Multi-Parameter Measuring Transmitter

MULTILINE 1000

1   Overview

This microcontroller-operated MULTILINE 1000 Multi-Parameter Measuring System is your indi-vidual, complete solution in analytical instrumentation and control. With the aid of up to 16 measuring modules in any combination, you can determine pH, conductivity, oxygen, ORP po-tential, temperature, chlorine, turbidity and other parameters. This is based on a patented modular bus-compatible system structure using measuring and active modules connected with one another and to the central unit via a bus. Four of the measuring modules can be inserted into the central unit, the actual MULTILINE 1000 controller. Further 12 measuring modules can be connected to the MULTILINE 1000 via external modules and the bus system. Because of this, the measuring modules can also be used as pre-amplifiers for separated measuring points. Active modules are interface modules for measured-value outputs, DAC modules for 0(4) … 20 mA analog current outputs, depending on the measuring signal, and relay modules for switch-ing, alarm and control tasks.

The MULTILINE 1000 Multi-Parameter Measuring System consists of the following main com-ponents:

- MULTILINE 1000 multi-parameter controller with power supply, touch screen display, in-ternal modules, data logger and logbook.
- External measuring and active modules.
- PC visualisation software.
- Sensors and accessories.

Multiparameter
measuring instrument

External modules

PC with visualization
program
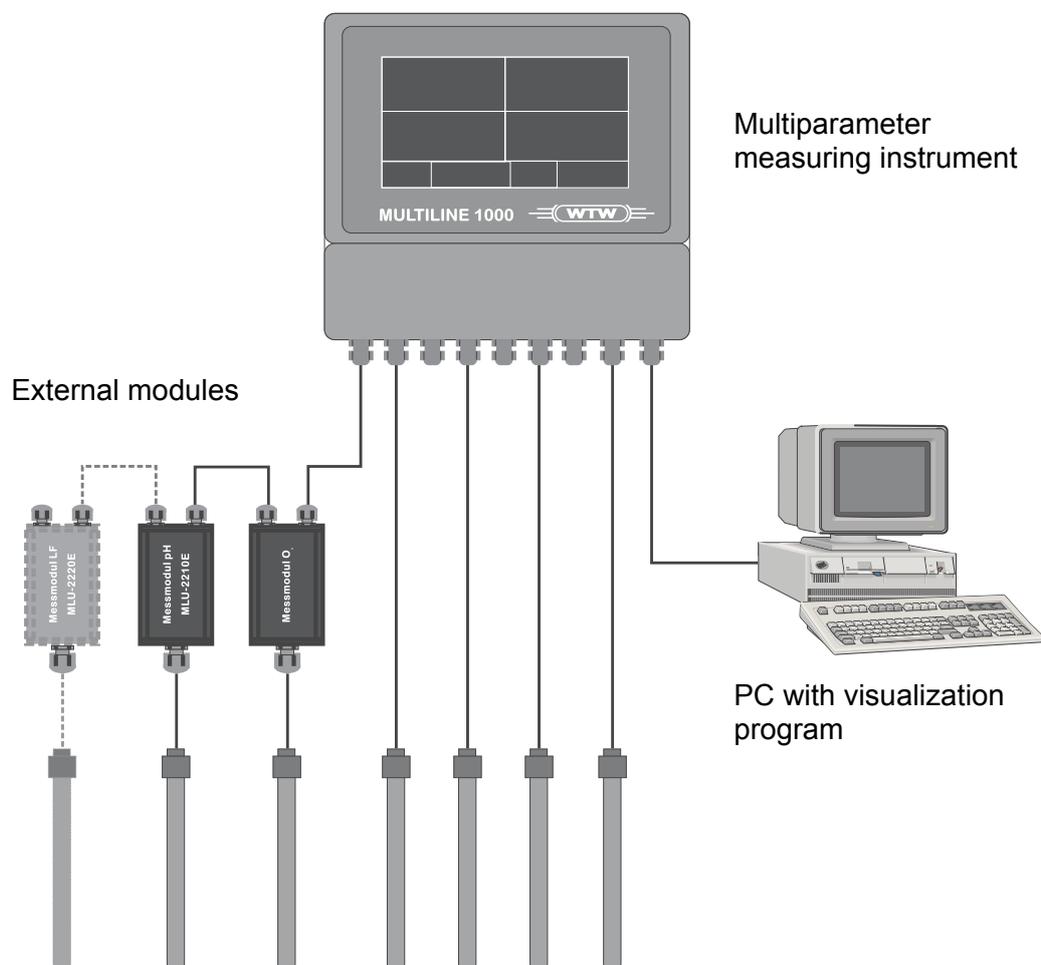
MULTILINE 1000 Multi-Parameter Measuring Transmitter
The MULTILINE 1000 multi-parameter measuring transmitter as the central unit of the measuring system contains power supply, a touch screen display, up to four internal measuring modules as well as output signal and relay boards. The clearly arranged terminal box of the MULTILINE 1000 represents the interface with the power supply, the sensors and with data output, or with the control outputs, respectively. The touch screen display is a distinguishing outward feature of the new generation of multi-parameter measuring systems and provides for easy operation, configuration and calibration of the measuring system to a decisive extent. Clearly arranged and supported by self-explaining pictographs, only those functions, controls and status information are indicated as are relevant for the respective task. Up to four measured values including their units, their temperature values, a possible second value as well as an individual description can be displayed on one screen page. A total of four screen pages facilitate the clear display of the measured values from all 16 modules, including their status signals. There is an additional fifth screen page to display virtual measured values by mathematical linkages (e. g. differential measurements). The MULTILINE 1000 offers room for up to four measuring modules in any combination and a DAC module for four configurable and scaleable 0(4)...20 mA current outputs. All measuring modules include Pt 1000 sensor temperature measurements. The assignment of the temperature measurement to automatic parameter compensation is freely selectable by the user.
A great number of practically relevant calibration algorithms and temperature compensation methods are supported by the MULTILINE 1000. The standard version includes four floating relay outputs for simple control, regulation or alarm tasks. The assignment of the contacts to the measured values, the switching values as well as a hysteresis can be adjusted by the user. For complex control tasks, the controller module can be activated with two PID controllers working independently of each other. These controllers can be assigned to any measured quantities and work as analog, pulse length or pulse frequency controllers using the analog current outputs or the relay outputs of the unit.
All values can be output via an RS-232 or RS-485 bi-directional serial interface. You can use the DataReader software program that each unit comes with to utilise the data logger via the RS-232 interface. The data logger can be configured for infinite or finite logging with an adjustable sampling interval and works independently of data output.
The data recorder graphically shows on the touch screen the measured data curve of the main measured quantity of each measuring module received within the last 24 hours. This display offers the user a quick overview of the measured value development, giving average, maximum and minimum values.
The units will come from the factory with pre-settings as per your order.

External measuring and active modules
Besides the four internal measuring modules, further measuring modules up to a maximum of 12 can be connected to the MULTILINE 1000 measuring transmitter at any sequence and choice. In addition, up to four external DAC modules with four 0(4)...20 mA current outputs each are available to utilise all measured values (also virtual ones) as current signals for further processing. The MULTILINE 1000 measuring transmitter provides the power supply for the measuring and active modules and automatically detects the modules connected.

Sensors and accessories
A particular feature of the MULTILINE 1000 Multi-Parameter Measuring System is that conventional electrodes and sensors (pH and ORP electrodes, conductivity measuring cells, oxygen sensors, etc.) can be connected without integrated pre-amplifiers or electronic circuitry. Thus, the entire range of electrodes, sensors and accessories for connection with the multi-parameter measuring system is available. Specific electrically isolated measuring modules with linear transmission characteristics are provided for the connection of sensors with integrated measured value processing. In addition to chlorine measuring cells, flow or other sensors can be integrated into the multi-parameter measuring system.
Details on measuring cells, sensors and other accessories are given in the chapter Accessories, Spare Parts of the system operating manual of the MULTILINE 1000 drinking water panel.

2   Safety

This Operating Instructions Manual contains fundamental information that should be observed in connection with the installation, start-up, operation and maintenance of the MULTILINE 1000 Multi-Parameter Measuring System. Therefore, it is absolutely vital for the user to read this Manual prior to working with it.

User qualification
The multi-parameter measuring transmitter and the entire measuring system have been designed for analytical multi-parameter measurements. It is assumed that the user/operator and the maintenance personnel have the proper professionals skills and experience to know the specific properties of analytical measuring systems, master the safe handling of chemicals, for example, in the maintenance of electrodes/sensors, and can assess any dangers and risks resulting thereof. The user must ensure that the national legislation and procedures concerning the protection of labour, the prevention of accidents and the handling of chemicals are observed.

Electrical installation work
The multi-parameter measuring transmitter comes ready for operation together with a power supply cable. The power connection must be shock-proof. Do not use an extension cable without any protective conductor, as this would eliminate the protective function. Any interruption of the protective conductor inside or outside the unit may result in the latter becoming dangerous if another fault occurs.
Opening the unit will expose live parts. The terminal box may only be opened for the connection of sensors and other peripheral units after the mains supply has been disconnected. Such work should be done by a skilled person who is familiar with the hazards associated therewith. Intervention into the unit will result in expiration of the warranty.

Installation and getting started
Install the unit and the external modules so that the conditions specified under 'Specifications' will be kept under any circumstances. The enclosures meet the IP 65 degree of protection requirements. A prerequisite to this, however, is the proper installation of the enclosure cover of the terminal box and of the seals (Important: Distinguish between the inside and outside.). Also, properly install the cables in the glands and tightly seal all cable glands not used. For outdoor application of the MULTILINE 1000 measuring transmitter and its modules, the use of a stand and a weather-proof roof is recommended. Do not use any sensor and bus cables other than recommended by the manufacturer. For the sensors and accessories, the instructions and regulations in the respective operating instructions manuals and specification sheets shall apply.

Proper usage
The MULTILINE 1000 multi-parameter measuring transmitter is intended for measuring, controlling and regulating analysis parameters. Taking into consideration the 'Specifications' paragraph in Chapter 15, operating and using the unit for this application is the proper usage. Any application beyond this and individual modifications or extensions are improper and will lead to loss of entitlement to the warranty. When connecting the unit with electrochemical sensors, always take into account their life and natural wear as this may result in malfunctioning of the measuring system and the regulation or control associated therewith. The user must take suitable measures to limit harmful effects of such malfunctioning.

General safety instructions
All components of the MULTILINE 1000 multi-parameter measuring transmitter have been manufactured and tested in accordance with the relevant guidelines and standards for electronic measuring equipment. They have left the factory in technically unobjectionable condition. The proper functioning and the operational reliability of the MULTILINE 1000 measuring transmitter and of the measuring system components will only be guaranteed if the generally usual

safety precautions and the specific safety instructions given in this Operating Instructions Manual and in the operating instructions manuals of the components are observed. If it is assumed that safe operation of the unit or of its components is no longer possible, remove the unit and its components from service and protect it against unintentional operation. Safe operation will no longer be possible if the unit or its components

- show any transport damage.
- has/have been stored under unsuitable conditions for a longer time.
- show any apparent damages.
- does/do no longer work as described in this Operating Instructions Manual.

If in doubt, please contact your supplier.

3   Layout of the measuring transmitter

Touch Screen

MULTILINE 1000

Mains
terminals

Relay
terminals

Current
outputs

Communication
terminal block

Sensor terminals
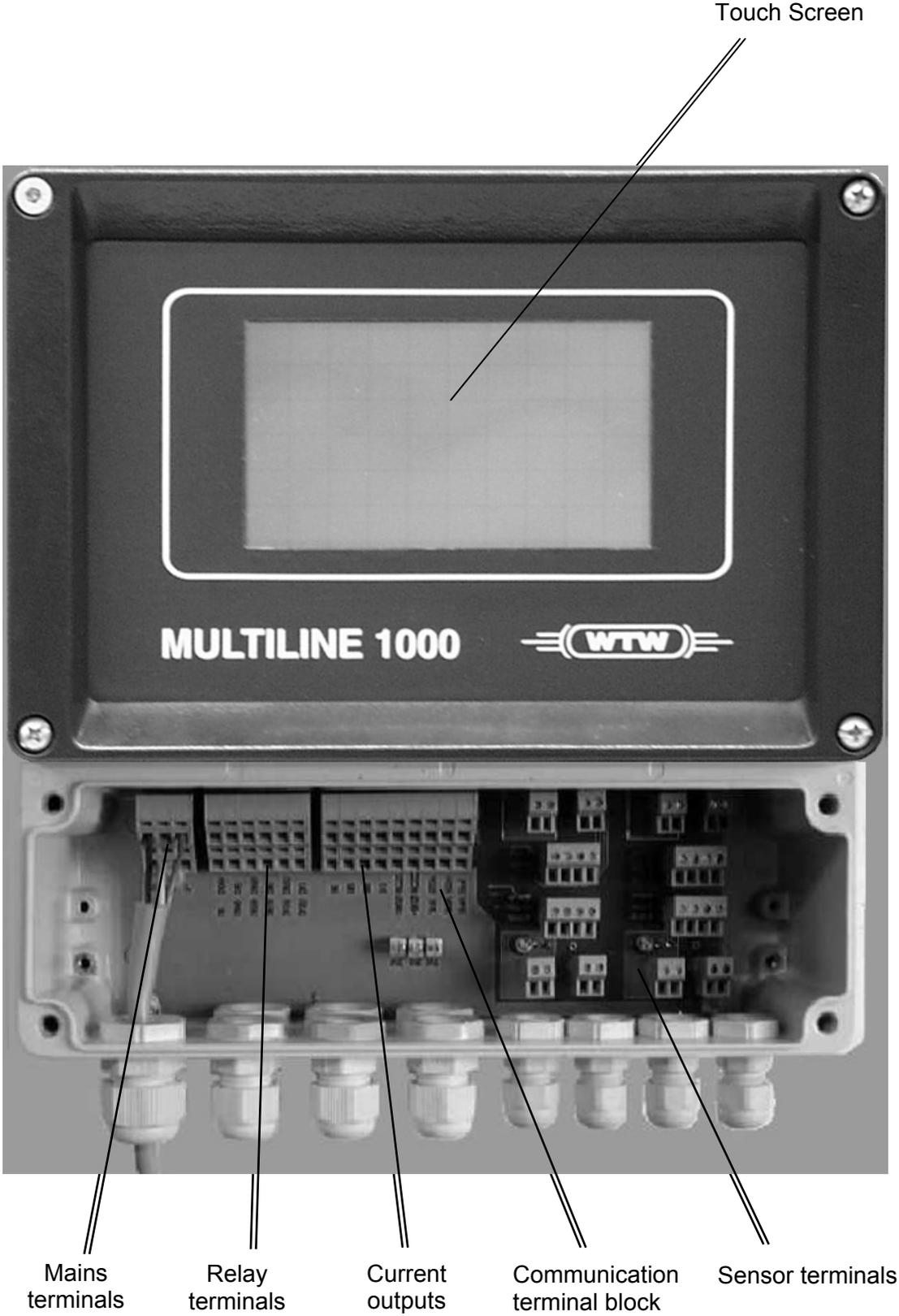
4   Installation

The MULTILINE 1000 multi-parameter measuring transmitter including its associated modules is supplied ready for operation and is preset according to your order. The internal hardware configuration of the MULTILINE 1000 measuring transmitter is fixed by the manufacturer in accordance with the tasks to be accomplished. The entire measuring system can be subsequently completed by the user with the aid of external measuring and active modules, taking into account the instructions given in this Manual.

The respective locations of all components of the measuring system must meet the ambient requirements given in the 'Specifications' paragraph. Since this measuring system is intended for the measurement, control and regulation of analysis parameters, it should be noted that calibration and maintenance of the sensors at regular intervals is necessary for the interaction between the measuring module and the MULTILINE 1000 measuring transmitter.

