reference level for all of this socket's signals. No electrical connection to the logger or its ground.

Pin 4: CTS-input
This is the interrupt-wire, which is used to prevent the logger from sending further symbols. If this line is activated for more than 7 seconds, the logger reports: RS232-damage!!!, if it wished to transmit at that time.

Pin 5: RTS-output
The logger uses this pin to signal that it doesn't wish to receive any more symbols at that point. It interrupts the computer. This line pulses in a one-second cycle.

Pin 6: RI-input
This input is only used to draw additional power supply energy from the computer interface and has no logical function.

Pin 7: DCD-input
When a voltage is applied to this pin, the logger is forced to wake up. This pin is used, for instance, by a modem call to turn the logger on if necessary.

Alarm Contacts, optional
3 pins
A switch is used to provide the momentary alarm state.
The contacts have no electrical connection to the rest of the logger's circuitry: they are therefore electrically isolated. A maximum of 0.5 A is allowed to flow over these contacts. When connecting inductive loads, special spark-inhibiting circuits should be chosen.

Pin 2: middle, variable switch
Pin 1: contact to 2, if alarm
Pin 3: contact to 2, if no alarm

Taking RFI into Consideration During Sensor Installation

Shielding and EMC

All of the logger's sockets have a metal thread and metal plugs with <u>fully</u> encompassing shielding are to be used on the sensor lines. This 360° shielding around metallic plug-housing allows measurements in the μV-range without interference from magnetic fields according to EN50082-2 EMC-effects, even over 100m and for example RTD100-measurements with 1/100°C resolution. The shielding is not to be simply soldered onto random pins. The shield is not permitted to conduct any current (for example, it is not to be misused as a ground-line). The shielding should not be connected to the conductive valve (i.e. RTD100 valves), but instead end 1cm previously, so that no vagabonding ground currents can flow over the shield. Sensor cables should be twisted when possible into pairs. During the installation, it is critical that no offset-currents are able to flow between the different points. Ground is not just ground! For that reason, the whole assembly must be grounded to one point or not at all. The best thing to do is to measure out the signals either isolated or ground-free. Especially active sensors with their own mains power supply can deliver signals that are not actually free from ground. Devices with internal mains supply are particularly unpleasant in this way. The

problem usually only becomes apparent when a number of these devices are connected to the logger. If this problem is suspected, the devices should be connected to the network and turned on step-by-step so that crossing effects can be identified. Since most PCs and laptops also cause this problem, the mikromec®*multisens* is equipped with an electrically isolated interface as standard. Thanks to this, a PC power supply cannot mix up wayward currents with measurement recordings.

When installing the device outside or using long sensor cables, lightning protection is also necessary.

The devices conform to the valid CE-declarations. The interference resistance is sufficient to use the device in an industrial environment. There are, however, some interferences which go far beyond the norm, for example ground-equalizing currents or lightning strikes when the device is used outdoors. These higher demands can be met by a clever interpretation of the installation. Since the connection-possibilities are so numerous, not every problem can be waylaid in the device itself.

The following rules are valid:

It is necessary to shield the lines. The shield has to cover the full 360° of the plug-housing. It is not acceptable to lay shielding across plug pins. Shields can only be placed on the logger side of the sensor plug housing – never on the opposing side!

Twisted line-pairs for signal pairs are preferable.

Cross-currents in the device should be avoided: sensors should be connected non-conductively, when possible, to plants/systems.

Power supply lines and sensor lines in meteorological applications should be led out of exactly one point in the protective housing. Fit a lighting protection module and run the ground tracks through precisely this point as well.

Create a clear potential connection over the whole arrangement. The grounds of the individual channels are not electrically isolated. That is advantageous for the accuracy and effort but has the disadvantage that, among other things, the multiple signal sources have to be brought to a common potential.

Only ground the device at one point, if at all.

Common mode range difficulties: As described in the chapter "Measuring Analogue Magnitudes," the two voltage inputs A and L on the **An** ports have extremely highly impedance. They have to be brought down to a lower potential, preferably one near the logger ground (pin M of the An-socket). In order to avoid common mode range problems, during voltage measurements you can resort to the so-called "Up-Modules." Their advantage is that they can cope with any eventual common mode ranges. This is achieved by reducing the internal resistance to the order of magnitude of 1MOhm.

If you have the capacity to filter, you can limit the signal to the really interesting bandwidth. For example: bounced contacts. Since these contacts are used in a very broad frequency range, there is no magic formula for this situation, only examples of an IF-input.

mikromec®*multisens* in Field Environments

TECHNETICS offers the mikromec®*multisens* as a complete system. These systems can usually be remotely controlled over radio or telephone and save the user time and effort. When setting up such systems, a number of rules need to be adhered to – mainly to do with EMC-difficulties. For these sorts of field stations, water-proof/weatherproof modems and power components, solar control knobs and jumper batteries with styled circuit-boards for lighting protecting are available. Radio/telephone-reachable and energy-efficient solar systems are also available. Already realized examples of these systems are: tank monitoring or weather stations, level measuring points along a river or for pumping attempts, transportable boxes for water-monitoring, spread out measuring networks for gas and water utilities, etc.

Building a Field Station

Building a field station requires a degree of care. In particular, EMC concerns must be addressed and the build-up of condensed water also has to be avoided. The mikromec®*multisens* is IP65 water resistant. That means that it is <u>not</u> submergible and not resistant against constant and pressurised water-flows. The surrounding moisture must not be allowed to condense for long periods of time. The level of humidity must be low enough to still allow splashed water to dry. Operation in <u>constantly damp environments</u> can only be achieved when a list of precautions have been taken and the operation still cannot be guaranteed by *TECHNETICS*. The humidity in the area of operation should be kept as low as possible. Check the location and ensure adequate ventilation for the protective housing, for example using a grille with a tight screen. There should be no direct transfer, for example, from a water level valve into the protective housing.

Avoiding or minimizing sweating: The protective housing and the mikromec®*multisens* itself should only be exposed to light and slow temperature changes. This minimises uncontrolled condensation build-up. In order to keep the temperature changes working on a device outdoors to the minimum, a ventilated roof as sun-protection is very useful. An even better idea is to set the station up in a shady area.

Defined cold-poles can be used within the protective housing to allow a locally-controlled, targeted condensation. Condensation must be able to somehow escape. A good idea is to install condensation drains in the underside of the protective housing. It is also useful to provide definite drainage possibilities for any condensation build-up on the roof of the housing. mikromec®*multisens* systems with downward-facing sockets should be used in these stations. So that no droplets settle on the logger, the ZG02 fixture can be set a few mm away from the metal mounting plate. The screw caps have to be put on carefully and always used extremely carefully so that no damp air can find its way into the device. In field stations, mikromec®*multisens* systems without the Memory-Card-Option should be given preference. Once in a while, the card slot cover should be greased sparingly with Vaseline and firmly and evenly screwed into place. The Memory Card

slot can only be left open for a short time in (when saving data). If it is left open for too long, the local humidity will quickly wear away the internal silica gel.

All cables should lead upwards to the logger so that no water can run down the cables into the logger and its input-sockets. For the sensors and power supply, only round cables are allowed – no crosspiece lines – otherwise the plug screws will not be able to seal. In field stations it is especially important to always note the battery voltage because it will be the first component, through anomalies in power use, to be able to inform the user of an error.

If water is sitting on the mikromec®*multisens* seals or sockets, there is then the acute danger that device will suck in the water over the course of the day's changing temperatures, since the housing is never hermetically sealed.

Especially multi*Loggers* can never be installed with the sockets on top because then water can enter the sockets.

Integrating the mikromec®*multisens* into Plants

In plants, there is also the danger of ground-equalizing currents and lightning coupling. The electrical uncoupling helps to solve the current problem partially but does not at all solve the lightning problem. Therefore, all signals, without exception, that reach the mikromec®*multisens*, must be set against exactly one grounding-track (protective-track). You can do this using purpose-built lighting protection modules or with a compact lighting protection board (with screw connectors) delivered by *TECHNETICS*. Spring-modules for lightning protection can be acquired, among others, from Phoenix-Contact, Dehn or through electronic mail-order suppliers. If the lightning protection modules are widely distributed or if they aren't protecting every line, the protection is ineffective.

For additional electrical isolation, there are isolation-modules from Stahl, Knick and Adamczewski; particularly for 20mA loops. The logger measuring system should not be electrically connected to conductive valves or fluids. Several temperature sensors, thermal couples and pressure sensors can lead to this problem. Here, low-pitched or impulse-style equalizing currents can be coupled, which can cause the logger to drop out. The system must never cause an electrical split between levels, but rather should be planned to be an electrical dead end, with lightning protection directly in front of it.

Ground is not just ground! It must be blocked at exactly one point.

If these rules are observed, the logger will perform admirably in a plant environment. If the field station is a permanent station, it is definitely worthwhile to have *TECHNETICS* provide pre-styled lightning protection boards, which it has ready-to-ship for this purpose.

The multisens-Systems' Measuring Mode

The direct functions while in the reading display:

If measured values are currently being displayed (indicating that the mikro-mec®*multisens* is actually measuring properly), it doesn't make any sense to try to enter numbers or letters. For this reason, direct functions have been assigned to the number and letter keys during the measuring process. These functions can be called up during measuring with one key-press. If the mikromec® is currently in the measuring function (where the actual measured values are shown in the display), the number keys can be used to directly call up recording functions, adjustment functions and status information. On top of each key, you can find a symbol or a section of text which describes the function. After performing a direct function, you are always taken back to the measurement display.

Single Measurement on Key Press

1
ABC
The 1 key always sets off a single measurement in the measurement display: that is to say, it saves the current reading on all selected channels with one key-press - and it also includes the date and time. A recording does not need to have been entered. The readings can be recalled with "data output" / "single measurement."

The measurement memory must not be completely full – something that is incidentally very hard to do. If all current measurements should be printed as well, please consult the instructions to the direct function for the 0 key at the end of this section.

Spot checks, Bookmarks or Charge Numbers

Individual measurements with marker entries:

2
DEF
This key can be used to assign a marking or identification to individual measurements in the order in which they were saved. After pressing the direct function key, the user is prompted to enter the sign/identification. The next number in order will be suggested and can be directly confirmed with SEL. This additional numerical information, which is assigned to the readings, is attached to the end of "individual measurements" with the 2 key. The actual measurements first have to be recorded using the 1 key. (See also "Superimposing a Marker in a Running Recording" (key 6) – it is in essence the same function, except that the identification or marker is superimposed in the recording.)

Superimposing a Marker on a Running Recording

6
PQR

If the 6 key is pressed while readings are being displayed, the user will be prompted to enter a marker-symbol of their choice. This symbol is then superimposed into the recording and can be shown on the curve during analysis. The purpose of this type of identification is that the "Charge Numbers" or the measurement location can be coded and then assigned to the current values. The individual sections of an experiment can also be structured during the measurement-registration in this way. If multiple recordings are programmed into the device (max 9), then marker will always be entered into the last recording – not into all of them at the same time! The last recording is the last one to be entered, which therefore by definition has the highest number.

Information Key "I"

i

This key is designed to provide the user with information on the menu they are currently in. For that reason, the text in the information display changes depending on where in the menu list the user is when the key is pressed. In the measurement display, this key gives a summary of the direct functions.

Starting and Stopping a Recording with a Key Press

4
JKL

The 4 key has the direct function of starting and stopping a recording while in the measurement display.
If no recordings have been set, the message "no recor. to start" will be reported. You can find more information of this function in the chapter "Registering" under "Starting and Stopping a Recording on a Key Press."

Starting a Pre-defined Recording

5
MNO

The 5 key has the function within the measurement display of starting a completely pre-defined recording afresh. The purpose of this function is to only have to enter recordings once when the tasks are always the same. This function is reserved for a later revision. Ask about an update over the Hotline.

Status-Key: Which Recording is Active?

status
7
STU

If you want to know which recording (=defined task) the mikromec®*multisens* is currently processing, or if there are any tasks to be performed at all, press the "status" key. If no tasks have been programmed in and no measured values are available, the following will be shown:

```
 P1:w_a



lim-SM:off st-SM:on
```

The abbreviation "lim:SM" means: limit-start individual measurement and is described in detail in the registration tasks chapter. In this case, no limit-individual-measurement will be made be-

cause the function is "off."

"st-SM" means status-change individual measurement. If this option is "off," the status ports will not be monitored and a status change will not prompt a set of individual measurements to be made. More information on this can be found in the chapter "The Logger's Specific Measurement Rules (Types of Registration)."

Note: The status-key has its name from the device status, not from the status ports in the Dig-sockets, which bear the same name.

Name-Key: Which Sensor is Displayed Where?

name

9

YZ−_

The name-key is used to display the sensor names in the measurement display. As long as the name key remains depressed, the sensor names will be shown in the place of the readings and the channel numbers shown to their left.

Display Key: Changing to an Alternative Format

display

8

VWX

The display key is not supported at the moment, but in the near future, after a software revision, the key will have the following function:

The purpose of the "display" direct function is to change the measured values' display format. Since there is only a limited amount of space on which to display the readings, there is an alternative method to display the values: always one channel per line. That is to say, in a line-format instead of a page-format. In the standard display, two channels are displayed per line – a procedure which doesn't leave any room for channel numbers or sensor names.

Pressing the display key will swap back and forth between the two display types.

The Star Key "*": Immediate Print Function

✳

0

⊔./%

The key performs and individual measurement which is then saved to the memory and then sent to a serial printer. If there is no available printer, the error message "RS232-error!" "Exit = Cancel" will appear. This option is available on devices with the firmware version 5.0044 and higher and was therefore not available on loggers produced before February 2000.

Printing with the mikromec®multisens

The mikromec®multisens sends the measurement data through the connection "RS232/Modem" to a printer that also has the RS232 serial interface. A portable, battery-powered printer is available as accessory DPU414.

Cables for serial printing are also available as accessories.

Please note that before printing, the baud rate of the printer and the mikromec®multisens must be set. This can be done over the main menu in "setep" / "RS232."

The DPU414 printer operates at 9600 baud.

1. Printing the Current Reading with a Key Press

Pressing the "0" key in the measurement display sends out the current reading on all selected channels with the date and time. This property is available from revision 5.0044 / Jan 2000.

2. Periodical Printing of Readings

The mikromec®*multisens* can be set to print readings automatically at certain times and/or at a certain interval.
To do this, enter a recording that records measurements at precisely the moment you want the readings to be printed. Then, from the main menu set "Simult. -> RS232" to "on."

Note: This simultaneous printing is deactivated when the mikromec®*multisens* is turned off. Therefore, it must be reactivated, if desired, when the device is turned on again.

Examples:
a) You want to print out one line, every hour on the hour for a week.
To do this, enter an appropriate recording (time starts record, start time 0:00, duration 7 days, interval 1 hour) and set the simultaneous reproduction to "on."
b) You want the device to permanently simultaneously print every 10 minutes.
For this, enter a loop memory recording (duration 10 mins, interval 10 mins) and activate the simultaneous reproduction.

3. Protocol of a Recording

You can produce a protocol of a recording from the mikromec®*multisens* main menu over "data output" / "recording" / "r1 … r9" / "RS232."
The protocol is made up of a measurement header which contains the entered values of the duration, interval and sensor names and the entire list of the saved values.

4. Printing a Recording through a PC

There is also the possibility to print the recordings through a PC, independent from the previously described possibilities. To do this, connect the mikromec®*multisens* to the PC, start MM-grafix and then go into the curve reproduction. If you then select print, a graphic and coloured illustration of the resulting curve can be produced on the PC's printer.

Measuring Analogue Magnitudes: Port-Type "An"

Basic Analogue Measurement Types

mikromec®multisens *Analogue Port "An"*

The *multisens*-systems' analogue ports allow a wide range of voltages and 20mA nominal signals to be measured, and through special supply signals, all basic measurement principals can be supported. This means that sensors can usually be connected without additional circuits. Thanks to the high supply voltage, pick-ups with integrated electronics can also be connected. Signals that cannot be normally measured are measurable using serial modules. Thanks to the integrated serial sensor bus, the *multisens*-systems are prepared for any future upgrades.

Analogue Port Type "An"
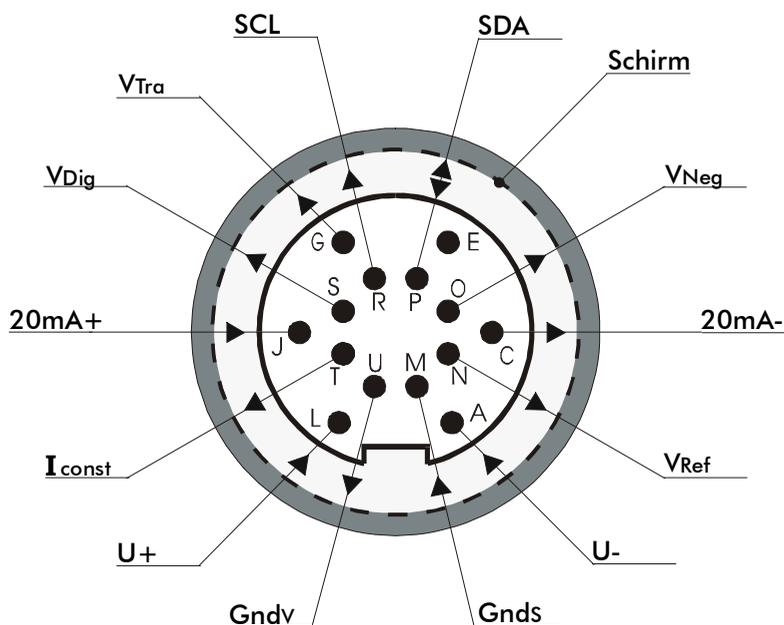
(View of the soldering side of the plug.)

Measuring ranges and principals
Voltage measurement
     Differential voltage measurement up to 12V
     Single ended voltage measurement up to 10V
Current measurement 0 … 20mA:
     Type "An" grounded 20mA measurements
     Type "Anp" potential-free 20mA measurements
     Type "Ani" 20mA electrically isolated
Resistance measurement
     4-wire up to 8kOhm and potentiometrically to 100kOhm
     Potentiometrically 2-wire with serial resistance up to 100kOhm
Thermo-couples:
     RTD100 / RTD1000

Bridge measurements: pressure sensors
    Precision reference 5000V
Sensor power supply: 5V, -7.4V, +12V

An-Input Sockets: Pin-Description
Type "An" "Anp" and "Ani" input sockets have 14 pins.

An-Input-Sockets in detail:
There are either 2, 4, 8 or 16 (14-pinned) An-sockets fitted to and numbered on
the device. The sockets are each strictly assigned to their corresponding channel.
An-ports can be used to measure analogue voltages from 25mV to 10V DC and to
excitate sensors. A precise constant current of approx. 1mA, a precise voltage of
5.000V and unregulated voltages are available.

Signal description of the Type "An" input socket:

Pin A	U-	negative voltage input
Pin L	U+	positive voltage input

The input resistance when the logger is turned on lies considerably over 10MOhm
and when the device is turned off, usually 500kOhm. The voltages, when applied
to the ground (pins U and M) including signals positive/negative can come to 10V.
The differential voltage between the pins can come to 12V. A ground connection
can be made with the ground-line (pin M). In the simplest case, connect pin M to
pin A and then attach pin A to the negative pole of the ground voltage and pin L
to the positive pole of the ground voltage. The logger therefore measures in gen-
eral differential. To perform "single-ended" measurements, all U-inputs are con-
nected to the ground.

Pins M and U are both ground potentials and connected inside the device. The
grounds of all the sockets are connected. The socket-body of the device and the
cable-shields of the sensors all have the same potential. Pin M is then used as a
current-free ground (GNDs) and pin U is then used if a ground for power supply
(GNDv) is required.

Sensor Recognition
The pins P = SDA and R = SCL provide the serial data connection for the sensor
identification. The sensor identification has not yet been realized but will be inte-
grated into the device at a later time, by means of a firmware update and an
EEPROM replacement. All SCL lines have different signals in each different socket.

Constant Current I$_{const}$
Pin T provides a constant current of just over 1mA. The constant current flows for
only as long as the corresponding channel is being measured. That means that it
is used in a time-multiplex with other channels. The constant currents of the dif-
ferent channels are extremely well synchronised. The constant current is used, for
example, with RTD100 and resistance measurements.

Reference Voltage V$_{ref}$
Pin N delivers a very constant reference voltage of 5.000V ±3mV. This voltage is applied to all sockets in parallel. Although this voltage can deliver 50mA, to minimise errors it is preferable not to overload it. The voltage is protected from short-circuits and can only be used as a current source and not as a current collector.

Sensor Power Supply
The following pins are designed to be used for the excitation of sensors and signal conditioning modules.

Transmitter Power Supply V$_{Tra}$
Pin G supplies the switched and secured battery voltage from the internal 12V lead-acid battery to excitate the sensors. It is not stabilised and can deliver powerful currents: ca. 400mA. The voltage is switched off for as long as the logger is turned off or asleep. It is automatically turned on by the logger to make measurements. It then lies between 12 and 14V. The current limiter engages heavily at 600mA and, in the case of long-term current overflow (ca. 200ms), the logger is turned completely off. This process enables "switch-on cracking," for example to tolerate the effects of connected electrolytic capacitors. If the overflow safety has been accidentally turned off, the on-key has to be pressed twice to release the safety once it has prevented an overflow.

Digital Power Supply V$_{Dig}$
Pin S supplies a digital excitation voltage of +5V. This 5V is not the reference voltage! The voltage is intended for sensor identification and (at this stage) is only protected from short circuits. Overflow voltages through this pin damage, among other things, the device.

Negative Power Supply V$_{Neg}$
Pin O supplies a negative power supply voltage of approx. –7.4V. This voltage has an internal resistance of 1kOhm and acts as the negative analogue supply for any eventual sensor adjustment circuits.

Pin E is reserved and is not allowed to be connected.

Plug types and reference sources: c.f. chapter "Producing your own Sensors"

The technical data is contained at the end of the instructions in the chapter of the same name.

Measuring (side tab)

Standard 20mA Current-Reading-Ports „An"

An, Ani and Anp input sockets only differentiate themselves in the form in which the 0...20mA is measured, and thereby only through pins J and C.
An-Socket, without additions i or p:

Pin J   I+20mA current input for 0 to 20mA current sources, positive pole
Pin C I-20mA   ditto   , negative pole

Between the two pins J and C, on both An and Anp, there is an internal resistance of 24 Ohm, which equates to a voltage drop of approximately 0.5V at 20mA. In order to measure the ground related current, Pin C and Pin U (= ground) must be joined. The An-port can only measure ground related current flows when you are measuring on multiple channels. If only one channel is electrically linked to the 20mA loop, you can also make measurements at any potential within the 20mA loop.

Quasi-potential-free 20mA Current-Reading-Ports "Anp"

Anp-sockets distinguish themselves in that you can measure in the 20mA loop on multiple channels in numerous positions – that is to say, "potential-free."
The figure "p" stands for potential-free: "Ip = potential-free current."
When connected to Anp-input-sockets, pins J and C also have the additional capability of measuring the 20mA at higher potentials, specifically in loops and not necessarily against the ground. Apart from that, they are identical to the An-inputs. The current resistance between J and C is just as small as with the An-inputs: 24 Ohm. If a device is equipped with this Ip-option, it is indicated directly on the socket with the "Anp"-channel number.
In Ip-devices, the two current input pins must lie within ±40V of the datalogger's ground. Ip-devices are in fact capable of registering the 20mA signals in a wider current-range, however they are less accurate and flawed with more errors than standard devices (An-devices). The standard devices, that is to say devices without the Ip-option, are more accurate but are only capable of measuring grounded currents. Standard devices (without Ip) also only allow current inputs of ±10V. The advantage of this variant is that it still takes up relatively little space and also its voltage resistance. Disadvantages include the additional errors through common modes and the loop current distortion. This variant is also not totally electrically separated.

Fully Electrically Isolated 20mA Current-Reading-Ports "Ani"

The Ani-input carries the figure "i" because the 20mA reading is isolated, that is to say, electrically completely separated. The effort involved in the circuitry in this device is considerable. The advantage of this device is its employment in loops: you do not need to worry at all about potential or loop distortions. The disadvantages are the price, the amount of space required and a 2V higher current load.

Apart from pins J and C, all pins have the same characteristics as the An-port types. The difference applies to the 20mA-measurement. The electrical data is better than that of the Anp-sockets. For more information on this, see the chapter "Technical Data." Pin J is engaged with +20mA of the pickup, and pin C with –20mA. During Ani-inputs, <u>no</u> bridge is made from C to M! Only these two wires are connected during current measurements over "Ani" inputs.

multisens-input: analogue **An**

3-wire current transmitter
magnitude/principle

AnI3L
short form

Pickup: mA-transmitter with 3-wire-technology

Measuring principle: pickup with 20 mA-current output is supplied by mikromec®

Measuring

Connection Plan:
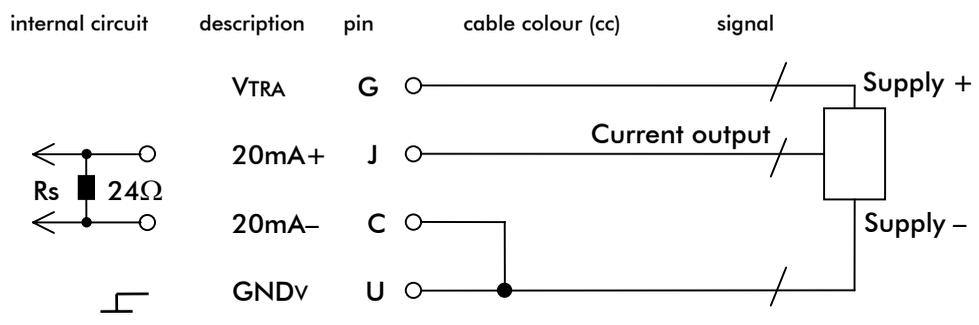
| internal circuit | description | pin | cable colour (cc) | signal |
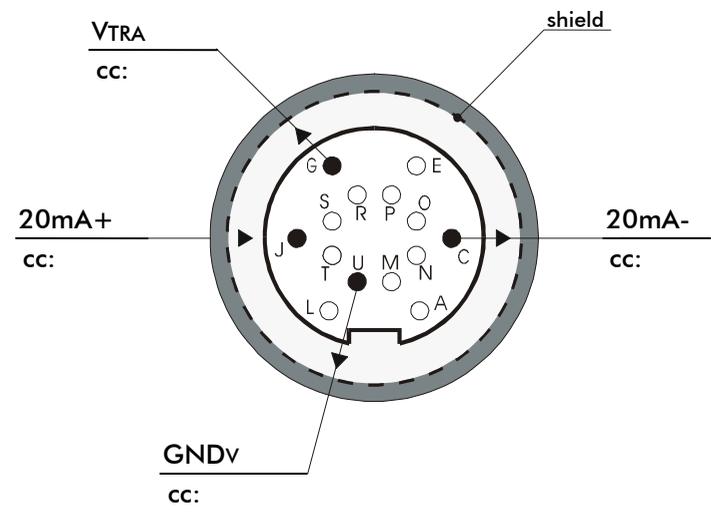
VTRA　　G　——————————————　Supply +

20mA+　J　——— Current output ———　

Rs ▌ 24Ω

20mA–　C　————————

GNDv　U　————————

Supply –

Input Plug Pins:　*multisens* analogue

soldering side of the plug

VTRA
cc:

shield

20mA+
cc:

20mA-
cc:

G　E
S R P O
J　　　C
T U M N
L　　A

GNDv
cc:

Pin/Signal Description:

20mA+　mA input +20mA
20mA-　mA input –20mA
VTRA　　supply +11...14V
GNDv　ground/supply –

mikromec® Configuration:

- Choose measuring range "Is_20mA" or "Ip_20mA"
- Control necessary pickup supply; supply voltage of mikromec®: 11V< VTRA <14V

multisens-input: analogue **An**

2-wire current transmitter

magnitude/principle

AnI2L

short form

Pickup: mA-transmitter with 2-wire-technology

Measuring principle: pickup with 20 mA-current output is supplied by mikromec®

Connection Plan:
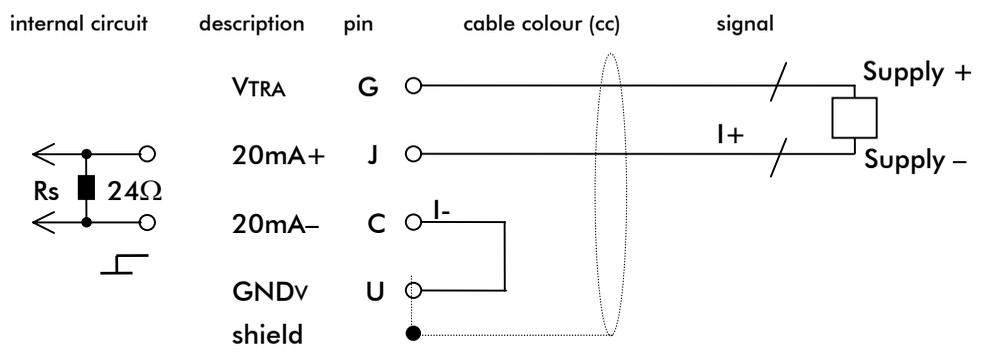
internal circuit · description · pin · cable colour (cc) · signal

V_{TRA}	G	Supply +
20mA+	J	I+ / Supply −
20mA−	C	I-
GND_V	U	
shield		

R_S ▉ 24Ω

Input Plug Pins:

multisens analogue

soldering side of the plug

V_{TRA}
cc:

shield

20mA+
cc:

20mA-
cc:

GND_V
cc:

Pin/Signal Description:

20mA+	mA input +20mA
20mA-	mA input −20mA
V_{TRA}	supply +11...14V
GND_V	ground/supply −
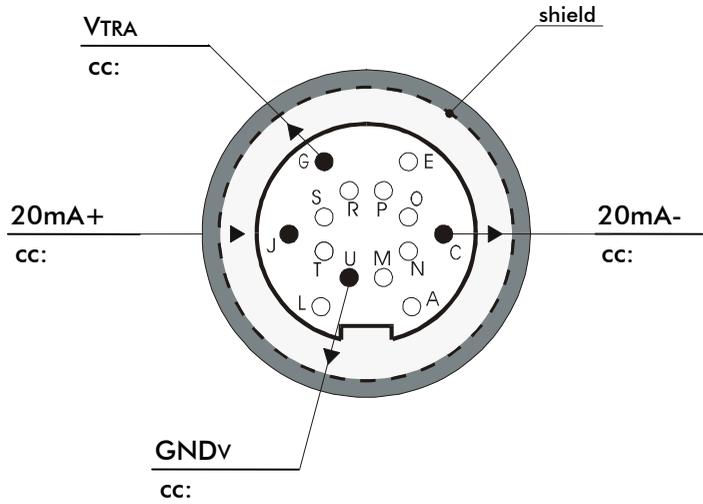
mikromec® Configuration:

- Choose measuring range "Is_20mA" or "Ip_20mA"
- Voltage drop on mikromec® input 0,5V at 20mA
- Control necessary pickup supply; supply voltage of mikromec®: 10,5V< V_{TRA} <14V

Measuring Electrical Voltages

Currents are measured using analogue input-sockets. The Pin L acts as the positive input and pin A acts as the negative input. Both inputs are highly ohmic. The ground connection is achieved through pins M and U. Thanks to this combination of pins, both single ended and differential voltages can be measured.

Voltage Measurements Directly on the Sensors

If the source you wish to measure has no conductive connections to other devices, apart from the datalogger, simply connect the positive pole of the voltage source with the positive voltage input (pin L) and the negative pole of the source with the negative voltage input (pin A). Now pin M and pin A must be connected, since there are no problems due to common modes here (see below), in order to create the ground connections. Voltages up to a maximum of 10V differential can be measured at the sensors using this method. This method offers the highest possible input resistance of several hundred MΩ. Using *TECHNETICS* measuring cables (order No. MKUd-A), the connection to pin M is made with an isolating resistance of 10 kOhm, so that no unintended larger currents can flow through the ground into other channels.

Circuit Diagram for Differential Voltage Measurement

Differential voltage measurements up to ±10V
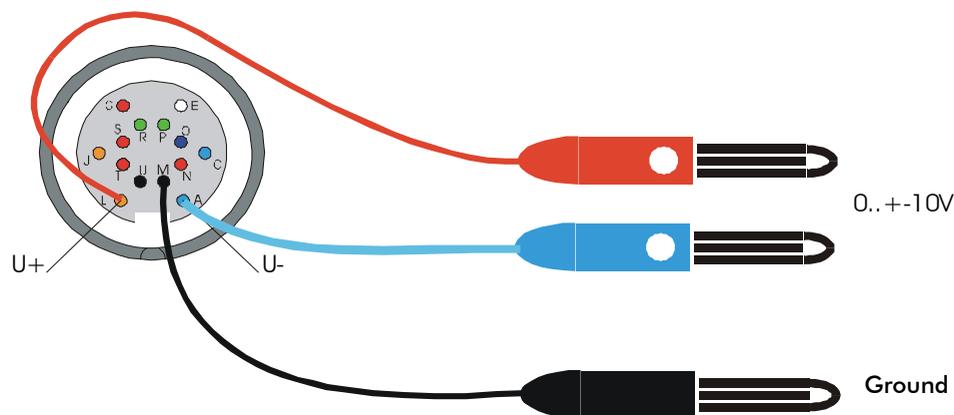
Circuit Diagram for "single ended" Voltage Measurement

Single ended voltage measurements up to ±10V
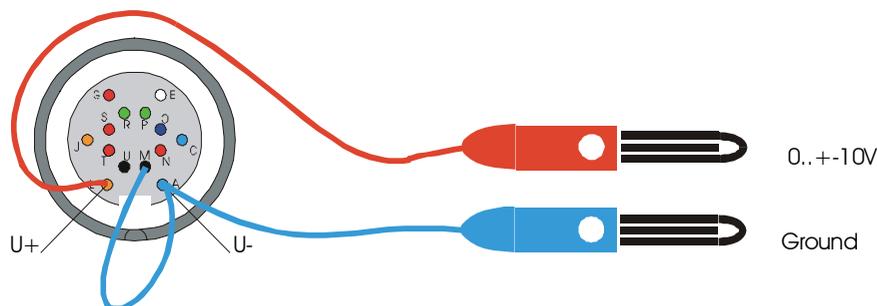
Voltage Measurement with Multiple Channels Using a Common Ground: "single ended"

If you measure multiple voltage sources, all of which have a common ground connection, each voltage source is connected to the datalogger through pins L and A and at least one pin (M or U) is connected to the ground. Since all pins labelled M and U on analogue sockets are connected to each other inside the measuring device, it is then possible to cause short-circuits with the "remaining" ground lines. For this reason, these *TECHNETICS* measuring cables (order No. MKUs-B) supply 10kOhm resistance between pins M to A.

