OPERATING INSTRUCTIONS

MCS100E
IR Analyzer

Commissioning
Operation
Maintenance

SICK
Sensor Intelligence.

Document Information

Described Product
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Contacts

Guarantee Information
Specified product characteristics and technical data do not serve as guarantee declarations.

Warning Symbols


Hazard (general)


Hazard by voltage

Hazard in potentially explosive atmospheres


Hazard by explosive substances/mixtures


Hazard by corrosive substances


Hazard by poisonous substances


Hazard by unhealthy substances


Hazard by high temperature or hot surface


Hazard for the environment/nature/organic life

Information Symbols


Important technical information for this device


Important information on electric or electronic functions


Supplementary information


Link to information at another place

Warning Levels / Signal Words

DANGER
Risk or hazardous situation which *will* result in severe personal injury or death.

WARNING
Risk or hazardous situation which *could* result in severe personal injury or death.

CAUTION
Hazard or unsafe practice which *could* result in less severe or minor injuries and/or property damage.

NOTICE
Hazard which could result in property damage.

MCS100E

1 Important information

Main hazards
Main instructions for operation
Intended use
Own responsibility

1.1 Main hazards

Important safety information in abbreviated form.

► Always observe the complete safety information (see cross-references).

WARNING: Noxious and irritating sample gas

When the sample gas contains noxious or irritating substances:

► Channel sample gas off safely (→ p. 24, § 3.2.2.1)

WARNING: Danger to life/health risks caused by leaks in the gas path

If noxious gases are channeled into the MCS100E: A leak in the gas path can create acute danger for persons.

► Ensure suitable safety measures.

WARNING: Hazards by explosive or combustible gases

⊗ Do not use the MCS100E for measuring explosive or combustible gases

WARNING: Hazard in potentially explosive atmospheres

⊗ Do not use the MCS100E in potentially explosive atmospheres.

1.2 Intended use

1.2.1 Purpose of the device

The MCS100E measuring device is used for continuous and selective measurement of emissions (e.g.: HCl, NH_3, H_2O, CO, SO_2, NO_x, O_2) in the stack gases of incineration plants.

The MCS100E is normally located in the SICK MCS100E system cabinets.

Application limitations

The MCS100E only measures the gas composition correctly for which it was calibrated (→ System Documentation). A change of the gas matrix can result in incorrect measured values.

***NOTICE:* Risk of contamination of the gas path**

If the sample gas does not have the composition for which the MCS100E was designed (→ System Documentation):

► Ensure that the MCS100E cannot draw in sample gas.

► Flush the gas path of the MCS100E with inert gas.

1.2.2 Installation site

The MCS100E gas analyzer is designed for operation in rooms or system cabinets.

1.3 Responsibility of user

Designated users

The MCS100E may be operated by *competent persons* only who, based on their device-specific training and knowledge of the device as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

The *Specialist level* of the MCS100E may be operated only by skilled technicians who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the hazards involved.

Correct use

- ► Use the MCS100E only as described in these Operating Instructions. The manufacturer bears no responsibility for any other use.
- ► Perform the specified maintenance work.
- ► Do not remove, add or modify any components to or on the device unless described and specified in the official manufacturer information. Otherwise
  - – the device could become dangerous
  - – the manufacturer's warranty becomes void

Special local conditions

- ► In addition to these Operating Instructions, follow all local laws, technical rules and company-internal operating directives applicable at the respective installation site of the equipment.

Retention of documents

These Operating Instructions and the System Documentation:

- ► Must be available for reference.
- ► Must be passed on to new owners.

1.4 Additional documentation/information

System documentation

Individualized versions of MCS100E with adapted internal or peripheral equipment exist. For the relevant information, see the delivered separate documentation, for example:

- • Operating Instructions of additional components
- ► Pay attention to the supplied documents.

MCS100E

2 Product description

Product identification
Functional principle
Characteristics
Variants

2.1 Product identification

Product name:	MCS100E
Manufacturer:	SICK AG · Rengoldshauser Str. 17A 88662 Überlingen · Germany

The type plate is located on the top of the right side of the housing.

2.2 Description

The MCS100E measuring device is used for extractive continuous and selective measurement of emissions (e.g.: HCl, NH_3, H_2O, CO, SO_2, NO_x) of incineration plants.

MCS100E can measure quasi-simultaneously up to 8 components (plus optionally O_2) at max. 12 sample points.

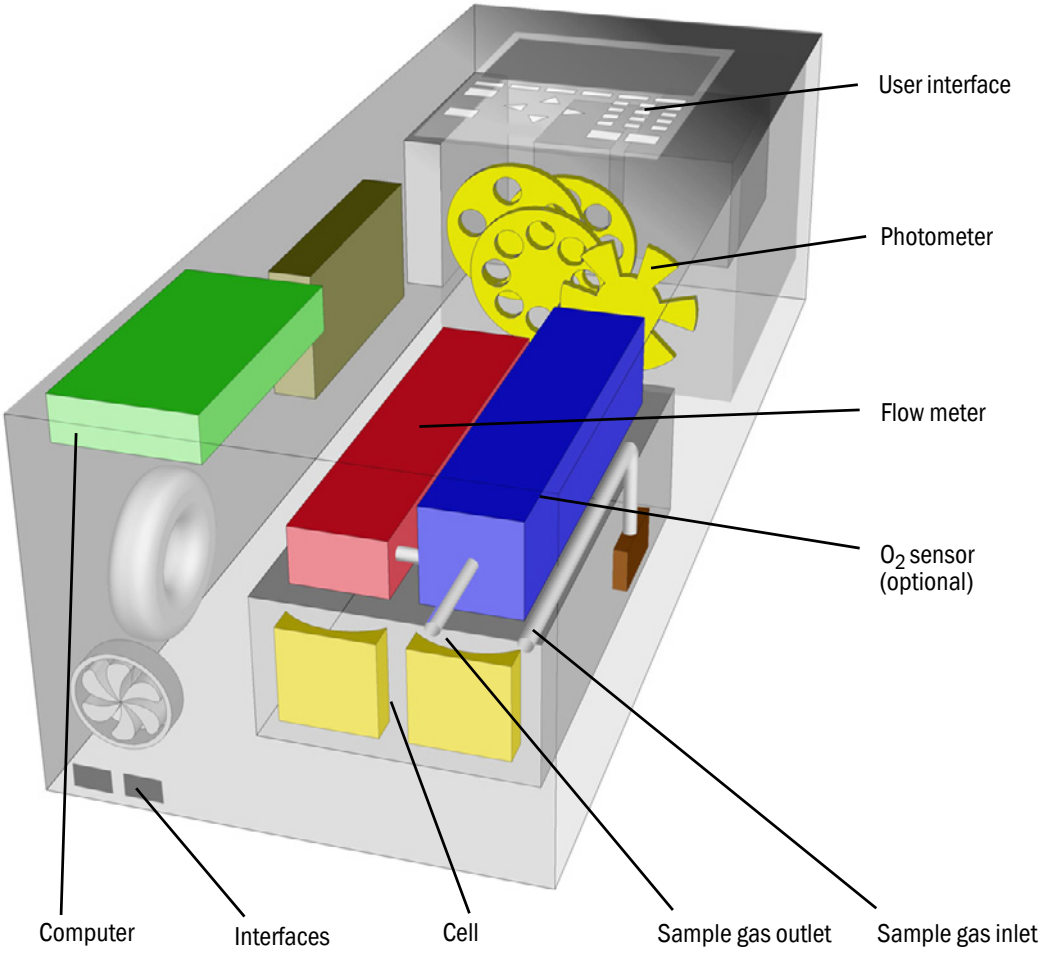
Figure 1 MCS100E

2.2.1 Design

MCS100E consists of the following main assemblies:

- Photometer with filter wheels (design dependent on application)
- Cell (optical path length dependent on application)
- Flow meter
- O_2 sensor (optional)
- Computer and electronics

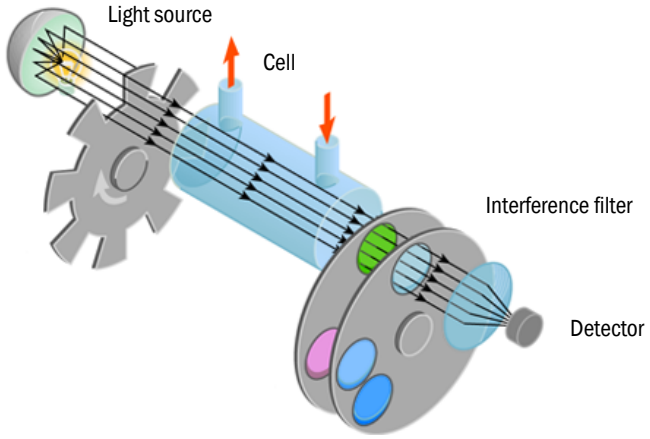
Figure 2 MCS100E setup



2.2.2 Measuring principle

MCS100E is a single-beam infrared photometer that works on the basis of the transmitted light measuring technique applying the single-beam dual-wavelength method and the gas filter correlation method.

Figure 3 Measuring principle



2.2.2.1 Correction of spectral interferences

In order to achieve greater measuring accuracy, interference sensitivities can be detected and compensated (depending on application).

Additive (spectral superposition) and multiplicative (dilution effects) effects are considered.

Moreover, external digital and analog signals can be read in and processed (option).

2.2.3 Thermostatic control

MCS100E is equipped with a self-resetting thermal circuit breaker that protects the instrument against thermal damage.

2.2.4 Cell

Sample gas filter

A sintered metal filter in the gas inlet of the cell serves as protective filter.

Beam path

The beam path corresponds to the principle of the White Cell with the beam being folded by mirrors. The mirrors are mill-cut in the end plates. Thus the optical path length of the cell is invariable (depending on the application).

Thermostatic control

The cell is thermostatic-controlled (temperature control → p. 83, § 5.7.11.12).

2.2.5 Flow meter

The flow meter functions on the resistance anemometer principle. It comprises two temperature-dependent, heated resistors, one of which is positioned in the gas stream begin measured while the other does not have gas flowing over it. The difference in the resistances is a measure of the flow rate.

2.2.6 O_2 sensor (option)

O_2 measurement is carried out by means of a circonium dioxide sensor.

The sample gas flows past the O_2 sensor, the gas exchange inside the sensor takes place by turbulence. Ambient air which reaches the cell by diffusion is used as reference gas.

2.2.7 Barometric pressure compensation (option)

Barometric pressure compensation for the MCS100E is available as an option.

2.2.8 Interfaces

Fiber optics interfaces

- 2 optical interfaces (fiber optics) for connection of:
  - I/O module boxes (containing the digital and analog interfaces) or HC8X heating controller (→ p. 26)
  - Printer or PC (→ p. 27)

Electrical interfaces (option)

- 1 serial *and* 1 parallel interface for connection of:
  - PC *or* MODEM *and* printer (→ p. 28, § 3.2.3.2)

OR

- 1 serial *and* 1 Ethernet interface for connection of
  - PC *and* Ethernet (→ p. 28, § 3.2.3.3)

2.3 Data storage

- Storage of measured values (→ p. 44, §5.2).
- Storage of status messages (→ p. 44, §5.2).
- Storage of results or signal outputs: (→ p. 86, §5.7.11.14).

2.4 Remote control

In remote control, MCS100E is operated via an external PC.

Screen contents and keyboard commands are transmitted.

- Ethernet (program TINY) (→ p. 29, §3.3.1).
- Modem (program NetOP) at serial interface (→ p. 31, §3.3.2).

2.5 Data transmission

2.5.1 Data transmission with MCS100E program

The MCS100E program must be installed on the external PC.

File transfer is carried out via the MCS100E menus (→ p. 90, §5.7.15.4 and → p. 91, §5.7.15.5).

Connection of external PC:

- Optical (fiber optics) (→ p. 27).
- Serial interface (→ p. 28, §3.2.3.2).

2.5.2 File transfer with modem

- At DOS level (program NetOP) at the serial interface (→ p. 31, §3.3.2).

2.6 Communication protocol

- Communication protocol: Modbus RTU (→ p. 126, §9.3).
- Interface: Serial interface (→ p. 28, §3.2.3.2).

2.7 QAL3 (DIN EN 14181)

> The procedure described in the following is TÜV-tested for MCS100E in the MCS100E HW emission measuring system.

2.7.1 Evaluation of zero and reference point data

In regular intervals – at the latest within the maintenance intervals as specified in the aptitude test - an internal readjustment of the measuring device is performed either automatically or manually at certain
time intervals by either automatic or manual sampling of reference gases for zero point and reference
point. As an option, the readjustment of the reference point can be performed by swiveling in an optical calibration filter (→ §2.7.2).

If the limit for readjustment is reached (usually a deviation > 6% off the
preceding calibration), an error is indicated.

Zero point

The value for the zero point is determined by sampling zero gas (usually dry instrument air) and
reading the instrument display resp. determining the corresponding analog signal. In practice, the
same zero gas that is used for internal readjustment can also be used for this procedure.

Reference point

The value for the reference point is determined by sampling a reference gas of known gas concentration and reading the instrument display resp. determining the corresponding analog signal. In practice, the
same reference gas that is used for internal readjustment can also be used for this procedure.

2.7.2 Use of the calibration filter option

As an option, the MCS100E HW measuring device can be equipped with a third filter wheel which allows to swivel-in so-called calibration filters (→ p. 17, Figure 2).

This function can either be started program-controlled or manually using the MCS100E standard software.

Zero point

As described above

Reference point, conventional method

As described above

Reference point, alternative method with calibration filter

The value for the reference point is determined by sampling zero gas and swiveling-in the calibration
filters one after the other by selecting the corresponding menu functions. Then the value is displayed
resp. the corresponding analog signal is given for each component.