4.1   MULTILINE 1000 Terminal Box
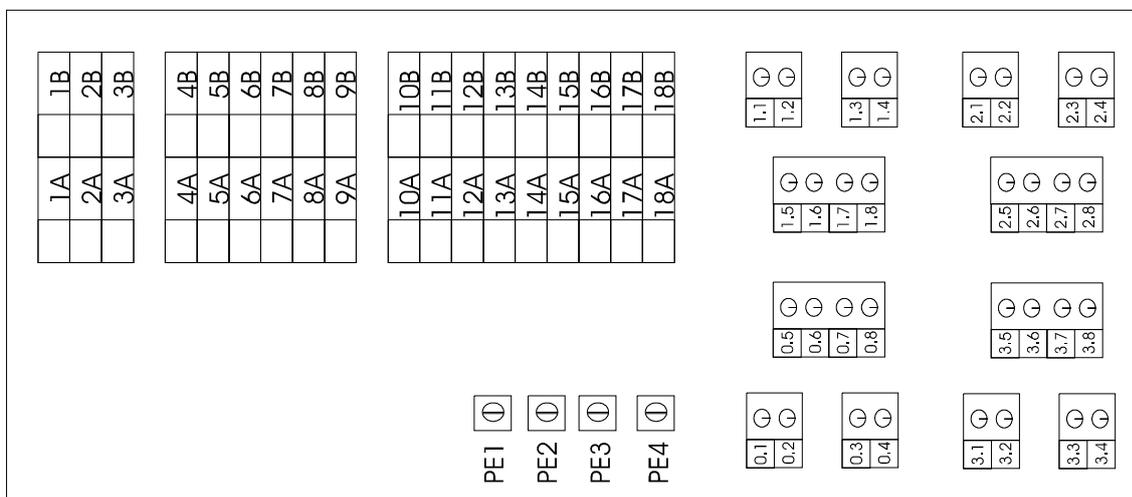
MULTILINE 1000 Power Supply and Outputs

Terminal	Description	Terminal	Description
1A	Mains supply neutral conductor	1B	Mains supply neutral conductor
2A	Mains supply PE-conductor	2B	Mains supply PE-conductor
3A	Mains supply L-conductor	3B	Mains supply L-conductor
4A	Relay 0 changeover contact	4B	Relay 0 n. o. contact
5A	Relay 0 n. c. contact	5B	Relay 1 changeover contact
6A	Relay 1 n. o. contact	6B	Relay 1 n. c. contact
7A	Relay 2 n. o. contact	7B	Relay 2 changeover contact
8A	Relay 3 n. o. contact	8B	Relay 2 n. c. contact
9A	Relay 3 n. c. contact	9B	Relay 3 changeover contact
10A	Earth - current output 0	10B	Current output 0
11A	Earth - current output 1	11B	Current output 1
12A	Earth - current output 2	12B	Current output 2
13A	Earth - current output 3	13B	Current output 3
14A	+12 V CAN supply	14B	CAN L
15A	-12 V CAN supply	15B	CAN H
16A	TX1	16B	Earth - RS232/RS485
17A	TX2	17B	Earth - RS232/RS485
18A	RX2	18B	RX1

The earth terminals of the current outputs are all referred to the same potential.
MULTILINE 1000 Sensor Inputs

terminal	potentiometric sensors (i.e. pH / ORP / ISE electrodes)	amperometric and conductive sensors (i.e. oxygen sensors, conductivity dells)	DC voltage / current input signal (linear characteristic)	flow sensors
X.1	measuring electrode	signal connector	signal connector +	vacant
X.2	vacant	screen	signal connector -	vacant
X.3	screen/reference electrode	vacant	vacant	vacant
X.4	screen/reference electrode	vacant	vacant	vacant
X.5	temperature sensor connection 1	temperature sensor connection 1	temperature sensor connection 1	GND
X.6	temperature sensor connection 1	temperature sensor connection 1	temperature sensor connection 1	frequency output signal from the flow sensor
X.7	temperature sensor connection 2	temperature sensor connection 2	temperature sensor connection 2	GND
X.8	temperature sensor connection 2	temperature sensor connection 2	temperature sensor connection 2	+5 V power supply for flow sensor

X indicates the respective item number (0-3) of the sensor.

4.2   Connection of External Modules

The MULTILINE 1000 measuring system has been designed so that you can connect further measuring amplifiers or current outputs, respectively. The layout of the bus system necessitates series connection of the modules, the bus line being looped through the module. The bus-side connector is suitable for this purpose. Remove your system from operation for the time of installation.
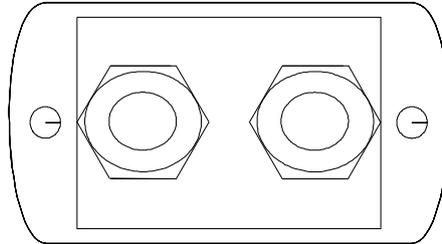
Open the module at the bus connection side (two screws under the sealing caps). If the module has been wired up already, undo the heavy-gauge conduit screws to be able to remove the cover. Now, unplug the connector. Connect the bus cable to the measuring amplifier. Ensure correct polarity of the voltage supply and properly connect the CAN-H and CAN-L signal lines. If the new module is the last one in the chain, i. e. it has a bus input at one side only, then you will have to connect a terminating resistor (120 Ohms) to the open bus side between CAN-H und CAN-L. Connect the screen of the cable to the cover of the module by means of the earthing screw. This will earth the enclosure and connect it to the next module within the chain. In the MULTILINE 1000 measuring transmitter, connect the screen to one of the PE terminals (PE 1…4). Re-plug the connector. Now, screw the cover to the module. Make sure the rubber seal fits properly. Finally, tighten the heavy-gauge conduit screws and fit the two screw covers.
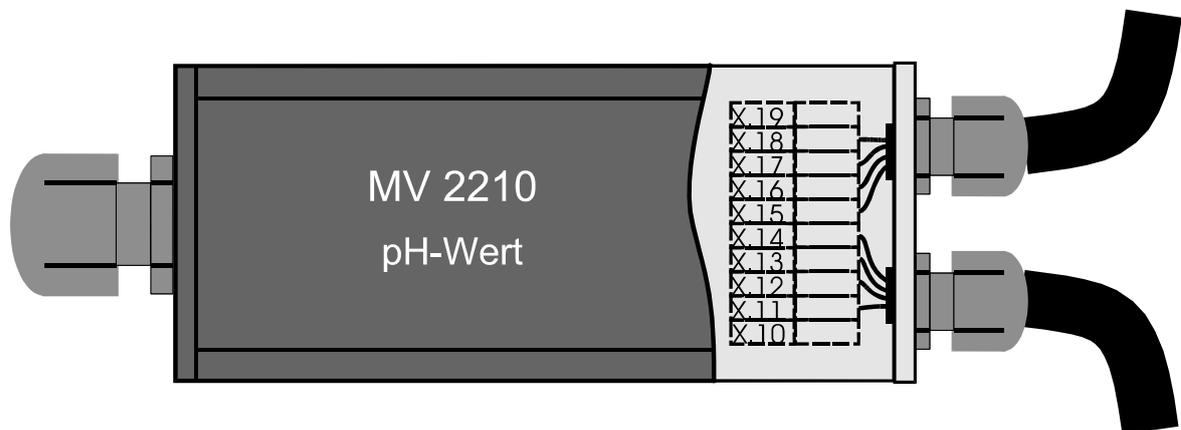
pH Measuring Module

Now, re-connect the mains supply. If you have wired up the new module properly, you will see the latter in the first display window where all modules connected are automatically detected. Now, you can proceed with any further settings.

DAC 1000
Normsignalmodul

X.19 X.18 X.17 X.16 X.15 X.14 X.13 X.12 X.11 X.10

X.29 X.28 X.27 X.26 X.25 X.24 X.23 X.22 X.21 X.20

MLU-2210E
pH

X.19 X.18 X.17 X.16 X.15 X.14 X.13 X.12 X.11 X.10

X.5 X.6 X.7 X.8   X.1 X.2   X.3 X.4
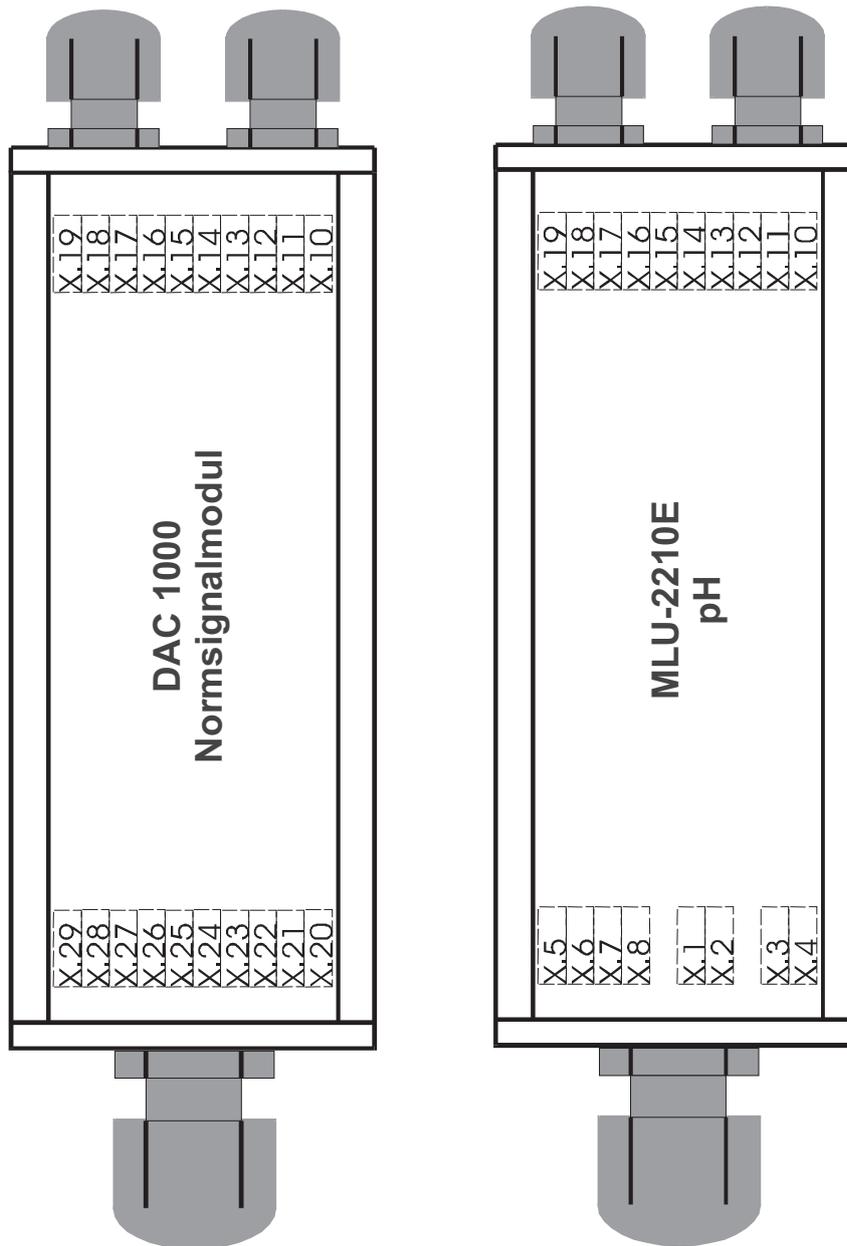
Measuring Module Sensor Inputs

terminal	potentiometric sensors (i.e. pH / ORP / ISE electrodes)	amperometric and conductive sensors (i.e. oxygen sensors, conductivity dells)	DC voltage / current input signal (linear characteristic)	flow sensors
X.1	measuring electrode	signal connector	signal connector +	vacant
X.2	vacant	screen	signal connector -	vacant
X.3	screen/reference electrode	vacant	vacant	vacant
X.4	screen/reference electrode	vacant	vacant	vacant
X.5	temperature sensor connection 1	temperature sensor connection 1	temperature sensor connection 1	GND

| X.6	temperature sensor connection 1	temperature sensor connection 1	temperature sensor connection 1	frequency output signal from the flow sensor
X.7	temperature sensor connection 2	temperature sensor connection 2	temperature sensor connection 2	GND
X.8	temperature sensor connection 2	temperature sensor connection 2	temperature sensor connection 2	+5 V power supply for flow sensor

X indicates the respective measuring amplifier number (slave 0 - slave 15).

Measuring and Active Modules Supply and Bus Connection

terminal	description / function
X.10	vacant
X.11	+12 V CAN supply
X.12	-12 V CAN supply
X.13	CAN L
X.14	CAN H
X.15	CAN L
X.16	CAN H
X.17	+12 V CAN supply
X.18	-12 V CAN supply
X.19	vacant

DAC 1000 Active Module Current Outputs

terminal	description / function
X.20	vacant
X.21	current output 0
X.22	earth - current output 0
X.23	current output 1
X.24	earth - current output 1
X.25	current output 2
X.26	earth - current output 2
X.27	current output 3
X.28	earth - current output 3
X.29	vacant

X indicates the respective DAC 1000 number
(slave 64 - slave 67).
All earth connections (0-4) are referred to the same potential.

MLU-2210E
pH
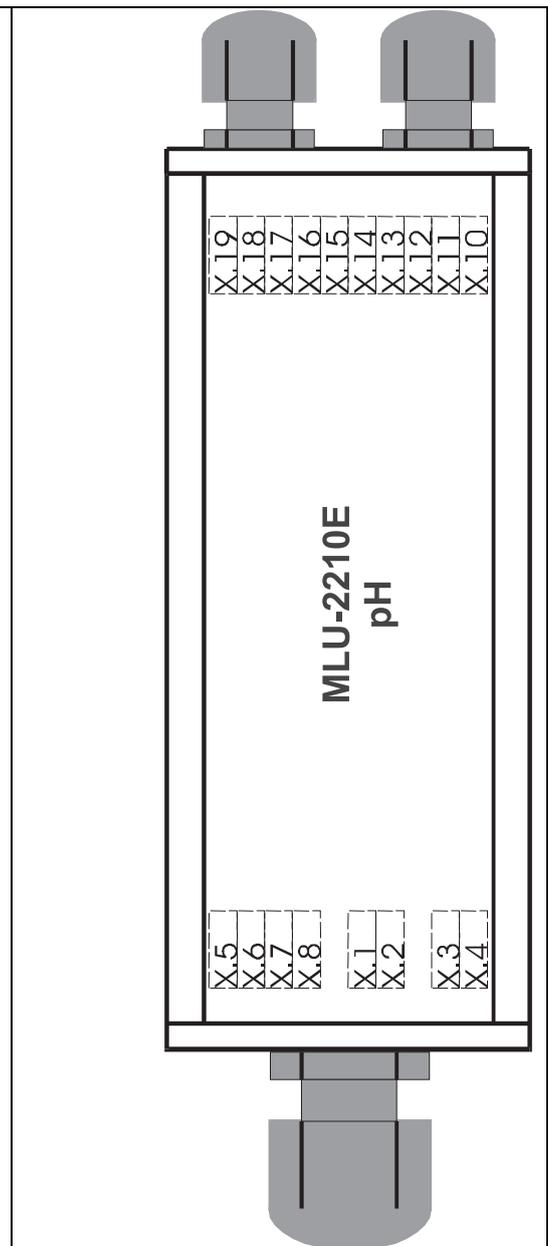
4.3   Sensor Connection Diagrams

4.3.1   Temperature Sensors
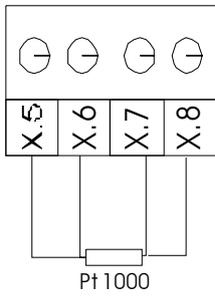
Four-wire circuit   Three-wire circuit   Two-wire circuit

Pt 1000   Pt 1000   Pt1000
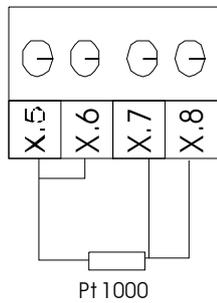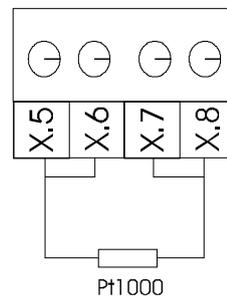
4.3.2   pH/ORP and Ion-Selective (ISE) Electrodes
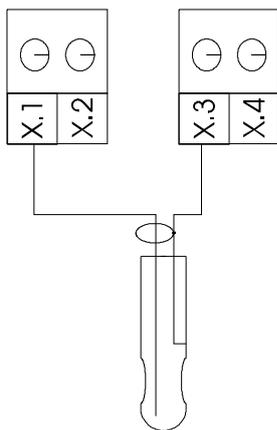
Combination electrode   Separated measuring and reference electrode
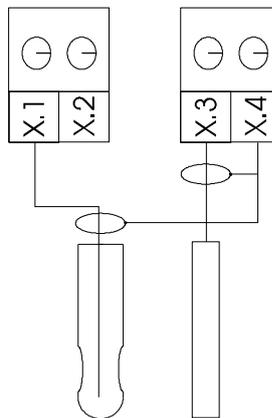
pH combination electrode with
integrated temperature sensor
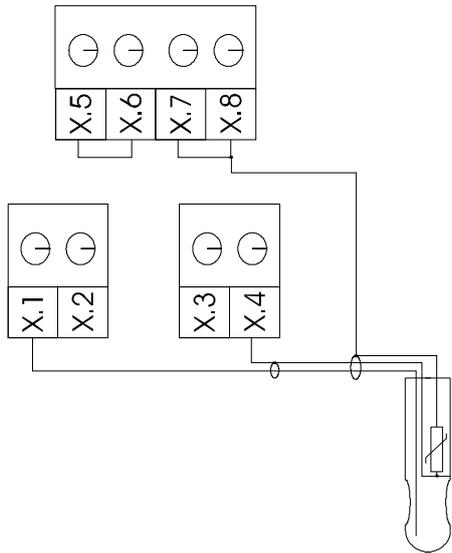
pH combination electrode with inte-
grated temperature sensor
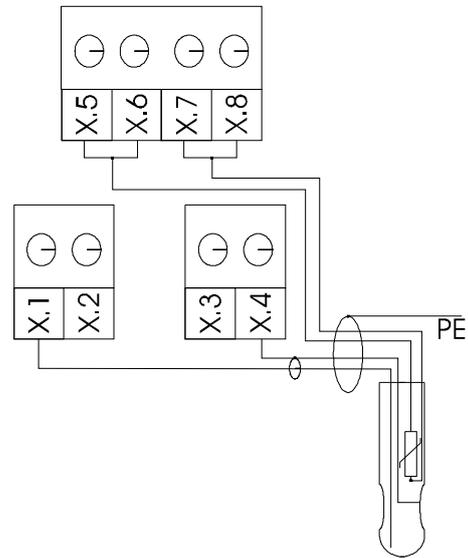
4.3.3 Conductivity Measuring Cell, Oxygen Sensor
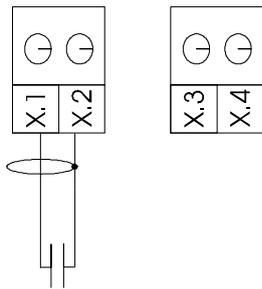
An integrated temperature
sensor connected as per
paragraph 4.3.1
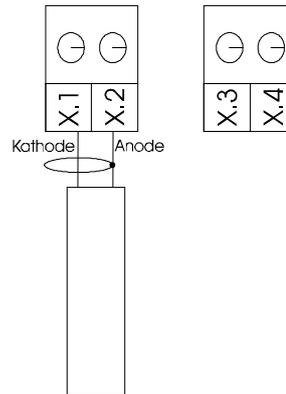
2-electrode conductivity
measuring cell

Membrane-covered amperometric
oxygen sensor

4.3.4 Chlorine Measuring Sensor and Analog Output Signal Sensor (Instrument)

Chlorine meas. sensor
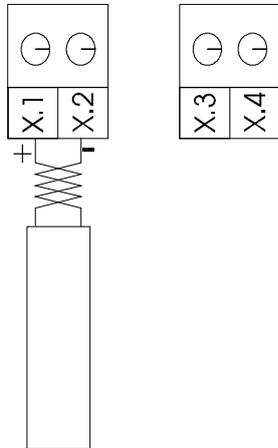
Sensor (instrument) with analog output signal
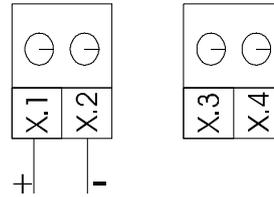
an integrated temperature sensor connected as per paragraph 4.3.1.