Measuring Voltages over Measuring Bridges: Pressure Sensors

Typical bridges have a resistance of 2kOhm and up. Therefore, the wire resistance plays a subordinate role. The bridge is supplied with a reference voltage of 5.000V and during measurement the voltage is measured with high input impedance resistance.

Circuit Diagram for Measuring Bridges

See next page:

positive supply

+5,000V

neg. supply

-

+

U+

U-

Ground
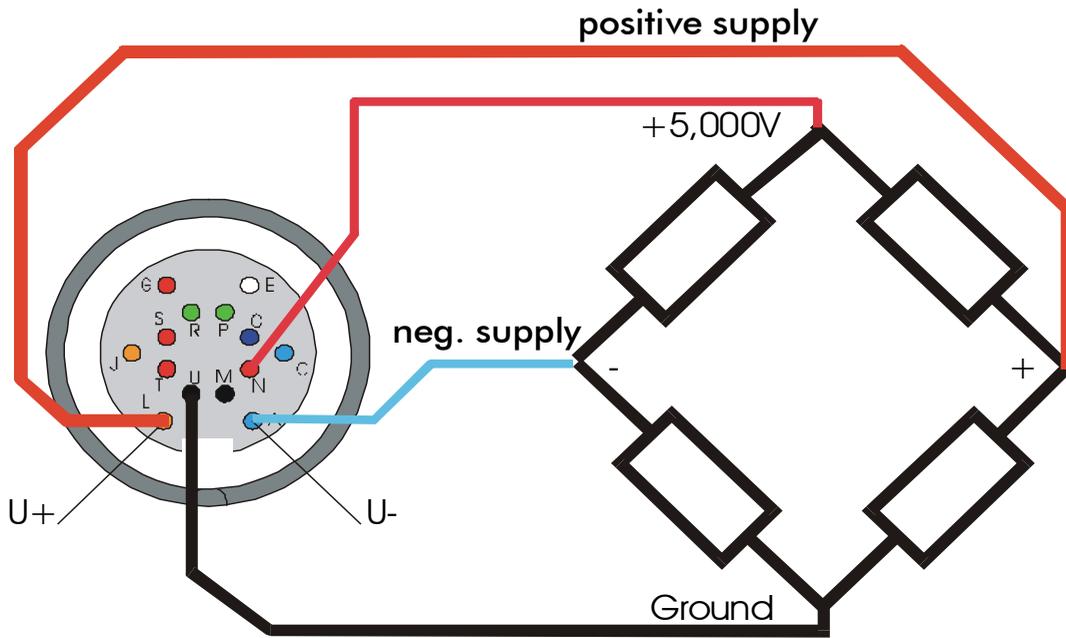
Measuring

multisens input: analogue | An | | measuring bridges |

magnitude/principle | Br |

short form

Pickup: measuring bridges, semiconductor pressure sensors,
       strain gauges pickups, load cells, torque measurement
Measuring principle: bridge measurement
       supply with precision reference
       differential voltage measurement

Connection Plan:

| internal circuit | description | pin | cable colour (cc) | signal |

5,000V   V Ref.   N

  ←   U+   L

  ←   U-   A

   GNDv   U

   shield   housing

Input Plug Pins:

multisens analogue

soldering side
of the plug

shield

G   E
S R P O
J   C
T U M N
L   A

V Ref
cc:

U+
cc:

U-
cc:
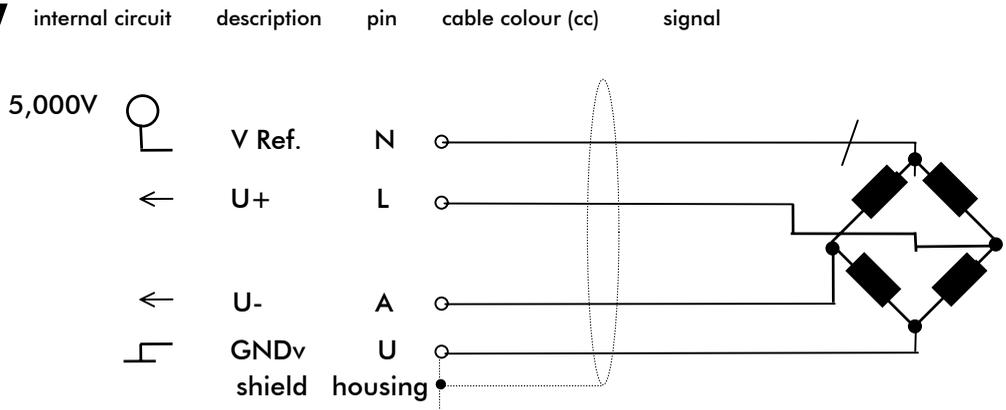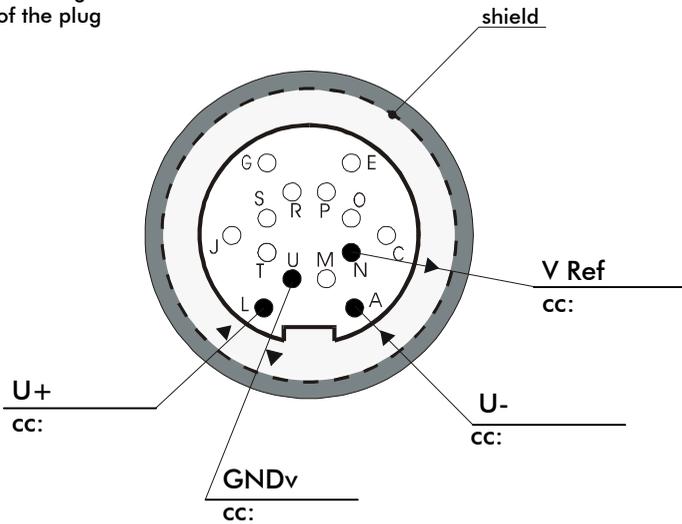
GNDv
cc:

Pin/Signal Description:

U+   voltage input +
U-   voltage input –
V Ref   supply 5,000V
GNDv   ground/supply –

mikromec® Configuration:

Measuring range: Choose voltage input U according to signal output on bridge at 5V supply.
Caution: In case of long cables consider voltage drop on the cable. Maximum load on reference: 40mA.

Up-Modules for Measuring Potential-free Voltages: MAUp-B

If the internal resistance is of limited importance and you want to measure "potential-free" voltages, you can attach the so-called Up-measurement-modules in series to the An-sockets: you have a positive and a negative cable which you can use in the same way as the two measuring cables of a multimeter. This procedure is able to tolerate smaller potential differences (up to ±40V) and is therefore considered to be "potential-free." It is rarely necessary to check the settings on neighbouring channels. The disadvantage is the 1 MOhm reduced input resistance. However, both lines have this 1Mohm — both the positive and negative lines. The modules are called **MAUp-B** and divide the associated differential voltage by ten. Therefore, the original voltage scales from 25mV to 5V are now represented on the following scales: 0,250V; 0.500V; 1V; 2V; 12.5V; 25V and 50V.

The Common Mode Problem

Since the analogue port model on the mikromec®multisens is not electrically insulted, you must pay attention to the common ground connection while making measurements on multiple channels. This is the way in which multi-channel devices, such as the mikromec®multisens, set themselves apart from the simple multimeter. The multimeter simply has two input lines which are connected to the voltage. If you try to measure voltages with multiple multimeters at different potentials (e.g. in a plant), the professional can tell you that you can no longer connect the multimeters electrically. This is because, among other things, the voltage potential in the plant can short-circuit. The electrical port of every multi-channel measuring device can only process signals in a limited range of potentials (common mode range) in relation to its own ground. In an An-port-channel this equates to ±11 volts applied to pin M (= pin U and the housing). Since you can no longer simply connect the negative measurement lines of a multi-channel device, these devices (without electrical isolation) have the two measurement lines of a multimeter and in addition a third line for the ground connection. This ground connection has the same capacity for all channels: that of the datalogger housing.
If isolated inputs are used (option "Iso"), this cyclical problem is no longer a consideration, because the valid range is then 2000V (instead of 10V) and therefore the ground line is no longer necessary. However, this electrical isolation has its disadvantages: the circuitry requires more room, has lower accuracy and more drift, more power demand and higher costs.
The electrical isolation offered in the Iso-option does not achieve its effects through photovoltaic relays with their modest common mode range of 50V, but inductively with an isolation of $>10^{13}$ Ohm.

Current Measurements: 20mA Signals

Two pins are offered on the An-input-sockets on the mikromec®multisens in order to measure standard current signals from 0 to 20mA and thereby also 4 to 20mA.

"An"- Socket with 20mA Standard Port

The standard version (Is) can only measure these currents at one initial point against the ground. It boasts An-sockets without the additions "p" or "i."
As an additional option, the An-input-socket can also be ordered as an Anp-version. This version can also measure the 20mA in loops – that is to say at a higher simultaneous capacity up to 40V. If you only want to measure a 20mA signal and the 20mA path has no electrical connection to the sensors or to signals from the other channels, you can still loop in the standard Is-input.

"Anp"- Socket with 20mA Measurement in Loops

If you have multiple loops, or at least one electrical connection to the sensors of other channels, you have to have the Ip-Option: Anp-sockets.
The Ip-option also carries with it a number of disadvantages such as lesser accuracy, a common mode error, higher costs and noticeably higher power usage on the standard mikromec®*multisens* when at least one of the channels has been used as an Ip.

"Ani"- Socket with 20mA Measurement, Fully Electrically Isolated

As a further option, you can also have the system delivered with electrically isolated 20mA ports. This type of port is called Ani. In this system, both 20mA pins (J and C) of the 14-pin input socket are 100% electrically isolated from one another and from the other channels.
The disadvantages of the Ani-option are the larger demands on space, considerably higher costs and the larger current drop.
When using an Ani-port, the 20mA pickup should not be supplied by the datalogger (pin G). That would impact the electrical isolation and some 20mA transmitters cannot safely drive a 2V load with only a 10.5V minimum power supply. If you can accept this and would like to provide an Ani-port transmitter, you must bridge J to M.
Note: see socket descriptions on An, Ani and Anp in the previous chapter.
The electrical properties and Ani-port-types are described in more detail in the technical data section.

Measurement of Temperature Resistance Sensors RTD100 and RTD1000

Choose the scales TPt100 (= scale for the RTD100) and greater for resolution of 1/100°C within the range from –30.00 to +69.99°C. The other scales have a resolution of 1/10°C: TPt> from –200.0 to 650.0 and TPt1000 from –200.0 to +300.0°C.
Both RTD100 and RTD1000 are non-linear. The linear representation is produced by the datalogger according to the current standards ITS90, DIN EN 60751 from June 1996 and IEC 751. The measurement errors that the datalogger makes are considerably smaller than the conventional RTD100. At 25°C, RTD100 sensors already deviate by ±0.3°C. You can use the function "adjust offset" to readjust individual measurements and using this method you can achieve a very high level of

accuracy. This characteristic differentiates the RTD100 sensors particularly from the thermo-couples.

RTD100 have nominally 100 Ohm and RTD1000 have nominally 1000 Ohm at 0°C. The individual rate of warming of the RTD1000 is therefore 10 times higher than that of the RTD100.

The individual warming "P" of the RTD100 (RTD1000) can be described as follows:

$$P = Ic^2 * Rthermomax / (\text{number of operating channels} + 1)$$

With a RTD100 and three operating channels, the individual warming of the element would be described as: $1.03mA^2 * 200$ Ohm / (3 channels + 1) = $53\mu W$.

With a RTD1000 the individual warming in the above-demonstrated example would be $530\mu W$.

The advantage of the RTD1000 is the higher change in Ohm/°C. Due to the element's higher resistance, the line resistance is lessened by a factor of 10. For this reason, RTD1000 are more suitable for 2-wire measurements than RTD100.

The mikromec®multisens cannot actually scale RTD100 and RTD1000 at 2-points because they are non-linear, however you can draw RTD100-elements over one another with the function "adjust offset." (Offset-choice, Single point calibration.)

2-wire Measurements with RTD100and RTD1000

The aim of the 2-line measurement is to save on lines. If this goal is unimportant, the 4-line method is preferable. The RTD1000 already has a high resistance and is therefore not as prone to line resistances as the RTD100 Measurements are achieved as follows:

RTD100 and RTD1000 are connected to the type An input sockets. The Anp and Ani variants can also be used this way. As far as the RTD100 and RTD1000 are concerned, all these types are identical. Even though this is a two-line method, in all four pins must be soldered onto the An-socket: Ic (pin T) is connected to the positive voltage input (pin L) and then used as a line to the RTD100. The same is done with pins M and A. Those two produce the second line to the RTD100. Both lines must be shielded because very small voltages are going to be measured.

If you lengthen the line, the temperature reading will be changed because the measuring device cannot differentiate between measurement and line resistance. In this case, you use the same scales as used with the 4-wire connection technique.

When using the 2-line method, the line resistance can be compared to a cleverly chosen parallel resistance. The compensation will only be correct for one exact temperature. If you plan to cover a range of temperature from ±20°C, the margin of error in practice will be approximately one full °C.

3-wire Measurement with RTD100 and RTD1000

The aim of the 3-line measurement is to conserve one of the four lines. In this method, only one of the sense-lines are led to the RTD100 element and it is assumed that the line resistances will be symmetrical. The actual signal is then corrected with the doubled value of the measured error voltage with a small correct-

ing circuit. Since the mikromec®*multisens* is able to perform 4-wire measurements, the 3-wire method is not supported by the device and requires an external module.

In order to make a compensation using parallel resistance, use the same method as described under the 2-line method.

4-wire Measurement with RTD100and RTD1000

This is the standard method to measure temperature with the RTD100. The point of this method is not to use the line resistance as an error in the measurement. Since a RTD100 registers a change of approximately 0.4 Ohm/°C, a few Ohm of typical line resistance can be translated into a mistake in the order of several °C. For that reason, in the method the current is fed to the RTD100/RTD1000 element and with the help of a second line pair, the voltage over the element is measured. The measuring wires are therefore free of current and for that reason, the resistance plays no part. If the line is lengthened, the displayed temperature will not change. The four lines must be shielded. You can make accurate measurements with lines of up to 100m.

Circuit Diagram for RTD100, RTD1000 and Resistance Measurement
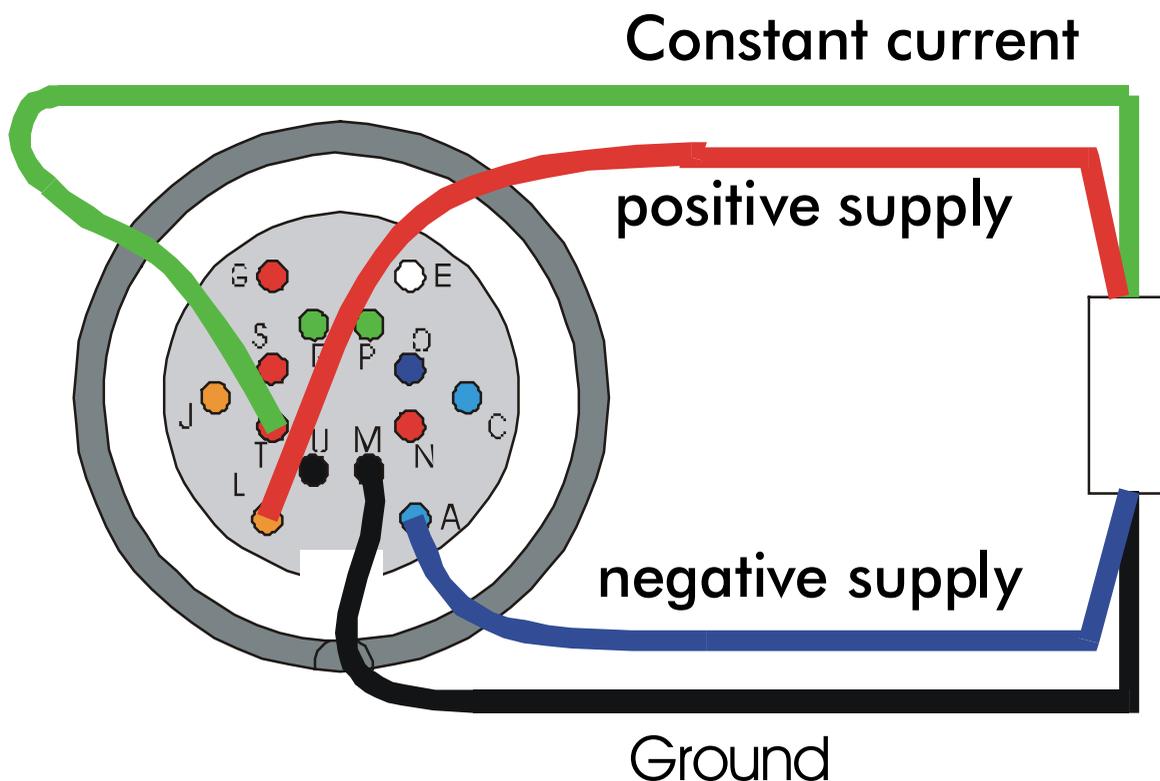
multisens input: analogue | An | | Sensor: temperature / RTD100 |

magnitude/principle

| TPt |

short form

Pickup: RTD100 element
Measuring principle:

4-wire resistance measurement, constant current ca. 1mA
the voltage drop over the element is measured directly
drop plays no part because of constant current
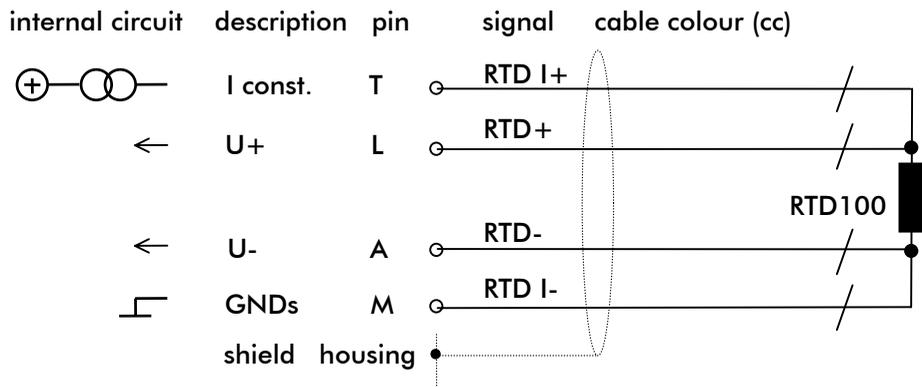
Connection Plan:

internal circuit	description	pin	signal	cable colour (cc)
⊕—◯◯—	I const.	T	RTD I+	
←	U+	L	RTD+	
				RTD100
←	U-	A	RTD-	
⌐_	GNDs	M	RTD I-	
	shield	housing		

Input Plug Pins:

multisens analogue

soldering side
of the plug

shield

G ◯   ◯ E
S   ◯ ◯ ◯ O
◯ R P ◯
J ◯   ◯ C
T ◯ ●   ◯ N
U ● M
L ●   ● A

RTD I+ / I const.
cc:

RTD+ / U+
cc:

RTD I-/GNDs
cc:

U- / RTD-
cc:
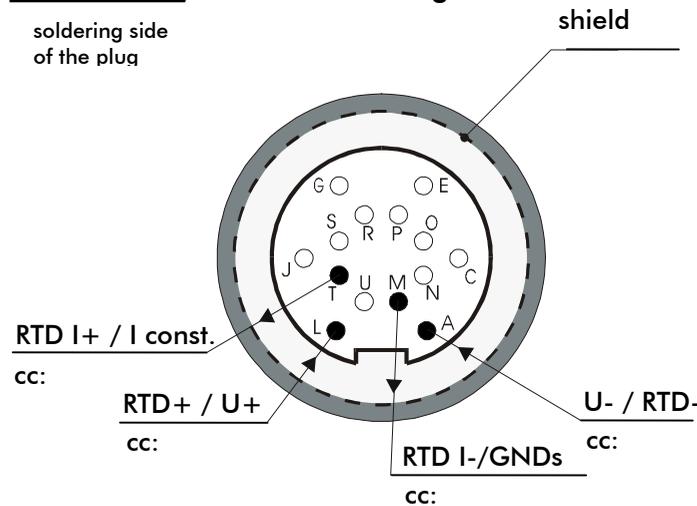
Pin/Signal Description:

$I_{const.}$: precision constant current 1,03mA switched
U+:   voltage input +
U -:   voltage input –
GNDs: signal ground

mikromec® Configuration:

Measuring range -30,00 to +69,99: TPT100<
Measuring range -200,0 to +550,0: TPT100>

Cable length up to 200m; use shielded cable
for 2-wire measurement bridge from L to T and from A to M; next to the element
for 3-wire measurement bridge from L to T; next to element

Measuring Resistances

Direct 4-wire Resistance Measurement up to 2K, with Power Supply

This procedure is to be used with resistances up to 2 kOhm.
This pinning relates to RTD100 and RTD1000 measurements.
The relevant resistance measuring cable has the order No. MKR4L-A with 4 wire ferrules. Up to 200 Ohm use the scale No. 30 which offers 0.1 Ohm degree of accuracy. From 200 Ohm to 2 kOhm use the scale No. 31 R_8kOhm, which shows an accuracy of 1 Ohm.
When using wind direction measurement pickups up to 2 kOhm, this method should be employed; but remember to use the scale No. 110.

Direct 4-wire Resistance Measurement 2 - 8K, with Power Supply

In order to measure resistances between 2K and 8K, use the cable with the order No. MKR4L8K-A. The only difference between this method and measuring resistance up to 2K is that in this case, pin M instead of pin O is used as the backward line (therefore Vneg instead of the ground) in order to reach a higher voltage capacity. Use the scale No. 31 which provides a resolution of 1 Ohm at 8kOhm.
When using wind direction pickups for 2k to 8kOhm, this method should be employed and still use the scale No. 110.

Potentiometric Resistance Measurement: 3-wire

This procedure is practical for potentiometers larger than 8kΩ that have no dead ranges. It is not recommended for wind direction pots. According to the potentiometric measurement, the potentiometer in question is connected between the reference voltage and the ground (pin N against pins M and A) and the voltage is measured at the sensor (pin L). The measured voltage is proportional to the connected resistance. The scale No. 32 is intended for this procedure. At 5,000V it gives a 100% accurate reading. You can then use this original value to scale the display to the desired values.

Direct 2-wire Resistance Measurement over 8K, with a Resistor in Series

In order to measure 2-poled resistances over 8K, use the cable with the order No. MKR2L2M-A. This procedure is not particularly accurate because there are errors in principal, which can only be dealt with by using a special purpose-designed scale. The method is to connect the resistance you want to measure in series with 2Mohm to the reference voltage of 5,000V. The resistance is then measured differentially and without current at the sensor. This procedure works better and better, depending on how close the measured resistance is to the set resistance (in the measuring cable) of 2MOhm. The only way to measure the highest possible resistance is to scale up the display. It is impossible to avoid a linearity error which lies unacceptably high at almost 20% at 1MOhm. At lower maximum resistance readings, however, the system works quite well without a custom scale.

End value	Voltage at Rmax	Linearity error at half of full deflection
2 MOhm	2,500 V	-17,0%
200 kOhm	0,455 V	-2,4%
80 kOhm	0,1923 V	-1,0%
10 kOhm	0,025 V	-0,125%
20 kOhm	0,495 V	-0,25%

You can come to terms with this problem with a custom scale.

Measuring

multisens input: analogue | An | Resistance measurement

magnitude/principle

AnI4L
short form

Pickup: resistive/potentiometric type pickups, displacement sensors
        up to 2kΩ
Measuring principle: constant current with 4-wire technology
        no error is caused by cable4 length

Connection Plan:
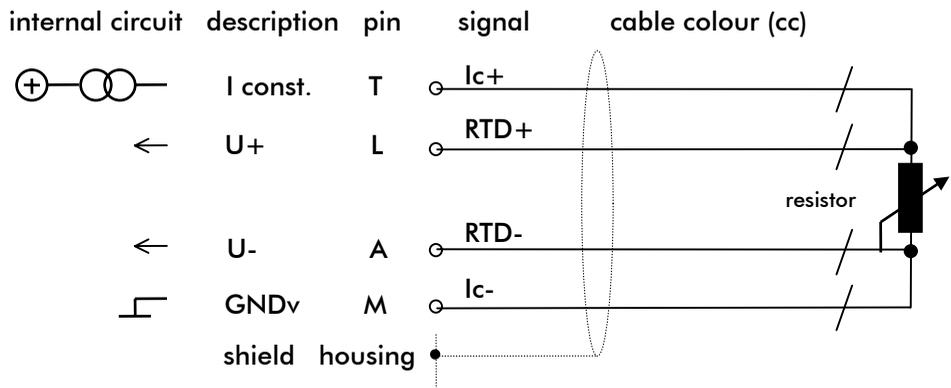
internal circuit	description	pin	signal	cable colour (cc)
⊕—OO—	I const.	T	Ic+	
←	U+	L	RTD+	
←	U-	A	RTD-	
⎍	GNDv	M	Ic-	
	shield	housing		

resistor

Input Plug Pins:

multisens analogue

soldering side
of the plug

shield

RTD I+ / I const.
cc:

RTD+ / U+
cc:

RTD I-/GNDs
cc:

U- / RTD-
cc:
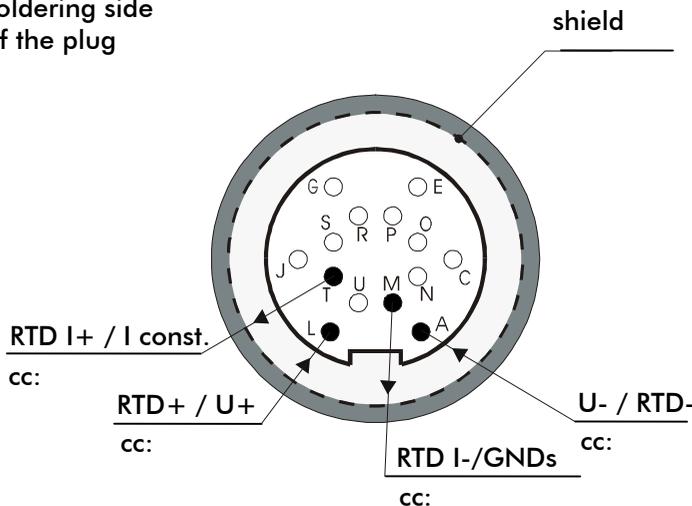
Pin/Signal Description:

$I_{const.}$: precision constant current ca. 1,03mA switched
U+: voltage input +
U -: voltage input –
GNDs: signal ground

mikromec® Configuration:

Select measuring range "R200 Ohm" or "R_2kOhm";
or voltage measuring range according to resistance: $U = R * I$ (I = 1,03 mA)
For resistances up to 8kΩ use negative supply (Vneg.); for resistances higher than 8kΩ use potentiometric measurement.

Wind direction pickups

Wind direction scale
The scale No. 110 inside the datalogger is suitable for wind direction pickups. This scale is also good for wind direction pickups with voltage outputs. What makes it special is its feature to produce mean vector values. If the mean vector feature is selected, the wind direction vector values will be displayed on the scale No. 110. This scale is also suitable for wind direction pickups with voltage outputs.

Scaling

The display will not exactly reproduce the requested information. It is therefore important to scale the display. Scaling the 0° doesn't usually pose a problem: set X1=0 and Y1=0. Then, enter the second point with the wind direction pickup: rotate the wind direction pickup to the highest value, as close as possible to the dead range e.g. 356.0°, where the dead range is 4°. In this way you achieve X2 = originally displayed value and Y2 = desired displayed value.
For example: If the datalogger only displays 341.2° although the pickup is still at the highest possible deflection of 356.0°, then X1 = 341.2° and Y2=356.0°. The datalogger will display the correct wind direction after being scaled using this two value-pairs.

Wind Vectors

The special scale No. 110 can average the wind direction reasonably accurately over a particular interval. Using this scale, the value change from 360° to 0° and vice versa is displayed correctly. This procedure doesn't actually reflect the wind strength. Instead, it displays every direction equally, regardless of the actual wind strength. The direction is displayed when the user chooses a series of measurements with the function "save mean values." If you would like to record on other channels which should not be averaged, then, before reading the average values, enter an independent series of measurements into the channel. The channel will then register these values without finding the mean. These two recordings must then be "combined" to achieve the result.

Measuring Wind Direction with a 360° Potentiometer

Wind direction pickups are delivered as 360° potentiometers. The resistance is typically 400Ω or 2KΩ. Nevertheless, they have, in principal, dead ranges, in which there is no contact between the lug and the other connections. To limit this area of limbo, attach the lug to the other side of the potentiometer and you then have a 2-wire potentiometer which can cover all of the dead range. The dead range should then provide a useful measurement instead of just an open measurement to the port. There are two ways to attach wind direction pickups with built-in potentiometer to the datalogger's An-sockets:

1. 4-wire resistance measurement (up to 8kΩ the 2-wire system is practical).

The 2-wire and 4-wire methods are described above in the section "Measuring resistances."

2. Potentiometrically using a resistance in series. Use the 2-wire system, which is only really effective from 8kΩ because of the in principal linearity error.

multisens input: analogue | An | | Wind direction |

magnitude/principle

| AnRpW |

short form

Pickup: potentiometric wind direction pickups
Measuring principle: resistance measurement with constant current
with 4-wire technology
measurement of voltage drop (U = R x I)
measuring range: 200Ω or 2kΩ
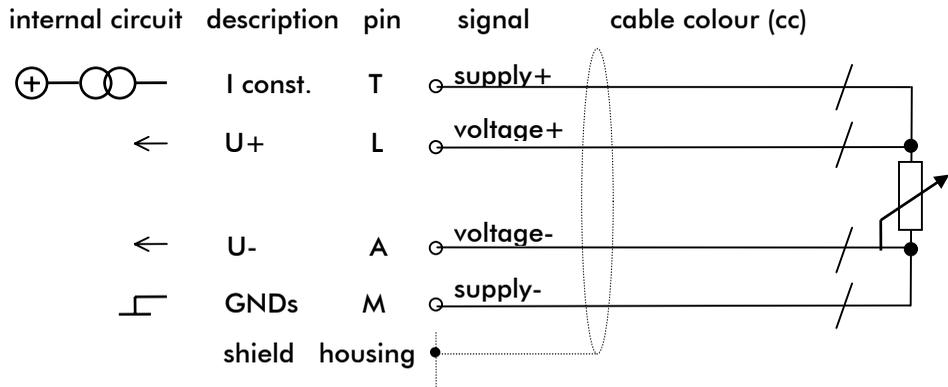
Connection Plan:

internal circuit	description	pin	signal	cable colour (cc)
$\oplus$—OO—	I const.	T	supply+	
←	U+	L	voltage+	
←	U-	A	voltage-	
⎽⎿	GNDs	M	supply-	
	shield	housing		

Input Plug Pins: *multisens* analogue

soldering side
of the plug

shield

G○   ○E
S○ R○ P○ ○O
J○ T● U○ M● N○ ○C
L●   A●

supply+ / I const.
cc:

voltage+ / U+
cc:

supply-/GNDs
cc:
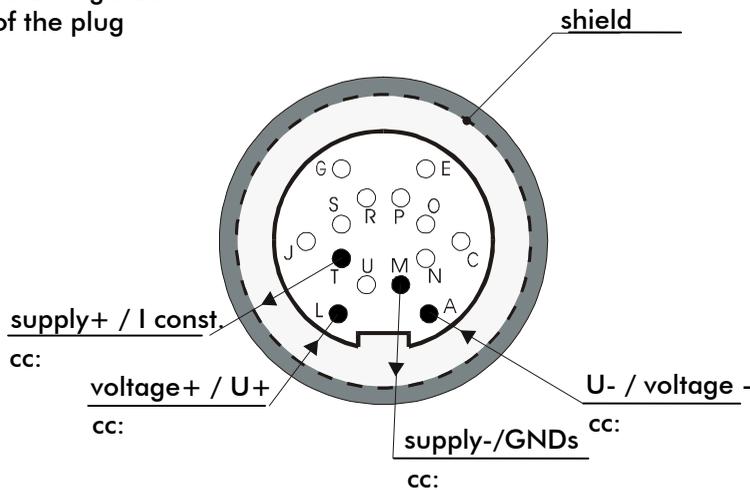
U- / voltage -
cc:

Pin/Signal Description:

$I_{const.}$: precision constant current ca. 1,03mA switched
U+: measuring voltage +
U -: measuring voltage –
GNDs: signal ground

mikromec® Configuration:

for wind direction pickups up to 2kΩ

multisens input: analogue | An | Wind direction, potentiometric

magnitude/principle

Pickup: wind direction pickups with potentiometer over 2KOhm

AnRpRvW

short form

Measuring principle: resistance measurement with constant current, 2-wire voltage measurement on bleeder (not linear!)