The set reference value corresponds to the value of the calibration filter.

> During gas calibration, the last measured deviation of the calibration filter values is overwritten and set
> to zero until the next gas calibration is performed.

MCS100E

3 Installation

Project planning
Transport
Setup
Installation
Initial commissioning

3.1 Transport

WARNING: Risk of injury by a heavy load
The MCS100E weighs approx. 70 kg.
Improper lifting can cause painful and sometimes permanent back injury.
► Use proper lifting techniques or auxiliary equipment to lift or move the MCS100E.

- Protect MCS100E from shock and vibrations.

3.2 Installation and initial commissioning

Only qualified personnel trained on the instrument may perform installation and initial commissioning of the MCS100E.
Please contact SICK Customer Service as required.

3.2.1 Preparing the place of installation

Make sure that the bearing capacity of the mounting location is appropriate.

3.2.2 Mechanical installation

MCS100E:

- ► Must be mounted in a vertical position.
- ► Use the existing mounting holes.
- ► Use appropriate mounting material only.
- ► Ensure sufficient heat dissipation, take care that instrument space is minimum 5 cm.

3.2.2.1 Sample gas connections

- Sample gas lines:
  - Sample gas inlet: 6 mm fitting with ferrule
  - Sample gas outlet: 10 mm fitting with ferrule

WARNING: Hot surface - risk of burns
The surface of the cell insulation is hot.
► Allow hot components to cool down.

WARNING: Noxious and irritating sample gas
Depending on the sample gas composition, it is possible that the sample gas contains noxious or irritating components.
► Discharge the gas outlets into the open or to an extractor.
► Observe information from the plant operator.

***NOTICE:* Condensate is formed at the sample gas outlet**
When the sample gas cools down, it is possible that condensate is formed at the sample gas outlet.
► Lay the sample gas outlet running downwards so that no condensate is accumulated.
► If necessary, provide for a suitable condensate collecting device and adequate ventilation.
► Protect the measuring gas outlet from frost.

NOTICE: **Lay the pipes properly**

Blocked pipes can falsify measured values and possibly damage the measuring device.

⊗ The sample gas outlet may not increase the intended working pressure (must be open to the ambient pressure).

⊗ Do not bend or crimp the pipes.

► Use temperature-resistant pipes.

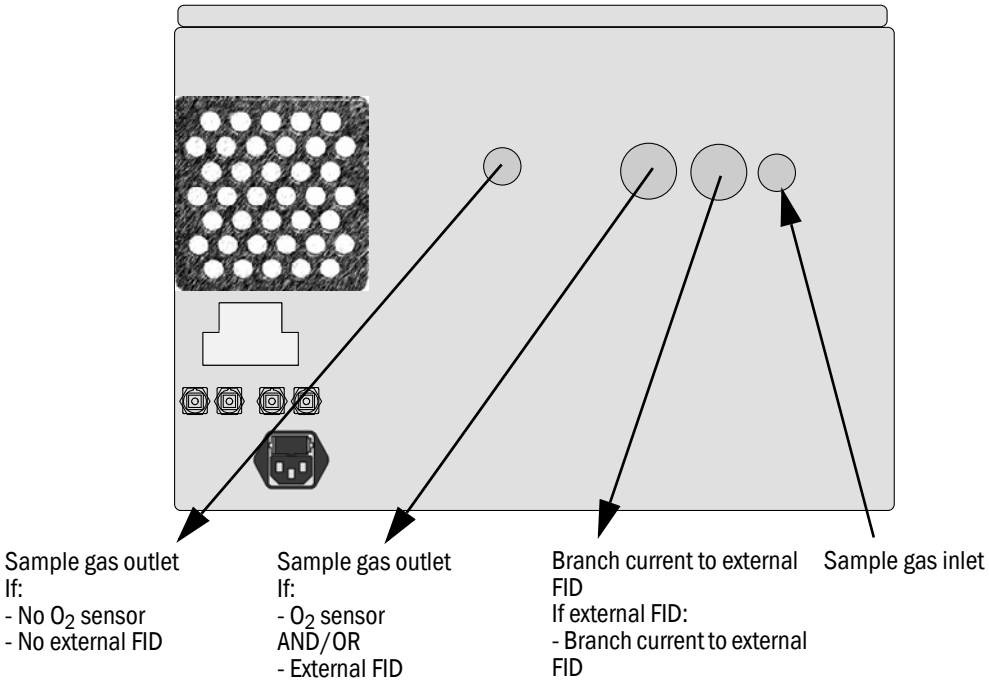
Procedure

1 Unscrew the cell cover screws.

2 Remove the cell cover.

3 Connect the sample gas lines.

Figure 4 Sample gas connections



4 Place cell cover in position and tighten screws.

5 Check sample gas lines for leaks.

3.2.3 Interfaces

3.2.3.1 Optical interfaces

The optical connections are located at the bottom of MCS100E.

Connecting the fiber optical cables:

⊗ Do not sharply bend the fiber optical cables.

- Minimum bending radius: 3 cm.
- The direction of the fiber optical cable can be as desired.
- The connectors can be plugged into the sockets in any 90° angle.

► Press connector into socket until you hear that it is locked.

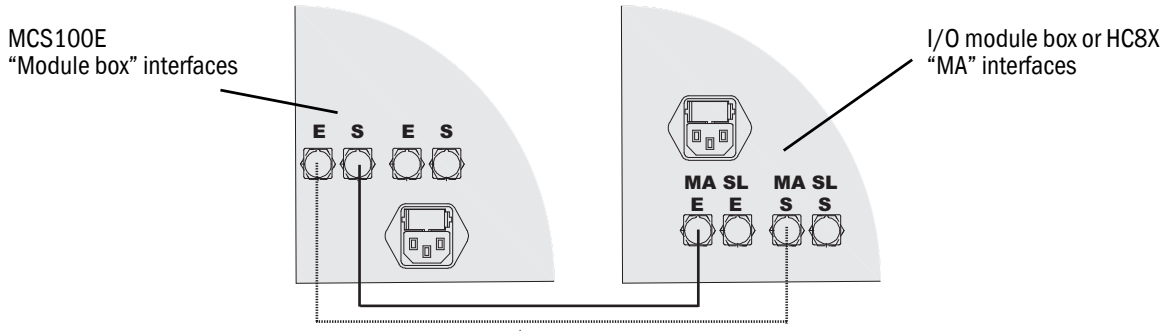
► To remove the fiber optical cables, pull at the connector only (not at the cable).

Optical interface "module box"

I/O module boxes (digital and analog input/output units) or HC8X heating controllers are connected to the interface to the "module box".

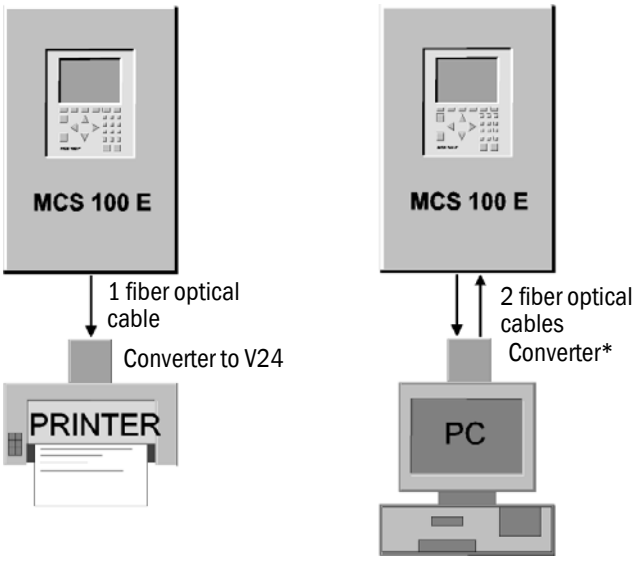
- Max. length of recommended fiber optical cables: 50 m (for further information, refer to Technical Data).
- Designation of the connections:
  - At the MCS100E: Module box "E" or "S"
  - At the module box:"MA E" or "MA S"
    (MA = Master, E = Receiver, S = Sender)

Figure 5 Connection of "module box" interface



Optical interface “PC/printer“

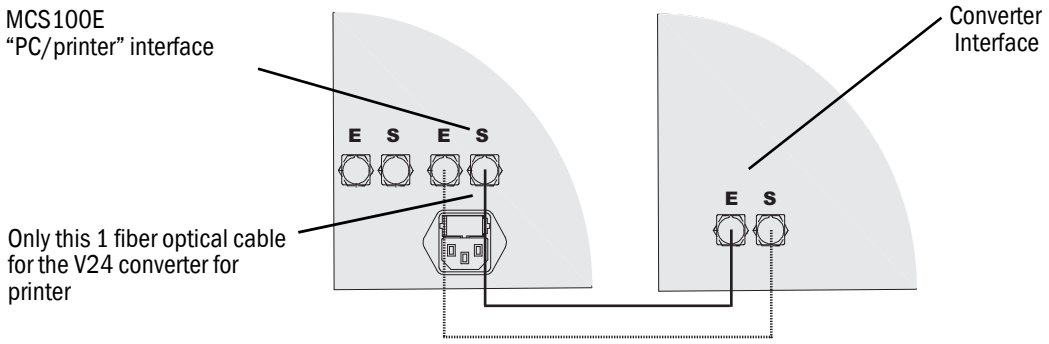
Figure 6 Optical interface“PC/printer”



*Plug-in board or converter with inherent power supply

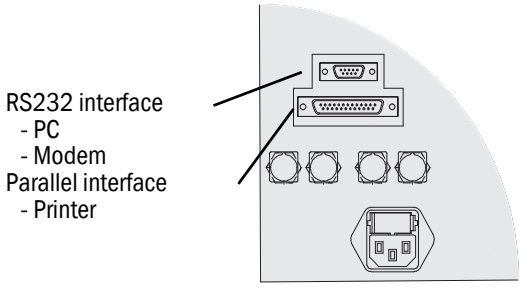
- The following equipment can be connected to the “Printer/PC” interface:
  - Printer *or* PC
- Designation of the connections on the MCS100E:
  “Printer/PC” “E” or “S” (E = receiver, S = sender)
- Maximum length of fiber optical cables: 50 m (unless required differently by the receiver)
- An appropriate converter is used for connection of the fiber optical cables to the electrical input of the terminal equipment.

Figure 7 Connection of “PC/Printer” interface



3.2.3.2 Electric serial and parallel interface (option)

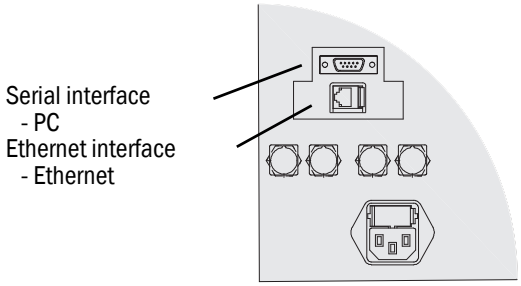
Figure 8 Connection to serial and parallel interface



- Serial line for PC or modem
- Parallel (“DOS-Interlink” cable 11-core) interface cable for printer.
- Use sufficiently screened cables.
- Max. cable length: Approx. 10 m

3.2.3.3 Electric serial and Ethernet interface (option)

Figure 9 Connection to serial and Ethernet interface

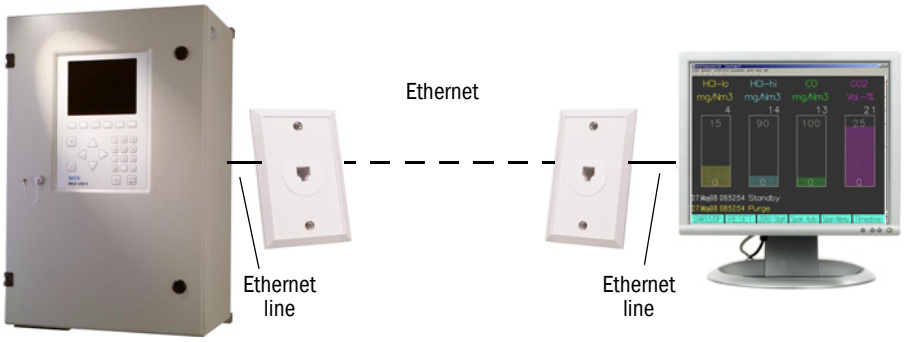


- Serial interface (→ §3.2.3.2).
- Ethernet interface
  - Type: Ethernet
  - Protocol: UDP
  - Connector: RJ 45
  - Cable: Cross-over on PC, 1:1 on hub
  - Data format: 10 MBit half-duplex
  - Addresses (preset):
    - IPADDRESS:192.168.0.x (see label on Ethernet interface)
    - SUBNETMASK:255.255.255.0

3.3 Remote control

3.3.1 Ethernet with TINY program

Figure 10 Remote control via Ethernet



Equipment

Control unit	Equipment
MCS100E side	Ethernet interface RJ45 for MCS100E (Part No. 2043636)
	Software package “TINY” (Part No. 2040228) (CD-ROM) (pre-installed)
	Ethernet connection RJ45
PC side	Ethernet connection
	Software package “TINY” (Part No. 2040228) (CD-ROM)
	PC with Java (JDK or JRE) (Java JDK is included in the “TINY” software package)

3.3.1.1 Connection on MCS100E side

► Connect the MCS100E to the Ethernet.

3.3.1.2 Connection on PC side

► Connect the PC to the Ethernet.