4.3.5 Flow sensor
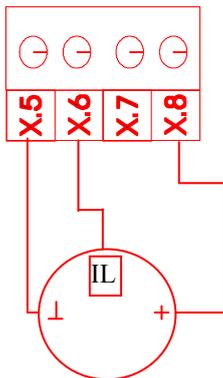
4.4 Cable Length Influence

The bus connection among the modules and to the MULTILINE 1000 as well as the individual power supply of the modules facilitates cable lengths of up to 800 m. It is absolutely vital that you should use specific cable intended for the connection among the modules and to the MULTILINE 1000. For this purpose, please contact the manufacturer or supplier of your measuring system. The connection is easy to establish. For up to 12 external measuring modules, the supply voltage for the modules is provided by the MULTILINE 1000. In the last module of the chain, you must add a terminating resistor to the open bus connection between CAN-H and CAN-L as described in paragraph 4.2. The modules can be arranged either directly in the vicinity of the MULTILINE 1000, or as pre-amplifiers in the vicinity of the sensors. In addition, the series connection facilitates subsequent extension of the measuring system by one or several modules.

If no impedance converter is used, the wiring for potentiometric sensors should not exceed 10 m. For conductivity and amperometric sensors and measuring cells, limit the maximum wiring length to 20 m. For detailed information, please refer to the specification sheets of the sensors and to the technical information thereto.

5   Basic Functions of the MULTILINE 1000 System

5.1   Measured Parameters

Each measuring module features determination of a main measuring parameter and the temperature. In addition to each main measuring parameter one or several so called secondary measuring parameters are calculated or directly measured. These secondary measuring parameters can be selected for displaying on the screen too (look as descript in para 0 Display Elements).

Temperature
Each measuring module has an input of its own for the connection of a Pt 1000 temperature sensor. Such temperature measurement can be used for automatic temperature compensation of the measuring parameter or of other parameters. The entry of an additive, linear zero displacement (offset) is possible as calibration. The display of the temperature value can be arranged individually. In principle, temperature measuring takes place within the range of -10 to 130 °C. For automatic temperature compensation, however, limited value ranges are available only, depending on the sensors used.

Redox potential (ORP)
In redox potential measuring, the voltage difference between the measuring and reference electrodes is displayed directly. In addition, conversion of the ORP voltage in relation to the potential of the standard hydrogen electrode as per DIN 38404, Part 6, is possible. For this purpose, it will be necessary to enter a temperature value or utilise a temperature measurement. The entry of an additive, linear zero displacement (offset) is possible as calibration. The span of the input voltage range is ± 2000 mV.

pH value
The pH value is the main measuring parameter directly calculated from the electrode voltage difference (secondary measuring parameter) between the measuring and reference electrode. For the exact determination of the pH value, calibration, i. e. adaptation of the measurement to the specific ratings of the measuring chain, is required. The gradient of the pH measuring chain indicates the variation of the voltage as a function of the pH value (mV/pH). The second parameter is the offset voltage at chain zero point pH 7 (asymmetry voltage). The temperature-dependent variation of the measuring chain gradient can be compensated automatically (ATC, automatic temperature compensation). The MULTILINE 1000 supports single-point, two-point or automatic calibration, using prescribed or freely selectable pH buffer solutions.

Conductivity
The conductivity measuring ranges for conductometric two-electrode cells are 0 to 200 µS/cm, 0 to 2 mS/cm, 0 to 20 mS/cm and 0 to 100 mS/cm. The useful measuring ranges depend on the cell constant and on the measuring cell used. Automatic temperature compensation takes place via the temperature measurement, e. g. by the temperature sensor integrated in the measuring cell. The MULTILINE 1000 measuring system supports linear, automatic temperature compensation with an adjustable temperature coefficient, referred to the reference temperature of 25 °C, and measurements without temperature compensation. The calibration to determine the cell constant of the conductivity measuring cell should be done as described in paragraph 9.2.2.
The conductivity module features calculation of resistance and salinity as secondary measuring parameters. The salinity is a sum parameter especially for sea water. The calculation for salinity from the temperature compensated conductivity value based on the "International Oceanographic tables" of the National Institute of Great Britain and UNESCO. These tables define the salinity in a range of 2 to 42 g/kg. Therefore only the conductivity values in the range of 0 to 20 mS/cm and 0 to 100 mS/cm are used for this calculation. In the range 0 to 200 µS/cm and 0 to 2

mS/cm the salinity value is given with zero. A special non-linear function for seawater is used for temperature compensation.

Oxygen content

The oxygen measuring module based on connection with membrane-covered amperometric sensors with an integrated temperature probe (use of other sensors on request). The limiting diffusion current upon the application of a suitable polarisation voltage is the measuring signal. From this the oxygen partial pressure, the percent air saturation (oxygen saturation index as per DIN 38404, Part 23) and the concentration of dissolved oxygen within the aqueous solutions as mass per unit volume (mg/l) or ppm are calculated. For measurements in gases, the measured value is represented as volume concentration (vol. % - special version). The MULTILINE 1000 system supports single-point calibration by comparison with known measured values or automatic air calibration.

Chlorine (free chlorine, total chlorine)

The sensors used to determine the concentration of disinfectants supply a DC output current signal (4…20 mA). The measuring signal is temperature compensated in the sensor. The corresponding measuring module ensures power supply for the sensor via a two-wire connection including electrical isolation. Single-point calibration by comparison with known measured values is required at regular intervals.

General linear and logarithmic characteristics

Measuring modules for analog current or voltage input signals are used for integration of external instruments, analysers or sensors with built-in electronics into the system. By means of the linear characteristic function the course of the measuring curve can be fixed or determined by two-point calibration. This measuring method serves for the integration and adaptation of sensors (instruments) having a linear output characteristic.

Another option is the logarithmic characteristic. The logarithmic measuring curve is used for measured quantities where the relation between the measured quantity and the sensor signal corresponds to the following equation:

$$U = U_0 + S \bullet \lg MW$$

MW: measured value
U: measuring module/sensor output voltage
U_0:   constant
S: gradient

The use of the logarithmic curve always requires previous two-point calibration.

Display Elements

Powering the MULTILINE 1000 initialises the latter. Then all possible slaves (measuring modules) that may be connected to the CAN bus are localised. The measuring modules connected are recognised automatically and displayed together with a description of what type they are. After all modules have been detected, the unit immediately changes to measured value display. All enabled outputs such as of relays, current drivers, interface communication and data logger storage are now active. You can use the << >> arrow keys to navigate through to your desired screen page. The representation of the individual measured values can be configured individually. So each main measuring parameter can be represented together with an accompanying secondary measuring parameter derived there from.

```
┌─────────────────────────┬─────────────────────────┐
│ Slave 0        Inflow   │ Slave 1                 │
│                         │                         │
│  93.5 %                 │ 103 µS                  │
│ 9.3 mg/l      21.2 ℃    │              21.2 ℃     │
├─────────────────────────┼─────────────────────────┤
│ Slave 2                 │ Slave 3        Effluent │
│                         │                         │
│ -273 mV                 │ 7.03 pH                 │
│                         │              18.5 ℃     │
├───────┬─────────┬───────┼─────────────────────────┤
│  <<   │  MENU   │  >>   │ R0:0 R1:1    23.01      │
│       │         │       │ R2:0 R3:0    09:27      │
└───────┴─────────┴───────┴─────────────────────────┘
```

The status of the internal relays is signed in the display field in the below right corner. The active status of the relay is shown by "1". If the unit MULTILINE 1000 is in the active hold function (automatic timer or manual hold function) this status is signalised by the sign "Hold" in this display field. The "LIMIT" information flash with one of the other status information if one value of any channel is out of the limit band (see paragraph 8.6).

Measured Value Representation Examples

Measuring module	Main measuring parameter	Secondary measuring parameter examples
MLU-2210E MLU-2210	pH value	electrode voltage in mV
MLU-2215E MLU-2215	ORP voltage mV	ORP voltage in mV referred to the standard hydrogen electrode potential
MLU-2220E MLU-2220	conductivity in mS/cm, µS/cm	resistance in ohm or salinity in g/kg

In addition to displaying the main measuring parameter and a possible secondary measuring parameter the temperature can be displayed if the temperature function of the accompanying module is used (compare 7.1 and 7.2). To identify the module the measured value is associated with, the measuring point number is always indicated in the upper left corner. So as not to lose track of the measuring points, you can assign your own individual names (10 characters max.).

In addition, a current time display window is provided on each screen page. You can set the clock by touching this display field. The subsequent dialog will enable you to do all the date and time settings.

The background lighting will become darker after the unit has not been operated for some 15 min. If you touch the display, it will be brightly backlit again.

If the unit is at some menu item with no entry for longer than 5 min. (with the exception of calibration), the display will automatically return to measured value reading.

5.2 Menu Structure, Password

To return to measured value reading from the individual menu items you must exit them one by one. All menu items of the unit by means of which measuring transmitter- or sensor-specific data can be adjusted have been designed so that the changes can be saved or cancelled. Two buttons are provided for this purpose:

Save and exit

Exit without saving

All measuring transmitter-specific data can be set from the MENU item. These are all output options such as current output, serial data output, measuring transmitter and limiting values as well as certain configurations of the unit itself.

Such menus are password-protected. All sensor-specific settings can be done from the sensor (measuring module) menus. You can call them by touching the display area of the respective sensor (measuring module). The first to appear is an overview page of the current data/settings of the measuring point. All calibration data of the sensor, the time of the last calibration, the temperature compensation used, the name of the measuring point as well as the data logger and serial output will be displayed. Corresponding changes of such data will only be possible in conjunction with a password (default password is "1").

5.3 System Startup / Extension

1. Switch on the unit.
2. Check whether all modules (slaves) are recognised.
3. Set up the display (refer to paragraph 6, 'Setting up the Display'.)
4. Set temperature compensation (refer to paragraph 7, 'Temperature Compensation'.)
5. Set data output/data saving (refer to paragraph 8, 'Data Output/Data Saving'.).
6. Calibrate the sensor (refer to paragraph 9, 'Calibration'.).
7. Set the current outputs, limiting values and controllers (refer to paras. 10, 'Switching and Current Outputs', and 11, 'Controller Module').

6   Setting up the Display

6.1   Displaying / Removing Secondary Measuring Parameters

1. Select the measured value display page where you wish to do your setting.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

5. Enter your password.
6. Select the Display Setup menu item.
7. To display the measured value the Display MV2 button should read "Y". So as not to display this value the Display MV2 button must read "N". If you touch this button you can change between the two values.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

The possibility to select between displaying the accompanying resistance or salinity value, as secondary measuring parameter is a special feature of the conductivity measuring module. The following steps are necessary:

1. Select the display page where the conductivity value is displayed and where you want to do your setting.
2. Touch the accompanying display value area.
3. Now, you will see the actual settings for this measuring point.
4. Touch the button below:

5. Enter your password.
6. Now you are in dialogue "slave setup". Touch the button second value and make your selection resistance or salinity value.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

6.2   Displaying / Removing the Temperature Value

1. Select the measured value display page where you wish to do your setting.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

5. Enter your password.
6. Select the Display Setup menu item.
7. To display the temperature value the Display Temp button should read "Y". So as not to display this value the Display Temp button must read "N". If you touch this button you can change between the two values.

Touch the above symbol to accept your settings or cancel them by touching the symbol below.

6.3   Assigning an Individual Measuring Point Name

1. Select the measured value display page where you wish to do your setting.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

5. Enter your password.
6. Select the Display Setup menu item.
7. Touch the Name button.
8. Through the keyboard displayed you can now type in any text with a maximum of 10 characters. Important keys are:

Keys	Function
⌃	SHIFT To shift to the second keyboard level.
ENT	ENTER To complete and accept your text entry.
DEL	DELETE To delete the last character.
ESC	ESCAPE To complete your text entry without accepting it.

9. Press ENTER to complete your text entry. The Name button will now read your text in the second line.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

7 Temperature Compensation

7.1 General

The MULTILINE 1000 measuring system facilitates the automatic temperature compensation of further channels of the measuring system by one temperature measurement. For this purpose, the respective probe and the Pt 1000 temperature sensor must be in the same measuring medium (note the temperature equalisation). If this requirement is met it will be possible to compensate several measured quantities by one single temperature measurement. However, you can also set a fixed compensation temperature for each measuring channel. If a temperature sensor or probe is used for temperature compensation of a different sensor please note that it will also have to be put in the calibration solution in order to facilitate temperature equalisation or compensation during calibration.

Please pay attention that although if you take over the temperature measurement for temperature compensation for a channel acc. para 7.2 the displayed temperature value is in accordance with the connected temperature sensor. Thus if no temperature sensor is connected, the temperature display for this channel should be switched off in acc. para 6.2.

7.2 Setting up a Temperature Measuring Channel for a Measuring Point

1. Select the measured value display page where you wish to do your setting.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

5. Enter your password.
6. Select the Temperature Setup menu item.
7. The Fixed Temperature button must read "N". If this is not the case touch this button once to make it change to "N".
8. Now, touch the Temp. SlaveX button and select the slave that provides the temperature signal for compensation.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

7.3 Setting a Fixed Temperature for a Measuring Point

1. Select the measured value display page where you wish to do your setting.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

5. Enter your password.
6. Select the Temperature Setup menu item.

7. The Fixed Temperature button must read "Y". If this is not the case touch this button once to make it change to "Y".

8. Now, touch the Fixed Temperature button and enter the temperature value in the subsequent dialogue. Press ENTER to complete this dialogue.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

8   Data Output / Data Saving

8.1   Serial Interface

The MULTILINE 1000 multi-parameter measuring transmitter has a serial port. This port can be alternatively used as an RS-232 or RS-485 (RS-422). For data recording and evaluation on a PC, the RS-232 port can be used in conjunction with the DataReader software. The RS-232 can also be used for remote data transfer in conjunction with a modem (AT instructions repertoire).

Prior to connecting the cable (disconnect the unit from the mains to do so), it is absolutely vital that you select the proper interface type.
For this purpose, proceed as follows:

1. Touch the MENU button.
2. Enter your correct password (press ENT to accept).
3. Call the Data menu item.

4. Call the Serial Output menu item.
5. Touch the menu item that shows the interface types (RS-232 or RS-485 or RS-422) several times until the correct interface type is displayed.
6. Save your selection.

Depending on the type of interface, use the following terminals:

Serial interface used as RS-232

Terminal	RS232 Name
18B	RxD
16A	TxD
16B or 17B	GND

Serial interface used as RS-485

Terminal	RS232 Name
17A	A(+)
16A	B(-)
16B or 17B	GND

120 Ohm terminating resistor required.

Serial interface used as RS-422

Terminal	RS232 Name
18B	RxD+
18A	RxD-
16A	TxD-
17A	TxD+
16B or 17B	GND

Two 120 Ohm terminating resistors required.

8.2   Serial Data Output ASCII

To cyclically output a measured value through the interface two settings is necessary. This is, on the one hand, the unit's default setting where the output cycle is prescribed. On the other hand, the individual measuring points must be enabled for data output one by one.
The individual data blocks are always 10 bytes long. Each line begins with a start string as well as with the date and the time and then outputs one by one all enabled measuring channels. The interface setting is 9600 bauds, 1 stop bit and no parity. All output characters are in the ASCII format.