Connection Plan:

signal	description	pin	cable colour (cc)
supply+	5,000V	N	
meas. voltage +	U+	L	
meas. voltage -	U-	A	
supply -	GNDs	M	
shield	housing		

resistor in series Rv

variab.res.: RPoti

Input Plug Pins: *multisens* analogue

soldering side of the plug

shield

G E
S O
R P
J O
U C
T M N
L A

U+

cc:

GNDs

cc:

U-

cc:

Vref

cc:
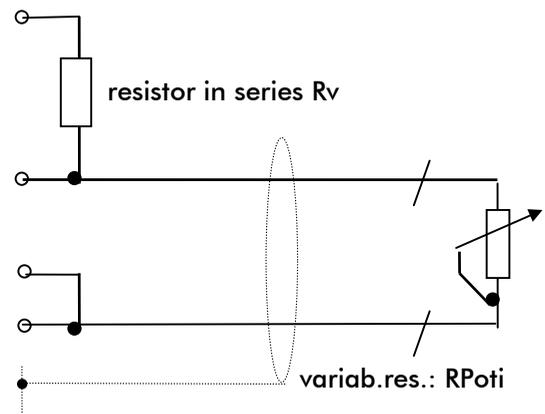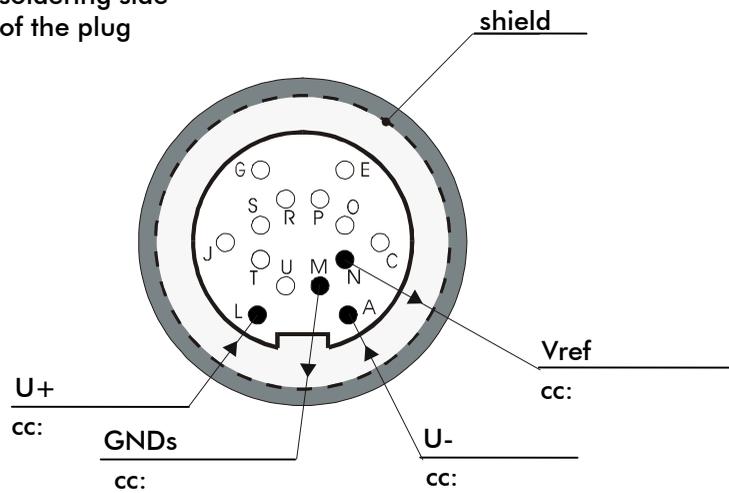
Pin/Signal Description:

V_{ref}: supply 5,000V
U+: measuring voltage +
U -: measuring voltage –
GNDs: signal ground

mikromec® Configuration: for wind direction pickups up to 100 KΩ

The series resistance has to be large compared to the wind potentiometer in order to minimize the non-linearity of this circuit. The output voltage is thus maximum = Vref*Rpoti/(Rv+Rpoti).
Select the corresponding UxxxV scale and carry out the precise adjustment by scaling. As non-linearity error remains: Rv/Rpoti = 1 -> -17%; Rv/Rpoti=24 -> - 1%; Rv/Rpoti=250 -> -0,1%.
Up to 8KΩ, prefer the linear resistance measurement with constant current.

Measurements with Thermo-couples

The datalogger is able to perform cold conjunction measurement directly at the input-sockets. An isothermic surface located under the An-sockets has thermal contacts with the relevant voltage port pins. Therefore, in order to perform precise temperature measurements (degree of accuracy ±2°C) the datalogger's input-socket panel must be placed in a thermally stable environment. Before making an exact measurement, the mikromec®*multisens* must be left in place for approximately 30 minutes in order to minimise the flow of heat and so that the components can thermally adjust. Every error in the determination of the cold conjunction measurement temperature will impact fully on the resultant temperature reading. The internal temperature can be indicated, and if necessary registered, as "T_internal." To do this, see the sensor list. The thermal conditions can be considered to be adjusted when then core temperature changes by less than 1°C within a 10-minute period.

The datalogger measures the readings from all standard thermo-couples and also contains their linear representations. This applies to types B, J, K, L, S, T and U.

To make the replacement of thermo-couples easier, *TECHNETICS* has designed the relevant adaptors to connect the coloured bipolar DIN-plug to the An-type input sockets (order No. for type K: TTKA). This solution allows the use of both mass-produced and disposable thermo-couples.

Thermo-couples must be connected with a thermo-wire directly to the point of the cold conjunction measurement. To make this easier, the so-called compensating-line for the different types of thermo-elements is available as both a flex and a cable.

Circuit Diagram for Thermo-couples

see next page

multisens input: analogue | An | | **Sensor: Thermo-couple** |

Pickup: K, J, L, T, U, S, B

magnitude/principle

| Tx |

short form

Measuring principle: measurement of thermo voltages, linearisation,
compensated by cold junction measurement temperature

**Anschluss-
schema:**

| description | pin | signal | cable colour (cc) |

U+   L   Thermo+

U-   A   Thermo-

             51kΩ

GNDs   M

shield   housing

**Input Plug
Pins:**

multisens analogue

soldering side
of the plug

shield

G○   ○E

S○   ○   ○O
    R   P

J○   ○   ○   ○C
     U   M   N
  T○

L●   ●A

U+
cc:

GNDs
cc:

U-
cc:
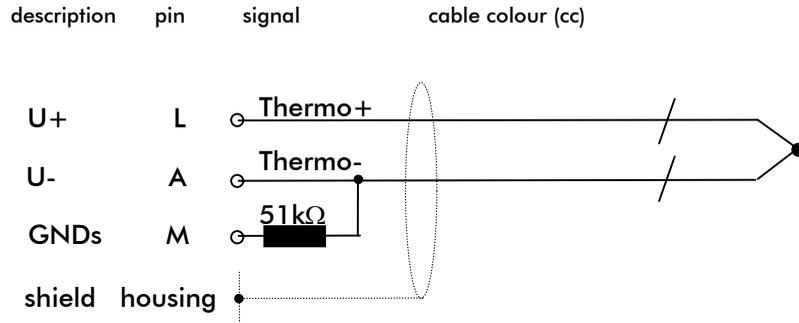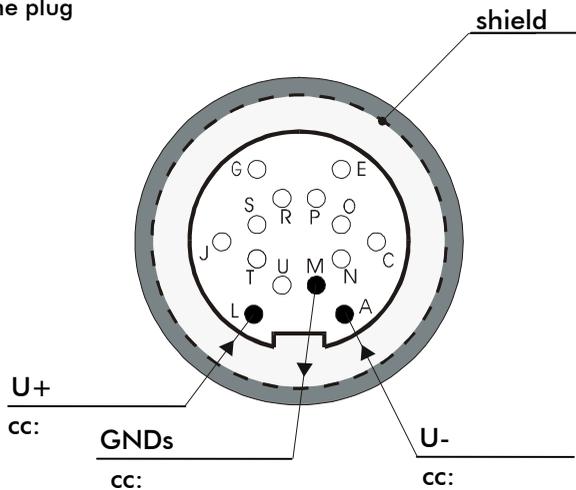
**Pin/Signal
Description:**

GNDs: signal ground,
         reference potential
U+:   thermo input +
U-:   thermo. input -

**mikromec®
Configuration:**

Select the corresponding scale TK, TJ, TL, TT, TU, TS, TB;
for types K and J there are two measuring ranges in the mikromec®*multisens*.

Note: Cold junction measurement is automatically carried out on the sockets of
the mikromec®. Let plug temperature assimilate to logger temperature. Avoid
heat effects.
Adapters with DIN flat connectors available to connect thermo-sensors. The
thermo-couple wire must reach up to the input plug pin.
Caution: If thermo-couples are not isolated, problems of potential are possible
(max. common mode range ±11V). The 51KOhm resistor is the reference poten-
tial.

Measuring Alternating Voltages

The datalogger can measure frequencies and alternating signals (i.e. turbines or vane probes). The datalogger cannot measure the values of the voltage and current waves on its own. It requires additional modules (TRUE RMS-MODULES) to be connected in series.

These modules analyze the signals from standard clamps and convert them into the equivalent DC voltage. The modules are connected to the An-type input sockets.

If you wish to make measure the supply network or power usage, please refer to the special prospectus entitled "Energy usage and high-voltage measurements."

Measuring pH-values with Temperature Compensation

The datalogger automatically performs the temperature compensation for pH-probes. To do this, an appropriate sensor to measure the temperature of the liquid must be attached to the preceding channel. Suitable sensors include the "RTD100>", "RTD1000" and all thermo-couples with resolution of 1/10°C (the scale "RTD100<" is not suitable because it provides a resolution of 1/100°C!). *TECHNETICS* offers probes with built-in RTD1000 sensors. Because pH-probes are so sensitive to leaked current, they are connected to the datalogger over an impedance converter or as fully electrically isolated sensors. The *mikromec®multisens'* temperature compensation can also compensate for pH-probes that are not buffered at pH7.

If you wish to operate several pH-probes through the datalogger, you should utilize external Iso-modules or pH-probes with integrated isolation amplifiers.

1. Properties of the pH-probe

The pH-probe is an extremely resistant probe with approx. 58mV per pH. This source can only be loaded with several TERA-Ohm (10^{12}). For this reason the probe is connected using an impedance converter to the datalogger's An-port (preferably channel "An-2"). If the probe's sensitivity falls considerably under 50mV/pH, it is defective. The initial value at 7pH (the null value) cannot come to more than ±30mV. The way to determine these values with help of the datalogger is described under the pH-calibration. The so-called "Nernst-voltage" of the measurement cell has to be thermally compensated in order to get a valid pH-value. The datalogger performs the thermal compensation calculation, which is contained within the scale U_pH/T. This scale requires a suitable temperature sensor on the previous channel (suitable sensors include the RTD100, RTD1000 and all thermo-sensors with a resolution of 0.1°C) in order to register the resultant temperature. The algorithm is linear and can be found in the associated literature: The sensitivity usually varies around pH7, so most pH-probes are buffered at pH7. This is demonstrated by the fact that the initial signal at pH7 is nominally 0mV. (The datalogger can also correctly compensate for pH-probes that are buff-

ered at different values!) Because the pH-sensors are so highly ohmic, the device is very sensitive to leaked current. The device must be carefully maintained and protected from moisture: clean the seals and then rub in Vaseline sparingly. Do not forget or leave out the O-rings in the impedance converter. If cable damage occurs, for instance tears or ripped plug-caps, the system is no longer useful and must be repaired. During assembly, no dirt or moisture can be allowed to get into the device. The cables are custom-built and cannot be repaired. If necessary, the entire pH cable must be replaced. The manufacturer indicates the life of the cable to be approximately half a year of use. Manipulating the cable when frosted over can cause particular damage. The useful life of the pH-probes is equally limited. If moisture or any electrical current affects the probe, even the minutest current (Giga-Ohm!), the cable will collapse and break more quickly. After a short circuit, it will only recover slowly – if at all. Unused pH-probes cannot be allowed to dry out. Disconnecting the pH-probes before storage can extend their life expectancy somewhat.

PC-Connection:
Despite the high isolation requirement, the logger can be connected to a PC over the RS232 interface during measurements. This is because the serial interface is electrically isolated. The circuit to the pH-electrode (for instance to the ground or to other sensors) has to be completely isolated.

2. *Installation*

In order to measure pH-values, an RTD100 sensor is connected to one channel (for instance, channel 1) and the pH-probe is connected to the next channel (for instance, channel 2). The order is very important. The RTD100 sensor has to be connected to the channel immediately preceding the pH-probe. Both channels are type "An." In order to minimize potential problems with the pH-probe, a thermo-probe version with the highest possible isolation resistance should be selected. In this configuration, the logger is able to carry out the pH-value temperature compensation. The logger also has a special calculation scale for this purpose: U_pH/T. (In this setup, the logger can measure $\pm 1.25V$. The expected range is approximately $\pm 0.500V$ for 0 to 14pH.) pH with temperature compensation can also be measured by devices with Iso socket-types. In this case, select the scale ISOpH/T. If the probes are already temperature-compensated, use the other two logger scales: U_1V_pH and if necessary ISO_pH.
Preselection of the pH scale for temperature compensation:
The first task is to set up the temperature sensor. In this case, it will be an RTD100. (RTD100 only possible as RTD100>!, RTD1000 and thermo-couples in the 0.1°C resolution!): using the select key to confirm, goto "Setup" / "Sensor Selection" / "chan1" / "change" / "temp.resistance" / "TPt100>" and then use exit key to jump back. Then the pH-sensor has to be set to the channel immediately following (in this case channel 2): under "Setup" / "Sensor Selection" / "chan2" / "change" / "hydro" / "U_pH/T." If you now go back to the measurement screen with the EXIT key, you see the temperature displayed in °C and the voltage of the pH-sensor in Volts. This display does not yet indicate the desired result in pH. The correct result can be obtained through calibration (headword: scaling).

3. Calibration

Two buffer-solutions are required – one for pH7 (compulsory, sensor-standard) and any other, for instance pH9. The buffer solution's exact pH value, independent from the temperature, is written on the bottle. You can acquire this, for example, from the firm INGOLD. Now the logger has to be informed how it is supposed to translate the voltage values from the pH-probe into an exact pH display. This is done by giving the logger two known points (X1/Y1 at pH7 and X2/Y2 at the other pH-value – typically pH9 or pH4). To perform the calibration, an RTD100 must be selected on channel 1 (scale "Pt100>") and "UpH/T" on channel 2 (or on channels 2 and 3, etc). You should perform the calibration as close as possible to 20°C. In the temperature and measurement range from 0 to 60°C and pH0 to 14, the pH temperature compensation interpolation error in the logger is less than pH0.1! If the measurement temperature is ±5°C from the optimal range, the display is then accurate to exactly 0.02pH. The pH probe is then submerged into the pH7 buffer solution. The RTD100 has to correctly display the temperature of the buffer solution, so allow time for the temperatures to equalize. Measure the temperature with the logger and then, using this result, find the exact rated pH value point on the table on the solution bottle, for example pH = 7.02 at 20.0°C. Perform the same procedure with the second buffer solution and note down its rated value as well (for example 9.26pH). Select the "U_pH_T" scale on channel 2 (socket-type An) as previously explained, then: "Setup" / "Scale Sensors" / "chan2 U_pH/T." / "1 Namex_U_pH/T". The logger enters the "x" into the name to identify that it is now a modified scale (from the basis-scale "U_pH_T.").
"2 dimension xxx," where the xxx is the unit of measure – in this case, pH: for "dim: xxx" enter an underscore with key 9 (press numerous times) in the first position, then using key 6, a small "p," then an "H" with the 3 key. Confirm with SEL. Adjust the comma position with   to 00.00_pH, since the desired range of up to 14.00_pH is adequate.

And now the actual adjustment:
It can be found under: "Setup" / "Scale Sensors" / "chan 2" / "4 X1 = 0.000_V_"

First scaling point: X1 = 0mV should display Y1 = 7.00_pH. Therefore, simply enter "1 type" and key in 7.00 pH as X1 – or, more precisely, take on the measured X1 value with "2 measure." The offset-voltage of the probe will be displayed and then taken on with the SEL key. The sensor is unreliable if this offset voltage is more than ±30V. Signal value X10.004_V_SEL = take value.

"5 Y1 = 0.00_pH": here, the previously noted rated value of the buffer solution pH7 at the current temperature must be entered: 7.02_pH according to the previous example. Display value Y1[_7.02pH].
Now the second buffer solution, for example pH 9.26 at 20.0°C! -> Submerge the probe and allow the temperatures to equalize. The temperature has to have been measured previously, in order to find the correct value on the table – we noted the value at the start of this procedure. The most precise result is achieved when both buffer solutions have the same temperature to within 1/10°C (a water bath can be used, for instance).

"6 X2 = 1.000_V_": Second scaling point: X2 = ca. –116mV should display Y2 = 9.26pH. Therefore, simply enter "1 type" and key in 9.26pH as X1 – or, more precisely, take on the measured X2 value with "2 measure." The voltage of the pH-probe in the current pH9 buffer solution will be displayed and then taken on with the SEL key. This voltage should lie at –116mV, otherwise the probe is unreliable.
Signal value X2: -0.116_V SEL = take value.

"7 Y2 = 9.26_pH": here, the previously noted rated value of the buffer solution pH9 at the current temperature must be entered: 9.26_pH according to the previous example. Display value Y2[_9.26_pH]. Here you can see how sensitive the pH-probe still is: (116+3)mV / (9.26-7.02)pH = 53.15mV/pH sensitivity! Values clearly under 50mV/pH indicate that the probe is worn out or tainted.

Use EXIT to leave the scaling menus. If an error occurs, the message "No temp-calibration!" appears. That can have the following causes: no useful temperature measurement on the previous channel, because, for example, the incorrect scale or sensor has been selected for the previous channel. Only RTD100>, RTD1000 or thermo-couples with a resolution of 1/10°C can be used.

Note: Procedure for probes that are not buffered at pH7: In the above procedure, the first reference point (X1/Y1) is not calibrated to pH7, but to the probe's pH value. That means that a buffer solution always has to be created that has the same pH-value at the probe's internal buffer. The logger always changes the sensitivity around the pH-value of the first reference point (X1/Y1) dependent on the temperature.

Error Analysis

If this arrangement fails (the system shows nonsensical values (for example clearly negative or excessive pH-values) or doesn't react at all anymore) you can find out where the error lies relatively quickly:

4.1)   Select "U_1.25V, in order to see the probe-voltage directly. If these errors are too large, the temperature compensation becomes uninteresting!

4.2)   Submerge the pH-probe into the buffer solution and note the voltage value: if the voltage changes by less than approx. 30mV or if the voltages didn't previously lie within ±0.500V or if it drifts within 2 minutes more than approx. 10mA, check the arrangement step by step as follows:

4.3)   Is it the pH probe itself or the cable/booster? If another functioning probe of the same construction type is available, simply exchange the probes. This work must be done extremely cleanly so that no moisture finds its way into the connectors during the changeover. If the error disappears and the previously defective systems functions with the new probe, the old probe is worn out or tainted. If the system is still defective, despite the new probe, the isolation cable or booster have to be examined:

4.4)   Plausibility-check of the logger:
The voltages that the logger displays after the U_1.25V scale has been selected, can be checked by using a digital voltmeter to measure the impedance converter's output voltage directly on its output plugs (internal wire against the external wire) or on the 14-pinned pH-plug (type "An") pin L (+) against pin A (0). To do this, remove the pH-plug from socket 2. This voltage is also there when the logger is unplugged, since the impedance converter is a battery. No damage can be done to the digital voltmeter through accidental short-circuits. Swapping pH-probes between systems for these checks is allowed.

4.5)   Check the booster (impedance converter):
Boosters have a built-in 3V-lithium-batterie type CR14250SE from Sanyo. The impedance converter delivers the probe voltage one-to-one to the logger. (Its offset voltage is usually approx. 70μV.) This voltage can be measured at the outputs with a digital voltmeter, which the logger does usually, in order to test the probe independently from the logger in case of an error. The internal wire is the positive connection! You can expect approx. 58mV per pH at the impedance converter's output.
Approximate values:

Voltage	pH-Value
+407mV	=> pH0
+116mV	=> pH5
+ 58mV	=> pH6
0mV	=> pH7
- 58mV	=> pH8
-116mV	=> pH9
-407mV	=> pH14

The voltages can also be directly (without any compensation) displayed on the logger: To do this, select the U_1.25V scale instead of the U_pH/T scale on channel 2. The direct mV values will be displayed. You can also use this method to check the impedance converter's battery without having to remove it. Select the scale U_1.25V on channel 2 and observe the voltage. Now take a 1.5V battery (or any other voltage source) and supply a voltage for a short time to the now free end of the pH-cable: the logger has to display at least +1.2V, and after switching the battery poles, -1.2V. That is the booster's saturation voltage. If the values are smaller, open the impedance converter and swap the 3V battery.

Notes: In the $\pm$1V range, the voltage has to be passed exactly through the logger (use a voltage calibrator with 10MOhm resistance on the short wires). The same voltage value must be displayed at the output of the impedance converter – with or without the 10MOhm resistance. You cannot measure directly at the pH-probe because of the high internal resistance. If the pH-probe breaks down through a cable with a booster, the impedance converter has to be measured using the above procedure. If the error then disappears, either the cable was damaged or there was moisture in the junction points. In humid environments, the impedance converter and its connections should be given special protection from moisture.

Connection Adapters/Measurement Modules for Analogue Magnitudes at "An" Sockets

Us Voltage Measurement Cable "Single Ended"

For voltage measurements against a ground, a ready-to-use double-wire connection cable with banana-plugs and –sockets can be delivered. (Order code: MKUs-B.)

Ud Voltage Measurement Cable "Differential"

For differential voltage measurement, a ready-to-use double-wire connection cable delivered with banana-plugs and –sockets. (Order code: MKUd-B.)

Up Module

At the sockets of port types An, Anp and Ani, small Up-modules (order code MAUp-B) can be connected in series. These are designed for "potential-free" voltage measurement. The module and the display operate in a bipolar manner: positive and negative voltages of equal quantities can be measured.

The point of this module is to limit the common mode problem – albeit at the expense of a smaller input resistance of approx. 1MOhm. Both of the wires – one red as positive and one black as negative – can be used, in a simplified way, like the two wires on a voltage-multimeter. This is done on all channels separately, without needing a real electrical isolation. This is particularly recommended at voltages over 500mV and at common mode voltages up to 40V.

A further advantage over directly using pins L and A on the An-socket for voltage measurements is that the negative path in the Up-module is also highly resistive (approx. 1MOhm). Therefore, during measurements with multiple channels and from strong sources (for example accumulators) even if the poles are connected wrong, nothing will be burnt up.

The Up-module is purely passive, has an extremely symmetrical and individual equalizing network of resistances with minimal drift and divides voltages by 10.

Ip Module

At the type An, Anp and Ani sockets, small Ip-modules can be connected in series. These are designed for "potential-free" current measurement.

The Ip-module is also purely passive and has an extremely symmetrical and individual equalizing network of resistances with minimal drift. Approximately 100Ohm are laid in the current path as a bridge.

Order code: MAIp-B.

External "Iso" Module for "An" Ports: MisoU/I

This externally connectable module gives the An, Anp and Ani ports the possibilities that go with a built-in Iso port type. The point of these modules is to provide electrical isolation to individual channels with An-type ports.

The technical characteristics are under: Measuring Analogue Magnitudes. Electrically isolated "Iso" ports are described lower on this page.

External 20mA Isolation Converters for "An" Ports: MIso20mA

This externally connectable module gives the An and Anp ports the characteristics of the Ani-ports. The MIso20mA is an isolation converter for 0 to 20 or 4 to 20mA standard measurement signals. You do not need to supply a 2-wire-transmitter with this module. The isolation is achieved using a direct current transmitter, which requires a higher load voltage (of 1.8V) than the mikromec®*multisens'* standard ports, with their 0.48V.

Measuring Analogue Magnitudes: Electrically Isolated "Iso"

Electrically isolated "Iso" ports are available as an option. They allow the electrically isolated measurement of 20mA standard signals and voltages of 2V and 10V direct voltage. An extremely high uncoupling for the source from all other signals is necessary in order to measure certain signals (for instance, pH-measurements). With the help of the in-built electrical isolation modules, this demand can be achieved. The option is called "Iso"-ports.
You can also use these ports to be able to tolerate higher common mode voltages than the An-ports and the Up/Ip-modules will allow.
If you only want to achieve the "Iso" possibilities on one channel, it is enough to simply connect a single external "Iso"-module to the standard "An"-socket. The module, just like the built-in Iso-channels, has a real isolation converter with 100% electrical isolation and at least 1000V isolation voltage. On top of that, the module is also capable of excitation to pH- and Redox-impedance-converters.

The Layout of the 5-pinned Iso Input Sockets

Pin 1: Input 2.000V
Pin 2: Input 10.00V
Pin 3: Ground, isolated
Pin 4: Reserved (isolated for +5.6V supply)
Pin 5: Input 20mA

Connection Adapters/Measurement Modules for Analogue Magnitudes at "Iso" Sockets

Useful series-modules for the Iso-port (and Iso modules connected in series) are impedance converters for pH-measurement and redox potential measurement. TRUE-RMS-converters are used to record alternating magnitudes. For other tasks, feel free to ask us about suitable modules.

Measuring Impulses and Frequencies: Port Type "IF"

Measuring Frequencies and Impulses

The IF-input in the mikromec®multisens accepts alternating signals with changing levels:
1. Voltages with 0 and +5V TTL-levels (more precisely HC-levels)
2. Pickups with NAMUR directions DIN 19234
3. Alternating signals from 100mV (effective) from turbines and vanes

Reed contacts, proximity switches, photosensitive relays and much more can be connected to IF-ports. Only one of these many input levels can be used on an individual IF-socket at any one time. This is because there is only one hardware counter per IF-socket. Two IF-sockets are standard, but two more can be fitted as an optional extra, which makes the maximum possible number of IF-ports 4.

The resolution of frequencies (and of course of impulses) is always a full number, i.e. 1Hz (or 1_i_). Not even scaling can produce a higher frequency resolution, because the input signal changes are only registered exactly once per second.

Impulses can also be recorded without gaps while in the sleep mode if the SML signal (pin K) is bridged to the ground. If that is not done, each time the device wakes up, an "error impulse" will be counted! The SML signal should only be bridged to the ground when the counting should proceed in the sleep mode, since this procedure requires a higher quiescent current.

Frequencies and impulses cannot be measured and recorded in the "fast measurement" mode.

At this time, impulses cannot be scaled. They are offered instead in a predefined graduation of "impulse weights."

The digital and status inputs do not lie on the IF-port, rather on the Dig-port.

Frequency Measurement

Frequencies can be directly displayed in the range from 0 to 9999Hz. Due to their nature, frequencies can only be displayed with a maximum resolution of 1Hz (i.e. 1 impulse per second). The pickups are connected to the IF-sockets. Different levels are accepted.

Because of the restriction to 1000 scale parts in the display, only 0 to 9999Hz are directly displayed. Through scaling (see that chapter) a range of 0 to 30kHz can be achieved at the expense of resolution. The individual IF-socket pins are filtered from strongly differing frequencies, so you have to make sure that the offered frequency signals can actually be registered at all.

Impulse Measurement/Counting

Impulse recording has its own peculiarities:
The channel's current counter state is shown in the "normal" display as long as no impulse-recording is running. The display style changes as soon as one of these

recordings starts: only the impulses in the interval are displayed and only at the end of the interval. The change in the interval is recorded. That means that during the first interval, no result can be displayed until that first interval is completed. The display becomes even less transparent when multiple recordings are running at the same time: the last recording to have been measured shows its mean differential counter reading on the display. Due to the principal nature of this problem, it cannot be properly solved by using different types of displays.

Back to displaying impulse values: select "Setup" / "Select Sensors" / "counts" and you see the current counter state in the display (no recordings should be active here!). Each impulse will be individually counted and displayed. If you want to reset the counter to 0, use "Clear" / "Reset Counters."

Note: If one or more recordings are running in which no impulses are being displayed, impulses are only displayed in the recording's interval. This leads to incorrect impulse counts being displayed. This error will be fixed in the next firmware-version.

Limitations of the Impulse Measurement

So far, impulses cannot be scaled or offset-adjusted. Therefore, there are already a number of finished scales (no. 94-98), which cover common pulse-levels: 1 l/Imp, 10 l/Imp, 100l/Imp and 1m³/Imp. *TECHNETICS* can offer customer-specific scales, which can be retrofitted to the device.

Measurement of Up/Down-Counter-Signals/Impulses

The mikromec®multisens, in its standard configuration, can only measure impulses upwards at the IF-ports. A special component, the Up/Down-Counter, allows for counting ports with two inputs. This system offers alternatively 0 and 90° signals, Up/Down or Pulse/Direction inputs. Feel free to ask us about any new developments in this area.

Basic Circuit of the Impulse/Frequency Measurement

The three input levels: NAMUR, HC/TTL and turbines on each IF-port go to one counter-channel. There is only one counter per channel but there are three of these signal-processing branches. The following describes some of the possible connection types:

Cable/Measurement Module for Impulses and Frequencies

The series box with screw terminals is available for universal use: order code IFAd. It is suitable for experimenting and for situations where pickups and counters are regularly changed.

Measuring the Signals from Reed-Contacts

Reed contacts are reeds, in a glass tube, that are sensitive to magnetic fields. Usually they are closers: contact is made as long as a magnetic field is acting on it.
There are also reed-change-over switches. Its magnetic field is caused by a fixed magnet or by a current-flow-allowing inductor.

Types of Pickups with Reed-Contacts

Under certain circumstances, the following work with reed-contacts:
Rain seesaws
Shell-stars for wind direction
Miniature relays
Quantity-counters with reed-plug-in-slots
Door contacts

Connecting Reed-Contacts: Debouncing

Reed-contacts are used to measure very slow or rare events, but also to measure counters or wind-strength measurers with several hundred Hertz. Since every mechanical counter can bounce (in principal), it makes sense to limit the signals to the maximum expected frequency. The reed-contact cannot be allowed to "see" any capacity whatsoever over its contacts, otherwise it will weld itself shut when it closes.
If you like to know afterwards if a "slow" contact or a counter is bouncing, it is advisable to display the signal with a recording with the best possible timed resolution of 1 second sampling interval. If too many counted impulses are regularly being counted within the interval, the sensor is bouncing.
The frequency that the signal has to be limited to depends on the refresh rate and the shortest retention time in the reed-contact's two positions.
The following debouncing has proven itself to be useful: connect 3K9 in parallel to the contact. Connect this parallel connection between pin F and M of the port type "IF." Additionally a 47nF capacitor parallel to it, between F and M. This connection works at up to 260Hz and requires that the switch is closed for >250µs and open for >3ms.

R in Ohm	3900	4700	3300
C	47nF	100nF	4,7µF(+ an Pin F)
Topen	3ms	5ms	1sec
Tclosed	0,25ms	0,5ms	1 sec
Fmax	260Hz	150Hz	0,5Hz

multisens input: impulse/frequency   `IF` | Reed-contact |

magnitude/principle

| Reed |
short form

Pickup: with Reed-contact

Measuring principle: closers built in a glass tube, reacting on magnetic field: gas meters, water meters, wind velocity pickups etc.

Connection Plan:

internal circuit   description   pin   signal   cable colour (cc)

For Reed-contact or closer external debouncing with R and C.

5V

33k

HCin

R=4k7

C=100nF   Reed-contact

Gnd

bridge activates
sleep mode

SML

Input Plug Pins:

multisens Impulse/Frequency

soldering side of the plug

shield

C   B
D
E   A   K
F   M
G   H   SML
J

HCin

Gnd

Pin/Signal Description:

HCin: HC-pulse input, Reed ⊕
Gnd: Ground, Reed ⊖
SML: Sleep mode (Low-active)

mikromec® Configuration:

Select:
„Impulse" or „Frequen" or „Imp-sum" or sensor name from the sensor list

Notes:
* Reed-contacts must be externally debounced   open: closed:
* Values for max. 1Hz: C = 4,7μF   R = 3K3   >200ms   >30ms
              max. 150Hz: C = 100nF   R = 4K7   >5ms   >500μs
              max. 300Hz: C = 47nF   R = 3900Ω >3ms   >250μs

TECHNETICS delivers ready-to-use cables with ferrules for Reed-contacts with frequency limit to 1/150/300Hz: Art.-No. MKIF-Reed-Ad-300

multisens input: impulse/frequency   IF

Namur-contact
magnitude/principle

Reed/Namur
short form

Pickup: with Reed-contact

Measuring principle: Reed-contact on Namur-input
with series resistance

Connection Plan:

internal circuit   description   pin   signal   cable colour (cc)

signal	pin
V_{10V}	E
NAMO	H
SML	K
Gnd	M

pickup ⊕   2700Ω

pickup ⊖

bridge activates
sleep mode

Input Plug Pins:

multisens impulse/frequency

soldering side
of the plug

shield

V10V

SML

NAMO

Gnd
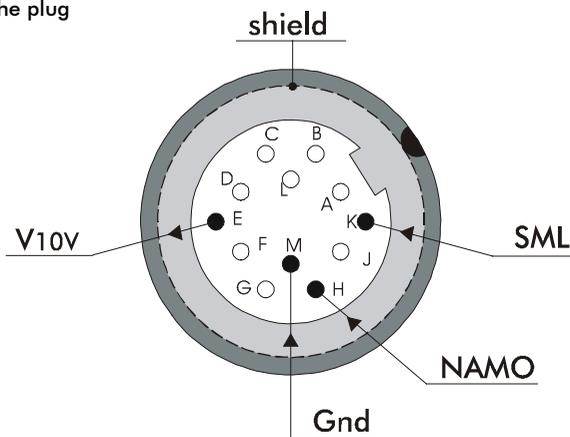
Pin/Signal Description:

NAMO: NAMO-pulse input, Namur ⊖
V10V: Supply 10V stabile, Namur ⊕
Gnd: Ground, Reed
SML: Sleep mode (Low-active)

mikromec® Configuration:

Select impulse or frequency measurement.

Notes:
This circuit provides debouncing/frequency limit to 200Hz in the mikromec®.
When the contacts are closed, a current of ca. 2.4mA is flowing. So this cir-
cuit is quite safe against disturbances.

Connection of 2-wire-Namur-Pickups according to DIN 19234

NAMUR pickups have two different current states and on the *multisens* loggers, they have a suitable input pin in the IF-port. You can use it count the pulses of one of these pickups. The NAMUR-pickup is supplied through its positive pole from the logger's 10.3V over pin E (=V10V) and is connected through its negative pole with the *multisens'* NAMUR-input over pin H (NAMO).