3.3.1.3 Program start on MCS100E side

► First-time start:

1 The MCS100E starts.

2 Exit the MCS100E program (→ p. 46, § 5.4.2).
You are at DOS level.

3 Switch off the watchdogs (→ p. 109, § 7.8).

4 Call up: TSETUP <IP_ADDRESS> <IP_NETMASK> <IP_ROUTER>
The addresses depend on the customer network

Example:
- IP_ADDRESS : *192.168.0.x (x = 0 .. 9)*
- IP_NETMASK: 255.255.255.0
- IP_ROUTER: 192.168.0.1

Call-up: TSETUP 192.168.0.1 255.255.255.0 192.168.0.1

Is it OK? [y,n] : <y> <ENTER> (saved in “C:\NOVELL\CLIENT32\NET.CFG”).

5 Switch off the MCS100E.

► Then automatic start when the MCS100E is switched on.

3.3.1.4 **Program start on PC side**

► First-time start:

1 Install Java JDK or Java JRE on the PC.
Installation file: In the “JAVAinst” directory on the CD.

2 Copy the “TINYclient” directory from the CD to the PC.

3 Using a text editor, enter the IP address of MCS100E in the “ts.bat” file.
Example:
- IP address of MCS100E: 192.168.0.1
java.exe -jar TinyClient.jar /Xde.kcf /D100 /K50 /R 192.168.0.1 password

4 If you want to call up the command line version of TINY:
- Connect with MCS100E.
- Call up “ts.bat”.
The DOS and the TINY windows are displayed on your PC.

OR

4 If you only want to view the TINY window:
- Start the Windows version of Java.
- Using a text editor, enter the IP address of MCS100E and display the path of the “javaw” program to your Java installation in “*Properties*” of “*Link*”.
Example:
C:\Programms\Java\jdk1.5.0\bin\javaw.exe -jar TinyClient.jar /Xde.kcf /D100 / K50 /R 192.168.0.1 password

► Automatic start

1 - Call up “ts.bat”.

OR

1 If you only want to view the TINY window:
Double-click “*Link*” “ts”.

For further information, see the “xxxx_install.txt” file on your CD.

3.3.1.5 **Special characters, e.g. on a German keyboard**

► Popup menu

Input of special characters in the MCS100E menus:

– Open a popup menu by clicking the window with the right mouse button.
– Click “Send Keystroke” “Custom Keys”.

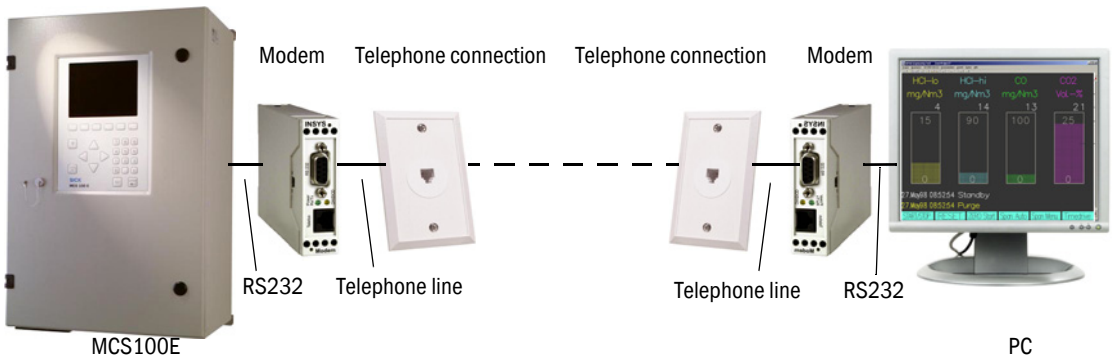
If the required keys or characters are not shown in the popup menu: Define the keys in a text file and call up the program with “/X<file name>” (→ §3.3.1.4).

If the program is started in version “Call in DOS” (→ §3.3.1.4) with the “/C” option: The codes are shown in a window.

For more information, see file “de.kcf” (open with a text editor) on your CD.

3.3.2 Modem with the NetOP program

Figure 11 Remote control via modem



Equipment

Control unit	Equipment
MCS100E side	RS232 interface for MCS100E ((Part No. 2023049)
	Modem (Part No. 6029430) Power supply unit 100 - 240 V, 24 V) (Part No. 6029654)
	NetOP software (pre-installed)
	Telephone connection (analog)
PC side	Telephone connection (analog)
	Modem
	NetOP software (Part No. 6029452).

3.3.2.1 Connection on MCS100E side

1 Connect the RS232C interface of MCS100E (→ p. 28, Figure 8) to the modem.
The modem setting cannot be changed.

2 Connect the modem to the telephone network (analog).

3.3.2.2 Connection on PC side

1 Connect the modem to the telephone network (analog).
   – If an external modem is used (this means: No modem PC card):
   Connection of modem exclusively to a “real” COM port of the PC
   - No USB ports
   - No USB-to-COM ports

2 Set the modem corresponding to the PC.

3.3.2.3 Program start on MCS100E side

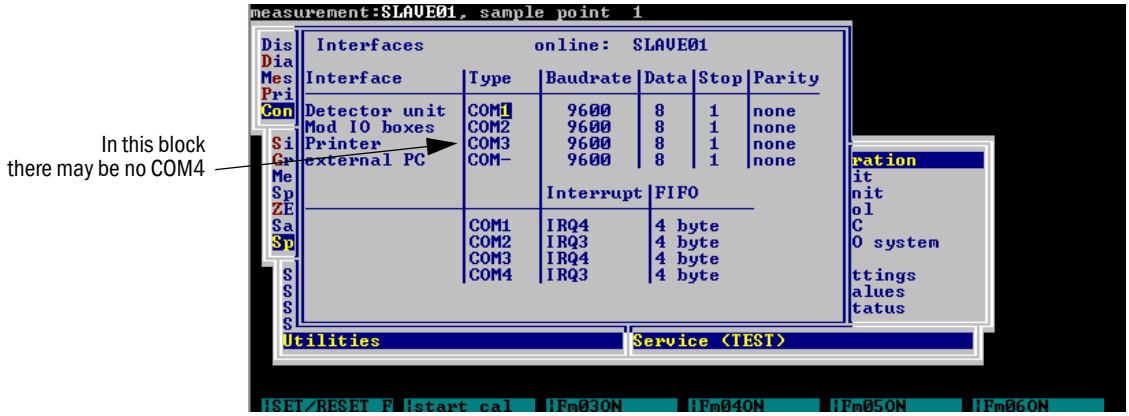
If NetOP has not been installed:
► Leave the installation of NetOP to an expert.

1 Start MCS100E.

2 If NetOP has not been pre-installed:
   – Copy directory \ndial to the root directory of MCS100E
   – Check BIOS settings:
   - COM port: COM 4 or AUTO
   - COM port may not be occupied already.

– In the *Specialist* menu*: Utilities: Service: Environment Configuration*: *Interfaces* (→ p. 93):
The “Interfaces” must not be assigned to any COM4. Example:

Figure 12 Settings



– Restart MCS100E.

3.3.2.4 Program start on PC side

1 Install NetOP on PC.

2 Start the *NDGUEST.EXE* program.

– *At the first call-up:* Set the parameters for *NDGUEST* according to the customer network
Procedure: ⟶ documentation supplied with the delivery.

– *“Quick DIAL”*
Specify the telephone number of the MCS100E telephone connection (comma for “Wait time”)

– The screen content of the MCS100E is shown.

File transfer via modem → p. 33, § 3.4.2

3.3.2.5 Terminating the transfer

1 Switch to the *NDGUEST* user interface with <ALT-X>.

2 “*Remote Control*“- “*Hang up*”

3 *“File” - “Exit”*

For more information on NetOP ⟶ documentation supplied with the delivery.

3.4 Data transfer to/from external PC

3.4.1 Data transfer via fiber optical cable

1 Install the fiber optical cable connection (→ p. 27, Figure 6).
2 The MCS100E measurement program must be installed and running on the PC (1.bat).
3 Start the desired data transfer on the MCS100E (for example → p. 86, §5.7.11.14, → p. 90, §5.7.15.4, → p. 91, §5.7.15.5).

3.4.2 File transfer via modem

For file transfer via modem, the running measuring operation must be interrupted.

1 Install the modem connection (→ p. 31, §3.3.2).
2 Exit the MCS program (→ p. 46, §5.4.2).
3 Enter at DOS level:
   a) *wdog disable <ENTER>*
   b) *cd\ndial <ENTER>*
   c) *ndtrans <ENTER>*

   A transfer message is shown.

   MCS100E is now at DOS level.
   ► Use only the specified commands.
   Otherwise, it is possible that the connection is interrupted; MCS100E "hangs" at DOS level and can be restarted locally only.

   d) *Ctrl-Alt-x* (call up NETOP).
   e) *Alt-T*: Determine transfer direction and directories.
   f) *Start*

   Data transfer is running.
   g) After the transfer, reply to the "*Close file transfer window*" prompt with "*Yes*".
   h) Change to the MCS100E screen with *Alt-z*.
   i) Exit the transfer program with *ESC*.
   j) Restart the MCS100E with "*1*".
   k) Change to NETOP again with *Ctrl-Alt-x*
4 Terminate the connection (→ p. 31, §3.3.2)

3.5 Modbus communication protocol

Communication protocol: Modbus RTU → p. 126, § 9.3

3.6 Hardware requirements for external PC

- If you want to install the operator menu on an external PC, the minimum requirements are:
  - IBM-compatible computer with 386 CPU
  - 1 MB DRAM
  - 2 MB disk for internal programs
  - 2 MB memory extension (required for data saving))

3.7 Hardware requirements for printer

- V24 interface
- IBM-compatible.

3.8 Electrical installation

As soon as the power plug is connected to line power, MCS100E automatically starts operation (→ p. 38, § 4.1). Before connecting the power plug to the line power, ensure that all necessary installation work has been done.

3.8.1 Power voltage adjustment

To adjust the power voltage:

- ► Adjust bridge according to the requested power voltage (see below).
- ► Use a backup with the current rating that corresponds to the power voltage (→ p. 36, § 3.8.1.2).

3.8.1.1 Adjusting the bridge for power voltage

The current values of the power fuses are voltage-dependent.

- ► Use different fuses if the power voltage changes (→ § 3.8.1.2).

Figure 13 Position of LED (red) and bridge for power voltage adjustment

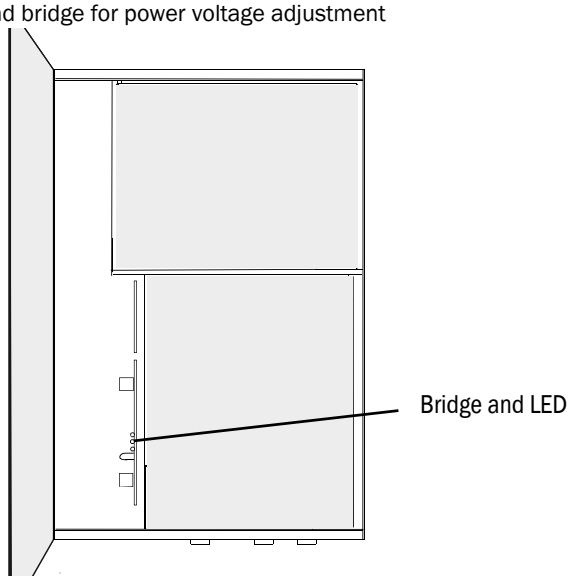
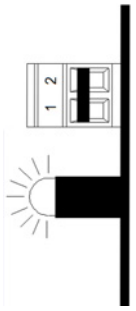
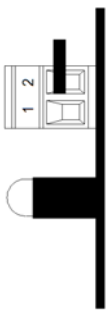


Figure 14 Bridge and LED for adjustment of 115 V or 230 V

115 V
Bridge closed between pins 1 and 2.
The red LED is on if power is switched on.



230 V
Bridge open between pins 1 and 2.
The red LED is off if power is switched on.



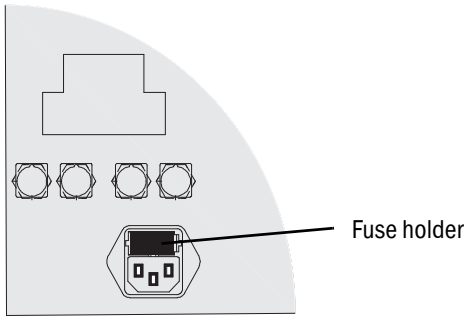
3.8.1.2 **Power fuses**

1 Put MCS100E out of operation (→ p. 100, § 6.1)

2 Remove power plug (otherwise the fuse holder cannot be opened)

- The fuse holder is inside the power plug housing.

Figure 15 Fuse holder



3 To remove the fuse holder, press the two notches at the sides and pull out.

WARNING: Hazard caused by incorrect fuses.

The fuses are dependent on the power voltage.

► Use only fuses with the required current rating and of the specified type for replacement.

⊗ Do not use makeshift fuses.

⊗ Do not short-circuit the fuse holder.

- Fuse types
  - 230 V: 5 AT (slo-blo) (2 each)
  - 115 V: 10 AT (slo-blo) (2 each)

4 Put in fuses (2 fuses) of the correct rating.

5 Press fuse holder back into position.

6 Reconnect power plug.

MCS100E

4 Commissioning

Preparation
Power-on procedure
Function test

4.1 Commissioning

As soon as connected to line power (power plug connected), MCS100E automatically starts operation.

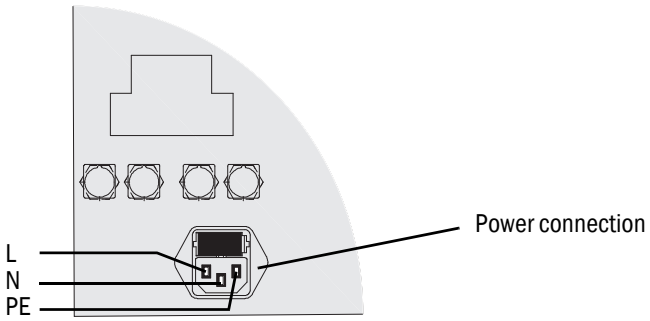
- In particular, check before power-on:
  - Power voltage adjustment (→ p. 35, §3.8.1).
  - Fuse ratings (depend on voltage) (→ p. 36, §3.8.1.2).
  - Correct connection of the sample gas lines (→ p. 24, §3.2.2.1).
  - Correct connection of the fiber optical cables (→ p. 26, §3.2.3.1).