Transmit status information:
Relay outputs can be used for supervision of limits or alarms as well as for switching determined functions. In this case it is possible to transmit the states of the relays in a special status message. The configuration of the relay outputs should be done on the MULTILINE 1000 in accordance with paragraph 10.1 'Configuring a Relay Output'.
With reference to the experiences of the user about the usual ranges for his measuring values under the given application, individual limits can be defined so that the system will create maintenance requirements if the limits are exceed (refer to paragraph 8.6 'Adjustment of individual limit bands').
Additional some states of the system are transmitted.
The transmission of the status for all available relay outputs, the limit states of the measurement values and the device status information of the MULTILINE 1000 needs release of serial data interface as descript in the section 8.2.2 'Basic Setting'. The information about the relay status will be connected to the line after the last transmitted value.

The output is in the following form:

Description	Start Line	Date/Time	Value 1	Value x
Data	0x13 0x10	ddmmyyhhminmin	EEEEWWWWWW	EEEEWWWWWW
Data length in bytes	2	10	10	10

Status information

Start	Status Relay	Separator	Status measurement value	Status
STATUS_	RRRRRRRRRRRR	_	LLLLLLLLLLLLLLLL	SSSS
7	12	1	16	4

dd	2 bytes for the day
mm	2 bytes for the month
yy	2 bytes for the year
hh	2 bytes for the hour
minmin	2 bytes for the minute
EEEE	4 bytes for the measured value unit
WWWWWW	6 bytes for the measured value
R	1 Byte Status Relay
L	1 Byte Status measurement value
SSSS	4 Byte Status device

R- Status:	0: open relay contact
	1: closed relay contact
	3: relay is not released

L- Status:	0: measurement value is in range
	1: underflow of range
	2: overflow of range
	3: Slave is not available

Status Code	meaning
0000	No problems on MULTILINE 1000
0001	HOLD manual activated
0002	HOLD in calibration mode
0003	HOLD in timer mode

All changes to HOLD state or return are transmitted. No transmission takes place during HOLD state.

The value output sequence is prescribed as follows:
Slave0 main measured value, slave0 secondary measured value, slave0 temperature value, followed by the respective three values for slave1 to slave15, and then by the four virtual channels with one values each. All slaves or measured values not enabled will not be output.

8.2.1 Enabling the Individual Measured Values for Data Output

Prior to the basic setting, the individual measured values must be enabled for data output. The output sequence is prescribed by the slave numbers.

1. Select the measured value display page where you wish to do your setting.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

5. Enter your password.
6. Select the Data Output menu item.
7. The Serial value button must read "Y" if the main value of this slave is to be output. If this is not the case touch this button once to make it change to "Y". You can enable the other two measured values for output in the same way. If you wish to prevent output the corresponding button should read "N".

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

8.2.2 Basic Setting

The basic setting can be used to adjust the time interval. You can specify every how many minutes/seconds the measured values are to be outputs.

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the Data button.

4. Now, touch the Serial Output button.
5. You can use the Minute and Second buttons to set the time interval.
6. If you will output the status of the relays as descript in paragraph 8.2 touch the button transfer status info to set it to enable
7. Finally, you must still enable serial data output. For this purpose, touch the Enable/Disable button to set it to Enable.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

8.3   Serial Data Output Modbus

The MULTILINE 1000 is capable for integration in Modbus systems. Modbus communication allows to use the interfaces RS232, RS485 and RS422 as transmitting medium. The sensor data information are made available in a sensor data block. The data communication is based on request and reply frames. The format of the frames is defined by Modbus RTU protocol. The Modbus master sends one request frame via Modbus command to the Modbus slave. Then the Modbus slave answer with a frame according to register list.

8.3.1   Protocol structure

Follow Modbus commands can be used:

Function	Function number
Read n (max. 16) Words, Read Input Register	0x04
Read n (max. 16) Words, Read Holding Register	0x03

8 register summarized as register blocks are associated by the slave ID of the measuring points. Slave 0 is requested by registers 1 - 8, Slave 1 by registers 9 – 16, etc.. Generally one register consists of 2 Byte. The structure of the register is described as follows:

Slave ID	Registers	Description	Data type
Slave 0	0001 Bit 7...0	sensor number (Slave ID)	Byte
	0001 Bit 15...8	sensor status	Byte
	0002 Bit 7...0	sensor type	Byte
	0002 Bit 15...8	device status	Byte
	0003 Bit 31...16	temperature value	Float 32
	0004 Bit 15...0	temperature value	
	0005 Bit 31...16	main value	Float 32
	0006 Bit 15...0	main value	
	0007 Bit 31...16	secondary value	Float 32
	0008 Bit 15...0	secondary value	
Slave 1	0009 Bit 7...0	sensor number (Slave ID)	Byte
	0009 Bit 15...8	sensor status	Byte
	0010 Bit 7...0	sensor type	Byte
	0010 Bit 15...8	device status	Byte
	0011 Bit 31...16	temperature value	Float 32
	0012 Bit 15...8	temperature value	
	0013 Bit 31...16	main value	Float 32
	0014 Bit 15...0	main value	
	0015 Bit 31...16	secondary value	Float 32
	0016 Bit 15...0	secondary value	
Slave 15	0121 Bit 7...0	sensor number (Slave ID)	Byte
	0121 Bit 15...8	sensor status	Byte
	0122 Bit 7...0	sensor type	Byte
	0122 Bit 15...8	device status	Byte
	0123 Bit 31...16	temperature value	Float 32
	0124 Bit 15...0	temperature value	
	0125 Bit 31...16	main value	Float 32
	0126 Bit 15...0	main value	
	0127 Bit 31...16	secondary value	Float 32
	0128 Bit 15...0	secondary value	
Relais	0129 Bit 7...0	relay status intern	Byte
	0129 Bit 15...8	relay status extern	Byte

Relay status: The bits 0 ... 3 characterize the status of internal relays of MULTILINE 1000.
              The bits 8 ... 15 characterize the status of additional external relays.

Sensor status: 00: measuring value within measuring range
               01: measuring value exceeds upper limit
02: measuring value exceeds lower limit

Device status: 00: Device operates normally
               01: HOLD manual activated
               02: HOLD by calibration activated
               03: HOLD by timer activated

Sensor type	hex
pH	01
redox	02
conductivity 0...200µS	03
conductivity 0...2mS	04
conductivity 0...20mS	05
conductivity 0...100mS	06
TEF Turbidity	07
O2 oxygen	08
linear	09
ISE ion selektiv	0A
CL2 free chlorine	0B
auto range conductivity 0...200µS	0C
auto range conductivity 0...2mS	0D
auto range conductivity 0...20mS	0E
auto range conductivity 0...100mS	0F
Freq.- counter	12
CL2 free chlorine (direct sensor input)	13
conductivity 0...200µS(4-Pol)	15
conductivity 0...2mS(4-Pol)	16
conductivity 0...20mS(4-Pol)	17
conductivity 0...500mS(4-Pol)	18
auto range conductivity 0...200µS(4-Pol)	19
auto range conductivity 0...2mS(4-Pol)	1A
auto range conductivity 0...20mS(4-Pol)	1B
auto range conductivity 0...500mS(4-Pol)	1C

0x03 ... 0x06 and 0x15 bis 0x18 are fixed measuring ranges conductivity
0x0C ... 0x0F and 0x19 bis 0x1C are automatical measuring ranges conductivity

Figure formats:

Float 32 Format accord. to IEE 754:

Format: SEEEEEEE   EMMMMMMM   MMMMMMMM   MMMMMMMM
                        ↑   ↑   ↑   ↑
                     BIT31   BIT16   BIT15   BIT0

BYTE Format (8 Bit):
Format: HHHHHHHH

Communication and Timeout:

Always data request from master is followed by reply from slave. This communication require different times:
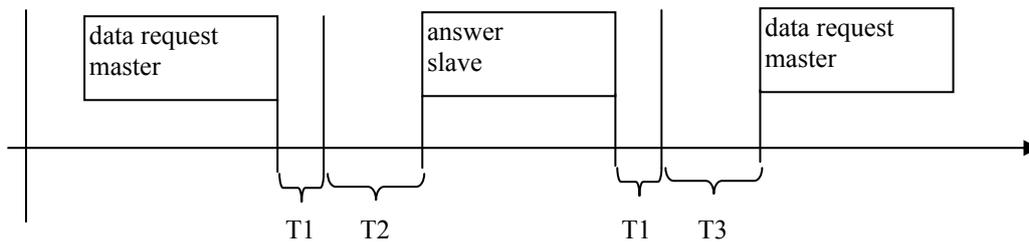
T1: end detection request protocol (Attention! depend on baud rate, always 3 character long)
T2: operating time of slave (max. 100mS), during this time another data request on the bus is not allowed.
T3: switching time from „send" to „receive" (only RS485) max. 10mS

T1 for different baud rates:

Baud rate	T1 [mS] end detection
2400	16,6
4800	8,3
9600	4,2
19200	2,18
38400	1,15

Example:
Reading Slave 0 and Slave 1 each with 8 Registers with one data request.
Data request:

Slave-Address 1 Byte	Function 1 Byte	Address 2 Byte		Words 2 Byte		Check sum 2 Byte	
0x01	0x03	0x00	0x00	0x00	0x10	0x44	0x06

Reply:

Slave-Address 1 Byte	Function 1 Byte	Bytes 1 Byte	Data block x Bytes	Check sum 2 Byte	
0x01	0x03	0x20	see table	0x5A	0x09

Data block:

Slave ID		Registers	Description	Data type	
Slave 0 8 Registers = 16 Byte	0x00	0001 Bit 0...7	sensor number (Slave ID)	Byte	slave 0
	0x00	0001 Bit 8...15	sensor status	Byte	within measuring range
	0x04	0002 Bit 0...7	sensor type	Byte	range 0...200µS
	0x00	0002 Bit 8...15	device status	Byte	operates normally
	0x41,0xC5	0003 Bit 16...31	temperature value	Float 32	24,7 °C
	0x7F,0x4A	0004 Bit 0...15	temperature value	Float 32	
	0x42,0xC4	0005 Bit 16...31	main value	Float 32	98,1 µS
	0x35,0xBD	0006 Bit 0...15	main value	Float 32	
	0x41,0x23	0007 Bit 16...31	secondary value	Float 32	10,2 kOhm
	0x17,0x34	0008 Bit 0...15	secondary value	Float 32	
Slave 1 8 Registers = 16 Byte	0x01	0009 Bit 0...7	sensor number (Slave ID)	Byte	slave 1
	0x00	0009 Bit 8...15	sensor status	Byte	within measuring range
	0x01	0010 Bit 0...7	sensor type	Byte	pH-value
	0x00	0010 Bit 8...15	device status	Byte	operates normally
	0x42,0x71	0011 Bit 16...31	temperature value	Float 32	60,3 °C
	0x36,0x5D	0012 Bit 0...15	temperature value	Float 32	
	0x40,0x9C	0013 Bit 16...31	main value	Float 32	8,89 pH
	0x7E,0xCE	0014 Bit 0...15	main value	Float 32	
	0x43,0x0B	0015 Bit 16...31	secondary value	Float 32	139,9 mV
	0xE8,0x1C	0016 Bit 0...15	secondary value	Float 32	

8.3.2 Interface parameters

The interface parameters are set in according to basic adjustment of MULTILINE 1000. Baud rate, parity / stop bit and device address of MULTILINE 1000 belong to it. Follow interface parameters are:
Baud rates:
- 2400
- 4800
- 9600
- 19200
- 38400

Parity and stop bit:
- no parity 1 stop bit (none 1stop)
- no parity 2 stop bits (none 2stop)
- even parity 1 stop bit (even 1stop)
- even parity 2 stop bit (even 2stop)
- odd parity 1 stop bit (odd 1stop)
- odd parity 2 stop bit (odd 2stop)

Modbus address: 1...247

8.3.3 Parameter Settings

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.

2. Enter your correct password.
3. Touch the Data button.
4. Now, touch the Serial Output button.

5. Set the interface type to Modbus by touching the button Disable/ASCII/Modbus several times until it shows Modbus .
6. In the next steps you can set the interface (RS232, RS422, RS488), baud rate, parity and Modbus address by touching the appropriate areas on the Modbus dialog window.
7. Touch the symbol below to accept your settings

or cancel them by touching the symbol below.

8.4 Data Logger

The data logger works in the same way as output through the serial interface, with the exception that the values are stored in the memory in addition to being output through the serial interface. If the memory content is called output will take place as described above (refer to paragraph 8.2, 'Serial Data Output').

8.4.1 Basic Setting

You can use the basic setting to adjust the sampling time, i. e. the time interval for the logging of the measured values. You can specify every how many minutes/seconds the measured values are to be logged. In addition, you can specify the type of memory management. Infinite means that data logging will be continued at the beginning of the memory if the same is full. A finite data logger, on the other hand, means that data logging will be stopped when the memory end is reached. A RESET button can be used to clear the data memory.

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the Data button.

4. Now, touch the Data Logger button.
5. You can use the Minute and Second buttons to set the time interval.
6. Finally, you must still specify the type of data logging. For this purpose, touch the Off/Finite/Infinite as many times as you need until the desired setting is read. Off means that no data will be stored in the data logger.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

8.4.2 Enabling the Individual Measured Values for Data Logging

After the basic setting, the individual measured values must be enabled for data logging. The output sequence is prescribed by the slave numbers.

1. Select the measured value display page where you wish to do your setting.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

5. Enter your password.
6. Select the Data Output menu item.
7. The logg. value button must read "Y" if the main value of this slave is to be output. If this is not the case touch this button once to make it change to "Y". You can enable the other two measured values for logging in the same way. If you wish to prevent output the corresponding button should read "N".

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

8.4.3 DataReader Software

To read out the data logger, the unit comes with the MULTILINE 1000Reader software. With the aid of this program, you can read out the data logger via the RS-232 interface. How to connect the interface cable is described in paragraph 8.1, 'Data Output/Data Saving'. This software runs on Windows 95 or later and is very easy to operate. Run setup.exe from the installation disk to install the software. Now, you will be prompted through the installation process. Having completed this procedure properly, you can use this program immediately. To begin with, use the Setup button to set up the interface of your computer, which is to be used for data transfer. Use a suitable cable to connect the MULTILINE 1000 to your computer. If the data logger contains any data the latter will be transferred after you have pressed the Readout button and saved in a text file you selected before. All data sets are delimited by TAB stops.

File layout:
Date *TAB* time *TAB* 1st value unit *TAB* 1st value *TAB* 2nd value unit *TAB* 2nd value *TAB*......

Example:
| 29.11.01 | 15:16 | pH | 6.99 | µS | 1961 | °C | 25.4 |
| 29.11.01 | 15:17 | pH | 6.99 | µS | 1961 | °C | 25.4 |

This facilitates the import of the text file into a different program.

8.5   24-Hours Data Recorder

You can use the data recorder to graphically represent in the touch screen display the measured value curve of the main measured quantity of each slave of the past 24 hours. The measured values are recorded at an interval of 10 minutes. Within these 10 minutes, an average value is formed and saved. Besides, the maximum and minimum values as well as the average (AVE) of the past 24 hours are displayed in a separate window. You can call the data recorder without any password as follows:
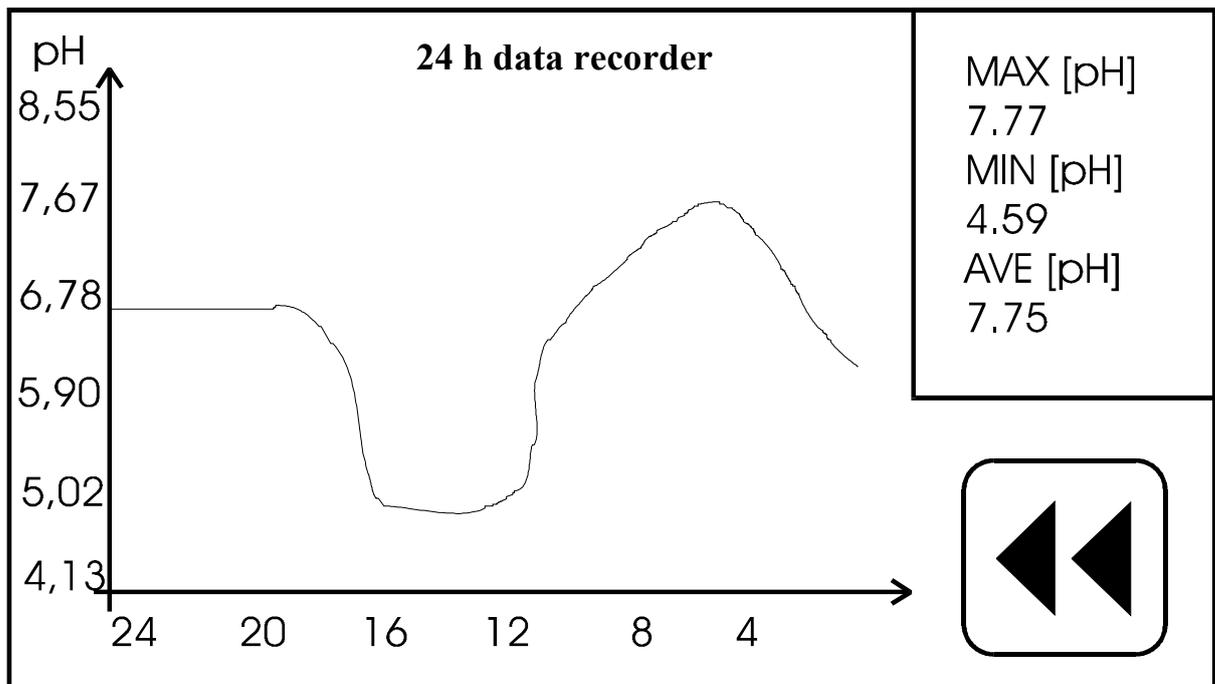
1. Select the display of the measured value to be represented.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

Please note that the values displayed upon switching on the unit may be of earlier origin. These will be overwritten within the next 24 hours after switching on.