Measuring

multisens input: impulse/frequency　　**IF**

Namur DIN 19234

magnitude/principle

Namur
short form

Pickup: Namur-pickup supplied by mikromec®

Measuring principle:　2-wire pulse pickup, Namur-Norm: DIN 19234
　　　　　　　　　　　water meters, gas meters, industrial pickups
　　　　　　　　　　　optical, inductive

Connection Plan:

internal circuit　　　　description　　pin　　　signal　　　cable colour (cc)

ON: ≥ 2,2mA
OFF: ≤ 1,0mA
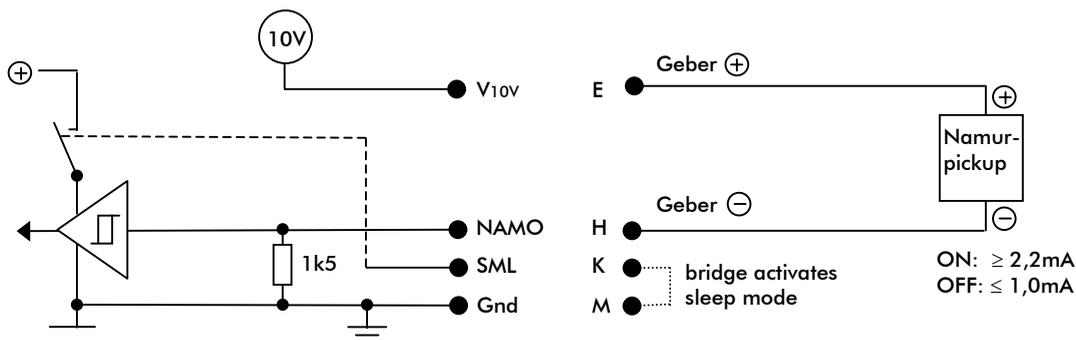
Input Plug Pins:

multisens impulse/frequency

soldering side
of the plug
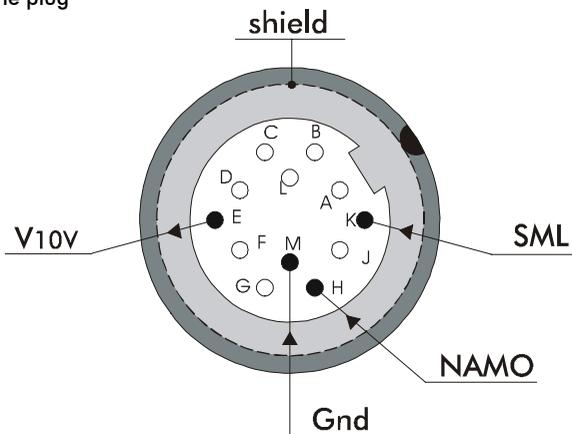
Pin/Signal Description:

NAMO:NAMO pulse input, Namur ⊖
V10V:　supply 10V stabilised, Namur ⊕

Gnd:　Ground
SML:　Sleep mode (Low-active)

mikromec® Configuration:

Select impulse or frequency measurement.

Notes:
The Namur input is frequency limited to max. 200Hz.
The minimum pulse width is 8msec.
The consumption of Namur pickups is ca. 3mA to 6mA and must be taken into account in sleep mode.
The switching thresholds are: < 1,2mA and > 2,1mA (< 1,8V and > 3,15V)

"IF" Input Sockets: Pin Description of Impulses and Frequencies

IF input sockets have 12 pins and up to 6 of these sockets can be fitted to each device.

The IF input sockets can count impulses and measure frequencies. The magnitudes can be offered with different levels. Every type IF counter-socket in the device is treated as a channel. It therefore only makes sense to put one individual signal through each IF-socket, even if inputs with different levels are offered for each socket (pins F, G and H).
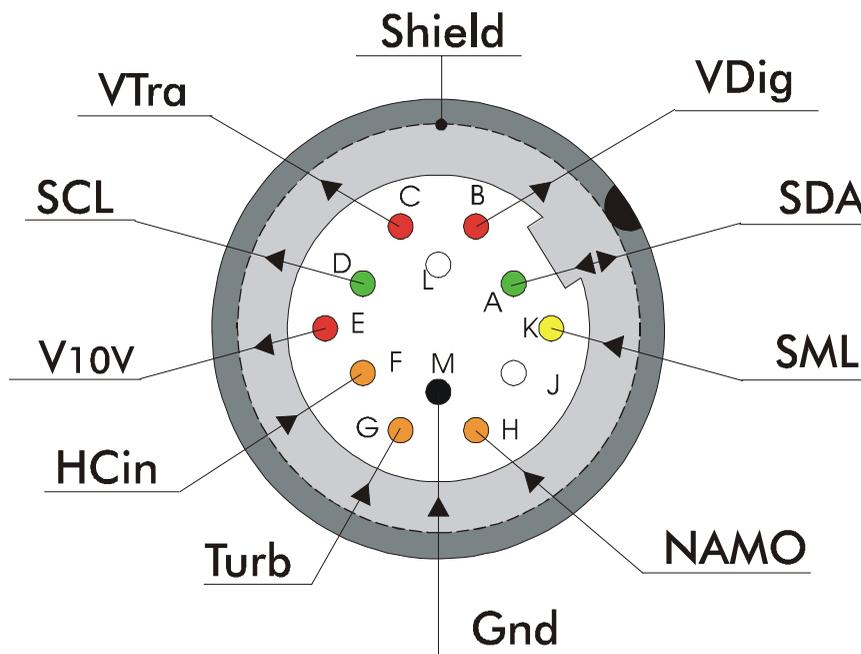
Pin F (HCin) is the TTL-compatible counter-input. Its nominal high-voltage value is 5V, it usually switches at 4.5V±0.2V. Under 2V it can safely recognize zero-levels and above 4.5V it can safely recognize one-levels. Pin F can stand up to 25V for a long time. The rising slope is counted. The input resistance is at least 33kOhm. The bandwidth goes to 30kHz (minimally).

Pin G (TURB) is the input for turbines and alternating signals. It works from 199mVeff to over 5Veff. At the same time, turbines over 2.2kΩ are supplied with 5V. The bandwidth is 10kHz. The turbine's positive pole is connected to pin G, the negative pole to pin M.

Pin H (NAMO) is designed for NAMUR-pickups. The NAMUR-pickup's <u>positive</u> pole is connected to V10V (pin E) and the pickup's <u>negative</u> pole to pin H. This input is limited to 200Hz. There are two current switching thresholds: under 1.2mA and over 2.1mA.

The pins A = SDA and D = SCL are the serial data connections for the sensor recognition. For a description, see An-sockets.

Pin C (Vtra) delivers the switched and electronically fused battery voltage of the internal 12V lead-acid battery used to supply the sensors. For a description, see An-sockets. If the internal electronic safety is triggered, it can be enabled again by pressing the On/Sleep key twice.

Pin B (Vdig) delivers the digital supply voltage of approx. +5V. This 5V is not the reference voltage! The voltage is common to all An- and IF-sockets and can only be loaded with 10mA total. This pin is not designed for free use, rather it delivers the supply to the optional EEPROMs for sensor recognition. If this voltage shorts, it leads to disruptions to the logger functions.

Pin E (V10V) delivers a stable supply of +10V. This voltage is not constantly protected from short-circuits. Its main purpose is to supply NAMUR-pickups. This voltage can also be active when the logger is turned off or in the sleep mode. You can achieve this by connecting pin K (SML\) to the ground.

Pin K (SML = Sleep Mode, Low-active = counting in the sleep mode)
This pin is used to keep the entire signal preparation circuit for the turbines and impulses continually turned on, independent from the logger's on state. This is useful for tasks such as adding the impulses from a water-counter and then storing the results to record them the next time the logger wakes up. This control line has an input resistance of at least 100kOhm. It can remain open. The SML pins of all IF-sockets are connected in parallel. That means that only one sensor with an SML-bridge is required to keep all the counter-circuits awake. The disadvantage is: the circuit with the continually turned on SML circuit constantly requires current and therefore, the running time of the mikromec®multisens sinks – although only fractionally. 300 hours of SML-counting reduce the running time in the switched-on state (usually 24 hours for an 8-channel device) by one hour.

Pin M is the ground. It is connected to all the other socket-grounds and to the logger-housing.

Pin J is reserved and is not allowed to be connected.

Pin L is reserved and is not allowed to be connected.

Unbroken Counting and Counting in the Sleep Mode

The mikromec®multisens can continue to count while it is "asleep." That is made possible by a bridge in the IF-plug. The counter's electronics remain continually active, which of course means a slightly increased standby power usage. Also, see the technical data and the pin-description of the IF-input-socket SML-pin in the previous section, IF-Pin K.

Revolution Measurements on Rotating Parts

The mikromec®*multisens* records the pulses for the revolution measurements over a reflex-pin or over an inductive proximity switch.

You can achieve the highest resolution by producing as many pulses as possible per revolution of the wave, cog-wheel, etc, that is being measured.

When making optical recordings, that can be achieved, for instance, by sticking on precisely divided grid lines. The restriction on even smaller divisions is given by the caliper's optical resolution. This is usually approx. 5mm.

Selecting Sensors and Scales for Revolution Measurement

Two fundamentally different setups are possible:
1. Sensor scale "Frequency" in the sensor group "count/frequency," corresponds to "9999Hz" (is scalable!).
2. Sensor scale "Count" in the sensor group "count/frequency," corresponds to "9999Im" (is not scalable!).

To 1: Sensor Scale "Frequency"

Each second, the number of pulses is determined, and if required, converted into a number of revolutions.

Example:

Grid lines with 20 grids (black and white) are on the wave.

A revolution of the wave each second gives 20 pulses per second (=20Hz).

This single revolution per second corresponds to 60 revolutions per minute.

The following scale will be set up on the mikromec®*multisens*:

$X1 = 0Hz$ corresponding display value: $Y1 = 0.0$ rpm
$Y1 = 20Hz$ corresponding display value: $Y2 = 60.0$ rpm

In general, the "20" for "X2" will be replaced by the corresponding grid-division per revolution.

The display scale "rpm" is sufficient in the above example from 0.0 to 999.9 rpm.

If the measurement range exceeds 1000 rpm, choose:

$Y1 = 0$ rpm
$Y2 = 60$ rpm

To 2: Sensor "count"

This is where the pulse count per recording interval is ascertained.

As long as no recording is entered into the datalogger, the impulse display runs upwards until it hits the highest possible value of "9999" and then starts again at "0."

After a recording has been entered, and as soon as the recording is processed, at the end of each interval the sum of the pulses in that interval will be displayed.

The mikromec®*multisens*' impulse display cannot be scaled.

That means that the conversion into the desired units, for instance revolutions per minute, is performed using the analysis software MM-grafix.

Example:

Given: 20 gratings per revolution, saving interval 1 minute;

20 measured impulses per minute correspond to one revolution per minute.

Therefore, the pulse-count per minute has to be divided by 20 in order to reach the number of revolutions.

Enter the formula: "k1 = k1*0.05" in MM-grafix (example with pulses in column 1)

Dimension: "rpm"

Sensor name: "revol."

Comparison of 1 and 2:

The display once per second from "1" is generally preferable; here you have the possibility of directly scaling the display from, for example, rpm in the datalogger.

If the pulse-count is very low (only a few pulses per second), the resolution in the display will become poorer, so that the sensor selection "count" becomes more practical.

Collecting Status Signals: Port Type "Dig"

The "Dig"-Socket: Status Inputs and Alarm Output

There is only one Dig-socket (12-pins) on the logger. It offers 4 digital inputs, but this can be increased to a maximum of 20 digital inputs using external expansions. *TECHNETICS* recommends here the series box (Order No. MStaAb4, 12 or 20) which provides electrical isolation for 4, 12 or 20 status signals. Electrically isolated contacts and short wires are required to connect 4 signals directly – that is to say without a MStaAb-box.
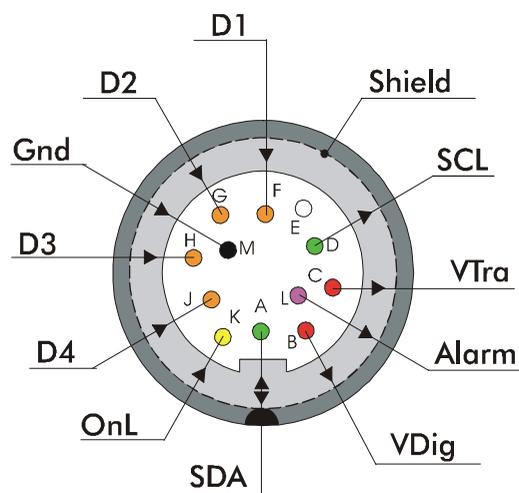
Pin-Description of the Dig-Port

The pins F, G, H and J (D1 to D4) are the 5V digital ports. Their switching threshold is approx. 2.5V and they are protected from excess voltages up to 40V. The input resistance is at least 100kOhm. If 5V are supplied, the logger displays a 1. Open digital inputs are displayed as a 0. To reach these pins, select the "STA 1-4" sensor scale in the logger. Further status inputs can be realized using additional modules.

Pin K (ONL = On, Low-active) has the function of performing forced turn-ons and resets on signal edges. The pin is low-active – that means: as long as this pin is connected to the ground, the logger is turned on. If the logger is already turned on for another reason, a reset will be triggered on both signal edges – that is to say at positive and negative changes. The pin can remain open as long as you don't require this function.

Pin C (Vtra) delivers the switched and secured battery voltage from the internal 12V lead-acid battery to supply the sensors. For a description, see An-Sockets.

Pin B (Vdig) delivers a digital supply voltage of +5V. This 5V is not the precision reference voltage. The 5V-voltage on pin B has an internal resistance of 1kOhm. It is not intended for random use, but rather to supply smaller consumers in the deliverable plug-in modules. If this voltage shorts, it interrupts the logger's function.

A voltage signal is given out on pin L (alarm), which corresponds to the status of the ALARM-LED on the front-plate. It has an internal resistance of 1kOhm. If one of a channel's limits is violated, 5V are given out. Usually 0V are given out. The pin only works when the device is turned on. The pin is inactive when the device is asleep.

The pins A = SDA and D = SCL are the serial data connections for the alarm modules and expansion modules for further digital inputs. All SCL-lines have different signals at the different sockets.

Pin E is reserved and is not allowed to be connected.

Basic Circuit Wiring for the Status Inputs

The first 4 status inputs are the pins F, G, H and J on the mikromec®multisens' digital input-socket. The pins have the following internal wiring:
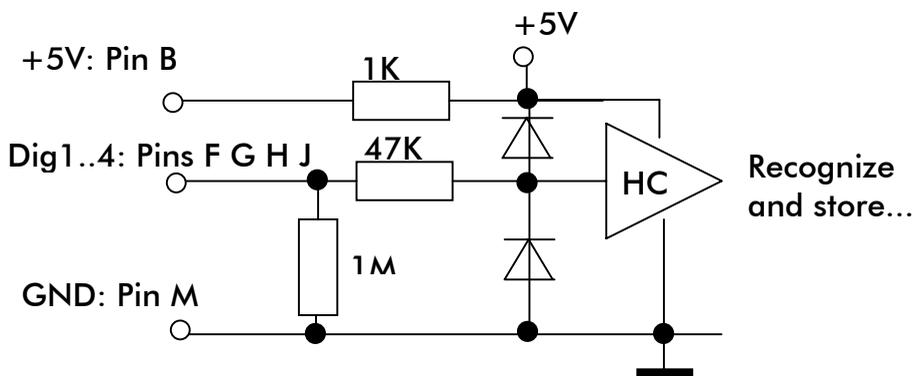
Internal wiring of the mikromec®multisens for status-inputs D1 to D4.

The inputs D5 to D20 are connected to the mikromec®multisens over an external status-box at the dig-port. This box has a slightly different wiring from the individual status inputs, which is described in the MStaAbxx documentation.

The following external wiring at the Dig-port produces a one-signal for each closed switch and a zero-signal for each open switch.
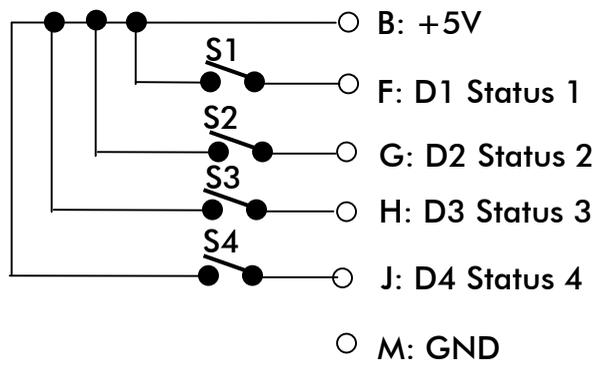
The following circuit is designed to connect up to 4 voltages. In this case, 4 switches can drop out if just one voltage is applied which changes the value between approx. 0V and its maximum value. These voltages do not have to be uniform. The most common signals are SPS-signals or TTL-signals. The upper value can lie between 5V and 24V. The lower cannot lie under 0.8V.
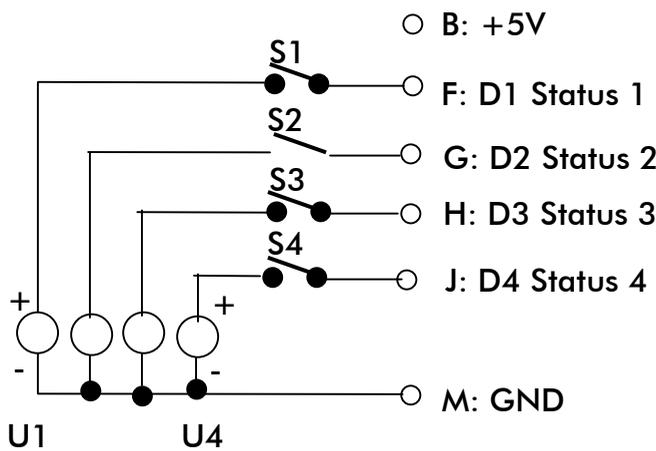
The Status-Inputs of the *multisens*-Systems

The mikromec®*multisens'* status inputs offer the possibility of recording logical voltage states with 0 and 1 over time. Additionally, you can also trigger measurements with these ports: record on status change or repeated triggering of a measurement task on a particular signal.

Expansion-Possibilities to 20 Status Inputs

The status inputs are offered as 4, 12 or 20 input versions. 4 inputs are always available directly on the Dig-input-socket. If no electrical isolation is required, these 4 inputs can be used directly. See pins F, G, H and J with 5V levels.

If more than 4 inputs or electrical isolation are required, the corresponding input modules are available from *TECHNETICS*. The input voltages for each line can be separately jumpered to 5V, 24V or 230V at these modules. Direct and alternating voltages are accepted. It is possible to connect electrically isolated or non-electrically isolated contacts. (*TECHNETICS* order no. MStaAb4, 12 or 20.)

Limit Values: Variable Thresholds which can Trigger Alarms

Limit values are thresholds that the logger checks during every measurement. If a limit-value is reached, an alarm will be activated (sometimes with a delay). A recording of these limit value conditions can also be started.

The logger monitors two limit values per channel. The user can decide if an alarm should be triggered if these freely chosen limits are exceeded. An alarm is displayed in the measurement display by a star behind the relevant channel and also by the ALARM-light-diode lighting up. At the same time as the light diode, a 5-Volt signal is sent through pin L on the Dig-socket, as long as the logger is active.

The way the alarm reports respond can be comfortably changed:

Should the limit value be exceeded for a certain amount of time before an alarm is triggered, or should the alarm appear immediately? (See "Alarm Min-time")

Should the alarm remain continually on or be revoked when the reading moves back within the limits? (See "Continual Alarm")

Should the alarm be triggered when the reading exceeds the maximum limit or the minimum limit? That means that each channel can monitor a certain "tolerance band."

Entering a Limit Value

```
Main-Menu
0   measure+record
1▶  setup
2   define recording+
```

```
            Setup
1   select sensors
2   scale sensors
3   offset adjust   +
4   clock
5   RS232
6▶  alarms
7   language
8   lock keyboard
9   time to wait
```

```
1   min. Alarm time
2   continuous alarm
3   modem call
4▶  limits
```

```
       limits
1   chan1      off
2   chan2    U   2.5V
3   chan3      off   +
```

Limit value thresholds can be assigned to each channel. Once these thresholds are exceeded, an alarm will be triggered. In this case, an alarm should be triggered when channel 2's value exceeds 1V. The alarm should engage without a delay and then disengage when the value falls back under 1V.

```
     Limits of ch1
1▶  limit 1
2   limit 2
```

```
< -5.000_V_
1   controlled
2   not controll
3■  change value
```

```
limit 1 of ch1
 change value:
      -[5.000]_V_
```

The limit value should be monitored at >1.000V, so +1.000V must be entered here. The entry is confirmed with SELect and the following appears:

```
limit 1 of ch1
alarm if 1.000_V_
1□ is exceeded
2■ is fallen below
```

```
   >=  1.000_V_
1■ controlled
2   not controlled
3□ change value
```

Use the ▲ to highlight "controlled" and confirm with SEL. Channel 2 is now monitoring values exceeding 1V. In order to make certain that the mikromec®multisens sets off the alarm with no delay, set the minimum alarm time back to 0 sec. Setting the minimum alarm time to 30 seconds would mean that the limit has to be continually exceeded for 30 seconds before an alarm is triggered.

```
      Alarms
1   min. alarm time
2   continuous alarm
3   modem call
4▶  limits
```

In the above menu, set "continuous alarm" to "no." If this option were set to "yes," the first alarm would remain on and would only be stopped by using "clear" / "alarm reset." If not deleted, the alarm will remain on even when the device is turned off or in the sleep mode. The light diode on the other hand is only on when the mikromec®*multisens* is turned on or awake.

Peculiarities at Impulse Limit Values

If impulses are being measured, limit value monitoring can be activated as well. The logger measures the impulses and monitors the displayed values on the limit values. It behaves in exactly the same way when recording tasks are running. As described under Recording Impulses, the values are not continually recorded and displayed, rather the results at the end of each interval. The mikromec®*multisens* therefore monitors pulses in running recordings in the recording interval.

Error Messages: Caused by a Limit Value!

The logger offers a voltage output for a collective interrupt report as standard: If any limit values are activated, the logger displays this directly with a star after the measured value. After the minimum alarm time, the ALARM light diode on the device lights up and +5V appear on pin L of the Dig-socket. The output L has an internal series protective resistance of approx. 1kOhm and is therefore not directly capable of running an optical coupler. The light diode and this voltage only appear when the device is <u>active</u>, which means that when the logger is turned off or is asleep, nothing in relation to the alarm state appears. This can be remedied using the optionally installable bi-stable alarm relay (ALRS), which always correctly indicates the current alarm state. The voltage signal at pin L is not electrically isolated, rather it is related to the device's ground.

Option: Built-in Alarm Contacts and AI-Sockets

The logger can be internally equipped (retrofitted) with an alarm relay, whose unipolar change-over contact is taken out through the 3-pinned AI-socket. This bi-stable change-over contact is completely isolated from the logger's electronics and always displays the last alarm state – even when the logger is turned off or asleep. The switch position then only changes when a change is absolutely necessary.

Option: External Alarm Module

External alarm modules offer the possibility of displaying alarm reports from different channels independently (over LEDs) and then, if desired, of driving something using these individual signals. This interchange can be performed as a relay, OPTO-coupler output (Open Collector, NPN) or as a 5V voltage level.

Alarm Call-Back over a Modem

The mikromec®*multisens* is able to dial one telephone number automatically if an alarm appears. The call is attempted again if the line is busy. In this case, if installed, the relay (option MMW) is activated, is order to switch on an autarchy-supplied station's modem (for instance a radio-modem in a solar station). The target number must already have been indicated to the modem. MM-grafix offers this possibility under "F4 Modem" / "Configure." The function "Call on Alarm" is available under "Setup" / "Alarms" / "Modem Call." If you only want to be called if the alarm lasts longer than, for example, 5 minutes, activate the "minimum alarm time." This possibility is intended in the remote-recording software to detect and display the alarms from distributed loggers. The user is then informed of the alarm from a central computer, for example per SMS or Fax.

The alarm is triggered (from rev. 5.0.0035) channel-dependently. That means that an alarm in another channel triggers another new phone call. The reason for this are tasks such as monitoring multiple tanks with one mikromec®*multisens*. In earlier versions, a call was only made when a collective-alarm was triggered – therefore not channel-dependently.

The detailed operation is described under the serial interface's *AM and AC "mcl"-commands.

Alarms and Limit Values

What are Limit Values?

A limit value is a user-definable measurement-signal threshold. The logger monitors the current measured value and decides if the limit (threshold) has been exceeded. The user can choose if a violation of the upper or lower limit should be reported. Exceeded limit values cause an asterisk * to be displayed directly next to the measured value.

Two individual limits are measured per channel. That means, for example, that limit 1 can be the maximum value and limit 2 the minimum value. The logger then monitors the values, ensuring that they fall within this tolerance band.

Different values can be given on different channels.

The "limit" function does not need to be used: to turn the limit-monitoring off, set all of the channels' limits to "not controlled."

The way in which limit value alarms are triggered is outlined in the next chapter.

Entering a Limit Value

Limit values must be entered for alarms to be triggered. You can start recordings and trigger individual measurements based on limits being exceeded. Details on this can be found under "Recording modes." Two limits can be set to each channel – these can be set to activate when a value exceeds or falls under a limit, or they can simply be left off. Exceeding and falling under a limit are both described in this instruction manual as "exceeding." If a limit is exceeded, an asterisk "*" immediately appears in the place of the first symbol of the unit of measure in the measurement screen. A logical OR of all limit value pairs on all channels over the minimum alarm time leads to the display of an alarm. This alarms is indicated by the red LED "alarm" on the logger.

```
    Main-Menu
0   measure+recor
1▶  setup                 Setup
2   define recordi    1   select sensors
                      2   scale sensors
                      3   offset adjust    +
                      4   clock
                      5   RS232
                      6▶  alarms
                      7   language              Alarms
                      8   lock kezboard     1   min. alarm time
                      9   time to wait      2   continuous alarm
                                            3   modem-call       +
                                            4▶  limits
```

```
    Limits
1▶  chan1    U_50mV
2   chan2    Tpt100<
3   chan3    off       limits of ch1
                     1▶  limit 1
                     2   limit 2
                            limit 1 of ch1
                          < -50.00mV_
                          1■ controlled
                          2  not controlled  +
                          3  change value        limit 1 of ch1
                                               Change value:
                                                  -[50.00]mV_
                                                        limit 1 of ch1
                                                     alarm if -50.00mV_
                                                     1  is exceeded
                                                     2■ falls below
```

Note: The status signals with their 4 digital signals can also be monitored. The comparator operators are related to the binary style with the lowest bit-value on the left. Numerous possibilities are provided in connection to the monitoring of status signals. These are described in detail under "Recording modes."

Minimum Alarm Time: Here you can choose how long a limit value has to be continually exceeded until the alarm is activated. The valid timeframe is 0 to 9999 seconds. If 0 seconds is entered, an alarm will be triggered the moment a limit value is exceeded. The minimum alarm time is applied to all channels.

Continuous Alarm: Here "yes" or "no" can be entered. If "yes" is entered, the alarm remains activated until it is cleared by the user. If "no" is entered, the alarm is deactivated the moment the value falls back within the limits.

Modem Call: The logger can report an alarm per modem. The modem then dials a pre-selected telephone number. The called computer then confirms the received alarm message and the logger calls the next time it receives an alarm call. The options "yes" or "no" can be selected.
The mikromec®*multisens* can also use a radio modem for general communication and to send an error-message to a computer. This operation is taken care of by the *TECHNETICS* user programs and is described in more detail under the mcl bus-commands. In the menu, the user only has to choose between "yes" and "no."

What are Alarms?

Alarms are triggered when limit values are exceeded. The alarm is displayed through a wire on the Dig-socket and by a red LED on the logger. If a limit is exceeded, it is indicated by a star in the measurement screen directly after the "culprit" value. The star indicates directly if the corresponding value is being exceeded or not. However, an alarm is only triggered after the freely-chosen minimum alarm time has been reached. Whereas the star (= exceeded limit value) disappears if the limit is no longer exceeded, the alarm message can be programmed to remain continually on (= continuous alarm). As an option, the logger can be equipped with potential-free alarm contacts which follow the status if the alarm-LED. Each time the device wakes up, the alarm-Led lights up for a moment. This has no meaning and has no impact on the alarm contacts.

Selecting the Alarm-Behaviour

```
   Main-Menu
0  measure+record
1▶ setup
2  define recording+
```

```
   Setup
1  select sensors
2  scale sensors
3  clock          +
4  RS232
5▶ alarms
6  language
7  lock keyboard
8  time to wait
```

```
   Alarms
1▶ min. alarm time
2  continuous alarm
3  modem-call      +
4  limits
```

Recording

Turning the Logger On/Off and the Sleep Mode

The mikromec®*multisens* is turned on using the on/sleep key. If sensors are selected, the measurement screen appears. If the logger is turned on by hand, it cannot turn itself off unless the battery is completely empty.

The logger can't actually ever be turned completely off. It has an internal alarm clock which wakes the device up when the next recording time has been reached. The logger then wakes up, remains on for a certain user-defined time (some sensors require this) and then saves the current measurements. If the scanning rate is $\geq$ 1 min, the device goes back into the sleep mode until that time. If the rate is less than 1 min, the logger remains on until that recording has been completed.

If at least one recording is active or waiting to be started, this is known as the sleep mode: the logger wakes up to make measurements and then goes back to sleep. The device can be switched on again in the meantime, to examine settings or to read values, without any difficulty. The user then has to remember to switch the device off again. Otherwise, the device will use too much electricity because it is no longer operating in the sleep mode.

Since many sensors can deliver a precise value within 2 seconds, the logger offers a variable wait-time. This is described in the later chapter entitled: "Setting up the Wait-time before each Initial Measurement."

The mikromec®multisens' Recordings

The datalogger's actual task is to save measured values. Since there are so many possible measurement tasks, the mikromec®*multisens* offers an equally diverse range of possible solutions in the form of different recording modes. These different recording modes are available because the user wants to reduce the quantity of measurement data and concentrate on what is really of interest. Through smaller quantities of data, the user achieves shorter transfer and processing times and the device can spend longer saving data.

The user then finds the measurement procedure that corresponds to the problem and "programs" this procedure into the datalogger. The different recording modes are described in general later.

Some possible measurement tasks would require the processing of multiple recordings at the same time. The mikromec®*multisens* can process up to 9 recordings and one recording made up of "individual measurements" at the same time. This is described in more detail in the chapter "Processing Multiple Recordings Independently from Another."

Recordings can be read-out at any time – even before their conclusion. If a recording is programmed in, the logger will wake up (if necessary), go into the measurement mode, make the measurements, save them and then turn off again. A blinking exclamation mark (!) indicates that a recording is either running or waiting. Recordings are also performed while the device remains continually on, as long as the user doesn't prevent the logger from doing so. The logger can be

interrupted, for instance, by making entries outside the measurement display. The logger can not measure and record in the "background." This is why the logger always goes back to the measurement mode after a number of minutes. Any missing measurements – however they are caused – are always correctly administrated by the logger: it records hyphens in the place of the missing values. This also happens when the lead-acid battery is empty.

An example of a recording in the way in which it appears on the PC:

Recording No: 1 Logger No: 2523
Temperature, Humidity and Pressure – *TECHNETICS* Office
Start: 11:30 31.10
Duration: Days: 90   Hrs: 00 Min: 01
Interval: 30mins

```
                   Sa100-rel.hu SCX15-

                   C__    %__    hP_

00001 '31.10/11:30:00   20.3   52.2   971
00002 '31.10/12:00:00   20.4   50.5   971
00003 '31.10/12:30:00   20.1   50.4   971
00004 '31.10/13:00:00   19.8   50.2   971
00005 '31.10/13:30:00   19.7   51.2   971
00006 …
00007 …

…
etc.
```

The top section of the list output indicates the user's pre-defined measurement procedure. In the lower section, the measured values are listed. One line indicates a measurement at one point in time. The list is made up of a number of different measurement time-points, which are given by the measurement procedure, and is limited by the amount of free memory in the logger.
A measurement time-point (a line in the list) contains the measurement's number, date and time with seconds and the measured value of one or multiple channels.

The following criteria are important in selecting the best-suited measurement processes:
1. How will the saving of individual measurements be triggered?
   - By key press
   - By time start
   - On reaching a pre-defined limit value
   - On a status change of a connected signal
2. How often should recordings be made?
   - "Fast Recording" with many measurements each second
   - Measurements with an interval of 1 second to 1 hour
   - Measurements with an interval of 1 minute to 1 hour in the "Sleep Mode."
3. How should the recording be ended?
   - After a predetermined time

- By key-press
- "Endlessly" as a loop recorder
- On reaching a memory limit

4. Which individual measured values should be saved?
   - Instantaneous values
   - Mean value within the preset interval

5. Which channels should be recorded?
   - All channels that are selected (and therefore appear in the measurement display) and then chosen while entering parameters for the recording.

The following table is an overview of the measurement procedures in the mikromec®multisens:

Measurement Procedure	Start on	Stop on	Recorded channels
Time starts recording	Time	Time	All selected
Loop memory recording	Time	Abort	All selected
Fast measurement	Key press	Duration (sec.)	All selected
Single measurement	Key press	---	All
Recording on limit being exceeded	Limit value	Duration(min.)	All selected
Recording on key press	Key press	Durat. Key	All selected
Limit start fast recording	Limit value	Durat. (sec.)	All selected
Single recording on limit	Limit value	---	All
Single measurement on status change	Change in a status input	---	All

You can reach the different recording modes through "Define Recording" / "Define."

```
   Main-Menu
0  measure+record
1  setup
2▶ define recording+       Define recording
                        1▶ define        r1 definition
                        2  restart   free: 115968
                        3  abort     1▶time starts reco.
                                     2 loop memory reco.+
                                     3 limit starts reco.
                                     4 fast measurement
                                     5 limit st. fast rec
                                     6 sgl.rec. on limit
                                     7 sgl. meas status
```
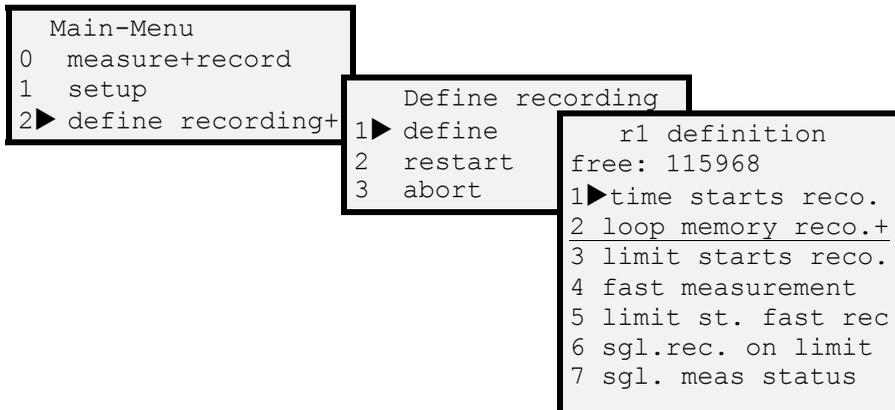
Setting up the Wait-time before each Initial Measurement

The "Wait-time" is the length of the delay between the point at which the logger wakes up and the point at which the first measurement is made. This gives the sensors a "warm-up" time. Some sensors, particularly intelligent sensors, require a small amount of time before they can deliver valid measurement data. The transient behaviour of some sensors can also be taken into consideration in this way. This wait-time can be set to between 0 and 55 seconds.