> ***NOTICE:***
> If a cold instrument is installed in a warm environment, there is a risk of condensation inside the instrument.
> - Allow the instrument to stand for approx. 24 h to adopt ambient temperature before switching on the supply voltage.

> ***NOTICE:***
> The heating-up time of MCS100E is approx. 4 h.
> - Do not apply condensing gas to the instrument before the end of the heating-up time.

- For connection to line power, a grounded cord connector is used (the MCS100E does not have a power switch).

Figure 16 Power connection at the bottom of MCS100E



The MCS100E is supplied with all parameters set.
It will start operating immediately after power-on.

4.2 External keyboard

To ease the entry of rather large volumes of data a standard type external keyboard can be attached to the keyboard connector (DIN-connector with 5 poles) at the door.

4.2.1 Country-specific assignment of keys

Depending on the type of external keyboard attached, it may be necessary to adjust the country-specific assignment of keys.

1 Switch MCS100E off and then on again.
2 Abort automatic start after query <*Start Program Y/N*> (→ p. 45, § 5.3.3)
3 If you want to remain at DOS level for more than 4 minutes: Disable the watchdogs (→ p. 109, § 7.8).
4 Start the "*Norton Commander*" at DOS level with: <c:\nc>
Note: Switch MCS100E off and on again before selecting the "*Norton Commander*".
5 In the "*Autoexec.bat*" file (<F4>):
   – Insert "*rem(blank)*" before the line with the previous language and
   – delete "*rem*" before the line with the desired language.
   Example: After switching from German (gr) to English (us):
   – *rem C:\dos\keyb gr,,c:\dos\keyboard.sys*
   – *C:\dos\keyb\ us,,c:\dos\keyboard.sys*
6 If required, enable watchdogs again (→ p. 109, § 7.8).
7 Exit the "*Norton Commander*".
8 Start the measurement program with *1.bat* (→ p. 45, § 5.3.2).

To enable the display of country-specific characters on the screen, country-specific code pages must be loaded. This task should only be carried out by a specialist who is well-acquainted with MS-DOS.

4.3 Language selection of the MCS program

The language of the MCS program is set:

- In the MCSCONF configuration program "*Directories and Files*"
- In the measurement sequence program in menu option *Specialist: Utilities: Service: Environment Configuration*: *Text file*.

4.4 Display setup

- Setting in the measurement program: (→ p. 92, § 5.7.15.7.1)
- Setting via external keyboard:
  – CTRL ALT +
  – CTRL ALT –

The settings are not saved.

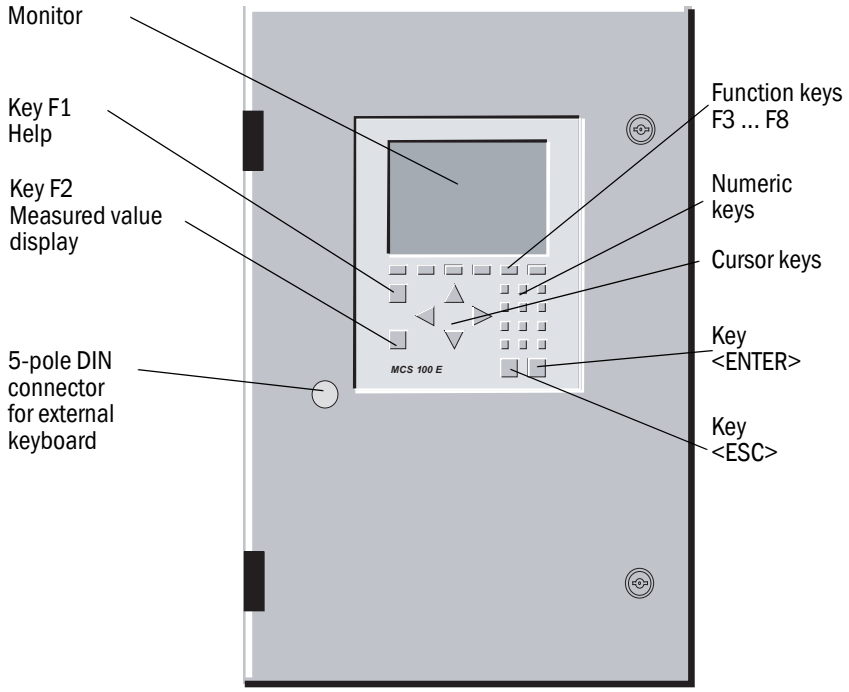
MCS100E

5 Operation

Operation
Status messages

5.1 User interface

Figure 17 Front of MCS100E with controls



Screen saver

The screen is automatically switched off after approx. 4 h if no key was pressed during this period.

► Press any key to switch the screen on again.

- Normally, the “Digital Input 1” is designed for a corresponding external pin switch (pre-set).

MCS100E is operated

- In measuring mode via the membrane keyboard.
- For setting parameters it is suitable to use an external keyboard (→ p. 39, § 4.2).

5.1.1 Significance of keys

Arrow keys

Within the menus you can move up and down, resp. left and right using the arrow keys.

Numerical keys

Enter the appropriate characters into those lines where you are expected to enter figures only. (Please use an external keyboard, if letters must be entered.)

<ESC> key

The <ESC> key is used to quit the menus, to terminate the program, to cancel a command, etc. If modifications were entered you will be prompted whether to save or not.

<ENTER> key

The <ENTER> key is used to open a menu, to confirm entries, etc.

F1 key (question mark)

The F1 key is used to go to a help menu. You will get help information on the actually used menu. The help information is related to the highlighted line, resp. the field where the entry mark is actually positioned. Use ESC to proceed within and/or quit the help menu.

From a menu field F1 displays:

- The revision number of the software
- The memory available on the flash disk
- The actually free main memory
- The assignment of the graphic buffers
- The addresses of the I/O module boxes connected
- General help

F2 key (measurement icon)

By means of the F2 key you quit the menu actually in use and return to the measured value display. Any changes made beforehand in the menu will be ignored.

Function keys F3 ... F8 (softkeys)

Different actions can be initiated with the function keys F3 ... F8 (softkeys), depending on the menu. The respective significance of the function key is shown at the bottom edge of the screen above the respective key.

5.1.1.1 Entering alphanumerical characters

1 Highlight the line in question.

2 Keep pressing function key F8 until the required character is displayed in the function key fields.

3 Press the function key which is positioned below the required character.

It is best to use an external keyboard for entering characters (→ p. 39, § 4.2).

5.2 Data and program storage

5.2.1 Structure of directories

The MCS100E software is located in a directory of its own,

containing:

- The configuration program
- The measurement program (1.bat) itself
- The text and help files (.txt and .hlp)
- Some other files associated with the program

The call-in .bat files (1.bat and mcsconf.bat) are in the directory C:\BAT\

Each “System” (→ p. 68, §5.7.11) created in the measurement program automatically creates an own subdirectory containing the system's default settings as well as the measured values and the messages of the message lines. The name of this directory is identical to the system's name.

Automatically and intermediately saved files are stored on drive d: (default setting).

The structure of the directories has to be entered in the configuration program (→ p. 123, §9.1.3.4) in *Directories and Files*.

5.2.2 Data files

The data files contain the measured values or status messages.

The name of the data files contains date and time of *file creation*, the last letter identifying the *type* of file.

File name: MMtthhmm.jjx

MM:	Month
tt:	Day
hh:	Hours
mm:	Minutes
jj:	Year
x:	x = 1: Messages from status bar 1
	x = 2: Messages from status bar 2
	x = d: Measured values stored

Example: 01230856.09d: The file was created on January 23rd, 2009 at 08.56 and contains measured values.

When 100 status messages are reached, a new file is automatically created (max. 5 files per status bar, the oldest file is overwritten).

Memory required for measured values

Per component with a cycle time of 60 seconds => approx. 10 Kbyte memory required per day.

The memory available is displayed in the main menu:

- Via function key F1
- In the graphics at the upper edge of the screen (when storage is “*active*”).

5.2.3 Program files

Files with names identical to their associated directory contain the measuring sequence (=system).

5.3 Starting the measurement program

MCS100E starts the measurement program and thus measurement:

- Automatically when MCS100E (→ §5.3.1) is switched on.
- AT DOS level by means of the 1.bat program (→ §5.3.2).

After the start of the measurements, the measured value display is shown.

To go to the main menu: Press <ESC>.

Which system (= measuring system) is started depends on the MCSCONF (→ p. 123, §9.1.3.4 Directories and Files).

► If you wish another system to be started *automatically*, the entries in the MCSCONF must be modified accordingly.

► If you wish another system to be activated *temporarily*: Menu: *Specialist: System, activate for measurement*.

5.3.1 Automatic start

Upon start, several prompts are displayed with which the automatic program start can be aborted.

If there are no entries, the program starts automatically.

5.3.2 Starting from the DOS level

► Enter: 1 <ENTER>

Parameters for the 1.bat program→ p. 109, §7.7

5.3.3 Aborting the start

► To go to the DOS level: Answer within 2 seconds to <*Start Program Y/N*> with <N>.

► If required, disable the watchdogs (→ p. 109, §7.8).

5.4 Stopping and starting measurement

5.4.1 STOP, START measurement

Menu: *Specialist: Utilities: Service: STOP, START measurement*

- Upon measurement “STOP”, all interfaces (e.g. I/O module boxes) are inactivated.
- Upon measurement “START”, all interfaces are initialized anew and measurement is started.

5.4.2 Quitting the measurement program

1 To quit the measurement program: Enter <ESC> repeatedly until a screen prompt for exiting the measurement program is displayed.

2 A password must be entered.
The password input is not displayed on the screen.

Definition of password: → p. 121, § 9.1.3.1
The password is identical with the password at “Specialist level”.

3 You are then at DOS level.

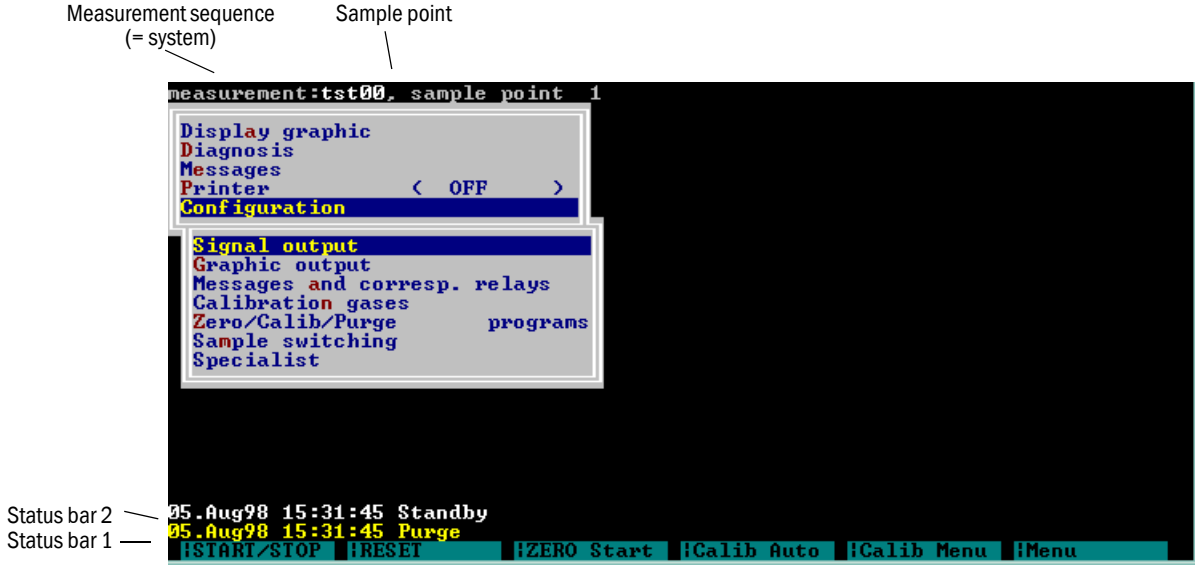
4 If required, disable the watchdogs (→ p. 109, § 7.8).

To be sure that - after having quit the program - MCS100E is in the basic condition (important e.g. for configuration of the I/O module boxes):

► Boot the MCS100E (<CTRL-ALT-DEL> or switch off/on).

5.5 Status bars

Figure 18 Status bars



Up to 3 status bars are displayed:

- At the top screen margin one information line with information on the current measurement.

  This line is not archived.
- Two status bars at the bottom screen margin:
  - Upper line (status bar 2): Fix, contains the operational state.
  - Lower line (status bar 1): Flashing, contains warnings and messages.
  - If no status bar is displayed, there is no active status.
  - Status bars 1 and 2 are saved in files (→ p. 44, §5.2)
  - Status bar 1 is output to the printer (if the on-line protocol *Main Menu: Printer: Print on-line: Protocol Start* is active).
  - If there are several active status messages, they are displayed successively (each message for approx. 4 seconds).
  - The texts associated to the status bars are programmed in the menu *Specialist: System edit: Message and corresp. relays*.