8.6   Limit Bands

The adjustment of individual limit bands for each measured parameter (main measuring parameter only) is a simple, effective and practicable function for supervision of the measuring system in general inclusive sensor diagnosing. The MULTILINE 1000 checks if the measured value is between a free adjustable upper and a lower limit value. This information are transmitted as a part of the status message in the serial protocol and can be used for control systems see para 8.2).
In addition to the transmission of this status information via interface the relevant measuring page shows this information in the accompanying display area and in the status information display field in the below right corner. In the status information field the symbol "LIMIT" flashes in change with "Relay" or the "HOLD" status information if a measured value passes his limit

band. In addition the symbol "Lim" flashes in the accompanying display value area behind the reading of the main measuring parameter.

Also the function SMS service can be used for transmission of the status information of the behaviour of the measured value in relation to his limit band. That means if you connect the MULTILINE 1000 with a GSM Modem (see para 8.7) and you release the SMS message service (see para 8.7.2) you get information on your mobile phone if the value of one channel is out of limit band.

To adjust the individual limit bands the following steps are necessary:

1. Select the measured value display page where you wish to do your setting.
2. Touch the display value area.
3. Now, you will see the current settings of the measuring point.
4. Touch the button below:

5. Enter your password.
6. Select the Limits setup menu item.
7. Now, touch the upper limits button after that the lower limits button and enter the range value in the subsequent dialogue.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

8.7   Modem Operation

The MULTILINE 1000 offers the following options in connection with a modem:

- Request of the data in the datalogger using a PC and software. For details, contact WTW.

- SMS limit indicator (see para 0 and **Fehler! Verweisquelle konnte nicht gefunden werden.**)

- SMS request service (see para 0 and **Fehler! Verweisquelle konnte nicht gefunden werden.**)

8.7.1 Start-up of the Modems

To avoid problems of communication between modem and MULTILINE 1000 set the modem to a fixed baud rate of 9600 (look therefore in the manual of the modem).

1. Switch off the MULTILINE 1000.
2. Connect the connecting cable MULTILINE 1000 – Modem in MULTILINE 1000 ($\rightarrow$ Paragraph 4 and 8.1).

   MULTILINE 1000: serial interface must beRS-232 (for Modem)

Terminal	RS232 Description	Provided cable
18B	RxD	white
16A	TxD	pink
16B or 17B	GND	grey
PE		screen

3. Insert the SIM-card in the modem (to the first start up the SIM-card must be empty, SMS messages must not stored on this SIM-card), install the antenna and the and power supply.
4. Switch on the main power of modem (MULTILINE 1000 must still be switched off!)
5. Switch on the main power of MULTILINE 1000.
6. Observe the recognition of the modem during the start up phase of MULTILINE 1000. The initialization of the modem follows the initialization of measurement and actor modules in the screen section "Modem function".

|	
Modem found!	$\rightarrow$ Modem connection is correct, MULTILINE 1000 recognised the modem
Modem not found!	$\rightarrow$ MULTILINE 1000 does not recognised the modem
	$\rightarrow$ check the modem connection
	$\rightarrow$ switch on the main power of modem
PIN available!	$\rightarrow$ SIM-card + PIN correct
PIN not available!	$\rightarrow$ SIM-card not insert in the modem or PIN incorrect/blocked
	$\rightarrow$ check the SIM-card
	$\rightarrow$ check the PIN, if it is necessary clearing with PUK + Mobil phone
SMS service available!	$\rightarrow$ SIM-card provides the feature SMS
SMS service not available!	$\rightarrow$ SIM-card does not provides the feature SMS
	$\rightarrow$ check the SIM-card

8.7.2 SMS Limit Indicator

With the MULTILINE 1000 and a connected GSM modem it is possible to generate a SMS
message to a free adjustable phone number if a value of any channel is out of his limit band.
That is an easy method to get actual information about any problems in your running process.
Therefore you have to adjust the limit band for each channel (see para 8.6). If you want to get
no message of one channel set the limit band to the beginning and the end of the range of the
channel. The message is only send if the value is less than lower limit or higher than upper limit.
Only one time the message will send for each channel. After getting a message you have to
reset the SMS status in MULTILINE 1000 than SMS service for all channels are available again.
If you not RESET the SMS status only the channels that have not send a SMS message since
last RESET are able to send their messages.
The message contains "KM2000" + an information string (freely selectable -> up to 10 charac-
ters) and the actual value with unit of the channel, which have sent the message:

Example:

For using this function the following steps are necessary:

1. Configure the serial output (RS 232).
2. Configure the limit bands for all Channels (→ Para. 8.6)
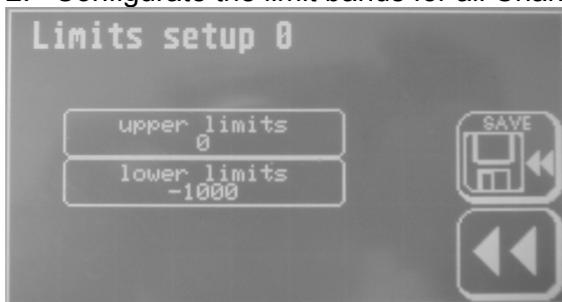
3. Configure the modem.
4. Touch the MENU button at the measured value output side.
5. Input the correct password (confirm with „ENT").
6. Touch the „Data" button.

7. Now touch the Modem button.
8. Specify the type of modem. For this purpose, touch the Off/analog/GSM as many times
   as you need until the GSM modem is select. The buttons PIN and SMS Service ap-
   pears.
9. Touch the PIN button.
10. Input the correct Pin of your SIM-card and confirm with „ENT".
11. Touch the SMS Service button.
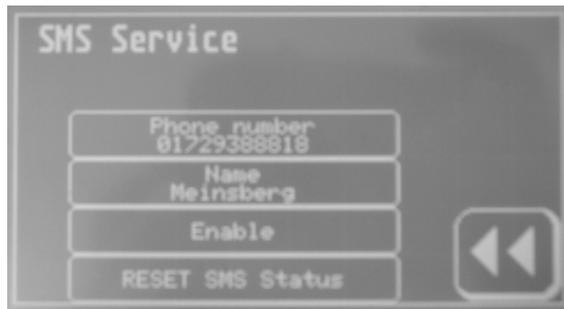
12. Input at first the phone number of the telephone which should get the message.
13. Input a special name for the MULTILINE 1000 which will be a part of the message (e.g. the location).
14. Enable the SMS Service
15. If the button RESET SMS Status is available please select this button once. The button disappear and all channels are released for SMS service
16. Go back to the dialogue "SMS Service" with

17.

Touch the symbol "SAVE" to accept your settings or cancel them by touching the symbol "BACK".

18. Switch off the MULTILINE 1000.
19. Connect the modem at the serial output in the MULTILINE 1000 (→ Para. 8.7.1).
20. Switch on the main power of modem (MULTILINE 1000 must still be switched off!)
21. Switch on the main power of MULTILINE 1000.
22. Observe the recognition of the modem during the start up phase of MULTILINE 1000. The initialization of the modem follows the initialization of measurement and actor modules in the screen section "**Modem function**".

Modem found!	→ Modem connection is correct, MULTILINE 1000 recognised the modem
Modem not found!	→ MULTILINE 1000 does not recognised the modem
	→ check the modem connection
	→ switch on the main power of modem
PIN available!	→ SIM-card + PIN correct
PIN not available!	→ SIM-card not insert in the modem or PIN incorrect/blocked
	→ check the SIM-card
	→ check the PIN, if it is necessary clearing with PUK + Mobil phone
SMS service available!	→ SIM-card provides the feature SMS
SMS service not available!	→ SIM-card does not provides the feature SMS
	→ check the SIM-card

To Reset SMS message service (after a sent message) the following steps are necessary:

1. Touch the MENU button at the measured value output side.
2. Input the correct password (confirm with „ENT").
3. Touch the „Data" button.

4. Touch the SMS Service button.
5. If the button RESET SMS Status is available please touch this button once. The button disappear and all channels are released for SMS service.
6. Go back to the measured value output side with

8.7.3 SMS Request Service

With MULTILINE 1000 and connection to a GSM modem it is furthermore possible to use the feature SMS-request-service. With this service it is very easy to request all the active measuring values of a MULTILINE 1000 via mobile phone. For this it is only necessary to send a SMS message to the MULTILINE 1000. After getting this SMS message the MULTILINE 1000 send also a SMS message to the in the **MULTILINE 1000 / SMS service adjusted telephone number**. This SMS message contains all the active displayed measuring values of the MULTILINE 1000.

Example:

Prerequisite for using the SMS request service is the correct installed and configured modem and as well as a successful PIN-request. The release of the SMS service (LIMIT) → ENABLE is in this case not necessary. The MULTILINE 1000 provides the SMS request service also when the SMS service is switched off → DISABLE.

For using this function the following steps are necessary:

1. Configurate and installation of the modem. (please see also para. **Fehler! Verweis-quelle konnte nicht gefunden werden.** and **Fehler! Verweisquelle konnte nicht gefunden werden.**)
2. Touch the MENU button at the measured value output side.
3. Touch the "Data" → Modem → SMS Service button.
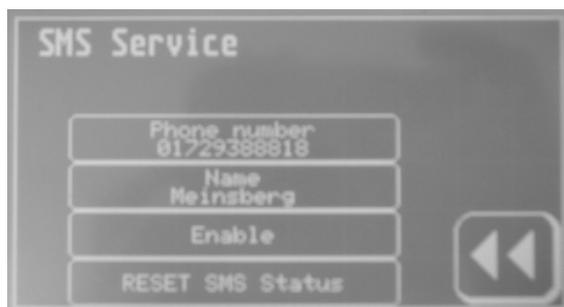
4. Input the phone number of the telephone which should get the message (SMS-LIMIT-Service and SMS-request-service).
5. Go back to the dialogue "SMS Service" with

6.

Touch the symbol "SAVE" to accept your settings or cancel them by touching the symbol "BACK".

For request the active displayed measuring values via SMS the following steps are necessary:

1. Send the SMS message „KM" to the mobile phone number of the modem connected at the MULTILINE 1000. This message is possible to be send from each mobile phone.
2. After getting this SMS message the MULTILINE 1000 send also a SMS message. This SMS message contains all the active displayed measuring values of the MULTILINE 1000 (also temperature and measuring value 2 are possible). **The MULTILINE 1000 send this message always to the in the MULTILINE 1000 / SMS service adjusted telephone number, no matter from which phone number the MULTILINE 1000 gets the SMS-message.** This prevents that the MULTILINE 1000 answer to expensive advertisement messages (SPEM).
3. The successful sending of a SMS will be journalised in the MULTILINE 1000 log book.

The sent SMS message from the MULTILINE 1000 has the following structure:
-   date and time
-   phone number of the connected modems
-   S 00: active measuring value 1 + unit; possibly more displayed measuring values (temperature + measuring value 2) + unit;
-   S 01: active measuring value 1 + unit; possibly more displayed measuring values (temperature + measuring value 2) + unit;
-   ....

The unit of the temperature is displayed with GRD (= °C) and the conductivity-unit µS is displayed with uS.

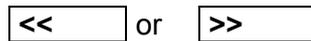example.:   31.05.05 15:23
                    +491703456789
                    S 00: 53 mv; 260 mVH; S 01: 7.01 pH; -1 mV; 29 GRD; S 02: 2,45 mg/l; 29 GRD

                    S 00 is Slave 0, S 01 is Slave 01, ...

9   Calibration

9.1   Calibrating a Measuring Point

1. Select the screen page with the measuring point to be calibrated.

    Use keys

    | << | or | >> |

    to select the screen page that reads the measured value of the measuring point to be cali-
    brated.

2. Touch the measuring point to be calibrated.

    Now, all settings of this measuring point are output. Current calibration data, temperature com-
    pensation settings as well as data saving (data logger) and data output (serial) are displayed.

3. Touch the calibration symbol.

4. Type in your correct password (see section 5.2 Menu Structure, Password) and press ENTER
    to confirm.
    (You can use the DEL key for corrections.)

5. Select the calibration method.

    All possible calibration methods for the respective measuring point type will be displayed.
    Press the corresponding symbol to select your desired calibration method. The individual
    calibration methods are explained in paragraph 9.2, 'Calibration Methods'.

6. Return to the measurement.

    After completing the calibration process, touch button

    as many times as are necessary to get back to the measured value screen page.

9.2   Calibration Methods

Take account of temperature compensation for all calibration methods. This means, if measured
values are compensated by temperature measurement, the associated temperature sensor
must also be dipped into the calibration medium to be able to determine the exact temperature.

9.2.1 Setting the Temperature Offset

This menu item enables you to set a temperature value offset. For this purpose, touch the button that reads the current offset. Now, an input dialogue will be displayed which facilitates the setting. The offset can be positive or negative.

Use the ENT button to accept the entry. To cancel the input dialogue without saving the value press ESC, while DEL enables you to correct values entered.

The value changed will now be displayed in its corresponding field. You can make any further changes.

To save the value change you must exit the Input Data dialogue field by pressing the button below:

If you do not wish to save the change press the button below to exit the Input Data dialogue:

9.2.2   Single-Point Calibration

Calibrate the measuring signal at this one point using a defined calibration solution or a known set point value, e. g. determined by a separate method or by means of a laboratory/field instrument. At first, you will be prompted to dip the sensor into the corresponding calibration medium. Having done so, press OK to accept the dialogue. Now, the currently measured value will be displayed. After the measured value has attained a stable state, accept the dialogue again by pressing OK. You will now be prompted to enter the set point value.

Use the ENT button to accept the entry. To cancel the input dialogue without saving the value press ESC, while DEL enables you to correct values entered.

As a result, you will now be given the new calibration values that you can save (SAVE button) or cancel (CANCEL button).

For calibration of measuring modules with linear characteristic for measurement of free or total chlorine in conjunction with corresponding chlorine measuring sensors, a single-point calibration as comparison with a known set point value determined by a means of a photometric laboratory method is recommended. Chlorine measuring sensors feature automatic temperature compensation integrated in the sensor. The temperature value shown during calibration should be adjusted to a fixed temperature (i.e. 25 °C) and is not taken into account.

In addition the MULTILINE 1000 offers a special free chlorine measurement method with automatic pH and temperature compensation. In this case the concentration of free chlorine is calculated as a virtual value on the basis of the real measured concentration of HOCl (e.g. Chlorine Measuring Cell FCML 68) in combination with a simultaneous pH measurement and a mathematical pH compensation automatically in a given pH range. The method for determining and calculation of virtual measured values is decrypting in paragraph 12. For the calibration of the virtual value free chlorine a special procedure is necessary explained in paragraph 12.2.

9.2.3 Two-Point Calibration

Calibrate the sensor at two separate points using two different defined calibration solutions or known set point values. The calibration points are supposed to include the measuring range or the measured values to be expected, respectively. You can choose any sequence of the calibration solutions or set point values.

At first, you will be prompted to dip the sensor into the first calibration medium. Having done so, press OK to accept the dialogue. Now, the currently measured value will be displayed. After the measured value has attained a stable state, press OK to accept the dialogue. You will now be prompted to enter the associated set point value.

Use the ENT button to accept the entry. To cancel the input dialogue without saving the value press ESC, while DEL enables you to correct values entered.

The next dialogue field will now prompt you to dip the sensor into the second calibration medium. After you have accepted this, the currently measured value will, again, be displayed. Press OK again to accept the stabilised measured value, before you will be prompted to enter the associated set point value.

As a result, you will now be given the new calibration values that you can save (SAVE button) or cancel (CANCEL button).

9.2.4 Automatic Calibration

For this method of calibration, the unit automatically recognises the value of the calibration solution used, taking into account the temperature of the calibration solutions. Automatic calibration may be single-point or two-point and is limited to the calibration solutions stored in the unit. This calibration method is applied to pH, conductivity and oxygen content measurements only.

9.2.4.1 Conductivity

The automatic calibration of the conductivity measurement is of single-point type and requires either a 0.01 molar (1.41 mS/cm at 25 °C) or a 0.1 molar (12.9 mS/cm at 25 °C) KCl solution. The temperature coefficients of these two calibration solutions are stored in the unit. The unit will automatically recognise which calibration solution you are using (observe the measuring range). For further conditions and tips, please refer to the sensor specifications.