Of course, when this option is engaged, the logger is turned on for longer for each measurement and then runs for a considerably shorter time. During the wait-time, no measured values are displayed.

Measurement Operation and Recording Measured Values

The logger always measures visibly – that is to say that you can always see if the logger is measuring. If the user takes the logger into different menus or entry screens, no measurements will be made or saved in this time. The logging then records blank entries ("-----") instead of values. The missing recordings are always correctly administrated.

The same thing happens when the battery is empty or through massive overuse of the serial interface.

So that the logger is not prevented from performing its actual job – that of measuring and recording – the logger always reverts back to the measurement screen after 5 minutes of inactivity. The recordings are then performed (and visible) as normal.

The Individual Measurement Procedures in Detail (Recording Modes)

1. Time Starts Recording

A time-start recording is used if recordings should be made over a certain time and at a certain time-interval.

The entry-overview to define a time-start recording is made up of the following points:

Channels: A selection of the sensors which have been activated under "Sensor Selection."

Start: Date and time of the first measurement.

Duration: The time between the start and the end of the recording – max. 380 days.

Interval: The period of time between recordings – between 1 second and 24 hours.

Kind: The selection between instantaneous values and the mean values of all measurements within an interval.

2. Loop Memory Recording

The loop memory recording is closely related to the time-start recording. It moves in a rigid time-scheme that never ends. Under duration, give how much memory should be reserved for the recording and that dictates how long the recording can last before the old readings must be overwritten with new ones.
The recording can be stopped by either using "End Recording" under "Recordings" or the recording can be cleared, including all related measurements.

To activate a loop memory recording:

Channels: A selection of the sensors which have been activated under "Sensor Selection."
            For example: "Ch1___56_" means that channels 1, 5 and 6 must be recorded.

Start: The date and time of the very first measurement. For example, "Start: 9:46 22.10" means that the recording will begin on 22 October at 9:46.

Duration: The time after which the memory will recycle. The maximum display is 380 days, 99 hours and 99 minutes. (Previously this was 79 days, 99 hours and 99 minutes.)

Interval: The period of time between recordings: in 1 to 99 minutes, or 1, 2, 3, 6, 10, 15 or 30 seconds or 1 to 24 hours. (Before 9/97 this was max. 99 minutes.)

Kind: The selection between instantaneous values and mean values of all the measurements within an interval:
                    1.) Either only instantaneous values are recorded, or
                    2.) The mean values within an interval are recorded, or
                    3.) Mean value/max. channel 1: Here, the maximum in channel 1 and the mean values on all other channels are recorded.

Examples of loop memory recordings:

1.) Continuing measurements should be made from a measuring station. Monthly protocols should be saved. In order to do this, define a loop memory recording on the desired channel and with a duration of a little over one month, for example 32 to 35 days. The data for the month is then read out between the 1st and 5th days of the following month. The advantage of the loop memory recording over the normal time starts recording is simply that no new recording needs to be entered since this recording never ends.

2.) If you want to record an event that is difficult to predict and only appears sporadically, you can define, for example, a loop memory recording where results are saved every second with a duration of one hour. If the event appears, the recording is then immediately read out. As an aid, you can also activate limit value monitoring so that you know that the event has occurred. The measurement data then shows the event itself, plus the data for before and after the event.

3. Fast Recording

A "fast recording" is a recording optimized for speed, whereby one or more channels are measured and recorded <u>multiple times per second.</u> The recording frequency is drastically increased over the usual second interval – up to 320Hz.

While the fast recording is running, all other recordings pause and no other measurements are made. After the fast recording is finished, the other recordings resume their functions. While a fast recording is running, there is no longer a measurement display. The actual measurement phase connects to a formatting phase, which can have the approximate duration of the actual measurement. During the time, the measurement counter counts backwards to zero.

The limit-start fast measurement (GRW) has the same entries and properties as the normal fast recording. The limit-start fast recording starts when a limit is exceeded or when an alarm is triggered.
Fast recordings can also be started one after another on key-press or once a limit is exceeded.

3.1 Limitations of the Fast Recording

The measured values are no longer displayed.
The fast measurement can either be performed on one single channel from 20Hz to 320Hz or on multiple channels – but then only with a set rate of 20Hz on 2 channels. The measurement rate lessens as more channels are selected.
Several scales are suitable for the fast measurement: frequencies, impulses and all status inputs above Sta_4.
Any other running recordings are interrupted for the duration of the fast recording.
The device can no longer be reached over the serial interface.
The keyboard is no longer scanned.
A belated formatting phase connects itself to the fast recording, which serves to reformat or to linearise the measured values. This formatting phase can last up to as long as the actual measurement. Since there is less time for each individual measurement, the accuracy falls from 12 Bit to approximately 10 Bit.
If you choose something that the mikromec®multisens can't do, the error message "Fastrec.impossible!" appears.

3.2 Entering a Fast Recording on One Channel

You can define a fast recording under "Define Recording" / "Define" / "Fast Recording" or "Limit Start Fast Recording."
The entry overview consists of the following:
Channel Number: Exactly one of the preset sensors from the list of selected channels – here only 1 channel!
Impulses and frequencies cannot be measured faster than 1/sec: no fast measurement is possible.
Duration: The duration of the recording in seconds.
Frequency: The period of time between two measurement recordings in seconds.

20, 40, 80, 160 and 320 measurements per second can be freely chosen.

3.3 Entering a Fast Recording on Multiple Channels

You can define a fast recording under "Define Recording" / "Define" / "Fast Recording" or "Limit Start Fast Recording."
The entry overview consists of the following:
Channel Number: Two or more of the preset sensors from the offered list.
Duration: The duration of the recording in seconds.
Frequency: The period of time between two measurement recordings in seconds.
                  As opposed to the single-channel fast measurement, the scanning rate cannot be selected, rather it depends on the number of selected channels.
                  The frequency (rounded off) = 40/number of channels

Channels to Record	max. scanning frequency
1 Channel:	20, 40, 80, 160, 320 Hz, see above for when only 1 channel selected
2 Channels:	20 Hz
3 Channels:	12 Hz
4 Channels:	10 Hz
5 Channels:	8 Hz
6 Channels:	6 Hz
7 Channels:	6 Hz
8 Channels:	5 Hz
9 Channels:	4 Hz
10 Channels:	4 Hz
11 Channels:	3 Hz
12 Channels:	3 Hz
13 Channels:	3 Hz
14 Channels:	2 Hz
15 Channels:	2 Hz
16 Channels:	2 Hz

4. Single Measurements

The mikromec®multisens can make and record sample measurements. These so-called single measurements are then all placed one after the other in the "Recording Number 0." A single measurement can be triggered, for example, by pressing the "1" key in the measurement screen. There are also other ways in which to trigger single measurements. Measurements are saved under "Single Measurements" when the recording type "Limit Starts Recording" is chosen. That means that every time a limit is exceeded, a measurement is saved. The description of the "Single Recording on Limit" is given later.
Recordings on status change also generally enter the results of their single measurements in recording 0.
Each single measurement always contains <u>all</u> selected channels together with the current measurement time.

5. *Limit Starts Recording*

5.1 Recordings Triggered by an Exceeded Limit: Limit Start

You often don't need to make continuous measurements, instead only when a preset limit on at least one channel has been exceeded. Limit values are described in detail in the "Alarm" chapter. The channel whose limits are being monitored doesn't necessarily have to be in the recording (that is to say, recorded). It only has to be selected, appearing in the measurement display and at least one of the two limits has to be entered and activated.
The entry of the other required parameters is described under "Time Starts Recording."

Everything that occurs after the limit has been exceeded will be recorded, and that for at least the given duration. If this first block is concluded, and the limit still hasn't been exceeded, the second block is immediately hooked up, etc. This guarantees that unbroken recordings are made for the entire time that the limit is exceeded. If no limits are exceeded, the recording will pause until the limit is exceeded once again. The next block will then be hooked up until the measurement memory is completely full. All these blocks are filed in the logger under a single recording number. If you want to store or run multiple recordings in the logger at the same time, the limit-start recording must be the one with the highest number, because at the start, their lengths are unknown. The last recording to be entered always has the highest number.

5.1.1 Limit Start with Overwrite

To be able to find rarely occurring erroneous events in an examined process, an additional variant of the limit start recording was introduced from firmware-version 5.00.0039. This variant does <u>not</u> lay down a new measurement block each time a limit is exceeded (=alarm), instead it always overwrites the first block. That way, the last event to trigger an alarm is always in the memory.

```
"3 lim-recording"

"Kind: After another"

"Save how?"
"1 After another"
"2 Overwrite"
```

5.1.2 Limit Start in the Sleep Mode

If you want to monitor limit values in the sleep mode and start a limit start recording on this limit violation, you have to use a trick: The logger has to wake up every now and then to be able to actually measure. This wake-up interval then dictates the time-periods, in which the monitored signal is to be checked. The first thing to do is to enter a small recording (r1 — for instance a loop recording with 10

min duration and 1 min interval). This recording wakes the logger up and starts the actual limit-starts recording, if necessary. The limit start recording is then entered as the second recording (r2). Don't forget to set the limit values!

5.2 Recording as long as Limit Values Exceeded: Single Recording on Limit

In order to record the values from all selected channels in a rigid timeframe while the limit is being exceeded, select „Single Recording on Limit" under „Define Recording" / „Define."
The recording rate can be between 1 and 99 seconds. A blinking „E" either top-left or in the time display is an abbreviated indication of this. The single measurement recording will now run endlessly in this time-pattern. The only way to end this recording is with „Clear" / „Last Single Measurement."
This type of recording is particularly useful when the duration of the limit-violation is unknown or varies greatly. In this setup, recordings will be made for as long as the event lasts. The measurements are entered into recording 0. The data can be retrieved using „Data Output" / „Single Measurement."

5.3 Fast Recording, Triggered by an Exceeded Limit: Limit Start Fast Recording

This type of recording corresponds logically to the limit start recording. The limit start fast recording is activated when more than 1 measurement per second (up to 320 measurements) are required. The restrictions on the fast recording also apply here. Other recordings are paused and there are no measured values indicated on the display. A running fast recording cannot be influenced using the keyboard. The actual fast recording then leads into an analysis phase, which lasts approximately as long as the actual measurement. See the previous chapter: Fast Recordings.

5.4 Recording Start on Trigger: Status Port Triggers Recording

This type of recording is covered by the limit start function: Under "Setup" / "Alarms" / "Limits" / "Chan7 STA_1-4" / "Limit 1" / "Change Value." Enter an example, ie "0001."
"Overwritten" SEL "Controlled" SEL EXIT EXIT EXIT EXIT EXIT
The monitoring criterion is therefore ≥ 0001, which means that recordings will always be made when at least one of the 4 status inputs is active (=1).

"Sta_1-4" must be selected on the corresponding channel (channel 7 or 11) under "Setup" / "Select Sensors."

Afterwards, go back to the measurement screen using EXIT. A star behind the "Sta_1-4" value indicates if one of the status-input's bits is set and if its limit has been exceeded. On top of that, the logger's Alarm-LED goes on.

6. *Single Measurements on Status Change: Single Measurment Status*

The mikromec®*multisens* checks the status inputs Sta_1 to 2, 4 or 12 once per second when in the measurement mode. If the measurement process "Single Meas-

urement Status" is activated, the datalogger saves the values of all the channels if at least one of the 2, 4 or 12 status inputs has changed its state since the last measurement.

These values are saved under "Single Measurements," that is to say recording 0.

In order to be able to actually recognize a change in the status lines, the relevant status inputs must be selected (for example "STA_1-4" under "Setup" / "Select Sensors" / chan7, chan11 or chan19 – depending on logger-model). If this selection hasn't been made, the following message will appear:

```
Status-single meas.
       aktive.
→ Select status in-
       puts!
```

Examples:

When was the refrigerator door opened and when was it closed again?

When did the burner turn on and how long did it burn for?

Starting and Stopping a Recording on Key Press

If the user is present during the recording and wants to blend out the uninteresting sections of recording, the user can do this (only!) in the recording type "Limit Start Recording."

A limit start recording ("Define Recording" / "Define" / "Limit Start") can be stopped and restarted in the measurement screen using the "4" key. If no limit values have been entered, the only way to control the recording is with the keyboard. If limit values have been entered, they will trigger the recording.

Starting an Already Defined Recording Afresh

If a recording has been defined and should be repeated again later, you can restart the recording using "Define Recording" / "Restart." The original recording with all of its data is completely deleted and the current time is used as the start time. Since this type of start overwrites existing data, the user is warned before the restart takes effects just in case the command needs to be cancelled.

Also fast recordings can be started afresh in this way.

Processing Multiple Recordings Independently from One Another

The logger is capable of processing up to 9 recordings at the same time (r1 to r9). Additionally, all single measurements recorded in recording 0 are condensed and transferred from the logger to the PC.

What can this be used for?

Examples:

1.) A recording has been finished and hasn't yet been deleted. The recording should remain in the logger but the next task is coming up. The next task is entered under "Recording" / "Define" and this is simply offered and administrated as r2.

2.) Recordings should overlap.

3.) A recording should record measurements on different channels completely independently of one another. The first 4 channels are assigned to Problem 1 and the second 4 channels are assigned to Problem 2. Then a recording can be defined which records the first 4 channels, and a second recording will record the second 4 channels.

4.) The scanning rate should be variable: for example, pump-attempts. There is an initial phase in which a lot happens (pumping) and a long phase in which activity is only slow (beading phase). Two overlapping recordings can be used to solve this problem: the first with measurements every second and a second recording which lasts for a number of days - making measurements every quarter hour, for example.

Since the mikromec®multisens reserves the necessary memory space during the entry process, the recordings can only be deleted either totally (all of them) or from the highest to the lowest numbered recording. Recordings cannot be "selectively" deleted.

Data Output

Reading the Recorded Values over the LCD-Display

The recorded values can be viewed at any time using "Data Output" / "Recording." Use the ▲▼-keys to scroll through the results line by line. At the top of the list the measurement task is described and then the results are listed with their corresponding times. If you try to scroll up past the start of the list, the message "---BEGIN---" appears.

Reading the Recorded Values over a Serial Interface

All values and a header from a connected, serial device are given using "Data Output" / "Recording" / "1▶ r1 finished" / "RS232." If the transfer fails or if the transfer is delayed for too long, the message "RS232-Break" is displayed. Ensure that the Baud-rate of the logger and the connected device agree. See the chapter "Configuration."

Printing the Recorded Values Directly onto a Printer

The mikromec®multisens can use a specialized serial printer (including printer module and suitable cable) to print out the measured values without the need of a PC. Goto "Data Output" / "Recording," "Single Measurement" or "Error Mes-

sages." In the next step, the logger offers to send the information through RS232, that is to say to the serial interface. If a printer is connected to this interface, the results will be printed in a list form.

In order to print every value "online," select "Data Output" / "Online to RS232." An enormous flood of paper would appear if one line were printed every second. The desired number of printed values can be very easily reduced by entering a (last) recording with the desired printing interval (for example, each hour). The printer will then only print (for example) a complete set of values once per hour and ends the task as soon as the recording is finished. All non-selected sensors are displayed as "--------." An 80-symbol printer is offered with the order No.: DDrDPU414-80.

Copying the Recordings to Memory Cards (PCMCIA / PC-Cards)

Recordings and single measurements use up the mikromec®multisens' internal memory. The optional memory cards act as a transport medium for the data. First, the data is recorded using a recording (r1 to r9). (The card remains untouched at this stage, even if plugged in.) If you want to collect the recorded data, insert the memory card into the slot and activate the copying procedure on the memory card with "Data Output" / "MC."

Exactly one recording (r1 to r9) can be transferred to a PC-Card.

To transfer multiple recordings, multiple PC cards have to be used and the recordings have to be transferred individually. Exporting a recording onto a memory card:

```
"Data Output"
"Recording"
"1▶ r1 finished"
"3▶ MC"
```

The recording (here r1) is then written onto the PC card. The writing procedure is verified and if an error occurs, this is reported with "Write Error."

Single Measurements and the Error Message Buffer cannot be transferred to PC card at the present stage.

The recordings' recording format is binary and is in a DOS file structure. Therefore, use PCMCIA-drive operating programs which perform <u>binary</u> readings. The program MM-grafix is able to support the widely distributed PC-card drive Omnidrive and the somewhat older CardPortEx.

Reading the Error Buffer

An error messages that occur while the device is running can be read using "Data Output" / "Error Messages" / "Display." The error messages are shown in the order in which they appeared. You can only scroll forward, not backwards.

If no error messages are saved, the text "No Error Messages" is given. There is a command to read the error buffer over a serial interface: *RE. The *CE command then deletes it.

Parallel Output: Simultaneous Reproduction of the Current Values on a PC

You can reach "Online to RS232" under "Data Output." This option sends the results to the serial interface as they appear. You can use any terminal program to follow the readings on a PC.

Mean Values, Minima and Maxima

Averaging Process in Recordings

The mikromec®multisens can record the <u>mean value</u> instead of the <u>instantaneous value.</u> All values in the individual second in the recording interval are averaged. Exactly one measurement is made per channel per second, these values are added, and then, when the recording interval has passed, this number is divided by the number of measurements (=seconds) and saved. The displayed values are not changed. The instantaneous values are displayed as before, but only the mean values are saved. Once the mean value has been saved, the total and the number of recordings are set back to zero and the procedure starts again afresh. The recorded mean value is therefore not influenced in any way by the values from the last recording interval, rather it is a true indication of that precise interval.

The values from every second are added together and then, at the end of the recording interval, they are divided by the number of actual measurements made. If the longest allowed interval of 99 minutes is selected, every 60secs*99min=5940 measurements per channel are averaged.

To indicate that an averaging recording is running, a blinking "M" is displayed. Mean values are never directly displayed, rather they can only be seen afterwards when the recording is read using the data output. A display that continually swapped between instantaneous and mean values would be too confusing.

The averaging process always works for the highest active recording including all of its channels. Therefore, if you wanted the first two channels to record <u>without</u> averaging and the next two to record <u>with</u> recording, two simultaneous recordings must be set up: one without any averaging properties and one with them.

Averaging Process and the Sleep Mode

If the logger is put into the sleep mode (with the on/sleep key) after entering a recording, it will only wake up on full minutes to make a measurement. It can only make measurements, and thereby calculate the required mean values, while awake. Therefore, the device has to wake up at the start of the recording time and remain on for the duration of the averaging recording. The logger doesn't do that, though. In the sleep mode with an interval of 1 minute, nothing will be averaged. If the recording interval for an averaging recording is set to more than 1 minute, the logger wakes up exactly once per minute to make a measurement. Then, at the end of the interval, these minute-values are averaged and the result then saved.

Multiple Recordings and the Averaging Process

If multiple recordings are active at the same time, only one of them can perform the averaging process. That is always the last recording to be started. (The last recording to be started is not always the last one that was entered!) This limitation exists because if each channel were averaged at the same time, the calculating effort would be prohibitively high.

If one averaging recording is running and a new one is started, the first one loses the averaging properties and these are transferred to the new recording. However, if an averaging recording is ended, the averaging properties do not fall back to the next recording in line. You cannot find out from the resulting recordings what averaging properties they had during the course of their "lives." If multiple averaging recordings are entered which do <u>not</u> overlap chronologically, there is no problem. Therefore, it is recommended that averaging recordings never be allowed to overlap chronologically.

Recording Maxima and Minima

The maxima and minima of multiple channels can only be determined afterwards with the help of the MM-grafix program.

Maxima can only be recorded in channel 1 and all other channels then record mean values. This function is under "kind" of recording alongside "actual values" and "mean values."

If you require a more detailed max/min recording, please ask on the hotline about any new solutions.

Communication

Data Transfer

Data Transfer and Access over the Serial Interface

Setting the Baud-Rate

The logger's transfer rate over its serial interface must agree with that of the connected device, in order for the two devices to understand each other. The following speeds are available:

300, 1200, 2400, 4800, 9600, 19200 and 115200 Baud

9600 baud is the default setting. Some computers have problems with higher baud-rates: data loss. There is also a problem that occurs at lower baud-rates: the logger does not have time to transfer all the data if measurements are made on all channels every second, so some measurements have to be left out.

The transmission frame is set to 8N1, that means 8 databits, no parity and 1 stopbit. This cannot be adjusted.

```
    Haupt-Menue
0   messen+speichern
1 ▶ Einstellungen
2   Messreihen      +
            Einstellungen
        1   Sensorvorwahl
        2   skalieren
        3   Offset justieren+
        4   Uhr stellen
        5 ▶ RS232
        6   Alarme
        7   Dialogsprache
        8   Tastatur sper
        9   Wartezeit
                    RS232
                1      300 Baud
                2     1200 Baud
                3     2400 Baud      +
                4     4800 Baud
                5 ■   9600 Baud
                6    19200 Baud
                7   115200 Baud
```

See also: Configuration of the mikromec®*multisens*

PC Analysis Software MM-grafix 7.0

The Analysis software from *TECHNETICS*, MM-grafix, is used to create representations of curves.
The datalogger is connected with a serial cable to a free serial port on the PC. The logger's serial port is labelled with "RS232/Modem."
Install MM-grafix from disk or CD-ROM onto the computer. Use the "System Setup" to select the appropriate port (for example, COM2) and the baud-rate

(recommended: 9600 baud). On top of that, enter "mikromec V5.0" into "System Setup" / "mikromec."

Set up the baud rate on the logger as well under "Setup" / "RS232" to 9600 baud. MM-grafix retains these settings until the next time they are changed by the user.

Using "Simultaneously as a Curve" the current curve can be depicted simultaneously on a PC-monitor. This happens independently from any measurement tasks.

Using "Recording from Logger" / "Recording 1," the already saved recordings can be brought to the PC.

The Serial Interface in Detail (from DOS to Windows NT)

Overview: The mikromec®*multisens'* serial interface is electrically isolated and is supplied solely from the excitation wires from the connected PC or modem. The mikromec®*multisens'* serial interface works reliably at up to 115.2 kbaud. There is a certain degree of confusion in the world about the quality of serial interfaces. 9600 baud is a baud rate that even older computers can handle without hassles.

MM-grafix 7.0 is a true Windows-program and runs from Windows 95 and higher. The *TECHNETICS* Windows programs "MMforExcel" and "MessNetz" are made directly for Windows98 and NT and only work in a true Windows environment. Their serial interface drivers are of a better quality. The problem of lost symbols no longer occurs under NT.

The Hardware-Handshake should be selected for terminal operation. Baud-rates slower than 9600 baud are only recommended in exceptional situations – for example, over very long transmission lines – since fewer measurements are made due to the long transmission time. Or said otherwise: the values from the last second cannot be transmitted at all. Instead, the first updated values are transmitted. The logger then has to leave measurements out and "-" is entered into the recording. However, the logger still ensures that all selected channels are measured and recorded, even under the most difficult circumstances. In these cases, the measurements are made less often.

How to Choose the Optimal Baud Rate

BAUD	Characteristics
300	Actually too slow. Only use for special Situations, such as
1200	radio transmission modules and other transfer proce-
2400	dures with limited bandwidth.
4800	
9600	Recommended transfer rate, and automatically set after full reset.
19200	Poorly configured PCs can no longer handle this speed!
115200	Depending on PC and software-driver equipment, the PC can no longer handle this speed!

The logger's data format is generally set to 8N1: 8 databits, no parity check and 1 stop-bit.

The interface plug has 7 pins and allows, on top of simple data transfer, the device to be activated using a delivered voltage: 5 to 10V on pin 7 (=DCD) against pin 3. This function is used to turn the mikromec®multisens on using a telephone call over a modem.

The mikromec®multisens works with a Hardware-Handshake. It therefore requires a "brake pipe" for each direction.

The mikromec®multisens can be set to output data through the serial interface. If the connected device doesn't receive any data for more than 7 seconds, the datalogger reports "RS232/Break." If the connected device (for example a printer or PC) starts accepting symbols again, the transfer will be continued error-free.

The mikromec®multisens Command Language

Why a Command Language?

If you don't have direct access to the logger (for example, because it is a long way away or mounted in a hard-to-reach area), these commands give you the opportunity to fully operate the logger. You can adjust the set up and retrieve single measurements and entire recordings. Information, which you would like to quickly display on a monitor in a certain way, can be retrieved from the logger and formatted accordingly. The same applies for cancelled printer protocols.
In some situations, you may wish to centrally collect the results from several measurement devices. To do this, you can write a program on a PC that solves these specialized tasks with the help of the later-described commands. "MM-grafix" also uses these commands to query recordings, etc.

Commands over the Serial Interface

These are ASCII-plaintext-commands, which enlighten the task of writing your own control programs. The mikromec®multisens can also be controlled using common terminal programs such as TELIX, PROCOMM, Windows-Terminal, Hyperterm, etc. To be able to safely and easily control the mikromec®multisens over the serial interface, the command language "mcl" (= *multisens* command language) was developed. This language can be used to call up all device functions, perform configuration, query status and output measurement data – all over the serial interface.
The software "MM-grafix" uses this commands to operate the mikromec®multisens, but the user can also use their own problems to communicate with the device. *TECHNETICS* already has drivers for the programs Lab-View, DIAdem DasyLab and EXCEL. Drivers can be easily produced for packages such as Measure for Windows, DIA-PC, HP-VEE or similar programs.

Freeing Up Serial Ports in PCs

It is often unclear, which serial ports are actually available. The first thing to do is to look for suspicious plugs and labels on the back of the computer. "COM1" is what you will usually find. A "COM2" is also usually present. Both COM-ports are 2-rowed, SUB-D inbuilt plugs (you can see the contact pins) and come in either 9- or 25-pin variants. The 9- and 25-pin variants perform exactly the same function and the mikromec®*multisens*-cable DKR9/25 comes with a 9-to-25 adaptor.

There is usually now nothing more to do except to note the selected port and enter it into the user software (for example, MMforExcel, MessNetz, Hyperterm of MM-grafix). This has to be done in every program, which is used.

There are a couple of stumbling blocks that are created by the numerous setup-possibilities of modern PCs:

The first is the BIOS-Setup: Here the COM-Ports (which are directly on the motherboard) can be disabled or turned into IRDA-Ports (use UART2 for IRDA). Both are best left out for the chosen port. You can often reach the Setup by pressing the [Delete] key at the beginning of the boot-up procedure. The COM-Ports that the BIOS correctly identifies are shown in a black/white text box during booting. Under DOS, this port is now accessible, but now Windows usually begins its own administration: Windows 3.11 and Windows 95/98 then register the ports directly. Under Windows NT, the ports have to be specifically released in the system setup. Under the offered connections in Hyperterm (found under: Programs, System Programs, Communication), you can see what is actually available. What is offered here is not currently being used by another user or by another program. As well as that, the COM-ports, which are shown here, are also actually physically there. Windows cannot actually recognize if one of these ports has been changed in the BIOS-Setup into a IRDA. The user has to adjust this themselves in the Setup.

The setup of the baud rate, handshake and parity are only performed by the program itself. The settings from the RS232 in the system setup are not relevant and can be left as it is.

*Exporting Data from the mikromec®*multisens* using WIN95/98 and NT with Hyperterminal*

1.   Start Hyperterminal

> ➜ Start
> ➜ Programs
>   ➜ Accessories
>   ➜ Hyper Terminal
>   ➜ Select "Hyperterm.exe"

2. Install connection to the mikromec®

"New Connection": Enter name, for example, "mikromec"
"Call Number":   Connection over: *Direct Connection over COM1* (or COM2)

(Please note: under WIN NT the serial interface has to be registered under "System Settings": see previous chapter!)

"Port Settings"   Baud rate 115200 baud, 8bit, 15stopbit, no parity, Hardware-Handshake.

3. Transferring Recordings

> ➔ Transfer
>   ➔ Record Text
>   ➔ Select File, ie. "NAME.PRN"

Send the recording from the mikromec®:
(remember to set the baudrate in the mikromec® as well)

> ➔ Data Output
>   ➔ Recordings
>   ➔ Recording 1, finished
>   ➔ Online to RS232

4.   Calling up the connection to the mikromec®
> ➔ Start
>   ➔ Programs
>   ➔ Accessories
>   ➔ Hyper Terminal
>   ➔ Select "mikromec.ht"

Communication to the Logger Directly with the Windows Hyper Terminal

If a connection is made to the mikromec® as described in the last section, all of the following documented bus commands can be sent to and read from the logger. Suitable baud rates are from 9600 baud to 115200 baud. Even the highest baud rate of 115200 baud functions reliably with Hyper Terminal. Baud rates under 9600 baud are not recommended, since the transfer process delays the measurements.

Example:

Enter
*iq3 <ENTER>
and the logger responds with its software version:
OK>Version 5.0.0033
If that works, the logger can now be completely remote controlled.
*RD1 <ENTER>
for example, outputs the entire recording 1 from the logger.
*GM1,1 <ENTER>
informs the logger to output the value of the first channel each second. This command can be revoked with:
*CM <ENTER>

Remote Control Command List: Complete Reference

Example of a remote control command entry:
        Command: *IQ3 <CR>
        Logger Answer: OK 5.00.0033

After a remote command, active local entries are aborted!
(Exception: IQ <x> commands
                       and RS 0, if no errors are reported.)

Communication with the PC over the serial interface:

-   The PC only ever sends <u>one</u> command at a time and waits until the logger is finished, before sending the next command.

    The logger only holds <u>one</u> command in its buffer and begins to process it after receiving the end-symbol and, if used, the command's checksum.

    If further symbols are received by the buffer after processing, the error END_ERR (003) appears. The symbols are ignored.
    If the PC sends another command before the first one is finished, the second one is lost.

-   The logger sends an acknowledgement after finishing the processing but before it gives an answer:
    "OK," if no errors have occurred
    "ER" if errors have occurred (e.g. syntax, parameters exceeding the permitted range, etc.)

    A non-allowed start-symbol is always acknowledged with "ER."

    If "ER" is sent, the PC then has to send an "RS 0" command, in order to find the exact reason for the error.

    The time until the acknowledgement is sent depends on the command and can sometimes take minutes (e.g. "clear all" and MC output).

-   Depending on the start-symbol or the answer, after the end-symbol a checksum is sent (ASCII-representation of the 1-byte-Hex-sum (Sum % 256) of all symbols that belong to the command, including start and end symbols and OK.

-   You have to wait for 0.2 sec after sending an <ESC>, before sending the next symbol, since <ESC> clears the buffer.
    (Symbols that appear after the ESC but before the buffer has been cleared are lost.)

If the PC sends a valid start-symbol but then more than 99 symbols and no end symbols, the logger brakes because the buffer runs the risk of overflowing.
Problem: The PC usually can't send an <ESC> command now, either, in order to clear the buffer. The hardware-handshake has to be disconnected with CTS/RTS!
(Telix: ALT-O, T, K, A)

Command Syntax for Serial "mcl" Commands: Complete Reference

<Start Symbol><opc>[parameter][.parameter]..<End Symbol>[<check>]

<Start Symbol> * if no checksum follows the command
$ if with checksum

No cut-off symbols are allowed between the start symbol and opc.

<opc>:   Command abbreviation, always 2 symbols long
:   Command-dependant parameter, only full numbers
                (with sign beforehand for measured values), prefix "H" for
                Hex-numbers

<End Symbol>: <LF> ($0A) or <CR> ($0D) or <CR><LF> ($0D0A)

                Problem with <CR><LF> if no checksum:
                Command is already started with <CR>. If the command is
                already finished before the <LF> comes, the <LF> is inter-
                preted as an inadmissible start symbol.

<check>:   Checksum, 2 ASCII-Hex-Figures

No difference is made between upper and lowercase letters, except in strings.

Logger Acknowledgement Format

On error in the last command:
ER

Otherwise:
OK[<Start Symbol><Answer><End Symbol>[<check>]]

On commands, that don't lead to a logger output, only OK or ER, additionally:

<Start Symbol>:   > if no checksum follows the answer
                       If with checksum

(An answer with check automatically follows a command with checksum. If the command has no checksum, the answer will not have one either.)

<Answer>:   Command-dependant string, can also contain CR/LF or entire recordings.

<End Symbol>: Hex $1A

<check>:   Checksum, 2 Hex-Figures in ASCII

Example:

PC	Logger		
*CL 0 <LF>	OK	(if finished)	
$CL 0 <LF>2D	OK		
$CL 0 <LF>78	ER	(checksum incorrect)	
$RS 0 <LF>43	OK#E002 / 006^ZB3		

(E002 is the error number for "checksum error."
^Z stands for Hex $1A.
The error occurred in column 6.)

Test with the Telix terminal software:

Local echo ON: Alt-E
Lead in Linefeeds ON: Shift-TAB
If necessary, bend over the logger's end symbol on <LF>: Alt-W / entering / Edit: 26 → 10

Communication

The actual serial string-commands

(The start and end symbols still each have to be entered)

- Inquiry:
    IQ 1 4-digit device number given
    IQ 2 3-digit model number given
    IQ 3 SW-release, ie. "Version 5.0.0033"

    IQ 0 Everything at once (separated by <SP>)

- Read Error-Status:
    RS 0 Gives the error-number and the error-position for the last command.
    E000 for no error
    E001 / nnn … E999 / nnn error numbers
    (appeared at the nnn-th or (nnn+1)th command symbol)
    Meaning of each error number: Page 180

    RS 1 Gives the number of remaining free measurement values
    RS 2 Gives the number of existing recordings
    RS 3 Gives the numbers of the active recordings
    RS 4 Gives the number of the already saved individual measurements.