5.6 Using the menus

5.6.1 In Menu fields

Selection of a sub-menu	Arrow keys, then <ENTER>
Quit menus/graphics	<ESC> (you are prompted whether or not to save any modifications)
Selection from a list	Arrow keys, then <ENTER>
Counting upwards in the numbering of lists	<ENTER>
Counting downwards in the numbering of lists	<–> (Minus key)
Entry of numbers	Numerical keys
Entry of texts	Alphanumerical keys
Switching from insertion to overwrite	<INS (EINFG)>
Accept prompt	<ENTER>
Reject prompt	<ESC>
Interrupt printing	<ESC>

5.6.2 In Entry menus

De-/Activate components (✓)	<ENTER>
Toggle (e.g. 0/4 .. 20 mA, decimals)	<ENTER>
Activate an entry line	<ENTER>
Entry of numbers (e.g. measurement ranges)	Numerical keys
Entry of texts (e.g. messages)	Alphanumerical keys
Copy text lines	<Shift–F3>
Display list of names	<Shift–F6>
Termination of entries: Accept modifications performed Reject modifications performed	 <ENTER> <ESC>
Quit menus	<ESC> (you are prompted whether or not to save any modifications)

You are not allowed to make entries in the fields that are automatically skipped. Entries in these fields can only be made in the relevant menus (of the same name) in the specialist level.

5.6.3 In file selection lists

Change sorting algorithms	<–> or <+>
Go to top margin line	<←> (arrow key left)
Tag files	<Space key>
Edit tagged files	<ENTER>
Reject entries	<ESC>

5.6.4 Safety prompts

Before saving changes in some menus you will be prompted whether or not the changes should be accepted.

Yes	The changes performed are accepted and saved.
No	The changes performed are ignored.

In some menus you will be prompted additionally, whether or not the changes performed should be accepted for the current measurement sequence.

Yes	The changes performed are immediately applied to the current measurement sequence.
No	The changes performed are saved and only applied after starting the next measurement sequence.

Function of keys

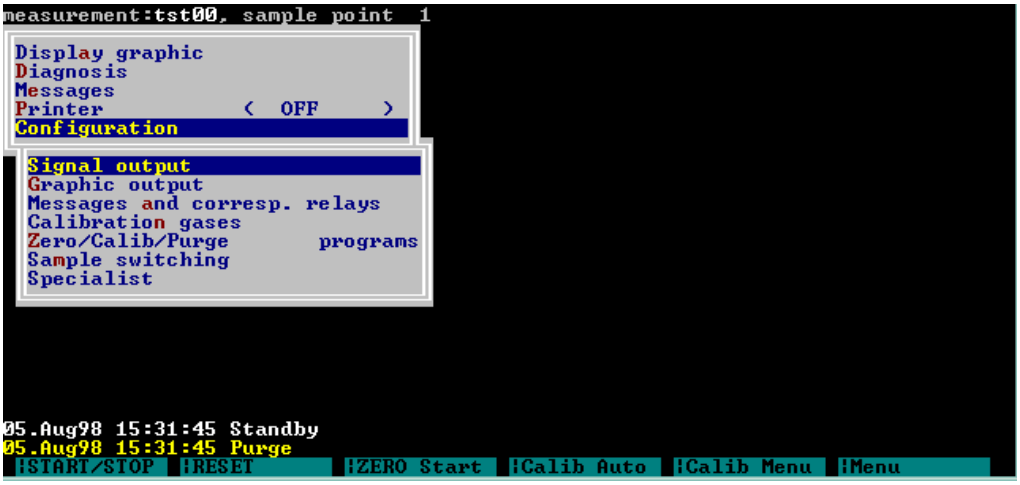
Accept safety prompt	<J> (Y) or <ENTER> on *Yes* field
Reject safety prompt	<N> on Yes field or <ENTER> on *No/Cancel* field[1]
Ignore safety prompt	<ESC>

[1] Starting from the *"Yes"* field, the *No/Cancel* field will only be displayed when pressing "once the arrow key, right".

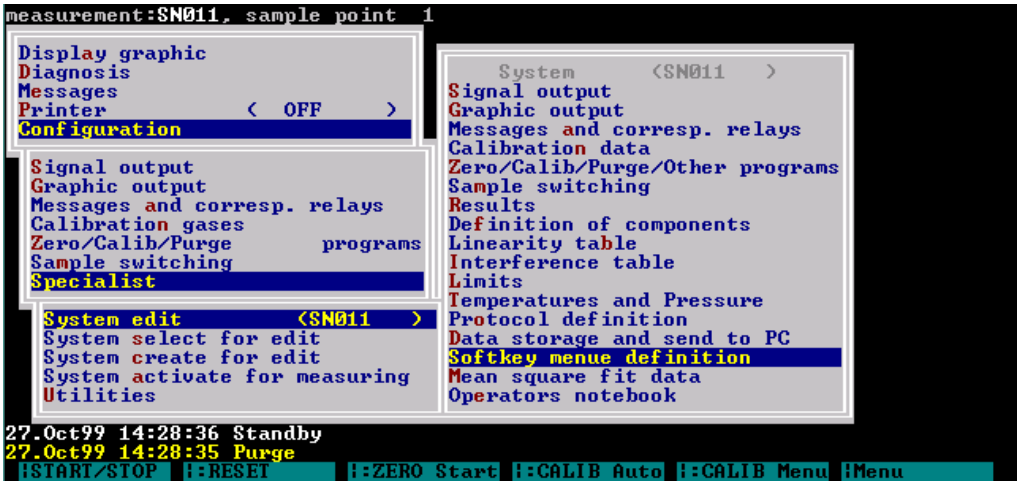
If the safety prompt is not answered within 120 seconds, then it will automatically be answered "*No*".

5.7 Menus

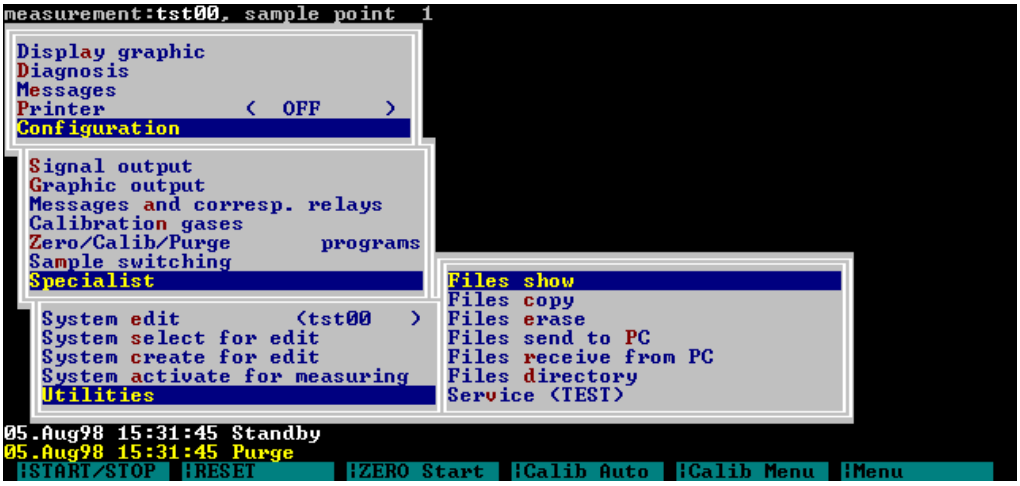
5.7.1 Main menu



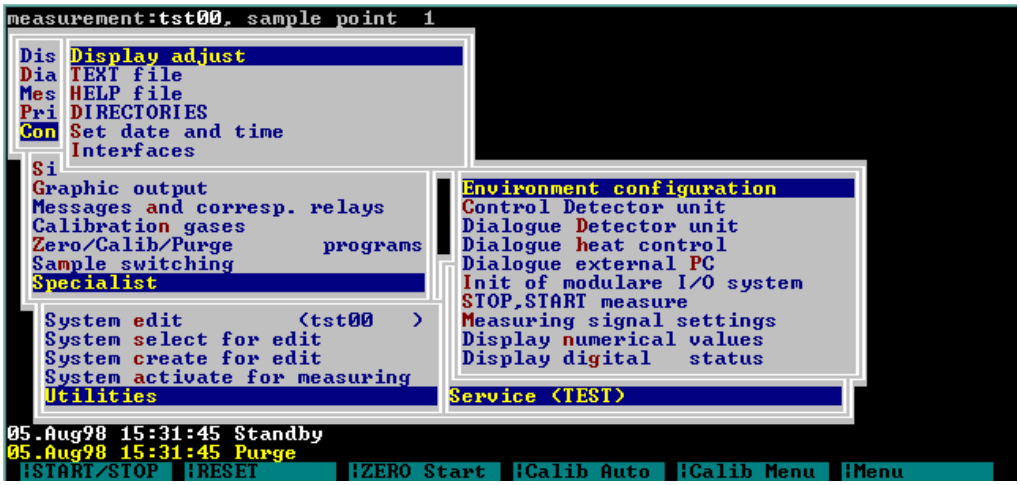
5.7.2 Specialist: System edit



5.7.3 Specialist: Utilities



5.7.4 Specialist: Utilities: Service: Environment configuration



5.7.5 Display graphic

Main Menu: Display graphic

In this menu option, you can select the graphic output of the measured values.

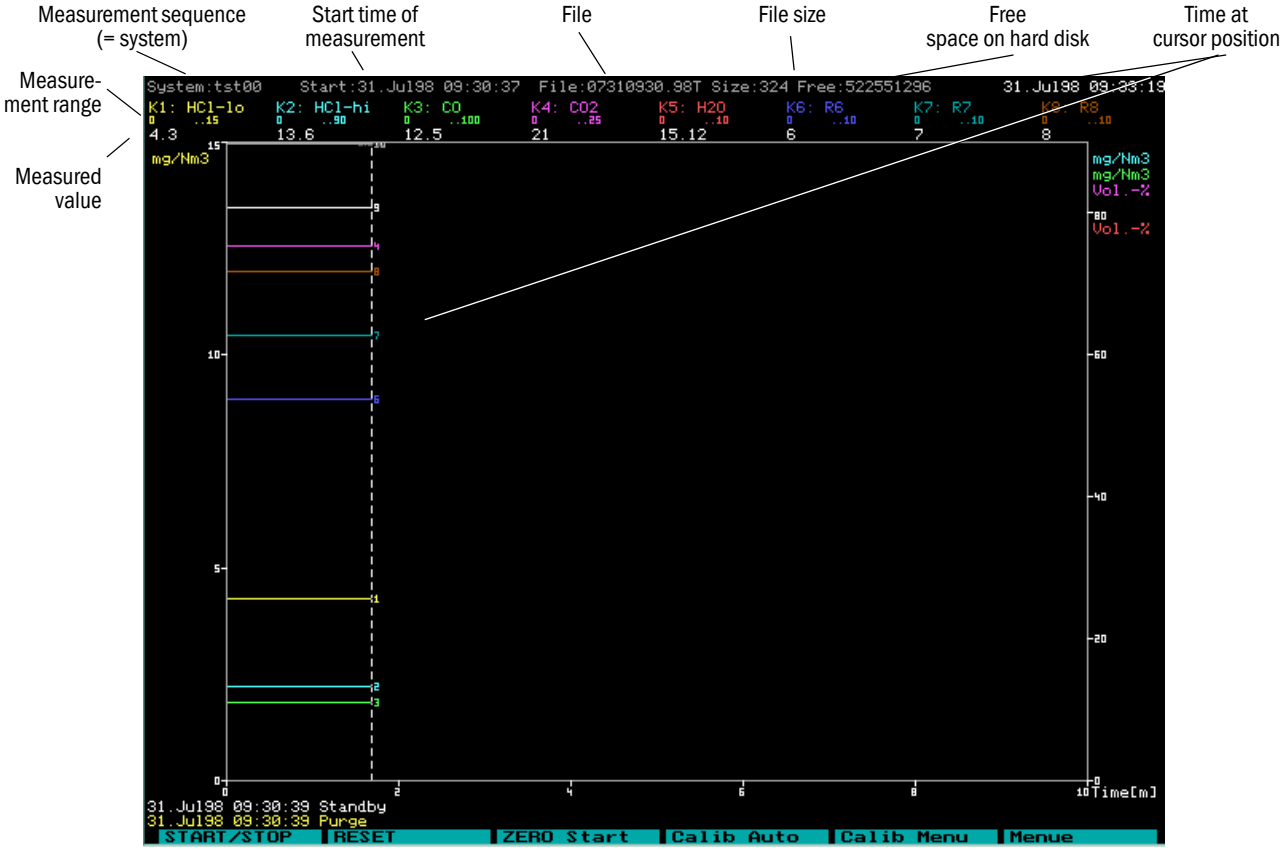
The graphic is displayed automatically after the start of the measurement program or if no key has been pressed for 10 minutes (parameter *KT* upon program start).

> If a menu is presented in the graphic, the graphic output will not be updated.

5.7.5.1 Graphic output: Time history

In this menu, the measured values are displayed over time, whereby totally 16 components can be represented:

- Max. 8 components as lines with numerical values for measurement range and measured value.
- Further 8 components as lines only.



Legend	
Measurement sequence	Name of measurement sequence.
Start	If “Actual”: Start time of measurement sequence If “Archive”: Start time of file
File	Name (and thus time of creation of file)[1].
File size	Actual size of data file.
Free	Memory still available on hard disk.
Time	Time at cursor position. If “Actual”: If no key was pressed for 10 seconds, the cursor jumps back on the time axis to the end of the recording.
K1..K8	Represent the first 8 curves from *Specialist: System edit: Graphic output* with - name of component - measurement range - measurement value at cursor time
Units, left	Units of the first group of components which have an *identical scale*. The scale is derived from *Main menu: Configuration: Graphic output: Measurement ranges* and is automatically adapted to the current measurement range.
Units, right	Units of the second group of components which have an *identical scale*. All further units (of the up to 16 possible components) are displayed at the right hand side and are scaled automatically according to their individual measurement range (bottom 0%, top 100% of the measurement range, independent of the scale displayed).
Time axis	Time displayed
Status messages	Upper (2nd) and lower (1st) status bar with current status messages[2].