At first, you will be prompted to dip the sensor into the calibration solution. Press OK to accept this dialogue. Now, an output window will appear reading the current measured value. After this value has stabilised, touch the OK button.

9.2.4.2 pH value

The automatic calibration of the pH measurement is of two-point type and requires knowledge of what buffer solutions you wish to use. The MULTILINE 1000 multi-point measuring transmitter offers the WTW buffer solutions for calibration (see chapter Accessories, Spare Parts in the system operating manual of the MULTILINE 1000 Drinking Water Panel.

You must take a choice in the first dialogue box. Again, you can choose any sequence of the buffer solutions. For further conditions and tips, please refer to the sensor specifications.

A subsequent dialogue will prompt you to dip the sensor into the first buffer solution. Press OK to confirm. Now, the current measured value will be displayed. After the display reads a stabilised value, touch the OK button. Now, the same procedure as for the first buffer solution will follow (dip sensor into buffer solution 2, wait for value stabilisation) for the second one.
As a result, you will now be given the new calibration values that you can save (SAVE button) or cancel (CANCEL button).

9.2.4.3 Oxygen content

The automatic calibration of the oxygen content measurement is a single-point calibration in the ambient air. Take the sensor out of the measuring medium and expose it to the ambient air. When doing so, make sure that neither considerable air flows nor direct sun radiation onto the sensor will affect calibration. For further conditions and tips, please refer to the sensor specifications. Now, the current measured value will be displayed. After the display reads a stabilised value, touch the OK button. In this connection, temperature compensation calls for particular attention and may require a setting time of up to 30 minutes.
After calibration is done, the new calibration values will be displayed. You can now decide whether you wish to save (SAVE button) or cancel (CANCEL button) the new calibration values.

9.2.5 Data Input

Data input stands for the input of the specific ratings of the sensor connected that have, for example, been determined at the laboratory before.

Touch the field to select the corresponding calibration value whose settings you wish to change. An input dialogue will now enable you to change the values within corresponding limits. If you exceed these you will get an error message to prompt you to enter a value within the fixed limits. Use the ENT button to accept the entry. To cancel the input dialogue without saving the value press ESC, while DEL enables you to correct values entered.
The value changed will now be displayed in its corresponding field. You can make any further changes.
To save the value change you must exit the Input Data dialogue field by pressing the button below:

If you do not wish to save the change press the button below to exit the Input Data dialogue:

Under the Conductivity (Cond) - Calibrate - Input Data menu items the cable offset calibration value is included. The latter allows the entry of a value (offset) for the compensation of the cable resistance. For this purpose, enter the cable resistance in Ohms for the 20 mS/cm and 100 mS/cm measuring ranges.

Measuring modules with linear characteristic can be calibrated by setting of two calibration values of the linear characteristic. Alternative to this two-point calibration a data input for two set points within the range of the corresponding linear characteristic is possible. You have to enter the corresponding measuring value (data input) to the given set points of the input signal (output signal of the sensor). The module MV 2270 is also a module with linear characteristic but for a counter signal (up to a frequency of 1.5 kHz).

10 Switching and Current Outputs

10.1 Configuring of a Relay Output

The MULTILINE 1000 features four internal relay outputs for use as limit, alarm, timer or controller function. This chapter describes the configuration of a relay output for use as a limit or alarm output and the configuration of one relay output as an adjustable timer i.e. for use as an automatic washing or rinsing contact for the electrode/sensor. The configuration of the controller functions is decrypting in paragraph11.
Each of these relays can be individually assigned to any measured value.
Always make sure that the relay you wish to employ is not used by a timer or controller function at the same time.

10.1.1 Internal Relay Outputs

This chapter describes the configuration of the four internal relay outputs as limit or alarm outputs.

Linking a relay with a measured value

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.

3. Touch the "limit val".
4. Touch the setup limits button.
5. To configure an internal relay touch the button internal relays
6. Now, you can touch the corresponding area to select your desired relay. You will be given an overview of the current settings of the relay selected.
7. At first, select the measured value you wish to assign the limit to. Touch the 1st Slave button for this purpose. Now, you will be given an overview of all measuring points connected to the bus. Touch the area that displays the slave you wish to use. In the subsequent dialogue, you must take the choice which value of the slave you wish to output as limit. Value1 is the main quantity and Value2 the secondary quantity (refer to paragraph 5.2, 'Display Elements').
8. Change the values for the limit and the hysteresis. Touch the respective button and enter your desired values.
9. Use the MINIMUM or MAXIMUM buttons to set the type of limit.
10. At the end, enable the relay. For this purpose, the Disable or Enable button must read Enable.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

10.1.2 Configuring of a Timer Relay

The MULTILINE 1000 features to switch one relay time controlled by an adjustable timer func-
tion. This function is the basis to realise an automatic washing or rinsing function for the elec-
trodes/sensors in connection with suitable pumps or valves, a very useful function for process
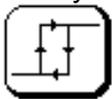application.
You can connect each relay with this function. Always make sure that the relay you wish to em-
ploy is not used by a limit or controller function at the same time. The two times for the control of
the timer function are configured in this menu. The time for switch on of the relay is the cycle or
interval time. The duration time gives how long the relay will be switched. During the duration
time, the relay is switched on; all measured values are frozen for the analog current and relay
outputs (hold function).
In addition a delay time can be adjusted in accordance with the description in chapter paragraph
13.5 'General Adjustments'. This delay time has no influence to the switching behaviour of the
relay contacts. Only the hold function for the frozen of the measured values for current and relay
outputs is influenced. The additional delay time for the hold function overwrites the specific re-
sponse behaviour of the electrodes/sensors after the end of a washing or rinsing cycle, so that
this changes do not influence the current and relay outputs.
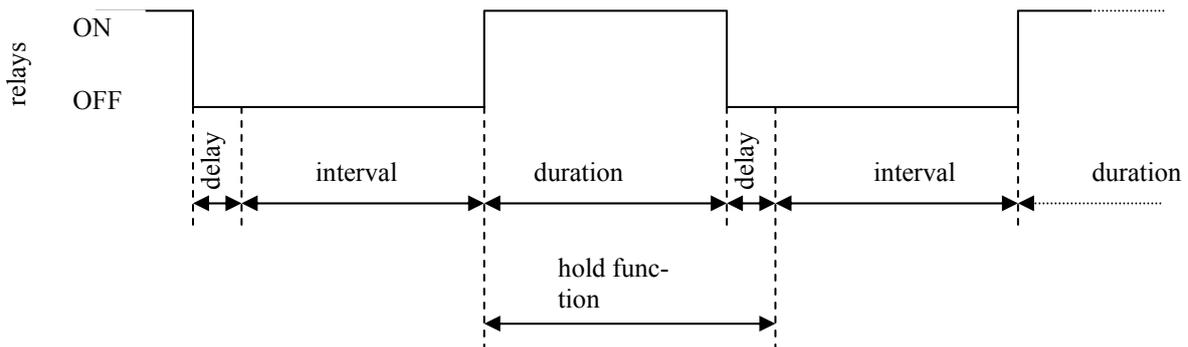
Linking a relay with a timer function

1.   Via the MENU key field on the measured value output side, you will get to the password
     entry menu item.
2.   Enter your correct password.

3.   Touch the "limit val." button.
4.   Touch the Timer button.
5.   Now, you can change the times for interval/cycle and duration. Touch the corresponding
     area to select your desired times and enter your requested values. Both values must be en-
     tered in hours.
6.   Select the requested relay output by touching the button Relay. You will be given an over-
     view of the useable relays. Only make sure that the relay you wish to employ is not used by
     a limit or controller function at the same time.
7.   At the end, enable the relay. For this purpose, the Disable or Enable button must read En-
     able .

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

Please note the adjustment of the delay time for an expansion of the hold function is decrypting in chapter paragraph 13.5.

10.1.3 Manual Activation of a Relay Function

For maintenance and service purposes the relay functions can be activated or released manually by touching the corresponding button. To select this menu please touch button

"Limit value" and select Manuel .

10.2 Configuring a Current Output

It can be said that it is possible to output any measured value through any existing current output. There are two different options for the current outputs. Four internal current outputs will be available in the terminal box of the MULTILINE 1000. In addition, up to four external DAC 1000 analog current output modules with four 0(4)...20 mA current outputs each can be connected to the MULTILINE 1000 measuring transmitter to utilise all measured values (also virtual ones) as current signals for further processing. The MULTILINE 1000 measuring transmitter provides the power supply for the external modules and automatically detects the modules connected. Thus, a maximum of 20 current outputs can be realised. The external current modules have identification numbers 64, 65, 66, or 67.
They can be connected via the CAN bus as described in paragraph 4.2, 'Connection of External Modules'.

10.2.1 Internal Current Outputs

Linking a current output with a measured value
1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the Current button.

4. Here you can choose now whether you wish to configure an internal or, if available, an external current output. To configure one of the internal outputs touch the Internal Output button.
5. Now, you can touch the corresponding area to select your desired output. You will be given an overview of the current settings of the output selected.
6. At first, select the measured value you wish to output. Touch the 1st Slave button for this purpose. Now, you will be given an overview of all measuring points connected to the bus. Touch the area that displays the slave you wish to use. In the subsequent dialogue, you must take the choice which value of the slave you wish to output. Value1 is the main quantity and Value2 the secondary quantity (refer to paragraph 0, 'Display Elements').
7. Change the value ranges for the 0/4 mA start value and for the 20 mA end value. Touch the respective button and enter the values.
8. Use the 0...20 mA or 4...20 mA buttons to set the current range.
9. At the end, enable the output. For this purpose, the Disable or Enable button must read Enable .

    Touch the symbol above to accept your settings or cancel them by touching the symbol below.

10.2.2 External Current Outputs

The external active modules for additional current outputs (DAC 1000 analog current output module) have identification numbers 64 to 67. This is also the way they are identified in the selection menu (refer to paragraph 5, 'MULTILINE 1000 Measuring System Basic Functions'). However, only those modules will be displayed that are actually available. Any other settings are the same as for the internal current outputs (refer to paragraph 10.2.1, 'Internal Current Output').

11   Controller Module

11.1 Basic Information

For complex control tasks, the controller module can be activated with two PID controllers work-ing independently of each other. These controllers can be assigned to any measured quantities and work as analog, pulse length (PWM) or pulse frequency controllers using the analog current outputs or the relay outputs of the controller module, respectively. Prior to using the controller module for the first time, enable the latter (only if this function has been added subsequently) by a password. For this purpose, proceed as follows:

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the Controller button.

4. Now, you will be prompted to enter the password to enable the controller module. Your dealer will give you this password after indicating your company data and your unit's serial number. Please note that each unit has its own password.
5. Having entered the password, you can now configure the controller module (refer to paras. 11.1 to 11.4).

Controller1 is assigned to relays 0 and 1, and controller2 to relays 2 and 3. Both devices must be used as quasi-continuous controllers. For simple control tasks, the integrated controller can be set as single proportional controller. You can also set a controller with a differential and/or integral portion. If you define an integral action time of 0 the controller will be used without an integral portion. The same applies to differential time.
Processes for controlling the pH value are non-linear. The transmission constant of the system in the set point value range is often higher by some orders of magnitude as at the limits of the control range. The use of a controller with fixed setting values will result either in an instability of the control loop near the set point value or in extremely long settling times (for batch proc-esses), or in high deviations (for continuous processes with greater disturbance variations), re-spectively. The controller integrated in the MULTILINE 1000 can be matched to such distinctive features of the process. The general static characteristic curve of the controller is shown below. It facilitates the realisation of different   transmission responses for certain parts of the control range.
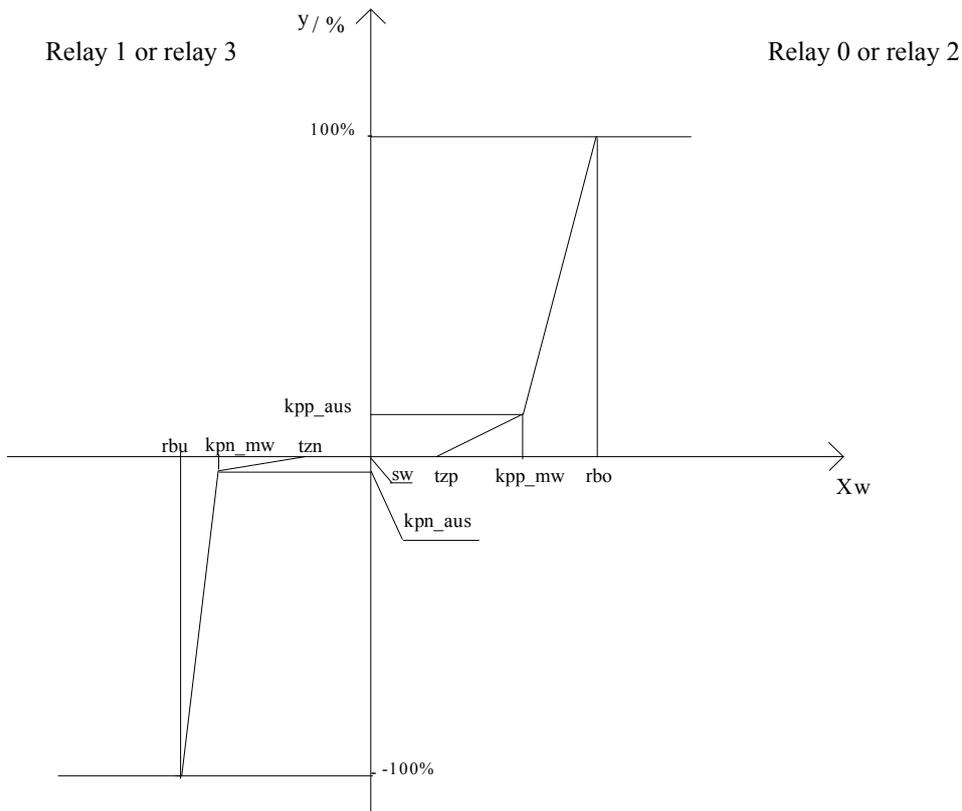
rbu	-	lower range limit
rbo	-	upper range limit
sw	-	set-point
tzn	-	deadband, negative range
tzp	-	deadband, positive range
kpp_mw	-	break point + x(input value)
kpp_aus	-	break point + y(output value)
kpn_mw	-	break point - x(input value)
kpn_aus	-	break point - y(output value)

11.2 Configuring a Pulse Length Controller

Within the cycle time, a switching pulse that intervenes into the control process is calculated, depending on the deviation from the set point. The control value is re-calculated at the beginning of each cycle time. The minimum time - the shortest period of a control action - can be set for adaptation to different active modules. It is   to prevent switching processes that are too fast for the active module. If it is undercut, and if the controlled quantity is out of the deadband, the active module will be triggered with the minimum time. If the turn-off time is shorter than the minimum time the relay will continuously stay turned on.

1. Via the $\boxed{\text{MENU}}$ key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the $\boxed{\text{Controller}}$ button.

4. Now, touch the corresponding area to select $\boxed{\text{Controller 1}}$ or $\boxed{\text{Controller 2}}$. You will be given an overview of the current settings of the controller selected.
5. At first, select the measured value you wish to control. Touch the $\boxed{1^{\text{st}} \text{ Slave}}$ button for this purpose. Now, you will be given an overview of all measuring points connected to the bus. Touch the area that displays the slave you wish to use. In the subsequent dialogue, you must take the choice which value of the slave you wish to output. Value1 is the main quantity and Value2 the secondary quantity (refer to paragraph 5.2, 'Display Elements').

6. Touch the Time Setup button to change the time response of the controller. Use the individual buttons to enter the values according to your requirements Touch the symbol below to exit this dialogue.

⏪

7. Touch the Parameters button to change the control parameters. Use the individual buttons to enter the values according to your requirements Always make one of your entries after the other, as the input limits always refer to the previous value and are matched. Touch the symbol below to exit this dialogue.

⏪

8. Now, touch the Analog/PWM/Frequency button as many times as are necessary to set it to PWM.

9. At the end, enable the controller. For this purpose, the Disable or Enable button must read Enable.

💾⏪

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

⏪

11.3 Configuring a Pulse Frequency Controller

Within the cycle time, a constant pulse train that intervenes into the control process is calculated, depending on the deviation from the set point. The controller is re-calculated at the beginning of each cycle time. The maximum number of strokes indicates the maximum of pulse trains (per minute) triggered for the control action.

Frequency Controller

1. Via the ⎡MENU⎤ key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the ⎡Controller⎤ button.

4. Now, touch the corresponding area to select ⎡Controller 1⎤ or ⎡Controller 2⎤. You will be given an overview of the current settings of the controller selected.
5. At first, select the measured value you wish to control. Touch the ⎡1st Slave⎤ button for this purpose. Now, you will be given an overview of all measuring points connected to the bus. Touch the area that displays the slave you wish to use. In the subsequent dialogue, you must take the choice which value of the slave you wish to output. Value1 is the main quantity and Value2 the secondary quantity (refer to paragraph 5.2, 'Display Elements').
6. Touch the ⎡Time Setup⎤ button to change the time response of the controller. Use the individual buttons to enter the values according to your requirements Touch the symbol below to exit this dialogue.