- Local Lockout:
    LL   The logger keyboard is locked
    (The lock is automatically deactivated when the logger is turned off)

- Goto Local:
    LO   The logger keyboard is unlocked again

- Set lock-outlevel:

    LK [<level>]
    <level>:   1: only keyboard lock
                   2: passwordrequired for "Setup" menu
                   3:   passwordrequired for "Setup," "Recordings" and "Clear." The only allowed bus-commands are RS, IQ, RE, RH, RD and UL.
                   4: all bus-commands are locked with the exception of RS and UL
    Locally, all keyboard commands are allowed.

    The currently activated level is given without parameter (not possible for levels 3 and 4). 0 means no lock.

- Remove lock (unlock):

UL <passwd>
> <passwd>: 4-digit password

Is 0000 after reset or MEM system error, can be changed with SP.

- Set new password
  SP <old>,<new>,<new>
  > <old>:   Current password which is supposed to be changed
  >
  > <new>:   New password, must be entered twice.
  > This password is unnecessary for UL and is queried locally in lock-out levels 2 and 3, before the concerned menus can be accessed.

- Set Dialogue Language
  SD [<d>]
  > <d>:   0: German
  >   1: French
  >   2: English
  >   3: Dutch (or Croatian HR, and Slovene on request)

  Displays the current setting without parameter.

- Read Errors:
  RE

- Clear Errors:
  CE

- Clock:
  CK [hh,mi,da,mo]
  > Without parameter: Gives the current time
  > With parameter: Sets the time and date (seconds always 00)

  Warning: The new setting is written into the clock immediately. The CK-command delivers the new value back only after the next full second!
  If a test-read is made, the old time is displayed.

- Clear:
  CL 0 Everything
  CL 1 Last recording
  CL 2 All existing impulse-counters
  CL 3 Last single measurement
  CL 4 All single measurements (from 5.x)
  CL 5 Reset alarm outputs

- Read Header:
  RH <nn>
  > <nn>:   Recording number
  >   0 for single measurements

Communication

- Read Data (all values from one recording):
  RD <nn>
    <nn>:   Recording number
                 0 for single measurements

- Save exactly one recording or a series of individual measurements on PC-Card:
                 Not yet in PCMCIA-DOS-file-format, instead binary!

  MC <nn>,"<name>"
    <nn>:   Recording number
                 from 5.x: 0 for single measurements
    <name>:   the file name under which the recording is saved in the DOS file system

  If only analyzed from 5.x, but still has to be entered (e.g. empty string MC 1, ""), is then ignored

- Get Measurement:
  GM <ch> [,<interval>]
    <ch>:   channels to be read
                 Bit field: e.g. H2003 means channels 1, 2, 14.
                 All channels that are specified here also have to be selected.

    <interval>: Interval in seconds (4-digits)
                 Sent with the running measured value.
                 When the logger is in a menu, those times do not count!
                 Therefore, use the LL-command beforehand for safety!
                 The first output is made after <interval> seconds.

                 As soon as the command is accepted, "OK" is sent.
                 Additional "OK>" before each output.

                 If no interval has been specified, a one-off output is made if all channels are being measured.
                 ("OK" just before the output.)

         The **GM** command ends any active simultaneous output to the RS232 (menu point 4.3).
         However, the simultaneous output does not end the **GM** command; therefore use the LL-command beforehand!

         If the remote control is turned on while a **GM** command is active, the **GM** command rests.

If a new **GM** command is given while an old one is still active, the new interval is adopted immediately.

The baud rate has to be at least 9600!

- Cancel Measurement (cancel measurement output):
  CM   End the last GM command

- Save single measurement:
  SM [<interval>]
  > <interval>: Interval in seconds (2-digit), with which the running single measurements are made if any limit value is exceeded.

  > Without a parameter, only a single measurement, independent from the limit value conditions.

  If a new **SM** command is sent while an old one is still active, the new interval is adopted immediately.

  Any limit starts single measurements activated over the keyboard are written over by the **SM** command; ended on an **SM** without parameter.

- Cancel single measurements:
  CS   Cancels the last SM-command or active limit value start EMs, that are started locallay.

- Make a single measurement on change in Sta_1-20:
  ST [<active>]

  Without parameter, displays the current setting.

  <active>:   0: function NOT activated
                1: function activated
                   an EM is made when the state of Stat_1-4 changes in any way
                2   STA_1 to STA_2
                4   STA_1 to STA_4
                8   STA_1 to STA_8
                12   STA_1 to STA_12
                16   STA_1 to STA_16
                20   STA_1 to STA_20

- Set/Show sensor:
  SS <k> [,<sensor-nr>]
  > <k>:   Channel number
  > <sensor-nr>Sensor number, which is supposed to be assigned to this channel

Communication

255 deselects the channel

If no sensor number is given, the display shows the one that is currently installed.
(If the channel is deselected, a number ≥128 is given out. It is the last installed sensor number +128.

- Scale Sensor:
SC <k> [,<basic-sensor-nr>,<x1>,<y1>,<x2>,<y2>, <commapos>,"<dim>","<name>"]

If only <k> is specified, the momentary settings (and errors) are displayed, if not scaled.

<x1> etc. are given without comma or unit of measure.

The basic sensor does not need to have been previously entered.
The channel is selected at the same time as the scaling process.

The scaling position can be scaled again, but it will always be taken out from the basic sensor.

<dim>, <name>: Special symbols cannot be entered in this way (e.g. Degrees, micro, Ohm). These have to be entered/change using the keyboard.

- There are no commands for calibration.
The PC performs these tasks using **GM** and **SC/SO.**

- Set Offset
SO <k> [,<basic-sensor-nr>,<x1>,<y1>,"<dim>","<name>"]
If only <k> is specified, the momentary settings (and errors) are given, if not already offset-adjusted.

<x1>,<y1> are given without comma or unit of measure.

The scaler/adjuster position cannot be readjusted later. These adjustments always have to be made from the basic sensor.

The difference y1 − x1 must fit into the basic sensor's value range.
Example for scaling limit of 70.00:
Value range: -3000 … +69.99
Valid: x1 = 20.00 y1 = +40.00 → offset = +60.00
Invalid: x1 = 30.00 y1 = 0 → offset would be –30.00.
Does not fit into the reproducible range!

- Set Limit:
  SL <k>,<nr>[,<onoff>[,<val>,<upper>]]

<k>:	Channel number 1 … 24
	(Channel must be activated!)
<nr>:	Limit value number 0 … 1
<onoff>:	0: Inactive limit value
	<val>,<upper> cannot be given
	1: Active limit value
	<val>,<upper> must be given
<val>:	Limit value without comma and dimension
	In Digi_IL octal! (ie. 17)
<upper>:	0: Limit value exceeded when value < val
	1: Limit value exceeded when value >= val

  If only the first two parameters are given, the display indicates the momentary settings: val with comma and dimension; if not monitored, D ("disabled") given.
  Ie. >= 1.000mV_
       D

- Display/Set Alarm Mode
  AM [<min_t>,<cont>]

<min_t>:	Minimum alarm-time in seconds, before an alarm-output is made (4-digits, decimal).
	Only the seconds where the logger is in the measurement mode count!
	(Warning, if device used in sleep mode: Only the time in which the logger is displaying values counts!)
	The minimum alarm time also stays when the logger is in menus.
<cont>:	1: Continual alarm
	(The output remains active after the alarm conditions are fulfilled until it is specifically revoked, see **CL 5**.)
	0: No continual alarm
	(The output is automatically reset when the limit conditions are dropped.)

- (De)activate/display Alarm-Call
  AC [<on>]

  Without parameter: displays the momentary setting.

<on>:	0: No modem-call

Communication

1: Each time an alarm occurs on a monitored channel, "ATDS=1" is given on RS232.
(Before firmware 5.0035 only on collective alarms!)

The output is repeated a maximum of 4 times within 3 minutes (in total 5 attempts), even if no more alarms are active in the meantime.
(The first repeat comes on the third-next full minute, which can be as soon as 2:01 min!)

In sleep mode, the call attempt is made the next time the logger wakes up (possible after 1 min).

If a new change 0 → 1 takes place within the repeat-time, a new call is made immediately and the repeat procedure begins afresh.

A new AC1-command aborts the repetitions and means that the next ATDS=1 will be sent to the logger-modem with the next change from 0 to 1.

If a string cannot be sent within 8 seconds, the process is aborted; repetitions then take place as described above.

Prerequisite for correct function is that the logger is in the measurement mode. Only here are the alarm ports set and the call-attempts made! If the whole minute, in which a call should be made, is spent in a menu, then the next attempt will only be made one hour later (if the logger is in the measurement operation at the time).

So that not too many calls are made due to quickly changing signals, the minimum alarm time should be 30 seconds if the device is not being used in the sleep mode.

The function "AC 1" can only be performed if the logger is correctly configured for it.
For loggers which are not fitted with this feature, an attempt leads to error E004 (inadmissible, unknown command).

- Set Baud Rate:
  SB [<b>]

	<b>		
		1:	300
		2:	1200
		3:	2400

<div align="right">

4:     4800
5:     9600
6:   19200
7: 115200

</div>

"OK" is still sent using the old baud rate.
After receiving the "OK," you have to wait 0.5 seconds before sending the next command with the new baud rate.

Without parameter, this command displays the current setting.

- Define Program (Recording)
  DP "<name>",<ch>,<duration>,<int>,<filter>,<ring>[<start>]

  <name>:   Name of the recording. All ASCII-symbols, which are also allowed in local-operation.
  Max. 8 symbols are saved left-justified and with "_" if necessary.

  Special symbols cannot be given this way (e.g. Degrees, micro, ohm).

  <ch>:   Channels to be recorded.
  Bit field: e.g. H4001 means channels 1 and 15.

  <duration>: Duration in format <dddd>_<hh>:<mm>

  <int>:   Interval in seconds, minutes or hours:
  <nn>s or <nn>m or <nn>h
  (only 1,2,3,6,10,15,30 seconds allowed, max 24 hours (earlier 99 mins))

  <filter>:   0: momentary value
  1: mean value
  2: mean value, reserved in channel 1 for later operation
  3: minima
  4: maxima

  <ring>:   0: stop after the duration is up
  1: loop memory
  2: limit start
     - not yet implemented:
  3: triggered by Digi_I
  4: previous history!

  <start>:   Start time point in format
  <dd>/<mo>,<hh>:<mi>
  Must be given when loop not equal to 2!
  Cannot be given when loop equal to 2!

Communication

Warning!!!:   Do not turn the logger off immediately after this command – instead wait for 1 second!!

(The logger still requires at least 1 second until the new alarm time is written into the clock.
If this time is not left, it is possible that the clock will not be able to start the recording.)

Example:
DP "NAME_ABC",H0084, 99_12:30, 10m, 1, 0, 20/10, 15:40

Name: NAME_ABC
Channels: 3 and 8
Duration: 99d, 12h, 30m
Interval: 10 min
Mean value
No loop memory
Start: 15:40 on 20. October

- Set/Display Wait Time (Warm-up Time) for the Sleep Mode
  DY [<delay>]

  Without parameter: gives the current wait time

  With parameter: sets the wait time

  <delay>:   wait time in seconds (1…50)

  The second display only begins to run after the wait time. That is why the delayed seconds in second-interval recordings fall at the END of the first minute.

  Any <ESC> commands received during the wait time are ignored.

  If the remote control mode is activated (with CTRL-A $01) during the wait time, each second a "_" is given as a life sign on RS232.

- Define Fast Measurement
  DF "<name>",<ch>,<frequency>,<duration>,<trigger>

  <name>:   Name of the recording. ASCII symbols, which are also possible in local operation. Always exactly 8 symbols.

  <ch>:   Channels, which are to be recorded.
  Hexadecimal bit field: eg H04 means channel 3.

Up to firmware revision 5.0021, only <u>one</u> channel is possible!

<frequency>: 0: 20 measurements/second
              1: 40
              2: 80
              3: 160
              4: 320

<duration>: in seconds, 4-digits

<trigger>: 0: immediate start
            1: start on limit condition

Communication

Short Overview: The Command Language of the mikromec®multisens

Under "Remote Control Command List: Complete Reference," page 153, you can find the complete descriptions.

Com-mand	Meaning	Syntax	Example
*IQ	Device IDs	*IQ <nn>	*IQ1 : Serial number *IQ2 : Model number *IQ3 : Firmware version
*RS	Status	*RS <nn>	*RS0 : Error-Number *RS1 : Free memory *RS2 : Number of Re-cordings *RS3 : Number of Active Re-cordings *RS4 : Number of Saved Single Measurements
*LL	Lock Keyboard	*LL	
*LO	Unlock Keyboard	*LO	
*LK	Set lock-out level		
*UL	Remove lock-out level		
*RE	Give error	*RE	
*CE	Clear error mem-ory	*CE	
*CK	Set clock	*CK	*CK : Display Time *CK14,25,24,1 : Set to 24.Jan, 14:25
*CL	Clear	*CL <nn>	*CL0 : clear everything *CL1 : clear the last re-cording *CL2 : reset all counters *CL3 : clear last single measurement *CL4 : clear all single meas-urements *CL5 : reset alarms
*RH	Give measuring head	*RH <nn>	*RH1 : Give memory head from Recording 1
*RD	Give recording	*RD <nn>	*RD2 : Give values from re-cording 2
*MC	Recording to MC	*MC <nn>, "<na-me>"	*MC2,"TEST"
*GM	Measure and transfer	*GM <ch>[, <in-terval>]	*GMH0001 : channel 1 measure and transfer *GMH2003,10 : Channels 1,2,14 every 10 sec.
*CM	End online transfer	*CM	

Com-mand	Meaning	Syntax	Example
	(*GM)		
*SM	Save single meas-urement	*SM [<interval>]	*SM
*CS	Cancel command *SM	*CS	
*SS	Select sensor	*SS <k>[,<Sensor-Nr>]	*SS1 : sets sensor on chan-nel 1 *SS2,33 : sets RTD100 on channel 2
*SC	Scale sensors	*SC<k>[,<basic-sensor-nr>,<X1>, <Y1>,<X2>, <Y2>, <com-mapos>, "<dim>", "<name>"]	*SC 2 : sets scaling on channel 2 *SC 4,11,400,0,2000, 1000,3,"Ltr","Water": Scaling on channel 4, 4...20mA -> 0...100.0 Ltr., Name of the sensors: "Water"
*SO	Offset adjust	*SO<k>,<Sensor-nr>,<X1>,<Y1>, "<dim>", „<na-me>"	*SO 2,33,225,227,"_oC", "Temp.": Choose Pt100 on channel 2, set 2.25°C to the value 2.27°C, therefore offset 0.02°C
*SL	Set limits	*SL <k>,<nr>[, <onoff>,[,<val>, <upper>]]	*SL 1,1 : sets limit 2 on channel 11 *SL 2,0,1,225,1 : sets on channel 2 limit 1, ac-tive value=22.5, Alarm on exceeding upper value
*AM	Alarm-Mode	*AM [<min-t>, <cont>]	*AM 0005,0 : Min alarm time = 5 seconds
*SB	Baud rate	*SB [<b>]	*SB : sets baud rate *SB 5 : 9600 BAUD (4:4800, 6:19200, 7:115200)
*SD	Dialogue language	*SD [<d>]	*SD : sets language *SD 0 : German *SD 2: English

Communication

Com-mand	Meaning	Syntax	Example
*DP	Define recording	*DP "<name>", <ch>, <du-rat>,<interval>, <filter>,<ring>, [<start>]	*DP "TEST",H0084,99_12:30,10m,1,0,20/10,15:40 Name of the recording is "TEST", channels 3 and 8, Duration 99days +12hours +30minutes, Interval 10 minutes, Aver-ages, No loop memory, start on 20.10. at 15:40
*DF	Define fast meas-urement	*DF "<name>",<ch>,<freq>,<durat>,<trig>	*DF "FAST",H0001,2,0010,0 Name "FAST", channel 1, 80Hz (0:20,1:40), 10 seconds long, Start im-mediately (1:on limit)

<Text>   Means the place-holder for a numerical value. To format, see the exam-ple to the right.
The mask for multiple channels, "<ch>", must be entered in hexadeci-mal form:
"Hxxxx"
Therefore: Only channel 1: "H0001" or channels 1 to 4: "H000F"

[Text]   Means an optional entry.

Each command is completed with the symbol CR (ASCII=13), which corresponds to the ⎡Return⎤ "Enter/Return" key.
The answer begins with "OK", sometimes other entries follow and it ends with the symbol (ASCII=26).
An erroneous command leads to the answer: "ER".

Remarks to Remote Control

The second possibility to communicate with the mikromec®multisens over the serial interface is the so-called remote control. It can only be documented briefly here. The remote control is model and revision dependent, since it uses keyboard codes. Therefore, this possibility is only really suitable for programming your own logger-access.
After <CNTRL A> [= <ALT 01>] the logger switches all of its LC-display outputs to the serial interface as well and also accepts the keys 0 to 9 and A to F, I, "." and "-". After a second <CNTRL A>, this mode can be turned off again. The logger's "normal" command language isn't understood in this mode! This possibility uses the *TECHNETICS* operating program MM-grafix in order to realize the so-called "remote control." A virtual device is displayed on the monitor. You can operate

this device in exactly the same way as you would operate the device locally. You can use mouse clicks or the keyboard to operate the device through MM-grafix.

The Allocation of Keys to Control Symbols

Key 1 to 0	= ASCII '0' to '9' (=30hex to 39hex) to the logger
EXIT key	= ASCII 'A' (=41hex = 65dec) to the logger
< key (left arrow)	= ASCII 'B' (=42hex = 66dec) to the logger
Clear key	= ASCII 'C' (=43hex = 67dec) to the logger
> key (right arrow)	= ASCII 'D' (=44hex) to the logger
SEL key	= ASCII 'E' (=45hex) to the logger
Down arrow key (and decimal point!)	= ASCII '.' (=2E hex = 46 dec)
Up arrow key (and sign change!)	= ASCII '-' (=2D hex = 45dec)
Info-i key	= ASCII 'I' (=49hex = 73 dec)
On/sleep key cannot be remotely controlled	
The optional display-light key cannot be remotely controlled!	
<CTRL-27>	ASCII Esc (=1B hex) always takes the logger straight back to the measurement screen! Unconfirmed entries are lost!
<CTRL-A>	ASCII 01 (=01 hex) toggles in and out of the remote control mode.

Data Transfer over Telephone and Modem

A modem can be connected to the logger for data transfer. The modem is connected to the telephone network and you can then make a phone call to operate the logger. You also need a modem connected to a PC into order to call the measurement location with the help of MM-grafix. After successfully creating a connection, the logger can be operated as if it were directly connected to the PC over the serial interface. The logger can therefore simultaneously output measurement values, you can collect saved recordings or operate the logger as a "virtual device" on the monitor.

Which Modem is Suitable?

Although a connection can be made with almost any commercially available modem with AT command capabilities, *TECHNETICS* offers modems which have proven themselves for this task. Unfortunately, modems react differently to the

same AT-commands, even those from the same manufacturer or modem type. Modems with a real transfer rate of more than 28800 bps are used. These modems are fitted with a wake-up circuit if necessary, which allows low-power operation.

GSM Radio Modems

If you want to operate a modem in the public digital network (GSM), you also need a suitable forced release for data transfer with special properties. These are available from numerous telecommunications companies. Suitable radio modems and forced releases are offered with the matching configuration software from *TECHNETICS*.

The disadvantage of this solution is the radio modem's constant electricity demand of approx. 45mA out of 12V. *TECHNECTS* has already realized a number of tailor-made field units, which can be reached over radio modems. Feel free to contact us about any new developments: the logger will be able to turn the modem on itself, in order to make its call, etc, so that it can be reached at a previously programmed timeframe. This solution can then gain its power supply from solar cells. A humidity-proof, robust radio set with magnetic foot-antennas are offered for changing use with laptops and the mikromec®*multisens*.

Turning On and Resetting over the Serial Interface

There are two different ways in which the logger can be connected to the serial interface:

The computer always turns on the logger and then resets it: cable type DKR9/25 (standard for all mikromec®*multisens* –both with and without keyboards).
The computer can neither turn on the logger or reset it: cable type DK9/25 (previous standard on all *multisens* devices with keyboards).

Option: Data Transfer per PC-Card (PCMCIA)

The logger can be fitted with a memory card slot according to PCMCIA specifications. An empty card can be inserted and used to collect the measured values from the logger in order to be able to analyze them later on a PC.
The mikromec®*multisens* works with memory cards which comply with PCMCIA specifications type I. The purpose of the memory cards is to transport the measurement data to a PC where it can be analyzed. The memory card does not need to be inserted in the logger while the recording is in process since the logger saves all the results internally as before. The data is then transferred to the memory card using a keyboard command. The logger doesn't clear the data in this process – information is only deleted after a specific command from the user. See: Data Output PC-Card.

Communication

Power Supply

External power supply: 11.8 to 14.5V DC (without charge!)
The delivered voltage can never be allowed to exceed 16.0 V DC (abs. max.)! External sensors can therefore only carry a maximum of 16V and run safely over 10.5V.

Charging/Parallel Supply

Charging device: Only use a lead-acid battery charging device either supplied by *TECHNETICS* or authorized in writing. Other supplies can lead to damage to the device. The charging end-voltage has to lie at 14.4V DC. This relatively high charging end-voltage is necessary to overcome a Schottky protective diode, and should me maintained precisely to within 1/10V. Suitable lead-chargers are current-limited to 350 to 600mA. *TECHNETICS* charging devices also ensure that the battery is not discharged by the charging device if the mains supply fails.
The typical sensor excitation voltage VTRA at the sensor sockets remains at the steady rates of 13.0 and 13.3V during continual charging with VNLB12 and also for continuously running mikromec®*multisens* operation. That also counts for zero-load up to approx. 50mA total load at VTRA.
The device is supplied with maintenance-free, location-independent, 12V/2Ah lead-gel batteries. Batteries can only be replaced with original components by authorized *TECHNETICS* service personnel.

Battery Replacement Interval

If a battery's capacity, and therefore the logger's running time, falls to 80% of its nominal value, the batteryshould be replaced. Usually, the batteries will last for 4 to 6 years of proper treatment (without deep discharging).
When changing the lead-acid battery, the internal Li-cell (3V nominal) and the clock battery (1.2V nominal) should be checked and replaced if necessary. See the chapter "Maintenance."

Testing the Battery Running Time

You select the internal battery voltage "UBAT" and start a recording with a duration of, for example, 4 days and an interval of 10 minutes. The logger is then put into the sleep mode with the on/sleep key.
Then the battery is charged, while the device is turned off, for 18 hours (up to 5 hours after the charging LED on the socket charging device has turned off – the yellow "Power" LED on the logger always stays on!).
The battery is now completely full. Therefore the charging device is disconnected from the logger to allow the logger batteryto begin to empty. The logger is turned

on with help of the on-key. The batteryvoltage can then be seen. The logger will then run and record continuously for approx. 24 hours until the batteryreaches the discharging threshold of approx. 11.4V.

The charging and discharging curve is then saved in the logger. If the logger is no longer on on the following day, plug the charging device in again and you can then see the moment at which the supply ended in the measured value graph. The time for which the logger measured <u>continuously</u> without the charging device is described as the running time. Irregularities at the end of the curve occur due the battery's recovery properties. Sealed batteries in particular demonstrate this behaviour. The logger only measures and saves values when the current energy is sufficient to completely perform a valid measurement.

If you have sensors that are also excitated (only sensors which require a total of more than 10mA are relevant!), you can use the above test with selected sensors. For roughly every hour of operation, thousand wake up times can be set where recordings should be made by using these sensors in the sleep mode.

Self-Discharging

A lead acid battery is used as operation and memory batteries. A fully loaded lead-acid battery is half-empty after 16 months at 20°C – without any use (approx. 3%/month), at 40°C after only 5 months, regardless of its capacity/build-size. Only the multi*Logger*-models mL4/7/11/19 don't have an internal lead-acid battery.

Data memory, without Li-buffering with the option 512000 measurement values: Including the stand-by power requirement (without SML operation) the battery is usually so empty after 9 months that the memory no longer functions safely. If you allow a recording to run for so long that the battery reaches the turn-off threshold of 11.1V, the remaining capacity is only enough to hold data for 4 weeks (typical value!).

The problem is remedied in the standard memory size of 128000 measured values through a special lithium-cell: "infinite" data and counter configuration memory! On top of that, pure exchangeable battery operation (=without internal lead-acid battery: multi*Logger*-special model) is possible!

Battery and Mains Threshold Values (Operation at 25°C)
  "Charge Battery" message appears when under   11.4 V battery voltage
  "Charge Battery" message disappears when over   11.4 V battery voltage
  Turn off under   11.1 V battery voltage
  Possible to turn on over   12.0 V battery voltage

Clock Running Time

The internal clock of a once fully charged loggers runs, independently of the lead-acid battery, for at least 6 months after the lead-acid battery is completely empty. If a device with an empty clock battery is turned on, the device warns the user and

then invites the user to charge it. The clock battery is automatically charged alongside the lead-acid battery. If the logger identifies a critically low power state, the wake-up interval is automatically lengthened to approx. 5 minutes and an amplified amount of charge is redirected from the larger lead-acid- into the smaller clock-battery.

The typical life of a clock battery is over 5 years.

Power Supply

Recognize and Fix Errors

Logger Short Messages

There is a row of events, which the mikromec®*multisens* recognizes and even records in an error buffer, so that a the problem can be later analyzed. The logger notices when and how often each error occurs.

One part of the messages belong to the normal operation:

Blinking Exclamation Mark

A blinking exclamation mark (!) signals that (at least) one recording is active. If you are currently in the measurement screen, you can use the status direct function key "7" to get an overview of what is currently running.

Blinking M

A blinking letter M means, that an averaging recording is active. See the chapter: "Mean Values, Maxima and Minima."

Blinking F

A blinking letter F means that an error has occurred and that can now be seen in the error buffer: "Data Output" / "Error Messages." The error buffer gives a text and a clear error number. Use this error number to peruse the error message in the chapter of the same name. You can then clear the message with "Clear" / "Error Messages." Then the blinking "F" disappears. If the F doesn't disappear, another error must have occurred immediately after the first one was cleared.
A typical cause for a blinking F is, for example, that the battery voltage has reached the lower threshold during operation: "Charge Battery" message.

Blinking S

A blinking letter S means that the status inputs at the Dig-sockets are being continuously monitored and that a single measurement with the values from all channels is being made on all status changes. Which of the up to 20 status inputs should be sensitive to changes can be chosen in the status single measurement entry: The first 2, 4, 8, 12, 16 or 20 status inputs trigger a single measurement. See "Measuring Status Inputs."

Troubleshooting

Viewing the Saved Error Messages

You can view all saved error messages under "Data Output" / "Error Messages" / "Display." You can scroll through them using the ▲▼ keys. The errors have identification numbers to make it easier to find them in the list. See the chapter: "Error Numbers," page 180.

If the contents of the error buffer are obviously nonsense, it should be cleared. The most common case is a blinking F due to a "Charge Battery!" or something similar. You may be tempted to do away with these, since they could possibly become annoying. However, since they represent an interruption to the normal operation, it is important not to silence them. The following section will describe how the error messages can be cleared. This would mean that the blinking F disappears. If this doesn't happen, a new error must have appeared. This can happen, for example, when you try to communicate with a module which isn't actually connected, or when the serial interface continually receives symbols at the incorrect baud rate, or something similar. For each case, a new entry will appear in the error buffer.

Clearing the Saved Error Messages

There is only one method in which to clear the error messages: The error messages have to be specifically cleared under "Clear" / "Error Messages." To be able to follow errors back as far as possible, after a total drop-out, reset, etc, the error buffer is <u>not</u> cleared.

The Logger Jumps out of the Menu into the Measurement Display

Timeout

If the logger is left in an entry menu, it is prevented from performing its measurement and saving duties. Therefore, after 5 minutes of inactivity, the logger reverts automatically to the measurement operation. While studying this instruction manual, you could be surprised by the logger suddenly doing this.

External Reset

If the logger is turned on externally, that triggers a hardware reset. This is the case when the data carrier DCD reports a message from the modem connection over the serial interface or when turned on or off by force with a contact at the Dig-socket through a connection between pins K an M.
Each time one of these described signals changes, a reset is triggered.

The Keyboard doesn't Respond

Remote Control

If the logger is being controlled remotely, the keyboard is generally locked. That is, for example, the case, when the saved measurement data is read or when MM-grafix is operating the logger (at which time the logger is displayed on the monitor as a virtual device). If this behaviour is undesired, the alternative is to use a serial connection cable which doesn't have the connection at DCD pin 7, and which therefore cannot turn the logger on.

Keyboard Lock

In order to prevent all erroneous entries, the keyboard can be barred from unauthorized users. See the chapter, "Lifting the Keyboard Lock." Further lock-out modes are described in the serial commands.

No Access from the PC to the Logger over the Serial Interface

The logger is attached to the correct interface and has the same baud rate as the PC program, but it still isn't answering! There are numerous tips on this topic in the chapter "Data Transfer."

The Logger won't Turn On!

If you cannot turn on the logger with the on/sleep key, then:
- The battery is empty → plug in the charging device → the power light-diode should go on immediately and the logger should then turn on again after 10 minutes at the very latest.
- The electronic safety is active: overload on at least one sensor-socket: disconnect the sensors, press the on/sleep key twice, the logger then has to turn on. On the Logbox-model, no on/sleep key is visible! It is however present in the form of a magnetic circuit (reed-contact) under the front plate at the diagonal line. Therefore, trigger the contact twice with a magnet, after which the "active" light diode has to turn on again. If you trigger the contact again, the logger is sent back into the normal sleep-mode → "active" LED is off! In order to simplify this procedure, the RS232/Modem cable should be plugged in.
- The battery is defective: If the battery is so defective that it could cause the device to short circuit, the power-diode will only light up very weakly, the charging device will, among other things, warm up slightly, but you won't

be able to turn the logger on. The internal battery should now be replaced: see the chapter "Maintenance."

- The internal fuse is blown: If the charging device is plugged in, the logger turns on immediately, if the charging device is unplugged, the logger turns off immediately.   The fuse must be repaired: see the chapter "Maintenance."
- The logger is defective: If the red Alarm-LED is on after the logger is turned on, but no reasonable information is displayed on the LCD, the device is defective: the built-in mini-processor isn't working.   Possible causes: the processor PCB is defective or massive amounts of water are in the device. The device must be sent in to be repaired.

The Logger won't Turn Off!

The mikromec®*multisens* switches itself on – that is to say, it can be forced on by a connected signal. Therefore, the following things keep the device turned on:

A Measurement Task is Currently Active

If the logger wakes up and has a recording, which has a saving interval of less than one minute, the logger remains continually on and cannot be directly turned off with the on/sleep key.

The PC Keeps the Logger On over the Serial Interface

The logger can be forced on at any time over the serial interface. That is done over the DCD signal (pin 7). MM-grafix activates the logger in this way over the output wire DTR of the PCs serial interface. As long as this signal is conducting a voltage, the logger remains on. This state is shown on Logboxes with the "active" light diode.

A Call from a Modem is Active

As soon as the logger has received a successful call from a connected modem, the logger reports this with the DCD wire. The activated DCD wire from the serial interface then turns the logger on. As long as the call stands, you <u>cannot</u> turn the logger off with the on/sleep key. This state is shown on Logboxes with the "active" light diode.

A Recording is Active

If a recording is active, the logger turns itself on and you can read the measured values. If the logger is woken up in this way, it doesn't allow itself to be turned off so that it can execute the measurement task. The logger also doesn't turn off if the recording interval is less than one minute or if mean values are being recorded.

"Ctrl+Alt+Del": Full Soft-Boot

If the device has hung in such a way that neither turning the device on/off nor through an external reset brings it back under control, there is one final possibility to bring the device back into a defined status: press the keys 3, 6 and 9 <u>at the same time</u>! The use of this "soft-boot" is recorded in the error buffer. You should only use this reset option as an absolute last resort. This reset also works if the keyboard lock is activated. The surrounding circumstances of this sort of action should be reported to *TECHNETICS* over the hotline.

All measured data is lost. The sensors are all deselected. All recordings and signal monitoring functions are aborted.

The Impulses are not Displayed!

When a recording is running, the impulses are always only displayed at the set scanning rate. This is described under Recording Impulses.

If "= = = =" is shown instead of the expected impulse display, there must be a hardware failure: the internal counter modules cannot be communicated with. Please check the connected sensors, particularly on the IF-sockets and at their SCL and SDA pins.