[1] Displayed only if data storage is active.

[2] If the status bar is empty: There is no current message

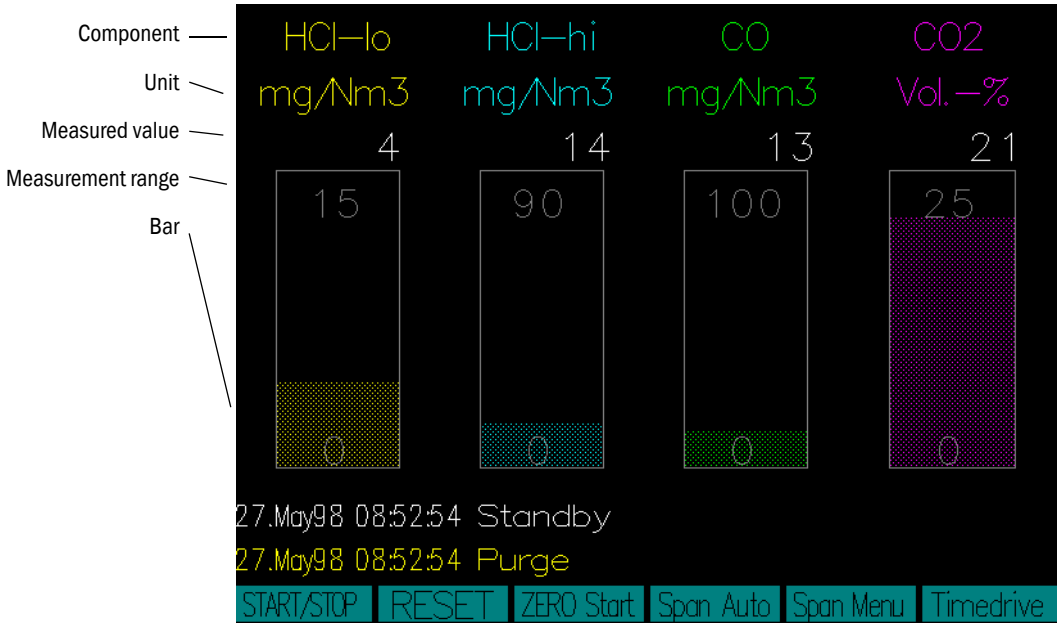
Key assignment	
<- and ->:	Move time axis
<5>	Display of number of curve on/off
<F1>	Help menu, there 0: If “Current“: Cursor to end of data recording. If “Archive“: Non-stop data display 6: If “Current“: Cursor to end of data recording. If “Archive“: Data display until end of screen
<F8>	Menu with: - Archive values - Time axis - Bar graph <ESC>: Create new scale for graphic
<ESC>	Quit graphic.

5.7.5.2 Graphic output: Bar graph

In this menu, the measured values are displayed as bar graph (assignment from *Specialist: System edit: Graphic output*).

Max. 4 (of 16) bars can be presented at one time.

- The name of the measurement and the time are displayed in the first line (→ p. 52, §5.7.5.1).
- Underneath the names of the components the corresponding measurement ranges and measured values are displayed (numerically and as bar graph).



Key assignment:	
<- and ->	Move bar and display next bar.
<F8>	Switch over to graphic “Time axis”.
<ESC>	Quit graphic and return to Main Menu

5.7.5.3 Archive Data

The measuring values *stored in the archive* are displayed.
You are prompted to enter the start time (see next chapter).

The graphic output of the values stored in archive corresponds to that of the actual values in *Main Menu: Display graphic Graphic output: Time History*.

There is no influence on the current measurement sequence.

Key assignment	
<- and ->:	Move time axis
<F1>	Help menu, there 0: Non-stop data display (Stop: Press any key) 6: Display of data until end of screen or press any key
<F8>	Menu with: Display of current values Scale time axis Data reduction (indicated value x means: every xth measured value is to be displayed) <ESC>: Create new scale for graphic
<ESC>	Quit graphic.

At the end of a data file the next file in chronological order is opened automatically and the data continues to be displayed.

The cause for a stop in recording of the last data file stored is displayed at the left bottom corner of the screen. If the cause seems unknown: “Unknown Stop Condition” is displayed.

Start time

The start time of the files stored in archive is indicated here.

Format:

dd.mm.yy hh.mm.ss (day.month.year hour.minute.second)

Time axis

The time scale (x-axis) of the time history is set here.

It is only after quitting the entry field that the display on the screen is updated.

The scale for the unit axis (y-axis) is set in the menu Main Menu: Configuration: Graphic output.

5.7.6 Diagnosis

Main Menu: Diagnosis

This menu option presents the status of the measurement sequence.

A list is displayed from which messages, the active components, temperatures, etc. can be selected for subsequent display.

While this menu option is active, the <F2> key (display of measured values) is disabled.

Settings:		
Messages	Display of current messages	
Temperatures[1]	No.	Numbering The following temperatures are default settings 1: O_2 sensor 2: Detector 3: Cell 4: Filter wheels 5: Heating controller 1, 1st controller 6: Heating controller 1, 2nd controller 7: Heating controller 2, 1st controller 8: Heating controller 2, 2nd controller
	Name	Name
	Current	Current value
	Nominal	Nominal value
	Hysteresis	The hysteresis (in °C) defines the switching thresholds of the temperature controller
	Limit	Limit monitoring
	ERROR	1: Current value > NOMINAL VALUE+limit high 1: Current value < NOMINAL VALUE-limit low 0: Limit not exceeded
	ALARM	1: Current value > nominal value+limit high remains set until RESET is carried out

[1] Additional information and settings –> menu: *Specialist: System edit: Temperatures and Pressure*

Settings		
Components	Result number of the component Name of component (selectable)	
	To the right of the Component	Measurement range (measurement range 2 full-scale).
	Amplification	Amplification level of measuring resp. reference signal 1 = lowest, 19 = highest level. The subsequent number represents the gain factor Max. energy is: Level 1 100% => 232,000 counts
	Reference Signal, Measuring Signal	Counts: The counts increase with the gain factor. Percent: Value independent of the gain factor. Example: Gain fct. 1 and 232,000 counts => 100% Gain fct. 2 and 232,000 counts => 50% etc.
	Absorbance, no corr.	Absorbance, no correction
	Absorbance add. corr.	Additively and multiplicatively corrected absorbance
	corr.Absorbance:	Calculated concentration
	Concentration	Drift since the first zero setting
	Drift total ZERO	Related to concentration in % of the measurement range (displayed at the top).
	Drift last ZERO	Drift since the last (current) zero setting Related to concentration in % of the measurement range (displayed at the top).
	Drift total SPAN	Drift since the first calibration in % of measurement range (displayed at the top).
	Drift last SPAN	Drift since the last calibration in % of measurement range (displayed at the top).
	T90 Time:	T90 time in seconds.
	Measuring cycle	Measurement frequency (for all of the components together).

5.7.7 Messages

Main Menu: Messages

The messages stored in archive from status bar 1 (lower bar) are displayed.
Switching to the messages of status bar 2: <ESC>.

These messages are output automatically to the printer, if the printer is active (*Main Menu: Printer: Print on-line: Protocol Start*).

The latest message is stated at the top.

Up to 192 messages are stored.

5.7.8 Print (On/Off)

Main Menu: Printer

Output is possible:

- With Print on-line: To a printer.
- With Print archive, output of stored values: To the printer, a file or the screen.

5.7.8.1 Print on-line (On/Off)

Main Menu: Printer: Print on-line

This menu option controls the output of the *current* measured values to the printer. For this purpose, “protocols” (see next chapter) are defined.

The name of the current measurement sequence is displayed in parentheses.

Upon selection of the menu, a sub-menu is displayed from which you can select the protocol definition or start and stop a printer.

If a printer protocol is active, a mark (✓) and the text “ON” are displayed.

Protocol Definition

Main Menu: Printer: Print on-line: Protocol Definition

This menu option is used to perform the settings for the protocol of the *current* measured values.

5 types of protocols can be created and given a name - to ease identification.

Settings	
Protocol type (1..5)	Selection of one of the 5 protocol types
Name	These names are used to ease identification, e.g. at protocol start and stop.
Output to	Only “Printer” possible
Filtering	Yes: Addition over the cycle time, divided by the number of measured values and subsequent output of the value. No: Actually current value is output
Cycle [Min]:	Output cycle time (in minutes) for printing. 0: Per measurement cycle one value is output.
Component selection	Selection of the components that are to be printed. (The list is derived from the menu *Specialist: System edit: Results*). By <ENTER> a list containing the *actual* components is displayed. If a field is selected within this list, then a list containing the *possible* components is presented. xxxxx.xx defines the format for display of the measured values, in this example 2 digits following the decimal point; changeable with <ENTER>.
Characters per line	Number of characters per line dependent on the paper format. Default setting: 80
Lines per page	Number of lines per page dependent on the paper format. Default setting: 72
Decimal separator	Decimal separator Comma or point
Format date	Format of date, change with <ENTER>.
Separator of date	Separator of date: . or /
Separator of time	Separator of time: 14:55:00 or 14-55-00 *Note:* The separators of date and time should be different to enable an evaluation program to find a distinguishing feature.

File extension for the protocol files is ”.txt”. Protocol files can be edited in the usual table calculation programs.

Protocol changes are executed immediately.

Protocol Start

Main Menu: Printer: Print on-line: Protocol Start

Upon entering the protocol name in this menu option one of the 5 on-line protocols defined is started. Then all messages of message line 1 as well as the zero and calibration programs are automatically output to the printer. Only one protocol can be started.

Protocol Stop

Main Menu: Printer: Print on-line: Protocol Stop

The active printer protocol is stopped.

The active printer protocol is displayed and you are prompted whether or not it is to be terminated.

5.7.8.2 **Print Archive (Name)**

Main Menu: Printer: Print Archive

This menu option controls the output of the *archived* measured values to the printer, to a file or to the screen. For this purpose “protocols” (see next chapter) are defined and the start and end times are entered, and then the protocol is started (whereby, if necessary, you will be prompted for the file name).

The name (name) of the archived measurement sequence selected for printing is displayed in parentheses. This name can be selected in the menu *Specialist: System, select for editing*.

5.7.8.3 **Start and end**

Main Menu: Printer: Print Archive Start and end

Enter start and end time of the protocol to be output, here.

Upon start, the protocol will begin with the 1st time entry found and continue until the last, respectively until time end. Missing times are printed as empty lines.

5.7.8.4 **Protocol Definition**

Main Menu: Printer: Print Archive Protocol Definition

This menu option is used to perform the settings for the protocol of the *saved* data

5 types of protocols can be created and given a name - to ease identification. The entries to be made correspond to those for the on-line protocol, however, the protocol of archived data can additionally be output to a file or to the screen.

Settings:	
Protocol type (1..5)	Selection of one of the 5 protocol types
Name	These names are used to ease identification, e.g. at protocol start and stop.
Output to	Printer File Monitor
Filtering	Yes: Addition over the cycle time, divided by the number of measured values and subsequent output of the value. No: Actually current value is output
Cycle [Min]:	Output cycle time (in minutes) for printing. 0: Per measurement cycle one value is output.
Component selection	Selection of the components that are to be printed. (The list is derived from the menu *Specialist: System edit: Results*). By <ENTER> a list containing the *actual* components is displayed. If a field is selected within this list, then a list containing the *possible* components is presented. xxxxx.xx defines the format for display of the measured values, in this example 2 digits following the decimal point; changeable with <ENTER>.
Characters per line	Number of characters per line dependent on the paper format. Default setting: 80
Lines per page	Number of lines per page dependent on the paper format. Default setting: 72
Decimal separator	Decimal separator Comma or point
Format date	Format of date, change with <ENTER>.
Separator of date	Separator of date: . or /
Separator of time	Separator of time: 14:55:00 or 14-55-00 *Note:* The separators of date and time should be different to enable an evaluation program to find a distinguishing feature.
Separator, column	9: TAB stop Separator for individual measured values. The decimal value of the ASCII character is entered here as these are usually non-printable characters.
Separator, line	13, 10: CARRIAGE RETURN, LINEFEED The entry of 2 characters is mandatory. The decimal value of the ASCII characters is entered here as these are usually non-printable characters.

File extension for the protocol files is ".txt". Protocol files can be edited in the usual table calculation programs.

The printer protocol settings *Main Menu: Printer: Print Archive Protocol Definition* and *Specialist: System edit: Protocol Definition* are identical.

5.7.8.5 Protocol Start

Main Menu: Printer: Print Archive Protocol Start

Enter here which type of protocol for data stored in archive should be started. When selecting a protocol with data output to a file, you will be prompted for the file name.

Before starting the output, make sure to terminate current on-line output, if necessary.

Protocol output of stored data is started.

Output can be interrupted with <ESC>.

5.7.8.6 **Print diagnosis**

Main Menu: Printer: Print Diagnosis

A diagnosis is printed, i.e. all active messaged, temperatures and components.

Before starting the output, make sure to terminate current on-line output, if necessary.

5.7.8.7 **Print Messages**

Main Menu: Printer: Print Messages

The status messages of status bars 1 and 2 are printed.

Before starting the output, make sure to terminate current on-line output, if necessary.

5.7.8.8 **Print System data**

Main Menu: Printer: Print System data

A list is displayed for selection of the MCS100E data to be printed. Upon selection of the system data you will be prompted whether or not to start printing. If you wish to print into a file, then you have to indicate the file name when prompted.

While this menu option is active, the <F2> key (display of measured values) is disabled.

Before starting the output, make sure to terminate current on-line output, if necessary.

5.7.9 Configuration

Main Menu: Configuration

5.7.9.1 Password for the configuration level

A password has to be entered to edit the menus “Signal output” and “Graphic output”.

The password input is not displayed on the screen.