7. Touch the ⎡Parameters⎤ button to change the control parameters. Use the individual buttons to enter the values according to your requirements Always make one of your entries after the other, as the input limits always refer to the previous value and are matched. Touch the symbol below to exit this dialogue.

8. Now, touch the ⎡Analog/PWM/Frequency⎤ button as many times as are necessary to set it to ⎡Frequency⎤.
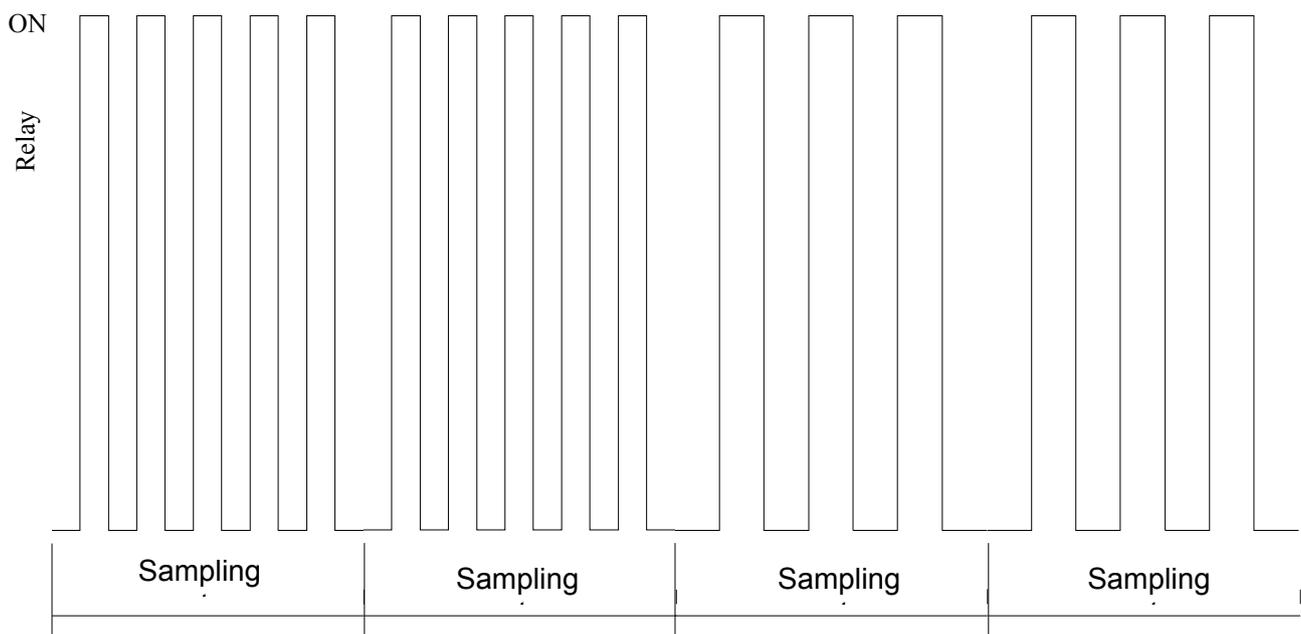9. At the end, enable the controller. For this purpose, the ⎡Disable⎤ or ⎡Enable⎤ button must read ⎡Enable⎤.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

11.4 Configuring an Analog Controller

The analog controller is firmly linked with two current outputs each (refer to the characteristic curve). After the sampling rate has elapsed, the controller is re-calculated and the resulting current provided at the output. This current will then be kept constant for the period of the sampling rate.

1. Via the ⎡MENU⎤ key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the ⎡Controller⎤ button.

4. Now, touch the corresponding area to select ⎡Controller 1⎤ or ⎡Controller 2⎤. You will be given an overview of the current settings of the controller selected.

5. At first, select the measured value you wish to control. Touch the 1st Slave button for this purpose. Now, you will be given an overview of all measuring points connected to the bus. Touch the area that displays the slave you wish to use. In the subsequent dialogue, you must take the choice which value of the slave you wish to output. Value1 is the main quantity and Value2 the secondary quantity (refer to paragraph 5.2, 'Display Elements').

6. Touch the Time Setup button to change the time response of the controller. Use the individual buttons to enter the values according to your requirements Touch the symbol below to exit this dialogue.

7. Touch the Parameters button to change the control parameters. Use the individual buttons to enter the values according to your requirements Always make one of your entries after the other, as the input limits always refer to the previous value and are matched. Touch the symbol below to exit this dialogue.

8. Now, touch the Analog/PWM/Frequency button as many times as are necessary to set it to Analog.

9. At the end, enable the controller. For this purpose, the Disable or Enable button must read Enable.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

12   Determining Virtual Measured Values

The MULTILINE 1000 Multi-Parameter System features determination, display and evaluation of up to four virtual measured values. Virtual measured values arise from a mathematical linkage (addition or subtraction) between two real measured values, which are measured by the MULTILINE 1000 in the actual configuration. Each measuring channel which measuring values should be connected to a virtual measured value must be configured and calibrated before in accordance with the description for this real measured value. These virtual measured values are displayed on screen page 5. If you touch the display value area you will get through a password entry menu item directly to the option for setting up the display as well as the serial output and the data logger. The individual settings can be made in the same way as those for a single measuring channel; only for the linkage another measured value is required which must be entered.

12.1 Calculation of Virtual Measured Values by Sum/Difference

The calculation of the difference between two conductivity measuring points for control of the efficiency of filters for water treatment as well as the calculation of the difference of two pH measurements for increasing of the reliability and/or for generating a maintenance signal or for monitoring of a cooling water circulation are excellent examples for successful application of virtual measured values by sum or difference. In addition to the standard difference calculation it is possible to select the absolute difference calculation. That means if value1 is lower than value 2 the normal difference calculation results in a negative value. But with absolute difference calculation, the results are positive all the time.
As much as it is possible for real measured values, all output units such as current outputs; limit relays, controllers and the data logger can be used for virtual linkages. For this purpose, a second measured value must be chosen via a mathematical linkage (addition or subtraction) instead of only one. The procedure is always the same and is explained by the example of limit monitoring.
The objective is the linkage of the measured values of two slaves and the monitoring of the difference between the two values.

1.   Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2.   Enter your correct password.
3.   Touch the "limit val." button.

4.   Touch the Setup limit button.
5.   To configure an internal relay, touch the internal relay button.
6.   Now, you can touch the corresponding area to select your desired relay. You will be given an overview of the current settings of the relay selected.
7.   At first, select the first measured value you wish to output. Touch the 1st Slave button for this purpose. Now, you will be given an overview of all measuring points connected to the bus. Touch the area that displays the slave you wish to use. In the subsequent dialogue, you must take the choice which value of the slave you wish to output. Value1 is the main quantity and Value2 the secondary quantity (refer to paragraph 0, 'Display Elements').
8.   Touch the Virtual button to select the second measured value for the virtual linkage.
9.   Then touch the 2nd Slave button to select the slave and its associated measured value similar to the first measured value.
10. Now, use the Off/Addition/Subtraction button to set the type of linkage.
11. Use the button below to exit this menu item.

12. Change the values for the limit and the hysteresis. Touch the respective button and enter your desired values.
13. Use the MINIMUM or MAXIMUM buttons to set the type of limit.
14. At the end, enable the relay. For this purpose, the Disable or Enable button must read Enable.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

12.2 Determining Free Chlorine as an Virtual Measured Value

The rules for determination of virtual measured values can be used to calculate the free chlorine content on the basis of the measurement of HOCl acid in the water and automatic correction of the pH-dependency of the equilibrium HOCl / OCl⁻ in the water by a simultaneous pH measurement. This method features direct readings of the free chlorine content in conformity with the photometrical DPD method without strong pH regulation and is most common in swimming pool water treatment and drinking water monitoring. This method should be used if a chlorine sensor without internal pH compensation for HOCl measurement is used only.

12.2.1 Chlorine Measurement with Automatic Compensation of pH

The virtual measured value „free chlorine" is determined from the concentration of the dissociation product of chlorine in water HOCl and the actual pH in the same water. The controller MULTILINE 1000 should be equipped with a measuring module for pH measurement as well as a measuring module for chlorine measurement. The measured signal of the chlorine module in conjunction with a chlorine measuring sensor for measurement of HOCl (i.e. Chlorine Measuring Sensor FCML 68) is mathematical linked with the measured signal of the pH module in conjunction with a pH electrode in the same measuring medium, so that the defined virtual measured value free chlorine with automatic pH compensation could be calculated. The given automatic temperature compensation of the pH and chlorine measurement features a virtual measured value free chlorine automatically compensated by temperature and pH. Configuration, calibration and adjustment of the temperature compensation of each real measured channel, which should be linked to the virtual measured channel, must be done before connection. For specification, measurement principle, function and calibration of the sensors/electrodes please refer to the accompanying operating manuals and data sheets.
For the calibration of the measuring module with linear characteristic for determination of acid HOCl in conjunction with the suitable measuring sensor (i.e. Cl 4) a single point calibration at one point using a defined calibration solution or a known value determined means of a photometric field or laboratory meter is recommended (refer to paragraph 9.2.2, 'Single-Point Calibration'). These photometric instruments determine the content of free chlorine in the sample water after adding a DPD reagent. This reagent changes its colour in accordance with the content of free chlorine but in addition the reagent adjusts a stable pH in the sample in the range pH 6.2 ... 6.5, so that about 94 % of the complete free chlorine exists as the dissociation product HOCl. Because of this the photometric value cannot be used directly for calibration of the chlorine measuring channel. The concentration of HOCl with reference to the actual pH in the measured medium must be calculated from the photometric measurement result of the sample water. With known pH in the medium at the time of calibration a factor corrects the displayed values from the photometer.

Calculate the calibration value for adjustment of the chlorine channel from the photometer result and the actual pH:

$$Calibration\ value = free\ chlorine(photometric\ unit) \bullet factor[pH]$$

pH	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8
factor	0.97	0.95	0.93	0.89	0.86	0.82	0.77	0.70	0.65	0.60	0.55	0.48	0.43	0.37

Example:
The photometer shows 0.8 mg/l free chlorine and the pH in the measuring medium at the same time is pH 7.0. So you can calculate a calibration value or set point for single point calibration of the chlorine (HOCl) channel MULTILINE 1000.

0.8 mg/l • 0.82 = 0.656 mg/l

For calculation of the concentration of free chlorine as an virtual measured value from the real measured value of HOCl and the actual pH, the pH-dependency of the equilibrium $HOCl$ / OCl^- is compensated automatically. The correction factor is in accordance with the dissociation curve of the chlorine dissociation products in the water.

Free chlorine can be calculated in the range pH 6.5 – 7.8 with the following equation:

$$free\ chlorine = \frac{HOCl\ (measuring\ value\ HOCl\ channel)}{factor[pH]}$$

The determined virtual measured channel for free chlorine follows exactly this equation and shows the content of free chlorine fully identical with the result from a sample measured by the photometric DPD-method. For pH < 6.5 the displayed value of the chlorine (HOCl) channel is nearly identical with the free chlorine content.
Please refer to the operating manual of the chlorine measuring sensor or ask for detailed literature for more information about the dissociation curve of the chlorine products in water and the activity of chlorine dissociation products as disinfects of water.

12.2.2 Configuring a virtual channel for free chlorine

For setting the display, configuring a switching or current output, data storage in the data logger or using a serial interface the virtual channel features the same procedures like a real measured channel. The procedure is always the same and is explained by the example of configuring the display for the virtual channel of "free chlorine".

1. Select the virtual measured value with the buttons $\boxed{<<}$ or $\boxed{>>}$ on the page of the virtual channels.
2. Touch the display value area, at the position the value should be displayed.
3. Enter your password.

4. Touch the 1ˢᵗ Slave button and select the slave used as HOCl measuring channel (measuring module for chlorine measurement in conjunction with a chlorine measuring cell suitable for measurement of HOCl i.e. Chlorine Measuring Cell CL 4).
5. Then touch the 2ⁿᵈ Slave button and select the slave used as pH measuring channel (measuring module for pH measurement in conjunction with the pH electrode located in the same measuring medium like the chlorine cell) for automatic compensation of pH to determine free chlorine.
6. Now, use the which operation? button to set the type of linkage and select the type free chlorine.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

Always make sure that the configuration of the virtual channel for measurement of free chlorine with automatic compensation of pH must be done in the following turn:

First configure as the 1ˢᵗ slave the HOCl measuring channel (measuring module for chorine measurement in conjunction with a chlorine measuring sensor for HOCl i.e. Measuring Sensor FCML 68),

and after this

configure the 2ⁿᵈ Slave as the accompanying pH measuring channel for determination and automatic compensation of pH.

13   System Information

13.1 INFORMATION

From the Information menu item, you can obtain information on the system such as the unit's serial number, the software version, and the data logger state and log-book entries. You can call this menu as follows:

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the INFO button.

Behind the "Information" heading, you will see the serial number and, below, the software version of your unit. For any other information, select the corresponding menu items.

13.2 Changing the Slave Number (ID)

This menu item serves for setting or changing a slave (measuring module) identification number. You will see this number in the upper left corner of each display channel. This number is important for the communication of the MULTILINE 1000 with the bus devices (slaves, internal and external active modules). Besides, this number prescribes the display position. So the slave having number 0 is displayed on the top left side of the first page and, for example, slave 5 on the top right of the second page.
It is extremely important that this number is assigned on the bus only once, or conflicts that adversely affect the correct functioning of the entire measuring system may be the result. You can use this menu item only to change this number into a different number still vacant, changing into a number already existing not being possible.

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the INFO button.

4. Touch the Change ID button.
5. Touch the Select Slave button for this purpose.
6. Select the slave whose number you wish to change.
7. Type in your new number (0…15) and press ENTER to confirm.
8. To be on the safe side, you will be asked once more whether you really want to save the new number if it has not been assigned yet.
9. After the new number has been saved, you will be prompted to make a reset. Press OK to confirm. Now, the slaves will be re-sorted when being read in and displayed with their new numbers. Any other data has been preserved. Please note that the settings concerning the controller, current output, limit value, data logger and the serial output would not be matched automatically. You will still have to make these setting for the slave you have changed.

13.3 Log-book

The log-book records all settings concerning the measuring system. Up to 200 of such entries can be stored. These entries are output together with the date, the time and with a code that represents the operator notes or errors of the unit, respectively.

Code	Function
CAL Sxx	Calibrating slave xx.
M slaveMV2	Changing secondary measuring parameter type of conductivity
M slaveLim	Changing the measurement range values
M slaveOut	Changing the data output of a slave.
M slaveDis	Changing the display of a slave (measured value output, name).
M slaveTmp	Changing the temperature compensation.
M relayLim	Limit relay configured.
M control	Controller configured.
M dataLogg	Data logger set.
M dataTran	Serial data output set.
M cur.outp	Internal current output set.
M pe curr.	External current output set.
M clock	Clock set.
M virtual	Virtual display channel changed.
M relay M	Relay manual set
M timer	Timer adjusted
M hold man	Manual hold (hold function activated)
E1 slavexx	Slave xx response error. Measuring amplifier no longer connected to bus.
E1 dac xx	External current slave xx response error.
WD-RESET	Reset by the software.
POWER ON	Mains supply interruption.

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.
3. Touch the INFO button.

4. Now, touch the Log Book button.

13.4 Data Logger State

This menu item indicates you the current remaining time or the cycle time of the data logger, respectively. If the data logger has been set to finite (refer to paragraph 8.3, 'Data Logger') the remaining time until the end will be important and is displayed here. If the data logger should have been set to infinite the time for a complete data logger writing cycle will be significant for data acquisition and evaluation.

13.5 General Adjustments

This menu point describes general adjustments of the MULTILINE 1000 system, which result to different menu points. You can generate your own password, you can define if during calibration of a module only this channel is frozen by the hold function or if all channels are frozen by the hold function, and you can adjust an additional delay time to expand the hold function of the timer relay function (look at paragraph 10.1.2). Also is it possible to change the user language of MULTILINE 1000.

1. Via the MENU key field on the measured value output side, you will get to the password entry menu item.
2. Enter your correct password.

3. Touch the „INFO" button
4. Touch the button | basic setup |
5. Now, you can change the adjustments to the detailed points.

Timer	Adjustment of a delay time, which expands the hold function for frozen measured values after the timer relay output switched off. Adjust the time in hours. Look at paragraph 10.1.3. The active hold function is signalised by the sign "Hold" in the display field of the relay outputs in the below right corner (see paragraph 0 'Display Elements').
Hold Calibr.	Select if during calibration only the actual calibrated channel (display shows "channel") is frozen (hold function) or if all measuring channels (display shows "all") are frozen during calibration.
Password	Create your own password.
Deutsch/English	Change the user language.

Touch the symbol above to accept your settings or cancel them by touching the symbol below.