The mikromec®multisens Error Messages

Error Messages with ID-Numbers

Error numbers 0 to 100 are errors in the remote control over the serial interface:

000	NO_ERR	no error
001	START_ERR	illegal start-symbol: only "*" or "$" are allowed!
002	CHK_ERR	the checksum following a command with a $ start, symbol is incorrect. Checksum error.
003	END_ERR	illegal command-end (neither CR nor LF) or the next command is already sent, before the last one was fully processed.
004	CMD_ERR	unknown command: syntax error!
005	NO_PROG	recording is not defined
006	NO_EMS	no saved single measurements available! (no EM available for "CL3"- command)
007	EEP_ERR	EEPROM-checksum is erroneous (for CL0, the EEPROM is read afresh)
008	RANGE_ERR	given parameter lies outside the allowed limits

Troubleshooting

009	MIS_DELIM	cut-off signal missing: parameters must be separated by "," . This error also appears if a parameter is missing or if a number has more digits as expected
010	NO_DIGIT	at least a single-digit number expected, or a numerical parameter is missing
011	UNDEF_CH	given channel number is not allowed!
012	UNDEF_SENS	given sensor-selection-number is not allowed (>126 or sensor is not allowed on this channel)
013	CORR_OVER	correction factor overflow! (sensor's scaling factor in scaling table is so large, that an overflow occurs during tuning)
014	DIS_SENS_ERR	sensor is not selected! Note: for SL, the sensor already has to have been selected
015	ILL_SIGN	illegal sign
016	UNSCAL_ERR	an attempt was made to read the scaling data from a sensor that has not been scaled.
017	SKAL_ERR	an attempt was made to rescale an already scaled position. you can only have one adjusted scale per channel.
018	NOT_TO_SKAL	an attempt was made to scale a sensor that cannot be scaled
019	SLOPE_ERR	the scaling gradient is too large
020	X1_ERR	during scaling, the selected X1 value was too large
021	TEMP_ERR	error during scaling (=calibration!) of a pH-sensor: overflow in temp-channel or no allowed temp sensor is selected on the previous channel
022	NO_QUOT	quotation marks missing in text entry
023	STR_TOO_LONG	transferred text is too long: e.g. name, dimension in scaling, name in recording entry
024	ZERO_PRG	no recording: everything must be cleared. This error must not occur!
025	TOO_MANY_PRGS	an attempt was made to enter more than 9 recordings
026	ERR_FILTER	illegal "filter" in recording entry
027	NOT_IMPL	function or command not implemented as yet!
028	ERR_RING	illegal "ring"-parameter in recording
029	ERR_DURA	illegal duration
030	ERR_DATE	illegal start time
031	ILL_INT_FMT	illegal format for the interval
032	ILL_INT	illegal value for the interval
033	NO_HEX	the entry is not a hexadecimal digit!
034	TOO_MANY_VALS	too many measured values are being produced
035	TOO_MANY_CH	too many channels
036	NO_MTW	no mean value in FID!
037	NO_CHANS	no channels to be recorded!
038	CHAN_DIS	recording channel is deselected!
039	ILL_K1_K2	K1-K2 is illegal; a counter, that is not recorded
040	ERR_FREQ	illegal frequency code in fast measurement
041	NO_FAST	no fast measurement possible for specified sensor!
042	ERR_TRIG	illegal trigger in fast measurement
043	EE_ADDR	long-word address in EEPROM-access too large!
044	IIC_ERR	IIC-error during access to internal EEPROM
045	IIC_ADDR	incorrect IIC-address for sensor-EEPROM
046	ERR_TIMO	timeout error
047	WRITE_ERR	MC-write error: cannot write successfully to PCMCIA (= PC-Card) memory card!
048	NO_CARD	no MC inserted: PCMCIA (= PC-Card) missing!
049	UNDEF_ERR	undefined error
050	PASSWD_ERR	incorrect password in TC,TE,TM
051	MEM_ERR	hardware-error in memory test (MEM-Test)
052	EE_ERR	hardware-error in EEPROM-Test

053	MC_ERR	hardware-error while testing the inserted memory card (PC-Card – "MC-Test)
054	LCK_ERR	logger is barred from this function
055	PWD2_ERR	new passwords differ
056 bis 099		so far unassigned error numbers

Error numbers, which appear directly on the LC-display and which are sometimes entered into the error-protocol:

101	PWF	internal clock reports powerfail: the logger was probably left unused for a long time and is nearly totally discharged. It either has an empty or defective internal NiCad clock battery. This battery is now empty, it is also charged alongside the main battery. See "Do Not Turn Off!"-Error message, see further below.
102	TIM	time was nonsensical! The clock is initialised to 00:00 in this case, all running recordings are ended.
103	KOR	self-calibration correction lies outside of the allowed range. This is a hardware error. If this error keeps occurring, the device must be repaired.
104	RES	"soft-boot"-reset was performed: you can recover the device after a crash with the 3-key boot. This is recorded in the error protocol.
105	CNT	the built-in counter units for frequencies and impulses are not performing in the intended manner. This error only occurs after the logger is heavily discharged
106	BTL	"Charge Battery" occurred: the logger discharged under 11.4V supply voltage level and now needs to be recharged. The recording is continued until the battery is completely empty. If the battery recovers, the recording is then continued.
107	E_RS232	RS232-reception error: serial interface RS232 frame-error: an attempt was made to communicate with the logger at incorrect baud rate.
108	OVR	RS232-reception buffer-overflow: serial interface. Cause: computer cannot be braked using the hardware-handshake: set "Hardware-Handshake" on the PC! The cable could be defective.
109	SPR	hardware-error: interrupt without identifiable cause.
110	E_BRK	hardware error/crash: HALT.
111	IIC_1	hardware error: SCL remains low.
112	IIC_2	hardware error: SDA remains low.
113	IIC_4	hardware error: no acknowledgement.
114	STK	hardware error/crash: stack overflow.
115 bis 199		so far unassigned error numbers
200	MEM_SYS	MEM system error: memory contents are corrupt: the logger has to be reconfigured. Any recordings have to be cleared. All sensors have to be reselected. (more information, see below)

further error numbers (no entry in the error protocol):

| 201 | NMI | hardware error: internal clock isn't working. Repair required if a day of charging doesn't achieve! "missing NMI: 201" |

Troubleshooting

Warning Texts

A number of error are given as messages during keyboard entries, but are not entered into the error buffer:

"Charge Battery!"

This occurs when the supply voltage falls under 11.4V. The measurement is adjusted. The event is recorded in the error buffer as error number 106 with the momentary time. Remedy: connect the charging device or change the exchangeable battery. If the voltage continues to sink under approx. 11.1V, the mikromec®*multisens* switches all functions back to pure data-conservation. The LC-display and keyboard are as good as dead.

Any interrupted recordings are correctly continued once power has been returned. In the down-time, dashes are entered into the recording in the place of the missing values. For recordings in the sleep mode, it can happen that these dashes are entered right up to the end of the recording if the battery is not recharged in time. You can view the error buffer to see if a "Charge Battery 106" error has occurred.

"RS232!EXIT=Abort!"

The mikromec®*multisens* was instructed to send data to RS232 (the serial interface), but for 7 seconds, no more data was accepted. The datalogger then continues the transmission as soon as symbols are accepted again.

"Wrong Entry!"

The start of a function that is not supported or which doesn't contain enough parameters.

For example, more than 200 marks were entered into a recording, and these marks fill up the logger's memory.

Additionally to "Wrong Entry!"

"Gradient Too Large"

This is given during scaling when the choice of the X2/Y2 points would cause too large a factor between the original and the target scales. The maximum possible factors are included in the sensor list (Title: Scaling Limit). Notice that the maximum factor is independent from the comma. Therefore, set the 4-digit numbers without considering the relationship to the decimal point: the original scale 0.000_V to 1.000_V should be rescaled to a target scale of 000.0xxx to 500.0xxx. The relevant factor is then 5.0, since the decimal point position is ignored!

"No Rec. Active!"

You tried to put a marking into a recording, although no recordings are currently defined.

"System Error"

This means an access error on internal peripheral modules. This should not occur in normal operation.

"No Sensors Selected"

The device is in the "Measure and Display" mode. Since the sensors are in the "off" mode in all channels, no measured values can be displayed.

"Channel Not On"

An attempt was made to rescale, although no sensors are selected on that channel.

"No Rec. Available"

This means that an attempt was made to clear or restart a recording, although no recordings are currently available.

"Too Many Values"

The entered recording has too many values. There is not enough free memory remaining on the mikromec®.

"Not Scalable"

The selected sensor cannot be scaled.

"Will Overwrite"

Warning, that performing this new scaling will delete the old values.

"Max. 9 Recordings"

9 recordings have already been defined. It is impossible to enter any more recordings.

"No Channel Chosen"

When entering a recording, the user forgot to set up at least one channel for the recording.

Troubleshooting

"Too Many Channels"

A fast measurement on more than one channel was entered. Since September '97, the mikromec®*multisens* devices can also measure multiple channels at more than 1/sec.

"Fastmeas. impossible"

The selected sensor is not suitable for fast measurement. For example, frequency measurements or other signals from IF-ports, like flows, etc. The status-ports over Sta_4 are not designed for fast measurement, either.

"No Meas. to Start"

The message, "No Measurement to Start" appears if an attempt was made to start a recording with a key press (key 4) in the measurement mode, although no recordings had been previously entered.

The only recordings you can start and stop with key 4 are limit start single measurements.

"Gradient too Large"

The selected resolution of the Y-range of a scale was too large.

The resolution can only be selected to be so large, that it falls within the measurement range (X-range) of 12500 scaling parts of the Y-scale. The upper limit for each sensor can be found in the list "Sensor Scales" under the "Scaling Limit" column.

"/X1/ too Large"

The entered scaling is not valid, because it leads to an X1 value, which is too large. X1 is the first of two values in the original/basic scale.

"Sensor Not Allowed"

The selected sensor cannot be used in this recording.

"Max. 79 Days"

The maximum duration of a loop memory recording was 79 days before September, 1997. This was extended to one year. This error message can occur in older devices and this limit can be alleviated with a firmware-update.

"Write Error"

The PC-Card cannot be successfully written to. While verifying the written value, it is ascertained that the read value does not correspond to the written value. (This error can specifically not be triggered due to a missing or empty PC-Card battery.) Possible causes for the write error are:

1. Write protection switch on the side of the PC-Card is set to WP (Write Protect). It must not be set to WP!
2. The PC-Card is not inserted into the slot correctly.
3. It is not an S-RAM Memory Card. The logger cannot write to Flashcards or ATA-cards.
4. The PC-Card slot is defective: dirty, corroded or bent pins.
5. The card is defective, e.g. through a brake or static discharge.
6. The card is actually an S-RAM card, but it is too small to save the entire recording. In this case, the error message doesn't necessarily occur immediately after activating the data output, but first, when the logger reaches the end of the card (earlier than expected).

"Do Not Turn Off"

The built-in clock battery is empty. This error is effectively prevented in normal operation. This message should no longer appear if the logger is recharged again or reconnected to the mains power supply. If the logger wakes up to make a measurement and realizes that the clock's power supply has reached the lower threshold, it automatically lengthens the wake up interval with this message to approx. 30 minutes to allow the clock battery to charge itself from the main battery. The priority for the logger is that the time is correct, even if the possible measuring time lessens. You shouldn't use "force" to turn the logger off, rather you should recharge it with the help of the charging device.
This error can occur in new devices with a weakly charged battery.

"System Error BREAK 100"

This means that a fatal error has occurred while performing the internal "operation system". This can be caused by extreme discharging or pulsating transverse currents through the device. The device then has to be initialised afresh: abort recordings, reselect sensors and re-enter recordings.

"System Error MEM 200"

The datalogger constant checks its data stock for plausibility. If a memory error occurs, the logger reports it. Measurement tasks cannot be run further. This error can have the following causes:
All electricity supply sources are disconnected or all batteries are/were fully discharged (only in devices with more than 128000 measurement values, because these don't have a second cushioning over the Li-cell).
Extreme disturbances: Transverse currents through the device, lightning strike nearby, disturbance current through the end-slides.
The second RAM-cushioning no longer works, because the lithium button cell is empty. If this error occurs, the lithium cell in the device (3V nominal voltage!) has to be checked. To do this, the device has to opened, therefore it must be sent back to the manufacturer. In loggers with a pure exchangeable battery (that is to say, no built-in lead-acid battery), the lithium cell is used to bridge the time while the battery is being changed and for full discharging/missing external battery. No lithium cell is built into devices with more than 128000 measured values.

For the sake of completeness: newly mounted and totally unused devices also report "System Error MEM!"

"EEPROM-Error"

This error is reported when the calibration data in the datalogger isn't plausible or when it doesn't fit with the version of the built-in software. This problem can only be remedied through a special EEPROM-charging program in connection with the workshop calibration data for the individual device.

"Data Output Active!"

This text is given, when the mikromec®*multisens* sends its measured data to a PC. The mikromec®*multisens* keyboard cannot be operated during this time.

"Status Single Measurement Active, Select Status-Port"

A status individual measurement was released, but no status-ports were selected. The mikromec®*multisens* now has to be given the status-ports it needs to monitor.

"Please Wait: Values Missing!"

This text is given if the mikromec®*multisens* wakes up and finds that (many!) measurement values are missing from the recording. The logger reports this message and registers the missing values as not have being measured. This process should only really be observed, when the mikromec®*multisens*, for any reason, is prevented from actually performing all the measurements in a recording. This could be because of a completely empty battery, or even extreme external overloading: constant, probably nonsensical commands over the serial interface prevent the logger from performing recordings. This error typically occurs when the mikromec®*multisens* with a currently running recording and an empty battery is connected to a charging device and then switched on.

"Only Change Locally"

This text is given, if someone tries to change the mikromec®*multisens*' baud rate with the remote control. Since that would not work well, it cannot be done with the remote control. It is actually possible to change the baud rate remotely: using the special mcl-command (*sb), which was specially described.

Appendix

Maintenance

Maintenance Performed by the User

The customer has no influence over the device's adjusting values. An instruction manual about calibration with the accompanying adjustment software can be delivered in special circumstances. You do have to check the calibration, however. The break-out-boxes are recommended for this. There is a break-out-box with 12 screw terminals (code: ManAd-12Sk) for the An, Ani and Anp port types. For IF and Dig ports, the break-out-boxes are called MIFDigAd-12Sk and they also have screw terminals. These boxes aren't intended for constant installation, since an effective screening cannot be put across the screw terminals.

Calibration Interval

In order to check the given technical data and accuracy, the device should be recalibrated every 2 years. The calibration is performed by the manufacturer. An individual adjustment protocol can also be provided. The adjustment data is saved in the device intransiently.
The devices have a constant self-calibration, which makes the relatively long biennial calibration interval possible.

Sensor Calibration

If the individual sensors require special fine-tuning, the "scaling" function, which creates a special scale, can be used. It is available in the so-called "Scaling Position" in the appropriate channel's sensor list.
To do this, you don't just use the set points in two-point-form in scaling, but they can also be used to measure the sensors during scaling. You can precisely generate set points (for instance pH or a rated pressure), and ensure that the mikromec®multisens can then exactly display the desired value. See the chapter "Scaling" under the headword "Calibration."
You can only use the unchanged base-scales, for example voltage, current, impulses, etc, to control the mikromec®multisens. If the mikromec®multisens is recalibrated by the manufacturer, if the highest standard of accuracy is required, all sensor calibrations should be performed again, since small changes to the logger's sensitivity will flow on and effect the scaled sensors.

Checking the Battery State: Run-Time Test as Recording

To check the capacity of the built-in battery, load the battery while the logger is turned off. The light diode on the VNLB12 charging device turns off before the

Appendix

end of the charging time. The charging procedure needs to be continued for at least 5 hours after the light diode turns off. The yellow power-LED on the front plate is always on, as long as the mikromec®*multisens* is connected to the charging device.

All channels should be turned "off" under "Settings" / "Sensor Selection." Only select the battery voltage on the last channel. It can be found as sensor 119 in the group "Diverse" as "U_Batt."

You confirm "U_Batt" with the SELECT key and you leave the setup menus by pressing the EXIT key several times. In the measurement mode, the time is now displayed. Pressing the down arrow (▼) scrolls to the second page, where the battery voltage is also displayed. It should display approx. 13.80V.

```
11:58:10
 13.74_V_
```

Now a recording, which records until the logger is forced to stop due to an empty battery, is entered in:

Recording to check the logger's run-time:

Enter the following recording by hand, or transfer it with MM-confix from the PC to the mikromec®*multisens*:

```
      Hauptmenue
1  Einstellungen
2▶ Messreihen      Messreihen
3  loeschen        1▶ eingeben
                   2  neu star   P1 eingeben
                   3  abbreche   noch frei: 1304
                                 1▶ Uhrzeitmessr   P1 Messw.:    5764
                                 2  Ringspeicher   noch frei: 130431
                                                   1▶K _____1
                                                   2 Start:12:07 29 11+
                                                   3     Messreihe
                                                   4  SEL = bestaetigen
                                                   5  EXIT= verwerfen
```
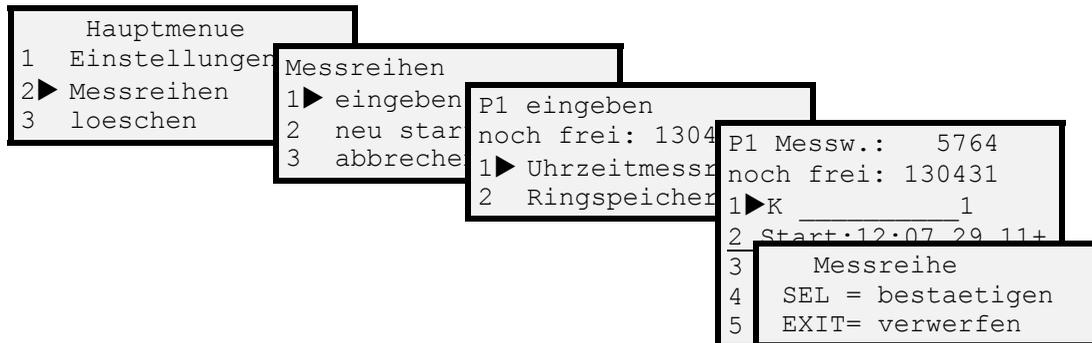
The mikromec®*multisens* remains on and the charging plug is removed after approx. 2 minutes (so that the start point is included in the body of the curve). Now, let the logger run for 24 hours undisturbed. If it then turns out that the logger turns itself off, plug the charging device back in and upload the resulting curve from the logger. There should be a blinking "F," since an error must have occurred in the last 24 hours: "Charge Battery" number 106. You can see the point in time at which the battery voltage reached the lower threshold: "Data Output" / "Error Messages" / "Display." After you have noted down the time at which the battery error occurred, clear the error buffer with "Clear" / "Error Messages."

The time for which the logger continuously measured the battery voltage after the charging device was unplugged is the run-time.

This run-time is different depending on model and equipment. It is usually 24 hours. You should record and save the run-time curve with a new device. Running the test again after several years of operation will show how good the battery still is. The battery should be exchanged when it reaches < 80% of its nominal capacity (= 20 hours for the models 224, 424, 824 and 16 hours for the model 1624).

Example Curve of a Run-Time Test

The depicted curve was produced by the previously described test. It shows the runtime of the mikromec®*multisens* with a new battery.

Appendix
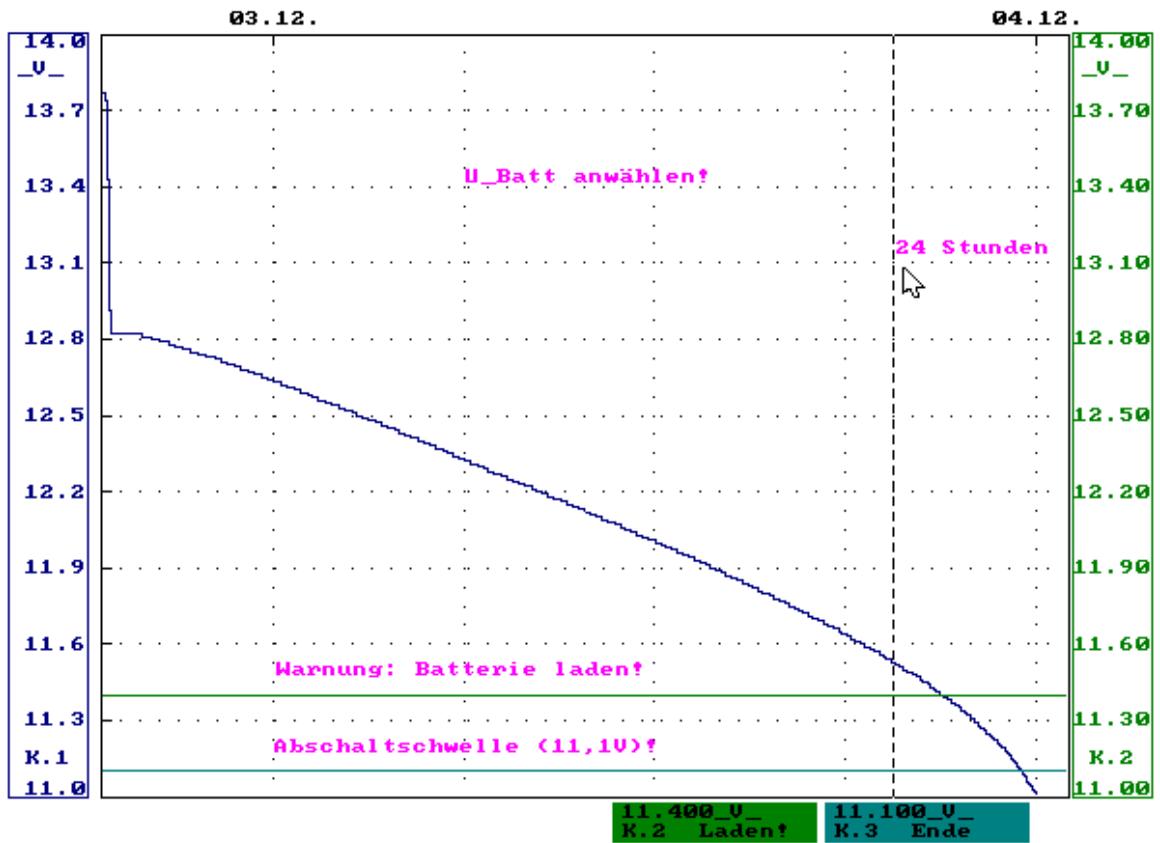
Checking the Battery in the Used PC-Card Memory Cards

In order to ensure that data is not being lost in PC-Cards during transport, all built-in batteries in all memory cards should be removed and checked at least once per year or if you are in any doubt about their effectiveness. The built-in batteries are usually CR2025 lithium button-cells with 3V nominal voltage. The cut-off limit is 2.7V. Move the data to a PC before performing this test, since all data on the card is deleted due to memory restrictions. If you are not going to be using a memory card for a number of months, you can remove the battery while they are in storage. Lithium cells can be stored for more than five years. The mikromec®*multisens* cannot test the battery in the memory card, since the card is supplied completely by the mikromec®*multisens*, for the entire time the card is plugged in. Therefore, the mikromec®*multisens* can also write to memory cards with completely <u>empty batteries</u> – the problem is that the card loses the data as soon as it is removed from the device. The mikromec®*multisens* doesn't lose the data in this case and another card can be written to if necessary.

Common Mode Test

The scales 25mV, 50mV, 100mV and 200mV are sensitive to common modes. This error is minimized by the workshop calibration. The test should be performed at 25°C ±2°C – the device's internal temperature also has to be equalized.
  Short circuit pins A and L
  Connect a separate voltage source with the ground M and +8V at A and L
  "Setup" / "Sensor Selection" / "Change" / "chan1"/ "U_25mV" SEL EXIT EXIT EXIT
The change from A and L between 0V and +8V must not produce a change in the voltage display over 0.01mV.
This test must be performed on all An-channels and they should all show the same common mode error, if at all. A control test has to be performed on a channel with the scales 50mV, 100mV and 200mV. In these scales, there should be no influence over 1 digit.

The current measurement-inputs in the type "Anp" input sockets also have a common mode error in a relevant order-quantity, which means that their common mode error has to be checked and taken into consideration: apply +30V on pin C against 0V = pin M. The displayed 0.00mA will be slightly distorted by applying this 30V common mode voltage. That is the Anp-port's common mode error. It cannot be adjusted. This test must never be performed on type "An" channels.

Disposal

The device contains lead and cadmium and must not be disposed of in the domestic rubbish. Faulty devices should be sent directly to *TECHNETICS*.

Maintenance Performed by the Manufacturer

Warning

The following maintenance activities can only be performed by *TECHNETICS* or by an authorized agent. The user is not authorized to perform these activities themselves!

Adjusting the Basis Scales

The basis scales are all scales which are not changed by the user in the so-called "scaling" process. These adjusted values are located within the device and saved in a database. The user has no influence over this calibration. It is recommended to send the device back to *TECHNETICS* for a recalibration every two years. An individual test report can be provided for a fee if requested.

Traceability to International Standards

The mikromec®*multisens* devices are calibrated by *TECHNETICS* in a traceable manner. When ordering the individual tuning protocol, a list for every measured quantity is made, recording which traceable measurement agents were used in the calibration. This process guarantees the traceability for each individual mikromec®*multisens* back to international standards and fulfils the requirements of the documentation according to ISO9000.

The electrical magnitudes are checked using a traceably calibrated digital voltmeter.
The traceability of the RTD100 measurement is guaranteed by the electrical resistance model according model according to DIN 43760 and following resistance measurement.
The fine-adjustment of the clock is performed against the 77.5kHz standard measure of the DCF77-clock.
All measurement durations and intervals are therefore calibrated.
The mikromec®*multisens* can be delivered with DKD certification for selected measurement points for a fee. This certification is given after the mikromec®*multisens* goes through an individual test by a DKD-authorized agent.

Individual Test Protocol

During the workshop calibration, a test report is produced which can be made available to the user for a fee. If this is requested, it is included in this instruction

manual in the appendix as a "Test Sheet." Order code: MLSP-number of channels.

Common Mode Adjustment

The adjustment can only be made by the manufacturer since this process requires that the device be opened.

The adjustment is made to channel 1 (port type "An") and its pins A, L and M on the (14-pinned) socket. Pins A and L are shorted for the entire test. The common mode error is the difference in the displayed value between 0 V and +8V common mode voltage. The common mode voltage is laid with positive on the bridge A, L and with negative on pin M (or U).

Now the 0V common mode should be applied and the displayed value should be noted. Typically, this value should be ±0.01mV. In the worst case, the value can be changed by several LSBs by applying the common mode voltage.

The adjustment is made with a 2mm screwdriver through the bore between IC19 and IC20. The bore is labelled with CM. The multichange potentiometer should be set to have minimum influence over the 8V common mode voltage. The goal is to have make no more difference to the displayed value by applying the common mode voltage. This adjustment can be made with a considerably better resolution by the manufacturer (see "Scaling"), which is why this process should only be used as a rough test without actually trying to change the settings.

Checking the Built-in Batteries

The three built-in batteries are <u>not</u> intended to be changed by the user.

If replacement types and test-procedures are given, that is merely to allow you to keep the device in operation if workshop service is unavailable for any reason. Any warranties are made void if the device is opened.

The battery-check is one of the tasks performed by the manufacturer in the biennial recalibration procedure.

Checking the Lead Acid Battery

The lead acid battery delivers the main energy for the logger itself, and also for the connected sensors. If the battery is completely discharged or totally defective, the logger cannot be turned on. It should however turn back on 3 minutes after the charging device has been plugged back in, at the latest. The yellow check-LED "Power" should always be on if a charging device is plugged in, since it displays the charging <u>voltage</u>. The red check-LED on the charging device itself can turn off, since it displays the charging <u>current</u>.

The battery capacity is tested using the previously described run-time test (earlier chapter: "Checking the Battery State"). If the run-time test is successful (remembering however that the device will have a considerably shorter run-time in practical use), the next step is to check the sensors' power supply. A further possibility

(only for measurements, which last for longer than 1 week!) is the SML signal from the IF-sockets. If the SML signal on one of the connected sensors is accidentally connected to the ground, the logger consumes three times as much power in the sleep mode.

Lead acid batteries die possibly cell by cell, which means that an external charging device will not be able to reach its charging end-voltage of 14.4V. The logger can still be turned on, although 2V of a cell are missing, but has no useful run-time anymore and the red LED on the charging device will never turn off.

The charging device is set to a charging end-voltage of 14.4V. With "U_Batt," the logger will only measure 13.8V, since a path of diodes to the battery have to be overcome within the logger.

Exchanging the Lead Acid Battery

The main battery is soldered up and cannot be accessed due to the water resistant device housing. It lies on the bottom of the device and is held in place with a holding-plate. It is a 12V, 2.0Ah Lead-Gel-Battery from YUASA, type NP2-12. If the battery is removed, the logger loses information such as its sensor selection configuration, any adjusted scales and all measured values. If any important scales or data are in the logger, it is recommended to upload them first. The front plate can be completely removed by undoing the 4 screws. The upper board is held in place by 4 bolts and can also be removed. The second, now free, signal processing board is attached to the housing in such a way that it cannot be re-moved, rather only swung to the side. Then the red cable "B+" should be care-fully unsoldered and protected from any contact in its surrounds – including from the housing: It is the battery's positive wire! Now the battery holding-plate can be removed and the battery can be unsoldered and removed. The installation is simply performed in the reverse order. If the device is put back together incor-rectly, the SMD-fuse can burn through directly next to the "B+" solder connection: see Exchanging the Fuse.

Checking the Clock Battery

Please note the warning at the start of the chapter.

The front plate is unscrewed and moved up approx. 3cm. You are then looking straight at the yellow clock battery. It is a single-celled NiCad battery with 1.2V nominal voltage (BT1). It should always have approx. 1.3V. Under 1V, operation can no longer be guaranteed. The logger has a built-in and constantly active rough-test for the clock battery. If it identifies any problems, it reports error 101.

The models multi*Logger* mL4/7/11/19 are all equipped with a commercially avail-able 1.5V alkaline mignon cell, which lasts in the place of the clock battery for 2 years. This is important because these devices are never connected to a charging device and only wake up rarely and for a short time to make measurements. These devices do not have a clock battery

Exchanging the Clock Battery

Please note the tip at the start of the chapter.
NiCad-Battery 1.2V Sanyo Cadnica 1N50AAAS 50mAh. Only use the original cell-type for replacements. The cell has special properties in relation to self-discharging and to charging ability under limited charging-current.
The positive pole is laid to the edge of the board and is labelled with BT1. Switching the poles destroys the clock module. The battery's positive pole in Rev B boards has to be cut back somewhat to avoid contact with C7. From Rev. C, this problem is remedied.

Checking the Li-Cell

Please note the warning at the start of the chapter.
You can only check this cell by opening the device, which means that this task can only be performed by the manufacturer. The housing lid has to be released and move approx. 3cm. Further demounting is not necessary. The Li-cell BT2 is a silver disc and in boards before Rev. C, it lies under IC5 on the underside of the board. The positive pole is the entire accessible outer surface with its 2 connectors. On Rev. B boards, the positive is labelled with BT2. The positive pole can be accessed with a DVM. As ground, you can use the mounting capsule's solder lug or the clock quartz's measurement surface. The cut-off limit is 2.4V. There is no BT2 in devices with 512000 measured values.
The Li-cell cannot be recharged and is used to conserve data. It is only placed under load when the main battery is fully discharged or is missing completely. Therefore it is not absolutely necessary for operation. In the purely exchangeable-battery-devices multi*Logger* mL7/11/19, the Li-cell is also loaded if no exchangeable battery or VNLB12-mains component is connected and it cuts off relatively quickly in this way within a number of months. If a SYSTEM ERROR MEM is reported, that is a hint that the BT2 is used up.

Exchanging the Li-Cell

Please note the warning at the start of the chapter.
Li-cell: 3V BR2032H2A from PANASONIC™ with 17.8mm RM solder lugs. To exchange it, the front plate has to be removed and the first board in the lithium cell has to be built out. It is extremely difficult to avoid data loss. The device's calibration data is non-transient, which means that it is lost when the Li-cell is exchanged. In devices which do not come with lithium cells, no cells can be retrofitted to them. The Li-cell is also removed when the memory capacity is increased from 128000 to 256000 and 512000 values.

Changing the Fuse

One 2A SMD-fuse (build-size 1206) is built in. This must not burn out at the sensor sockets if a short circuit occurs. The fuse is not designed to be replaced by the

user, it is only a fire protection. The actual protection is guaranteed by a reversible electronic fuse. If the fuse burns out, the device can still be operated by the charging device - however, as soon as the charging device is unplugged, the device switches off. To change the fuse, see the section "Exchanging the Lead-Acid Battery." The fuse type is:
AVX F1206A2R000FWTR or Littlefuse ALF SMF Type: R418002.

LCD-Lighting Option: Changing the EL-Foil

Please note the warning at the start of the chapter.
The option LCD EL-lighting only has a limit life expectancy of approx. 2000 hours. After this time, the foil has to be replaced because the lighting power diminishes significantly.

The Point "Maintenance" in the Main Menu

Under this menu point, interventions, which the user should not perform, are possible. Therefore, these actions are completely protected by password.
Under the point "Maintenance," the following functions are realized:
- (overwritable) complete memory test
- complete memory card test for the PC-Card option
- complete overwriting test of the calibration-EEPROM: tuning data is lost!
- assembler-monitor for interventions into the system
- raw value displays with full resolution
- display of the autocalibration-data

Updates, Retrofitting and Equipment

Technical changes or improvements can be built in as updates, particularly improvements in relation to the device's software.
Order code: MM5.0-update.

Existing devices can be fitted out by the manufacturer:

- Up to 4 IF-channels (counters, frequency measurement) can be built in.
- The An-sockets can be upgraded to Anp- or Ani-sockets: that changes the measurement of 20mA signals. See the chapter: "Measuring 0…20mA Currents." The Ani-upgrade is only conditionally possible.
- Logbox-devices can be fitted out with display and keyboard.
- Potentially isolated alarm contacts can be retrofitted. An additional 3-pinned Al-socket can be built into the devices rear wall: option "ALRS"
- The memory can, under conditions, be upgraded to 512000 values.
- A PC-Card (memory card) interface can be built in.

Appendix

Technical Data

General Technical Data

External Masses and Weights

Width x Height x Depth

mikromec®logger   W-Housing:
Model: MLm 424   184mm x 138mm x 94mm
Model: MLm 824   184mm x 138mm x 146mm
Model: MLm 1624 184mm x 138mm x 180mm
All above weights are given without the swinging handle. The swinging handle projects 17mm over both sides of the housing, and the total width is extended from 184mm to 217mm.

For the above standard devices, there is a wall-mount in the so-called W-housing, which comes from both sides out from under the device. The 4 easily-reachable screws allow the device to be removed from, for example, a mounting plate, without needing to remove the entire mounting plate. The wall-mount has the order code WR2000H and the external mass 214mm x 135mm and 11mm height. Hole-separation: 200mm times 120mm, bore 5.5mm with 10.5mm sinking.