Definition of password: → p. 121, §9.1.3.1

5.7.9.2 Signal output

Main Menu: *Configuration: Signal output*

This menu option is used to define the:

- analog signal outputs and the
- Measurement ranges

Settings	
Channel	Number of the analog output.
Mark (✓)	Analog output active (✓)/not active.
Name	Name of component derived from a list which is based on *Specialist: System edit: Results*. Display list by pressing <ENTER>
Unit	Unit of component. Displayed automatically from *Specialist: System edit: Results*
Measurement ranges	Switching of the measurement range is programmed here. Measurement range 2 is the larger measurement range and relevant for the plausibility check for zero setting- and for calibration, with the drifts etc. The measurement ranges are automatically switched over (this is also true for the graphic output). Switching over can be interrogated in the menu *Specialist: System edit: Zero/Calib/Purge programs/other programs* (Variable RHi). Hysteresis is 5%. If a component has been defined more than once, then the 1st definition is relevant for the plausibility check.
Relays	Number: Number of the relay The relay “Number” is activated (deactivated) when the measurement range 2 (1) is active (the relay indicates that the analog output switched to another output range). 0: No relay to be assigned - Number: Inverted setting
Current	0..20 mA 4..20 mA

Max. 32 outputs can be activated.

The menu option is identical to *Specialist: System edit: Signal output*

5.7.9.3 **Graphic output**

Main Menu: Configuration: Graphic output

This menu option is used to define the graphic.

32 channels can be defined.

In *Time History*, 16 lines can be represented simultaneously, the first 8 lines with corresponding values.

With the *bar graphs*, 4 (four) bars (of max. 16) can be represented simultaneously, whereby it is possible to scroll with the arrow keys right/left.

Settings	
Channel	Numbering (no further significance)
Mark (✓)	The channel is/is not displayed in the graphic
Name	Name of component Derived from a list which is based on *Specialist: System edit: Results* . Display of list by <ENTER>.
Unit	Unit of component. Displayed automatically.
Limit values	When entering a mark (✓), the limits defined in *Specialist: System edit: Limits* are displayed as lines in the graphics.
Measurement ranges	Scale of y-axis in time history. 2 scales are possible, which can be switched over automatically depending on the measurement range.
Decimal	Defines the display of the measured values in the bar graph menu, e.g. xxxx.xxx = 3 digits following the decimal point. Adjustable by <ENTER>. In the time graphic, the display of the numerical values shows always the complete sequence of digits following the decimal point.

Key assignment:	
F7	Copy line from signal output.
F8	Set standard (adopt measurement ranges from *Specialist: System edit: Signal output*).

The menu option is identical to *Specialist: System edit: Graphic output*

5.7.9.4 **Messages and corresp. relays**

Main Menu: Configuration: Messages and corresp. relays

In this menu the relays that are marked with "*x*" in the upper line can be assigned to texts. This means, the relay is set/reset corresponding to the text which is displayed on the screen.

Settings		
Relays	2 relays (left and right column) are possible.	
Number	Number	Number of the relay (Selection only possible, if marked with x in a.m. list)
	0	No relay to be assigned
	-Number	Inverted setting
System status	The texts are displayed in the same order as defined in *Specialist: System edit: Message and corresp. relays*.	

The free relays and texts are defined in the menu *Specialist: System edit: Messages and corresp. relays*

5.7.9.5 Calibration gases

Main Menu: Configuration: Calibration gases

In this menu, zero and calibration gas sampling is adjusted and controlled.

Settings	
Component	List of active components (based on *Specialist: System edit: Results*). As soon as you reach the field for the component O2, there is an automatic switch-over to the menu containing the O2 data (see below).
Measurement range	Measurement range is entered automatically (from *Specialist: System edit: Results*).
Calib gas conc.	Span gas concentration of the span gas connected (enter).
Plausibility limits in % of meas. range for Zero and Calib. value	The value to be entered (default setting: 6%) defines the tolerance (in % of full scale) which must not be exceeded by Zero- resp. calib. gas sampling (since the last monitoring). If the value measured at Zero resp. calib. gas sampling *is within the tolerance* as entered here: The measured value is accepted. If the value measured at Zero resp. calib. gas sampling *exceeds the tolerance* as entered here: The measured value is accepted, but a message is output to the printer and a flag (Zero: ER17, Calib ER17: ER18) is set for interrogation in *Specialist: System edit: Zero/Calib/Purge programs/other programs*. 0: No plausibility control, calibration is always performed.
Drift (% meas. range):	The drift with the Zero resp. calib. gas sampling control is automatically entered here. Last: Drift since last control Total: Drift since first control, e.g. last service These values are also displayed in the main menu option “Diagnosis”.

O_2 menu field

This menu defines the calibration of the O_2 sensor.

Span gas sampling is performed either manually from this menu or automatically via the calibration program Specialist: System edit: Zero/Calib/Purge/Other programs (Flag C16 for component 16).

Calibration can be interrupted by either <ESC> or resetting the flag or by interrupting the calibration program.

During calibration, a message indicates for how long the O_2 signal still has to be stable. The actual O_2 values are displayed continuously.

In case of a malfunction during calibration a corresponding error message is generated.

The O_2 calibration data are stored in an individual file (SNxxx.O2C).

Settings	
Temperature high	Nominal temperature, as set (from *Specialist: System edit: Temperatures)*
Analog In low..high [mV]	Scales the 12 bit analog input: Example: -250 mV .. +250 mV
Span gas 1 and 2 [%]	Enter span gas concentration in % Span gas 1: High concentration Span gas 2: Low concentration Example: 20.95 .. 2.1.
Span gas 1 and 2 [mV]	Display span gas 1 and 2 in mV, values and tolerance (e.g. ±0.25) can also be entered manually. Example: 0.00 .. 47.00 (±0.25)
Line constant [mV]	Line constant as calculated upon calibration. Value (-25 .. 10). Can also be entered manually. Example: 0
Steepness [mV]	Steepness as calculated during calibration. Value (35 .. 55). Can also be entered manually. Example: 47
Actual [digit] [mV] [%]	Actual value in digits, mV, %
Relay for span gas 1	The relays that are to be set resp. reset (-) upon sampling of span gas 1 can be entered here.
Relay for span gas 2	The relays that are to be set resp. reset (-) upon sampling of span gas 2 can be entered here.
Time Stability, Timeout	Time stability: 120 (example) The measured value must remain constant for minimum this time (120 sec. in the example), otherwise the calibration will start from the beginning. Time timeout: 900 (example) If no stable measured value is obtained within this time (900 sec. in the example), then the calibration is terminated and an error message (ER18) is displayed.
Start CALIB with 1 point	<ENTER> starts calibration with 1 point. If calibration was successful, a prompt is displayed “Accept?”. When the answer is YES, then line constant and steepness are calculated. If calibration was not successful, then the value will be accepted anyway but an error message (ER18) is displayed. In case of a timeout the value is not accepted and an error message (ER18) is displayed.
Start CALIB with 2 points	The same as for point 1, but the 2nd test gas follows after the 1st test gas.
Set default values	“Yes”: Default values are set.

5.7.9.6 Zero/Calib/Purge programs

Main Menu: Configuration: Zero/Calib/Purge programs

The programs ZERO, Calibration and Backpurge (of sampling probe) can be adjusted here.

Each second the programs are interrogated cyclically. If the conditions are met, then the actions are performed.

Active programs, digital conditions, flags etc. can be viewed in *Specialist: Utilities: Service: Display digital status.*

As the programs ZERO, calibration and backpurge are factory-programmed, you only need (and can) enter/modify the times here. The information displayed is based on the entries in the menu *Specialist: System edit: Zero/Calib/Purge programs/other programs*.

If the program definitions for ZERO, calibration or backpurge do not exist, the menu cannot be opened.

Settings	
Program Number	Number of program.
Program name	Name of program.
Active	Mark (✓) = program becomes immediately active upon software start.
Cycle	Cycle, indicating how often the program will run. DD:HH:MM: day:hour:minute
Start	When starting the measuring sequence the start of this program is synchronized to this time. Flag|hh:mm: Flag number OR hour:minute
Duration minutes	Duration of time program, thereafter the program becomes inactive again and has to be started anew. 0: Program is continuously running.
Hold minutes	As of the start of the program, the analog output is held for this period in minutes and then released. 0: Analog output is not held.
Average at minutes	Average from this time until final time. (This makes it possible to wait for rise times.)
Only for the backpurge program:	
Interval	Total interval containing the pulse time
Length of pulse	Duration of the backpurge pulse
Relays	The pulse triggers the relay defined here. At the end of a backpurge program the relay is always set to the rest state. (No entries possible in this menu.)

5.7.9.7 Sample switching

Main Menu: Configuration: Sample switching

With MCS100E sample (point) switching is possible.by switching cyclically from one sample point to the next. The system is pre-purged for a selectable time with the new sample gas, before the new measured value is accepted.

Settings	
No. of Sample points	Number (max. 16) of sample points (No entries possible in this menu.)
Start time	When starting the MCS100E, the start of sample switching is synchronized to this time.
Sample point number: active	Number of sample point to be edited Mark (✓) = sample point is being measured
Values hold/zero	Defines whether the values from the inactive (=not being measured) sample point should be held (“Hold”) or set to zero (“Zero Setting”).
Remote control	Inclusion of sample point into sample point switching via digital input. Select number of digital input. (LOGICAL AND by “Internal control”)
Internal control	Inclusion of sample point into sample point switching via flag. Select number of flag. (LOGICAL AND by “Remote control”)
Sample selected minutes	Specifies in minutes for how long the sample point will be active.
Sample selected relay	THIS relay will be set/reset (-) as soon as the sample point is active.
Sample data valid minutes	Defines the pre-purge period. The “last” minutes are “valid”.
Sample data valid relay	THIS relay will be set/reset (-) as soon as pre-purge is terminated and measurement is performed at the sample point.

The menu is based on the menu option Specialist: System edit: Sample switching

5.7.10 Specialist menus

The specialist level is used to program the measurement sequence (= the system) and to perform software settings.

Wrong entries in the specialist menu can have a disruptive effect on the measurement sequence, lead to incorrect measurement results and may damage internal and external system components.

► Entries in the specialist menu may only be made by aptly trained personnel.

In the specialist level some menu options from the freely accessible Main Menu are repeated. This is to avoid the time-consuming “jumping” from one level to the other.

5.7.10.1 Password for the specialist level

To edit the specialist level, a password has to be entered.

The password input is not displayed on the screen.

Definition of password: → p. 121, § 9.1.3.1

5.7.11 System edit (Name)

Specialist: System edit

This menu option contains the configuration for the *system* (= the measurement sequence) *name*. The *system* to be configured can be:

- The actually active *system*. In this case any modifications to the settings have an immediate effect on the configuration.
- A *system* that is not active at the moment (Selected in: *Specialist: System, select for editing).* In this case, there is no effect on the actually active *system*. The *system* edited can subsequently be activated via *Specialist: System, activate for measurement.*

5.7.11.1 Signal output

Specialist: System edit: Signal output

The following are defined here:

- Analog signal outputs
- Measurement ranges

Settings	
Channel	Number of the analog output.
Mark (✓)	Analog output active (✓)/not active.
Name	Name of component derived from a list which is based on *Specialist: System edit: Results*. Display list by pressing <ENTER>
Unit	Unit of component. Displayed automatically from *Specialist: System edit: Results*
Measurement ranges	Switching of the measurement range is programmed here. Measurement range 2 is the larger measurement range and relevant for the plausibility check for zero setting- and for calibration, with the drifts etc. The measurement ranges are automatically switched over (this is also true for the graphic output). Switching over can be interrogated in the menu *Specialist: System edit: Zero/Calib/Purge programs/other programs* (Variable RHi). Hysteresis is 5%. If one component has been defined more than once, then the 1st definition is relevant for the plausibility check.
Relays	Number: Number of the relay The relay “Number” is activated (deactivated) when the measurement range 2 (1) is active (the relay indicates that the analog output switched to another output range). 0: No relay to be assigned - Number: Inverted setting
Current	0..20 mA 4..20 mA

Max. 32 outputs can be activated.

The menu option is identical to *Main Menu: Configuration: Signal output*

5.7.11.2 **Graphic output**

Specialist: System edit: Graphic output

This menu option is used to define the graphic.

32 channels can be defined.

In *Time History*, 16 lines can be displayed simultaneously, whereby the first 8 lines are depicted with their measured values at the top.

With the *bar graphs*, 4 (four) bars (of max. 16) can be represented simultaneously, whereby it is possible to scroll with the arrow keys right/left.

Settings	
Channel	Numbering (no further significance)
Mark (✓)	The channel is/is not displayed in the graphic
Name	Name of component Derived from a list which is based on *Specialist: System edit: Results* . Display of list by <ENTER>.
Unit	Unit of component. Displayed automatically.
Limit values	When entering a mark (✓), the limits defined in *Specialist: System edit: Limits* are displayed as lines in the graphics.
Measurement ranges	Scale of y-axis in time history. 2 scales are possible, which can be switched over automatically depending on the measurement range.
Decimal	Defines the display of the measured values in the bar graph menu, e.g. xxxx.xxx = 3 digits following the decimal point. Adjustable by <ENTER>. In the time graphic, the display of the numerical values shows always the complete sequence of digits following the decimal point.

Key assignment:	
<F8>	Set standard (adopt measurement ranges from *Specialist: System edit: Signal output*).

The menu option is identical to *Main Menu: Configuration: Graphic output*

5.7.11.3 **Messages and corresp. relays**

Specialist: System edit: Messages and corresp. relays

In this menu, texts are defined and relays are assigned to these texts. The texts are started (according to their numbers) in the programs *Specialist: System edit: Zero/Calib/Purge programs/other programs*. When activating/deactivating the texts, these are displayed and stored in the message lines 1 and 2 (→ p. 44, § 5.2); message line 1 is also output to the printer (if on-line protocol is active.