13.6 Hold

The MULTILINE 1000 realises automatic change into the hold function if you activate the cali-
bration menu or if the timer relay output switches on. The unit terminates the hold function
automatically and goes back to the actual measuring mode if you leave the calibration menu or
if the timer relay output switches off. In addition to these automatic hold functions a manual hold
function is available to adjust or check requested functions and to avoid data transmission or
unintentionally activation of relay and controller outputs during this operation. If the hold function
is active all outputs (analog current outputs, limit outputs, controller outputs) are frozen and the
data transmission of the serial interface is interrupted. The outputs remain in the last   stage
upon the hold function will be cancelled or enabled. Only the display of the MULTILINE 1000
shows the actual measuring values or the activated function or menu. In addition the data log-
ging system as well as the log-book are not influenced by the hold function. The active hold
function is signalised by the sign "Hold" in the display field of the relay outputs in the below right
corner (see paragraph 0 'Display Elements').
For the automatic activation of the hold function during calibration in accordance with paragraph
13.5 'General Adjustments' you can select if during calibration of a module only this channel is
frozen by the hold function or if all channels are frozen by the hold function. Activation of the
hold function only for the channel to be calibrated features continuous data outputs for non-
influenced channels i.e. for use of separated measuring points.
During activation of the timer relay output (relay is switched on) i.e. for control of an automatic
cleaning system (see paragraph 10.1.2 'Configuring a Timer Relay') the hold function for all
channels will be activated, because the cleaning function influences normally all sensors / elec-
trodes in one measuring point. The actual readings in the display of the MULTILINE 1000 fea-
ture an easy check of the cleaning function and the influence to the different channels. You can
expand the time for the hold function by an additional delay time for the timer relay function
(look at paragraph10.1.2) to adapt this to the response time of the sensors / electrodes.

1. Via the MENU key field on the measured value output side, you will get to the password
   entry menu item.
2. Enter your correct password.

3.

4. Touch the „INFO" button
5. Touch the button Hold, this changes to Hold active

Now you can realise all changes or tests on the MULTILINE 1000 without results of the changes
to the outputs. The data transmission via serial interface is interrupted.

To leave this function, the adjustments you have to do are identical to those descript above.
Only the button changes from Hold active to Hold.

14 Basic Information

The functions basic information can be entered without pass word. Here you get an overview about the system MULTILINE 1000. Additional to the current adjustment of the device you can also look for sets of data in the data logger. Further it is possible to adjust the clock.

14.1 Data logger search function

1. Touch the area date/time in the right down corner.
2. Touch in dialog "basic information" the button read logger. Now you can see the first set of data, which is stored in the logger. Pay attention that only released data are displayed (refer to paragraph 8.4.1 'Basic Settings' and 8.4.2 'Enabling the Individual Measured Values for Data Logging').
3. With the button

   you can leaf through the logger.
4. Additional you can use a search function. With that it is possible to look for a certain set of data. To use the search function touch the button

   and input in the following dialog the date and the time.
5. With the button

   you start the searching. If an entry is found you will see the data and you can leaf through the logger from this logger position.

14.2 Information of the controller adjustment

All adjustments of the controller are displayed clear on one display page. Therefore you get quickly an overview of the current settings.

1. Touch the area date/time in the right down corner.
2. Touch in dialog "basic information" the button info controller
3. Touch the button of the controller (controller 1 or controller 2) you want to display.
4. If the controller is released you get now all the information. On the left site you see all the parameters and on the right site are the time settings and the linked values displayed.

15 Technical Data

15.1 MULTILINE 1000 Multi-Parameter Measuring transmitter

Power supply	115 / 230 V AC (-15/+10 %); 48...63 Hz, app. 25 VA (special version 24 V DC)
Ambient temperature	-10 ...+55 °C
Display	touch screen display 240 x 128 pixels, back-lighted
Menu languages	German, English
Data transmission	serial interface RS-232 (prepared for modem operation) or RS-485 (RS-422)
Controller outputs	4 floating relay outputs; I ≤ 5 A, U ≤ 250 V AC resistive load for limit or alarm functions; one of them as relay with timer function (washing contact; time interval adjustable 1…9999 hours)
Data storage	integrated data logging system for approx. 50,000 values incl. date and time
Log-bock	approx. 200 activities incl. date and time
Enclosure	extremely rugged aluminium case for wall mounting with separated strip compartment, protection IP 65 (NEMA 4X); dimensions look at drawings
Electrical connections	screw and clip terminals, plug able
Electromagnetic compatibility	89/336/EEC, EN 61326 class B, NAMUR NE 21
Measuring modules	four internal measuring modules in any combination; inputs isolated; storage of calibration data, sensor supervision by individually adjustable limit bands; manual and automatic temperature compensation; detailed specification see table
Active modules	Analog Current Output Module DAC 1000:
	4 current outputs 0(4)…20 mA, scaleable, resolution 10 bit
	Controller Module PID 2000:
	2 adjustable PID controllers with analog, pulse or frequency output (by using the analog or relay outputs)

15.2 External Measuring and Active Modules

Power supply	12 ... 24 V AC/DC (supplied by the measuring transmitter MULTILINE 1000)
Ambient temperature	-10 ...+55 °C
Cable connection	power and data transmission between the modules and to the measuring transmitter MULTILINE 1000 via screened 4-wires bus cable; max. 1,000 m (depends from the number of nodes and their arrangement)
Enclosure	aluminium profile case, protection IP 65 (NEMA 4X); dimensions look at drawings
Electrical connections	internal screw terminals, plug able
Electromagnetic compatibility	89/336/EEC, EN 61326 class B, NAMUR NE 21
Measuring modules	up to 12 external measuring modules in any combination; inputs isolated; storage of calibration data, sensor supervision by individually adjustable limit bands; manual and automatic temperature compensation; detailed specification see table

Active modules   Analog Current Output Module DAC 1000:
                                     4 current outputs 0(4)…20 mA,
   scaleable, resolution 10 bit

15.3   Measuring Modules

Internal Module (order number)	External Module (order number)	Main Measuring Parameter range resolution	Secondary Measuring Parameters	Temperature range / resolution	Electrodes / Sensors
MLU-2210 (190 026)	**MLU-2210E (190 025)**	pH value pH 0...14 pH 0.01	electrode voltage in mV	-10…130 °C 0.1 °C	pH combination & separated electrodes, temperature sensor Pt 1000
MLU-2215 (190 051)	**MLU-2215E (190 050)**	redox potential -2000…+2000 mV 1 mV (ORP)	redox(ORP) voltage in relation to the standard hydrogen electrode	-10…130 °C 0.1 °C	redox(ORP) combination & separated electrodes, temperature sensor Pt 1000
MLU-2220 (390 026)	**MLU-2220E (390 025)**	conductivity 0…200 µS/cm 0.1 µS/cm 0…2 mS/cm 1 µS/cm 0…20 mS/cm 0.01 mS/cm 0…100 mS/cm 0.1 mS/cm automatic range selection	salinity 2…42 g/kg resistance	-10…130 °C 0.1 °C	conductive 2-electrode sensor; temperature sensor Pt 1000
MLU-2260 (290 051)	**MLU-2260E (290 050)**	concentration (chlorine, chlorine dioxide etc.) 0…2 (10) mg/l 0.01 mg/l	sensor current in mA	-10…130 °C 0.1 °C	sensor for disinfections measurement (i.e. chlorine), temperature sensor Pt 1000
	MLU-2270E (480 260)	flow 0...100 l/h 0.1 l/h acc. sensor specification	frequency in Hz		vane flow sensor

Details on measuring cells and sensors are given in the chapter Accessories, Spare Parts of the system operating manual of the MULTILINE 1000 drinking water panel.
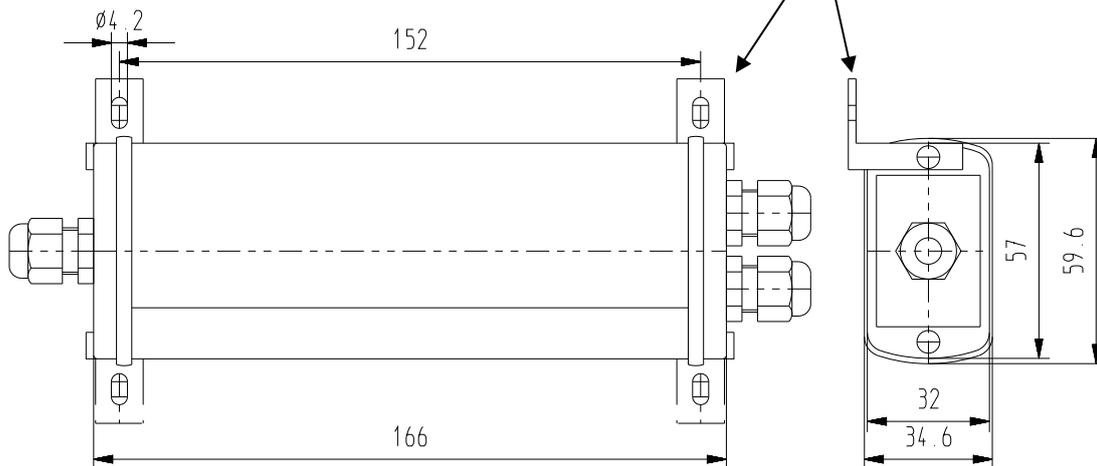
15.4 Dimensioned Enclosure Drawings

MULTILINE 1000 Multi-Parameter Measuring transmitter
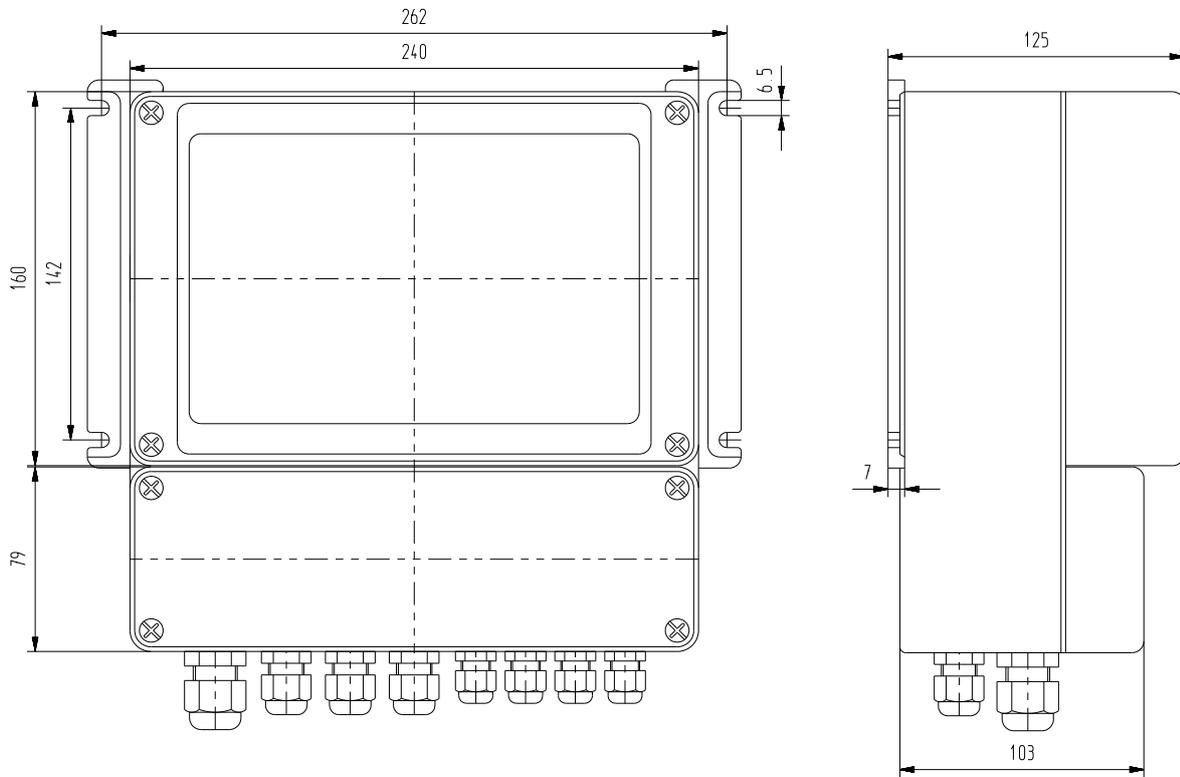
External measuring and active modules

Wall-mounting kit
incl. 2 off wall-mounting brackets
 (optional)

Dimensions in mm

16 Unit Configuration

Unit serial number: Date:

Internal measuring module positions

Position	Measured Quantity	Slave Number
0		
1		
2		
3		

Internal current outputs (DAC 1000)

Output	Measured Quantity	Lower Limit	Upper Limit
0			
1			
2			
3			

Limit relays

Relay	Measured Quantity	Lower Limit	Upper Limit
0			
1			
2			
3			

Controllers

Controller	Measured Quantity
1	
2	

External measuring modules (slaves)

Slave Number	Measured Quantity
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

External current outputs (DAC 1000)

	Measured Quantity	Lower Limit	Upper Limit
Slave 64			
Output 0			
Output 1			
Output 2			
Output 3			
Slave 65			
Output 0			
Output 1			
Output 2			
Output 3			
Slave 66			
Output 0			
Output 1			
Output 2			
Output 3			
Slave 67			
Output 0			
Output 1			
Output 2			
Output 3			

Characteristic features:

Cable assignment bus-cable (CAN-bus) from metrofunk cable-union

Cable-type: Li2YC11Y 3x3-222
Shield   ground (will be transmit over the box to the next module)
red/black   +12V
brown/black   -12V
orange   CAN-L
black   CAN-H
Regard: Stranding wire pairs belong together, because no error free data transfer is possible. The cable contains three stranded wiring pairs, each one pair for power supply + 24 V and GND. The 3rd pair is for data communication.
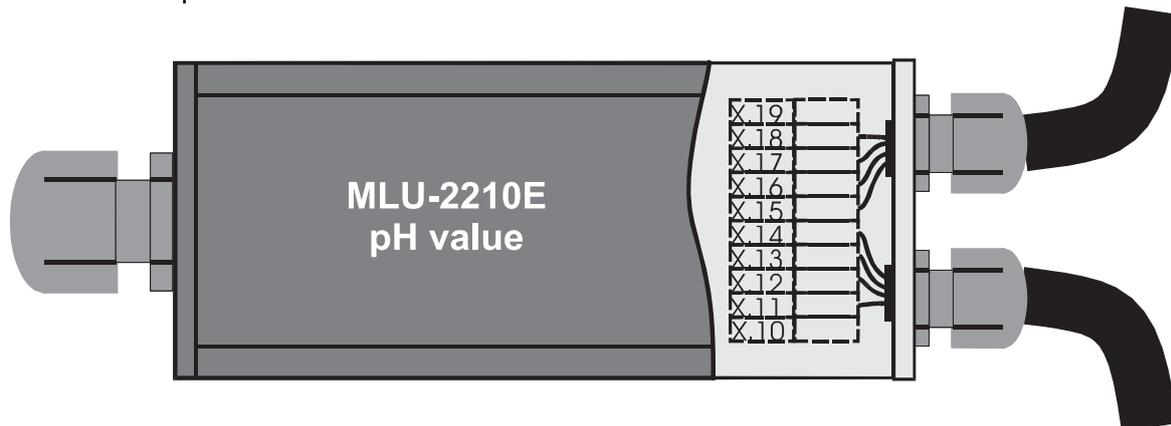
Termi-nal	Function	Cable-colours
X.19	free	
X.18	-12V power supply CAN	brown/black
X.17	+12V power supply CAN	red/black
X.16	CAN H	black
X.15	CAN L	orange
X.14	CAN H	black
X.13	CAN L	orange
X.12	-12V power supply CAN	brown/black
X.11	+12V power supply CAN	red/black
X.10	free	

On the last module must be a terminating resistor (120 Ohm) between CAN H and CAN L.
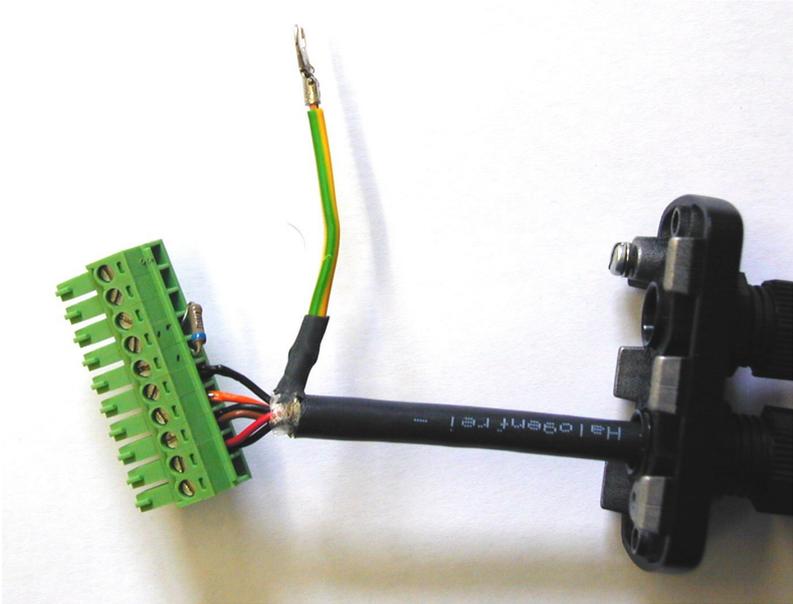
The picture shows the CAN-bus connector with terminating resistor and ground cable connector.