Installing the W-housing frontally: using the previously described wall-mount WR2000H, the 4 additional spacer tangents can be used to attach the device to a connector panel. If you plan to use this type of mounting, it makes sense to order a mikromec®*multisens* <u>without</u> a handle.

Article Codes:
For MLm2xx,   Standard sockets (=upwards), no handle: -oH
For MLm4xx,   Standard sockets (=upwards), no handle: -oH
For MLm8xx,   Standard sockets (=upwards), no handle: -oH
For MLm16xx,   Standard sockets (=upwards), no handle: -oH

The MLm mikromec®*multisens* variant with downward-facing sockets (instead of only upwards!) can be used for wall-mounting in areas which are sometimes humid.

For MLm2xx,   Downward sockets, no handle: -UB
For MLm4xx,   Downward sockets, no handle: -UB
For MLm8xx,   Downward sockets, no handle: -UB
For MLm16xx,   Downward sockets, no handle: -UB

External front-plate mounting for MC (Memory-Card models):

For MLm2xx-MC   no handle, with covered sockets:
For MLm4xx-MC   no handle, with covered sockets:
For MLm8xx-MC   no handle, with covered sockets:
For MLm16xx-MC no handle, with covered sockets:

mikromec®rack*Log* for 19"-installation:
The device is specially made for 19" installation, however, it has no water-proofing, in contrast to the already described W-housing.
3HE x 48TE x 175
(129mm x 213mm x 175mm)

mikromec®*Logbox* in a plastic housing:
Model: MLm 424 184mm x 138mm x 95mm

mikromec®*logger* devices with exchangeable batteries:
Model: ML7
Model: ML11 220mm x 140mm x 70mm, 1600g
Model: ML19 200mm x 200mm x 70mm

Vibration:

20g at 0 to 2000 Hz

Shock:

Fall from any position from 50cm height on a hardwood plate without damage or 200g for 1ms.

Operational Height:

-500m MSL to +5000m MSL, without pressure adjustment.
For operation in aircraft, the individual airline's regulations are valid.
Storage up to 12200m (40000ft).

Used Sockets/Plugs for Sensor Connection:

In pin-number expansions according to DIN 41524, 45322, 45356 etc, offered from multiple manufacturers, for example Binder series 423, regard protection type, unused sockets should be closed with protective caps.
Ordered from *TECHNETICS*, BÖRSIG, among others, manufacturer: Binder.

Designation	Abbrev.	Order Code	Max Wire Strength	Plug Cycles	Protect. Type
RS232/MODEM:		423- 7	0.25 mm²	>=500	IP67
or:	ZS7	681- 7	0.25 mm²	>=500	IP40
Alarm-contact-plug	Al: ZS3	712- 3	0.25 mm²	>=500	IP65
Power supply plug	POWER: ZS4	712- 4	0.25 mm²	>=500	IP65
Digital-port-plug	Dig: ZS12	423-12	0.25 mm²	>=500	IP67
or:		681-12	0.25 mm²	>=500	IP40
Counter-port-plug	IF: ZS12	423-12	0.25 mm²	>=500	IP67
or:		681-12	0.25 mm²	>=500	IP40
Analogue-sensor-plug	An: ZS14	423-14	0.25 mm²	>=500	IP67
		681-14	0.25 mm²	>=500	IP40

Climate

Temperature Ranges

Measurement Use:	-20°C to +60°C
Storage:	-25°C to +70°C max; +15°C optimal
Battery Charging:	+5°C to +35°C; +20°C recommended

Humidity

Measurement use and storage: At up to 95% rel. humidity, no condensation. For use in continually humid environments, special protective procedures must be implemented. These are described separately in the chapter "Building Field Stations." Even if the mikromec®*multisens* has been continuously used for a number of years in a constantly humid environment, *TECHNETICS* cannot guarantee its operation! Stagnant water on the device can lead to system failure and it must be avoided.

Electricity Use

Entire device, 7- and 11-channel versions:
Without activated Ip-Option: typically 78mA
With option 'p' and at least one selected Ip-channel: typ. 106mA
The external sensors' demands must be added to this sum!

Use in sleep mode or when turned off, full battery: 80μA typ.
  During sinking supply, the current reduces linearly,
  until it approaches the switch-off threshold (11.1V±0.1V) steeply
  increases into a small voltage range to ca. 300μA.
  From 11V upwards to ca. 6.1V it falls from 70 to 50μA.
  The user must prevent the lead-acid battery from totally discharging in a timely manner.
Use in the sleep mode, with activated SML (counts while asleep, therefore IF pin SML on ground!):
  Rev C and D 1,3mA type. (to Rev B: 250μA type)
Recharge interval for unused devices:
  At least every 6-months for 18 hours.

Run-time in continually "on" state and with recordings with an interval less than
1 min (without active Ip-measurement at Anp): typically 24 hours
Estimated run-time while awake:
The Sensor-'Warm-Up-Time' can be freely set: so-called Wait-Time.
  With short turn-on time: 3sec   -> 25000 Wake-up events
  With long turn-on time: 6sec   -> 15000 Wake-up events
It is a good aid to protocol the internal battery voltage 'U_Batt' during measurement
tasks, to be able to estimate the run-time reserves, particularly with changing
sensor-loads and environment temperatures or solar power-supplies.
For devices with 4 analogue channels (7 total) the same run-time as for 8 (11)-channel
devices is given!
    24 hours, or 25000 wake-up events of 3 sec duration.
In 4- or 16-channel Anp-devices with activated Ip-measurement the run-time sinks to:
    17 hours,   18000 wake-up events of 3 sec duration

In 16-analogue-channel (19) devices, the run-time sinks to:
    12 hours,   13000 wake-up events of 3 sec duration

Technical Data multisens: Measurement Ports

For mikromec®multisens-family model series:
224, 424, 824,1624 each in Iso-, An-, Anp- or Ani-version.
x44-models have 4 instead of the usual 2 IF-Ports, but apart from that they are identical.

The data presented here can be changed without notice at any time in the development of the series.

Protection Type:
IP65, splash-water-protection, sockets have to be tightly closed with protective screw-caps or sensor plugs.
mikromec®rackLog : IP62
Memory equipment: 130000 measured values (Option: 523000 measured values)
Display: LCD 20 symbols * 4 lines (not mikromec®Logbox and multiLogger!)
Serial interface electrically isolated, isolation voltage 500V AC
Supported BAUD-rates: 300, 1200, 2400, 4800, 9600, 19200, 115200 BAUD
Data format: 8 N 1 = 8 Databits, No Parity, 1 Stopbit

Simply said, the mikromec®multisens measures with ±16000 parts and ±20ppm/K drift. Details can be found in the following list. The display scales are limited to a maximum of 10000 values. Recording is also limited to this resolution.

Internal resolution: 15bit or ±16000 values min. at 120% range modulation.
                    13bit no missing codes
Repeatability: to 10000 values, depending on the measurement range
typically 12bit over the temperature
Display size "only" maximum of 10000 scaling parts! That often means a representable numerical range of −5000 to +4999.

Reference voltage:
  5.000V ±5mV max, ±3mV typ. at +25°C
Reference's temperature drift:
  ±20ppm/K max, ±3ppm/K typ.
Load current from reference (all sockets together):
  40.0mA max, safety from short circuits limited to 58 to 66 mA
  The reference voltage is not a current-sink, only a source! As a sink, the voltage source has an internal re-sistance of 100 kΩ. As a source, it has a typical internal resistance of 35 milliΩ without the plug connec-tion.
Reference's load current stability:
  Load of 60mA typ. Leads to 2mV typ. reference voltage break-in
  - 45 ppm/mA typ. ; ±0.01%/mA max.
Reference's long-term drift:
  ± 180 ppm per anno (20ppm/kh) typ.
Reference constant current:
  1.0319 mA ± 0.0005 mA, at 25°C, max.
  Works from 0V to 2.7V, and. 0 Ohm to 2.2KΩ min. (2.7K typ.)
  In time-multiplex > 1/3 to 1/21, against ground.
  Temp.-drift: synchronous operation with the reference voltage
Resistance measurements:
  0 to 200 Ohm (can be overmodulated to 240 Ohm)
  0 to 8kΩ against V- (cannot be overmodulated)
  The constant current can also be delivered against the −7.4V (instead of the ground) if the repeatability is somewhat lower. That increases the measurable resistance range (voltage hub) from the above 2.7K to 8K Ohm safe measurement range. With limitations, a 10K Ohm measurement range can be reached: The limi-tation is that only one of these measurements per each channel's twin group is connected (due to the internal 1kΩ serial protective resistance!).
  Potentiometrical resistance measurement to ca. 100kΩ possible:
  Circuit: serial resistance >> measurement resistance: linearity error depending on resistance.

For voltage measurements (Ud-measurements) the following is valid:
'Ud' pin A and L on the An-socket are not electrically isolated!
Common mode voltage range (signal + measurement signal maximum):

±10V min   [±12.4V typ]
 The sum of the signal plus the delivered common mode cannot leave the common mode voltage range. For differentially picked up voltages, the common mode relation should be produced using a third wire!

Common mode suppression at 25°C:
 -92dBmin, -100dB typ., goal and adjustment value: -120dB
 -120dB: ±10V common mode leads to ±10V/1E6= ±10uV=±0.01mV
 common mode error.
 -100dB: dto, Error = ±100uV = ± 0.10mV
 -92dB: dto, Error = ±250uV = ± 0.25mV

Overmodulation range: to +120% of the underlying Voltage-/current-scale.
Example: 30.00mV is still safely displayed in the ±25mV-range.
Over 120% to a maximum of 125% overflow is produced (Display: <<<<)!
Temperature behaviour in common mode suppression:
1/25000 pro °C difference from 25°C, even warming of the device is assumed.
Interchannel cross-talk / Overmodulation behaviour:
 -96dBmin
 5V produces ca. 4/100 °C error on RTD100
              or 4/10 °C error on thermo-couples J,K,L,T,U
                        4°C   S,B
Remedy: connect relatively high voltages from 1V upwards on the channel after the sensitive mV-measurements.
Channel synchronisation:
 Lay all channels on the same voltage, then the following is produced:
 ±2 digits of the basis-scale max, typ.: better than 1/4 digit in the basis-voltage ranges 25mV to 10V.
Noise-sensitivity / Network-hum suppression:
 Noise < 10% from the measured value and under 10KHz are better 1/10000 suppressed.
 Network-hum (50Hz)- suppression: better 100dB
 Integrated 15bit A/D-converter-process with 50Hz-Synchronfilter.
Real-time clock:
 Calibration accuracy, min: 1/400000   at 25°C
 = Setting the period duration to: 7.812500ms ± 0.010μs at 25°C
 = that means: basic tuning is better than 0.1s / day
 Standard drift, 2*sigma-value: 0.2sec/day   at 25°C
 Temperature drift, typ.:   ±1.6ppm/K or (±1.3sec)/(day*(±10°))
The tuning happens traceably over DCF77 optional GPS-time standard to the PTB, Braunschweig.
 Max. path deviation of temp. in 2 years: ±5sec/day (±60ppm)
 The clock has no real calendar, therefore no intercalary days or leap years.
 Recommended device calibration interval: 2 years.

Accuracy Balance of Different Basis Scales

'Ud'   (low)   ±25.00mV ±50.00mV   ±100.0mV ±200.0mV
Limits of the measurement range, see sensor list!
Resolution: to 0.01mV
Tuning accuracy: ±1/4 LSB
Temperature drift, typ.:   5ppm/K
Temperature drift, max: 20ppm/K
Common mode range: ±10Vmin   (±12.4V typ.) Measurements therefore recommended near 0V!
Common mode error, typ.:   0.01mV/8V common mode voltage
Common mode error, max: 0.05mV/8V (-104dB)
Common mode error over temp: 0.003mV/(°C*V)
10V cross-talk error typ.:   0.05mV

Interior resistance / Loading the measurement source over pin A and L of the AN-14-socket:
Within the allowed common mode range: >> 10M Ohm
HI-pin (L) to LO-pin (A) or against ground.
Outside the allowed common mode range and when turned off/in sleep mode: > 40K Ohm
HI to LO-pin of voltage measurements: 80KOhm abs. min in every state.
A turned off or sleeping mikromec®*multisens* logger loads a voltage, which is connected to the pins A and L, of more than 0,5V with a minimum of 80kOhm. Under 0,5V it is usually more than 10MOhm.

'Ud'   (high)   ±1.250V ±2.500V ±5,000V ±10,00V
Tuning accuracy: ±0,001V 0,001V 0,002V 0,01V

Temperature drift typ.: ± 10ppm/K.
Common mode error typ.: -118dB ; -100dB min
Cross-talk error typ.: - 80dB, not relevant to the display!

Port resistance:
Within the allowed common mode range: >> 10M Ohm
Outside the allowed common mode range: > 40K Ohm
In a turned-off or sleeping device: >= 80 kOhm over 0,5V signal,
In signal voltage over 0,5V Ri > 10 MOhm under 0,5V signal.

RTD100 electrical basis-deviation: ±0.05°C max (without sensor errors!)
4-wire-measurement (2-wire possible, 3-wire nonsensical!)
Cross-talk error: RTD100<, therefore in 1/100°C Resolution: ±0.40°C at 5V on previous channel.
Drift: ±3/100°C per 10°C device-temperature-change typ. (±8/100°C display/10°C device temperature change, max.) or:
maximal ±0,50°C over the device use temperature range from –20°C to +60°C without cross-talk effect and overmodulation in the previous channel. (0,24°C typically)
RTD100 synchronisation between channels: ±0.02°C typ.
Scale: 'Pt100<'; measurement in the 25mV range with subtraction of ca. 106mV:
Measurement range from -30.00°C to +69.99°C
Scale: 'Pt100>'; measurement in the 200mV-range with subtraction of ca. 106mV:
Measurement range from -200.0°C to 550.0°C (can be overmodulated to 650.0°C)
Long-term drift in RTD100-measurement:
‚Pt100<' with 0,01°C resolution: ±0,03°C/year max
‚Pt100>' with 0,1°C resolution: ±0,08°C/year max.
Non-linear scales, not scalable with 2-point method, but can be offset-corrected with 1-point method!
RTD100-sensor error dominate the mikromec®multisens' errors !
Die linearization is performed according to ITS90, DIN EN 60751-1996, IEC751.

RTD1000
4-wire-measurement and 2-wire-measurement.
Drift: ± 0.02°C/10°C device temperature change.
Internal: measurement in the 2.5V range, without subtraction.
Measurement range -200.0 to +300.0°C
The channel cross-talk problem isn't relevant here, as opposed to in the case of the RTD1000! The range can be extended to high temperatures and voltages by allowing the constant current to flow against V- = -7.4V.
Non-linear scales, so far cannot be scaled or corrected!
Linearization is performed according to ITS90, DIN EN 60751-1996, IEC751.

Analogue port types:
Per channel, alternatively one An, Anp or Ani-port-type can be built in:
Apart from the properties of pins J and C, the 3 variants are exactly the same:

Current measurement at the An-port:
'Is' 0..20mA measurement at pins J and C, related to ground, bridge in sensor plug C against M necessary!
 Apparent ohmic resistance: 24 Ohm / 0.5V max.
Common mode error doesn't occur since related to ground.
Erroneous current: compensated to ±100mA overloaded; otherwise no protection!
Measurement and display bipolar.
Designed for power supply from 2-wire transmitters from the logger.

OPTION Anp:
'Ip' 0..±20mA current measurement with common mode voltage up to ±40V at pins J and C:
Measurement with current loops.
Common mode error:
±0.10 mA per ±10V common mode voltage
Apparent ohmic resistance: 24 Ohm / 0.5V max.
Current error: < 10µA at 30V common mode max -> leak resistance > 3M Ohm
Measurement and display bipolar.
Designed for power supply 2-wire transmitters from the logger.

OPTION Ani:
Fully electrically isolated 0..20mA measurement ports at pins J and C.
Burden voltage typ. < 1.5V at 20mA / 2,5V max
Loop distortion: irrelevant because << 0,005mA
Temperature path 20ppm/K typ. (50ppm/K max)
Measurement unipolar, but protected by pole-switching up to 100mA
Allowed differential voltage pin J after C: 22V max
Allowed common mode voltage limited to 40V for safety reasons. The isolation test-voltage of pins J and C, against the housing, is 500V DC.

'Temp_int' internal cold-conjunction compensation,
Tuning basis-accuracy at the calibration temperature(at 25°C):
25.0°C ±0.2°C max (±0,1°C typ.)
After thermal transient oscillations of the configuration (at least 1/2h) related to the UD-connection point's transient temperature for thermo-couples, cold-conjunction measurement:
Measurement uncertainty ±10°C around the calibration temperature: max ±0.5°C (±0,1°C typ.)
Repeatability: ±0.2°C max over the logger's working temperature range.
Measurement range of the scales: ±110°C (theoretically!) allowed: -20.0 to +60.0°C device temperature.
Resolution of the scale: 0.1°C
Types J,K,L,T,U deliver 1mV per 25°C or 0.01mV for 0.25°C
        S,B   deliver 1mV per 100°C   0.01mV   1.0 °C
The properties of the individual scales are included in the sensor list.

'U_bat' power supply voltage measurement / internal lead-acid battery
Nominal voltage 12V, the measurement is made on the G pins (=Ubat) at the An-sockets.
Deviation: ±0.25V max
Resolution 0.01V
If operated by exchangeable batteries, the higher of the two voltages is displayed. If operated by a charging device, the charging voltage is displayed.

Frequency measurement: 'FREQEN'
Display range: 0 to 9.999 KHz
Resolution: 1 Hz
Measurement range: 0 to 30.0 KHz min (from 9,9KHz to 30KHz only reachable through scaling)
Tuning accuracy: ± 1LSB max over temp. (or 0.15Hz over 30°C and after 2 years and remaining tolerances, max.)
System cycle drift: -1.5ppm/K typ., ±30ppm/K max
Impulse measurement: (Warning: not yet scalable!)
Resolution: 1 Impulse, max pulse count display range: 9999
NAMUR-port laid on DIN19234:   (*TECHNETICS*-modification for lower power requirement!) is current-control, under 1,2 mA low, over 2,0 mA high.
 The NAMUR-impulse-/frequency-port is limited to 200Hz.
Turbine port: (AC-coupling)
   AC-signals from 100mV AC to 10V AC are processed. (effective value!)
   Frequency: 1.0 to 9999 Hz
SML-pin:
If one of this pin's sensor plugs is connected to GND, the device's internal circuit remains active. This means, for example, that you can collect unbroken impulse measurements and only save them from time to time with the help of a recording with an interval greater than or equal to one minute. All SML-pins are linked internally, therefore a bridge is enough to set the device into the SML-mode (counting while asleep). The V10V-power supply then remains turned on at all sockets. The disadvantage of this operation is the higher standby power use while asleep. Under the power supply's turn-off threshold, the current use is not increased, since SML is completely turned off if the battery is flat. The internal resistance of the SML-signal is > 100 kOhm.

Status-ports: DIG
Sta1_4: 4 Bits at DIG-sockets. DC-coupling, not isolated, therefore linked to ground through pin M
Open ports are displayed as 0000.
Thresholds: low under 1.3V, high over 3.7V
±40V is tolerated, protective wiring integrated.
Internal resistance: Ri > 50 kOhm min, Ri >1M typ.
With serial module from 4 to 20 status-ports with electrical isolation possible.

Isolated analogue port type 'ISO':
All Iso-ports are completely electrically uncoupled. They have no conductive connection to other Iso-ports, An-ports or the logger housing. The signal isolation is achieved through inductive coupling.
Input resistance pin 1   200KOhm (± 2V   final swing) to 2,4V   (40V abs max)

Input resistance pin 2   1MOhm   (±10V   final swing) to 12V   (40V abs max)
Input resistance pin 5 = burden: 91,6 Ohm   (±20mA final swing) to 24mA (50mA abs max)
Ground pin 3: local ground line for this precise ISO-port.
Isolation test voltage: 500V AC
Isolation resistance: >> 10^12 Ohm (1 TOhm)
The isolation resistance is more than adequate for the isolation of pH-probes.
The mikromec®multisens' power use increases by 1/3, as soon as at least one channel of the scales of the ISO-port is selected. The total run-time then sinks to 2/3 of its nominal value.

Limits for Recording Tasks

Recording interval:
With up to 8/11 channels, every second up to 24 hours (previously: 99 minutes).
With up to 16/24 channels, every two seconds up to 24 hours (previously: 99 minutes).
Fast measurements can be performed on one channel at up to 320 measurements per seconds or on multiple channels between 2 and 20 Hz, strictly dependant on the number of channels.

Recording duration:
The recordings 1 to 9 can each be up to 380 days (previously: 99 days) long.

EMC and Radio Transmission Data

The EMC guideline 89/336/EWG is used.

The low-voltage guideline 73/23/EWG is valid for all devices, which work with voltages over 50V DC or 75V AC. This is not the case with the mikromec®multisens 5.0.

The machine guidelines are valid for all devices with at least one energetically moving part. The mikromec®multisens logger 5.0 doesn't have any of these parts. Relays are not covered by the machine guidelines.

Device and acceptance tests are documented by TECHNETICS.

Protective type:
  IP65 according to IEC529, VDE0470
  The device sockets must be closed with the appropriate protective caps.

Electrical safety:
  IEC 348
  Protection class III according to VDE 0411 protective low-voltage
  Safety low-voltage (=SELV) according to EN41300
  Tested according to IEC1010, safety requirements for electrical measuring devices:
  Protective class 3 lt. IEC 1010
  Only use authorised charging devices.

Switch-on current limit according to NAMUR-recommendations
  Imax <= 15 * Inom

Radio noise suppression, transmission:

EN 55011 (1991), DIN/VDE 0875 T.11(9/92) Limit value class B
Post 242/91, 243/91, 46/92, 89/92 certified by the manufacturer.
FCC Rules Part 15/B, Computing device, class B
EN50081-1 (1992) Professional basic standard limit value class B
Connected wires can influence the values.
Pay attention to the *TECHNETICS*-recommendations on cable production!

Noise immunity, EMC:
According to Namur-recommendation AK4.6 NE21 May '93 each without function
failure in:

  ESD:
    IEC801-2 (1991) direct/indirect:8KV ; air discharging: 15KV
    (VDE0843/2)
    Connected wires can influence the values:
    Pay attention to the *TECHNETICS*-recommendations on cable production!

  Immunity against EM-fields:
    IEC801-3/VDE0843/3 and prEN50082-2 (1/93) (professional basis standard)
    as well as NAMUR 12/1990 'General Requirements':
      10KHz to 1GHz: 3V/m, ITM-frequencies: 10V/m
Fast Transients: (Burst)
  IEC801-4(1988)/VDE0843/4
    Data wires 2 kV
    Mains wires 4 kV
  Surge voltages:
    IEC801-5/E DIN VDE 0843 Part 5/02.1992
    500 V between signal wires
    1 kV I/O-wires, power supply against ground
  Connected wires can influence the values:
    Pay attention to the *TECHNETICS*-recommendations on cable production!

Mains drop-out up to 20ms and above through built-in battery:
Without function deterioration, automatic start-up after longer interruption.

Alarm relays ALRS (optional!):
  1A, 250VAC, isolation group A according VDE 0110: not for inductive loads
  Prevent interrupt sparks!

Appendix

Terms Definitions

Datalogger
A datalogger is an electrical device which records as well as measures, usually for slower events (with a scan each second) and also over longer periods of time (hours to months).

Channel
The datalogger doesn't only measure one quantity only, rather it can measure many different sensors after another and then save the values if necessary. The number of switching possibilities that the logger has is given by the number of channels. Not all channels have the same properties. There are usually 4 to 16 An-channels, 1 Dig-channel and 2 IF-counter channels on mikromec®*multisens* devices.

Sensor choice, selection, sensor lists
You have to select a sensor (=scale) from the sensor list to tell the logger how to interpret the electrical signals in this one channel. One sensor list with 126 entries is offered for each channel under "Setup" / "Sensor Selection." The entries are sorted into groups for related measurements such as "Voltages," "Meteo", and some are empty. Empty lines mean: the sensor or the scale that belongs in this place is not available on this channel or model.

Recording, measurement task
A recording doesn't just contain the procedure – what should be saved how often – but also the resulting measured values. The mikromec®*multisens* can administrate up to 9 independent recordings, which can be stored however the user desires. Therefore the recordings are entered as "r1" to "r9."

Single measurement
Saving a complete series of momentary measured values of all channels with date and time.

Fast measurement
Only one channel is measured and recorded as fast as possible. The scanning rate in a fast measurement lies between 20 and 320 scans per second. To be able to work so quickly, the measurement display is not performed.

Sleep mode
The logger doesn't completely turn off. It has a built-in alarm clock which activates the device as soon as a wake-up time point is reached. The type of operation during this wait-time, between these wake-up points, is described here as the sleep mode. While in the sleep mode, no measurement display can be seen. While in the sleep mode, no new impulses are counted. The signal adjustment electronics in the mikromec®*multisens* can be separately activated using the SML-

pin in the IF-socket, so that unbroken impulse measurement can be performed while the device is "asleep."

Waking up, wake-up time-point
If a recording has been entered that, for example, should record every quarter hour, and you turn the logger off with the on/sleep key, each of the measurement time-points becomes a wake-up time-point! The logger can only wake up at full minutes.

Scaling
Scaling means producing a display corresponding to the correct quantity using a 2-point adjustment. Sensors often give an electrical signal, which is proportional to the interesting magnitude. By using scaling, you can reach the linear representation of the logger's electrical input-signals that should actually be displayed. Scaling is described in its own chapter. The mikromec®multisens can only scale linear sensors.

Offset-adjustment
This is a special type of scaling: one-point-adjustment. The mikromec®multisens performs either scaling, offset-adjusting or nothing at all as the modification. In this way, the linear scales can be scaled, the non-linear ones offset-adjusted and, for instance, impulses can only be modified by changing the scale.

Run-Time
This is the time for which the logger can work continually until the battery is empty. A typical value here is 24 hours.
The various options increase the device's overall current requirement and therefore restrict its run-time: for example, 16 channels instead of 8 or Anp-ports or Iso-ports.

Alarm module
Externally connectable modules are available to make handling the individual limit values simpler.

Continuous alarm
A triggered alarm (through exceeding a limit) remains, until it is specifically cleared by the user. If the continual alarm is turned off, the alarm goes away as soon as the value falls back to the tolerated range.

Limit value
It is described under limit values and alarms: a freely chosen threshold value, with which the current measurement signal is compared. The mikromec®multisens offers two independent limit values per channel. They are used to monitor if the signal in question is staying within the allowed limits: for example, 4 to 20mA. Everything which lies above or below the limits triggers an alarm (also a cable breakage).

Limit value start
It is described under the recording modes: the recording only starts if a limit is exceeded.

Alarm call-back, modem-call

The mikromec®*multisens* can automatically call a central point over a modem if an error event occurs.

CE-Conformity Explanation from the Manufacturer

The manufacturer

TECHNETICS Data Logging Systems
Bettackerstr. 14
D-79115 FREIBURG

hereby declares, that the devices in the series:

mikromec®*multisens*:

mikromec®*logger*
mikromec®*rackLog*
mikromec®*Logbox*

conform to the EU guidelines in relation to interference emissions and interference immunity.
Testing fundamentals:
PrEN 50082-2 1/1993
NAMURrecommendations NE21 (standard requirements), edition 05/1993

Interference radiation:
EN50081-1 1992

Interference immunity:
IEC801-2 1991 8/15KV
IEC801-3 1984 3V/m
IEC801-4 1988 2KV

The devices have the CE-markings.

Freiburg, the 7th August 1995

(R. Maier, Dipl.-Phys.)

Scaling Sheet

Using this form sheet, you can produce and document any necessary scales. Scaling means using an original electrical value to produce the desired display value. Once a scaling has been entered, saving, reading and later processing of the values are only performed in the scaled form with name and dimension.
Selecting a basis-scale from the sensor list:
Select this scale under "Setup" / "Sensor Selection."
You now use exactly two value pairs ((X1;Y1) and (X2;Y2)) which are used to translate the original X-value into the new displayed Y-value: Y1 comes from X1 and Y2 comes from X2!

Basis Values: X-values These are the unchanged measurement values from the basis scale: ‚FROM !' ->	**Target Values:** Y-Values These are the final values to be displayed: -> ‚TO !'
Basis Scale: ☐☐☐☐☐☐	Desired-Name: ☐☐☐☐☐☐☐
Basis Scale Number: ☐☐☐	Number of the new scale: No. 126
Unit of Measure of the Bas. Sc.:	Desired Dimension:
	Comma position : 0 0 0 0
X1: ☐☐☐☐ ☐☐☐	Y1: ☐☐☐☐ ☐☐☐
X2: ☐☐☐☐	Y2: ☐☐☐☐

This information is entered under "Setup" / "Scale Sensors" in the relevant lines. The following table gives an overview for all channels:

Channel	Name	Dimen-sion	X1 Signal FROM !	Y1 Display TO !	X2 Signal FROM !	Y2 Display TO !
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐
	☐☐☐☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐	☐☐☐☐

Check

TECHNETICS recommends a workshop calibration every two years. Order code: MLSC-number of channels.

The individually measured deviations and the proof of traceability are delivered with the calibration sheet. Order code: MLSP-number of channels.

General Plan of all Device Sockets

Modem/V24
7 pins: RS232

DCD input
CTS input
GND isol.
RTS output
RxD input
RI input
TxD output
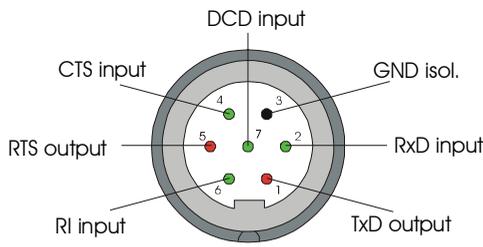
Analogue input
14 pins: An, Ani, Anp

Sensor identification
VTra   SCL   SDA   reserved
VDig.   VNeg
20mA+   20mA-
Iconst.   VRef
U+   U-
GNDv   GNDs
Both grounds are connected
with each other
in the datalogger..

Counter input
12 pins: IF

n.c.
VTra
Supply
output
Vdig = +5V
output
SCLn
(Sensor identific.)
SDA
(Sensor identification)
V10V
+10Vstab.
output
SML input:
bridge to Gnd=
counting in sleep mode!
HCin
pulse input
n.c.
Turb
Turbine input
GND
NAMO
Pulse input
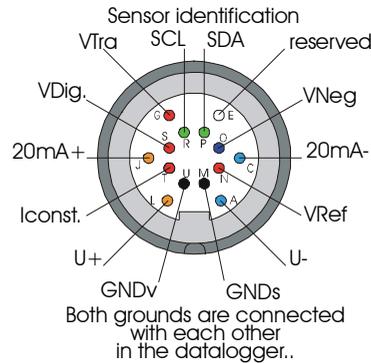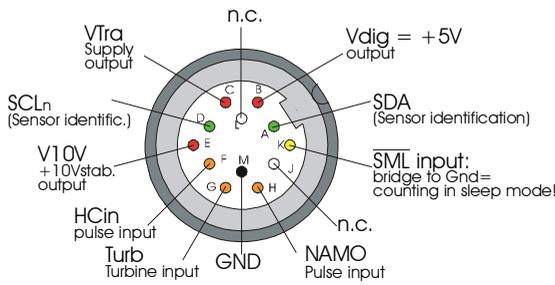
Digital input
12 pins: Dig

D2
(Status input 2)
D1
(Status input 1)
n.c.
Gnd
SCL
D3
(Status input 3)
VTra
D4
(Status input 4)
Alarm
[+5V output]
OnL
turn on
(lo=on!)
SDA
Vdig.(+5V)

Supply
4 pins: VNLB12

Input:
exchang.battery
+12V lead-acid
Charging and
supply ground
Charging
and supply unit
n.c.
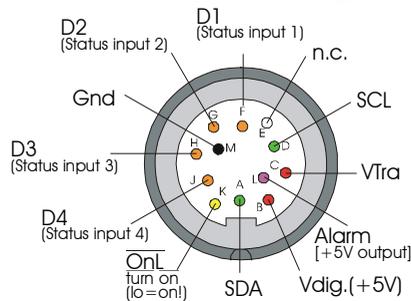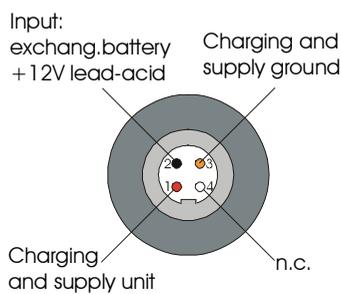
Alarm contacts
3 pins: Al

In the middle:
two-way contact!
Contact to 2
if alarm!
Contact to 2
if no alarm!
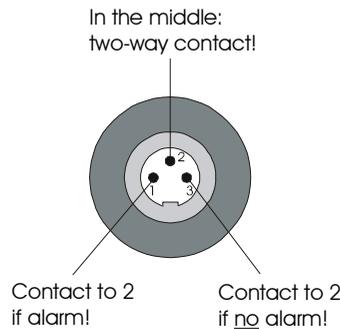
Isolated input
5 pins: ISO

GND isolated
(according to channel)
reserved for
+5.6V suppl.
output
+-10V
input
+-2V
input
+-20mA
input
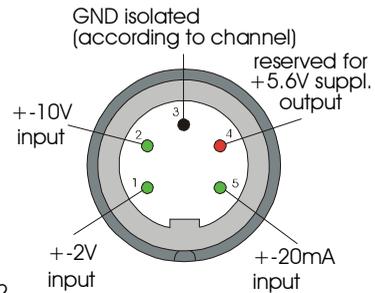
View on the plugging side of the built-in socket
resp. on the soldering side of the plug!

INDEX   A B C D E F G H I K L M N O P R S T V W