Settings	
Assignable relays:	It is entered in this line whether a relay is free (x) or pre-assigned (no x). Texts can only be assigned to free relays.
TX x:	x = Number of text, in numerical order
Mark (✓)	✓ = This text is active at present.
Relays	2 relays (left and right column) are possible. Num-ber: Number of the relay (Selection only possible, if marked with x in a.m. list) 0: No relay to be assigned - Num-ber: Inverted setting
Priority	1: Lower status bar, flashing: Warning or alarm 2: Upper status bar, not flashing: Operational state
Text	Text, displayed in the status bar

The relays can also be assigned in the main menu *Main Menu: Configuration: Message and corresp. relays*.

5.7.11.4 Calibration data

Specialist: System edit: Calibration data

This table is used to control the calibration conditions for the individual components.

There are two types of calibration:

- With span gas
- With internal Standard

Calibration with span gas

The calculated span gas concentration is compared with the entered nominal value for span gas.

Discrepancies generate a calibration factor for span gas.

During measurement operation the measurement results are then corrected by the calibration factor for span gas.

When calibrating with span gas the calibration factor for the internal standard is set to 1 again.

Calibration with internal calibration standard

The entered nominal value for the internal standard is multiplied by the calibration factor for span gas.

Discrepancies with the nominal value generate a corrected internal calibration factor for the internal standard.

During measurement operation the measurement results are then corrected by the calibration factor for span gas as well as by the calibration factor for the internal standard.

Procedure

The following list was created to define the values displayed in this menu and explain, how the program performs the correction of the measured values:

- Record measuring signal and reference signal
- Calculate absorbance
- Perform Zero correction
- Add Extra Offset
- Perform additive interference sensitivity correction
- Perform multiplicative interference sensitivity correction
- Linearization (e.g.: Calculation of absorbance into concentration, digits into analog values, flow meter)
- Multiply by CALIBRATION factor
- Multiply by EXTRA factor

Settings	
Component	i (= Ri) (i = 1..24) (not selectable) The components corresponding to the results R1..R24 are selectable (at the right) by <ENTER>. The components are automatically adopted from the list out of *Specialist: System edit: Results*. The measurement range is derived from *Specialist: System edit: Signal output* As soon as you reach the field for the component O_2, there is an automatic switch-over to the menu containing the O_2 data (see below).
4 active IF Tables	Enter number of interference table to be used for calculation. Max. 4 tables can be specified. 0: Interference table is not used for calculation.
1 active LIN Table	Enter number of linearization table to be used for calculation. 1: One table can be entered 0: No LIN table to be calculated
Span gas conc.	Span gas concentration of the span gas connected (enter). Internal standard: Nominal concentration of internal standard (enter)

Settings	
Calibration factor	This factor is used for multiplicative correction of the measured values. It is calculated automatically upon calibration and can be corrected here, if required. The calibration factor has an influence on the calculated concentration. Left column: Factor for span gas Internal standard: Factor for internal standard
Extra Offset	Extra offset is used for additive correction of systematic drifts in addition to the offset of the zero measurement. Extra offset is not taken into account with zero measurement or calibration. Extra offset is added to the calculated absorbance.
Extra factor	The extra factor is used for multiplicative correction of systematic derivations from the calibration factor. The extra factor has an influence on the calculated concentration. The extra factor is not taken into account with zero measurement or calibration.
Plausibility limits in % of meas. range for Zero and Calib. value	The value to be entered (default setting: 6%) defines the tolerance (in % of full scale) which must not be exceeded by Zero resp. calib. gas sampling (since the last monitoring). If the value measured at Zero resp. calib. gas sampling *is within the tolerance* as entered here: The measured value is accepted. If the value measured at Zero resp. calib. gas sampling *exceeds the tolerance* as entered here: The measured value is accepted, but a message is output to the printer and a flag (Zero: ER17, Calib ER17: ER18) is set for interrogation in *Specialist: System edit: Zero/Calib/Purge programs/other programs*. 0: No plausibility control, calibration is always performed.
Oppress value	If the measured value is less than this value, then display THIS value.
First calibration value	Calibration value e.g. after service. Display in concentration. Used to determine the drift.
Last calibration value	Calibration value of last calibration. Display in concentration. Used to determine the drift.
Actual calibration value	Actual calibration value. Display in concentration.
First zero value	Zero value e.g. after service. Display in concentration. Used to determine the drift.
Last zero value	Zero value of the last zero. Display in concentration. Used to determine the drift.
Actual zero value	Actual zero value. Display in concentration.
Actual zero value [ABS]	Actual zero value. Display in absorbance.
Zero, CALIB all comp.	If a zero or calibration program is started with the option “all components”, then THIS component is set (Yes) or not set (No).
Multiplication by result	Multiplication by the indicated result. This is used e.g. for printer correction. 0: No multiplication
Drift in [% measurement range]	Drift in % of full scale
Drift total CALIB	Drift (span gas) since last drift reset (e.g. after service)
Drift last CALIB	Drift (span gas) since last drift correction
Factor	Equivalent to calibration factor (see above in this Table)
internal	Calibration factor for internal adjustment standard
Drift total ZERO	Drift (zero gas) since last drift reset (e.g. after service)
Drift last ZERO	Drift (zero gas) since last drift correction

O_2 menu field

This menu defines the calibration of the O_2 sensor.

Span gas sampling is performed either manually from this menu or automatically via the calibration program *Specialist: System edit: Zero/Calib/Purge/Other programs* 16 (Flag 16 for component 16).

Calibration can be interrupted by either <ESC> or resetting the flag or by interrupting the calibration program.

During calibration, a message indicates for how long the O_2 signal still has to be stable. The actual O_2 values are displayed continuously.

In case of a malfunction during calibration a corresponding error message is generated.

The O_2 calibration data are stored in an individual file (SNxxx.O2C).

The changes performed become active after the next calibration.

Due to the measurement principle and procedure it is not possible to calibrate the O_2 sensor to "0". Therefore, instead of zero gas, a gas with known content of O_2 (usually instrument air with 20.95 percent by volume O_2) is fed for calibration.

Settings	
Temperature high	Nominal temperature, as set (from *Specialist: System edit: Temperatures)*
Analog In low..high [mV]	Scales the 12 bit analog input: Example: -250 mV .. +250 mV
Span gas 1 and 2 [%]	Enter span gas concentration in % Span gas 1: High concentration Span gas 2: Low concentration Example: 20.95 .. 2.1.
Span gas 1 and 2 [mV]	Display span gas 1 and 2 in mV, values and tolerance (e.g. ±0.25) can here be entered manually. Example: 0.00 .. 47.00 (±0.25)
Line constant [mV]	Line constant as calculated upon calibration. Value (-25 .. 10). Can also be entered manually. Example: 0
Steepness [mV]	Steepness as calculated during calibration. Value (35 .. 55). Can also be entered manually. Example: 47
Actual [digit] [mV] [%]	Actual value in digits, mV, %
Relay for span gas 1	The relays that are to be set resp. reset (-) upon sampling of span gas 1 can be entered here.
Relay for span gas 2	The relays that are to be set resp. reset (-) upon sampling of span gas 2 can be entered here.
Time Stability, Timeout	Time stability: 120 (example) The measured value must remain constant for minimum this time (120 sec. in the example), otherwise the calibration will start from the beginning. Time timeout: 900 (example) If no stable measured value is obtained within this time (900 sec. in the example), then the calibration is terminated and an error message (ER18) is displayed.
Start CALIB with 1 point	<ENTER> starts calibration with 1 point. If calibration was successful, a prompt is displayed "Accept?". When the answer is YES, then line constant and steepness are calculated. If calibration was not successful, then the value will be accepted anyway but an error message (ER18) is displayed. In case of a timeout the value is not accepted and an error message (ER18) is displayed.
Start CALIB with 2 points	The same as for point 1, but the 2nd test gas follows after the 1st test gas.
Set default values	"Yes": Default values are set.

From this menu, the specifications in the menu "*Main Menu: Diagnosis* and *Main Menu: Configuration: Span gases* are derived.

5.7.11.5 **Zero/Calib/Purge programs/other programs.**

Specialist: System edit: Zero/Calib/Purge programs/other programs.

The programs are programmed in this menu option.

There are 5 types of program; 4 of these program types (ZERO, Calibration (with span gas or internal standard) and backpurge) are pre-defined; and one program type is freely programmable.

Each second the programs are interrogated cyclically. If the conditions are met, then the actions are performed.

Active programs, digital conditions, flags etc. can be viewed in *Specialist: Utilities: Service: Display digital status.*

The time settings of the programs ZERO, Calibration and backpurge can also be edited in the menu option *Main menu: Configuration: Zero/Calib/Purge program*.

Settings	
Program Number	Number of program.
Program name	Name of program.
Active	Mark (✓) = program becomes immediately active upon software start. (In the further sequence, programs can be switched on/off by the parameter Pi.)
Name & message mode	The program is given a name by which it can be identified in other menus. 31 characters can be entered. For programs that are not running continuously (thus duration > 0) you can select in the right column whether the name and the remaining running time are to be displayed on the screen top or bottom or not at all.
Program type	*The programs ZERO, CALIB (internal standard), CALIB (span gas) and BACKPURGE are pre-defined by these names and can also be edited in Main Menu: Configuration: Zero/Calib/Purge programs/other programs.* The program type NORMAL is freely programmable.
Cycle	Cycle, indicating how often the program will run. DD:HH:MM: day:hour:minute Of no significance with program type NORMAL.
Start	When starting the measuring sequence the start of this program is synchronized to this time. Flag|hh:mm: Flag number OR hour:minute Flag = 0 means: Flag is not interrogated (“always set”). hh:mm of no significance with program type NORMAL.
Enable Flag	Flag for disabling resp. enabling the program. Indicate Flag number. Positive or no sign: 1: Program enabled 0: Program disabled Negative sign 0: Program enabled 1: Program disabled Programs disabled by a start condition will not be executed later.
Duration minutes	Duration of time program, thereafter the program becomes inactive again and has to be started anew. 0: Program is continuously running.
Hold	As of the start of the program, the analog output is held for this period in minutes and then released. 0: Analog output is not held.
Average at minutes	Average from this time until final time. (This makes it possible to wait for rise times.)

Only for the backpurge program:	
Interval	Total interval containing the pulse time
Length of pulse	Duration of the backpurge pulse
Relays	The pulse triggers the relay defined here. At the end of a backpurge program the relay is always set to the rest state. (No entries possible in this menu.)

Commands

The commands serve as basis for the programs.

The control of measurement sequences is defined in the programs. This is achieved by linking conditions and actions by means of logic operators.

Conditions resp. actions are again interconnections of variables with logic operators. Variables for conditions are e.g. digital inputs (DI) or high and low warning limits (WH resp. WL). These can either be active (set) or not. Variables for actions are e.g. digital outputs (DO) or programmable texts (TX) each of which can be switched on, off or over.

When performing a measurement sequence the individual conditions of activated program lines are interrogated cyclically every second. If the conditions are met, then the actions are carried out, e.g.

NOT DI12: ON DO4

This program line defines that the digital output (DO 4) is switched on, if the digital input 12 (DI 12) is not active (set).

Programs can also be entered in a short form. The example stated above would then read:

!DI12:DO4

Key assignment::	
<Shift–F3>	Copy
<Shift–F4>	Insert
<Shift–F5>	Cross-reference (display where variables are used)
<Shift–F6>	Display list of names

Syntax[1]
Formula = { Condition: [[Switch]Variable { ,[Switch]Variable } Field limiter }
Condition = Variable { [Operator] [(] Condition [)] }

1 The use of capital or small letters is free

Commands	
Variables, for interrogation only:	
Ti	Timer (i=1..116), e.g. Ti>t: Timer i greater than t (t in seconds) Ti =t: Timer i equal to t Ti <t: Timer i smaller than t Timers 1..100 are set to zero during start of program. Timers 101..116 resume operation after start of program as well as after “Power On“

Commands	
TIME, T	Time, e.g. ZT>t: Time greater than t (hh.mm.ss) ZT=t: Time equal to t ZT<t: Time smaller than t
Di	digital inputs i
AHi	high alarm of limit result i
ALi	low alarm of limit result i
WHi	high warning of limit result i
WLi	low warning of limit result i
kFi	Function key i (i = 3..8)
ERi	internal error (i = 1..32) ER1: ERROR: PROGRAM RUN ER2: ERROR: MEASURE RUN ER3: ERROR: CHOPPER MOTOR ER4: ERROR: SYNCHRONISATION ER5: ERROR: CALCULATION ER6: ERROR: MEASURECOUNTER OVERFLOW ER7: ERROR: AMPLIFIER STEP ER8: ERROR: CONTROL UNIT ER9: ERROR: Power failure ER10: ERROR: no data from LPM40 ER15: ERROR: Gain Level REF<> MES ER16: Receive gain level data ER17: ZERO-value invalid ER18: SPAN-value invalid ER19: MOD-IO box error ER32: RESET errors Internal errors are stored in a file MMddhhmm.yy3 (MonthDayHour-Minute.Year3), but not printed out directly. Confirmation of errors: Via program (flag).Errorflags 1..8: Reset at Restart of LPM40.
RHi	Measurement range 2 of analog output channel of result i active
Variable	
HRi	Hold result i
HAi	Hold signal output channel i
DOi	digital output (relay) i
Fi	Flag i (i=1..200)
Ni	Zero setting of component i
Ci	Calibration of component i with span gas
CCi	Calibration of component i with internal standard
TXi	Text i
Pi	Program i (Start/Stop of programs,)
Commands, upon interrogation only	
UND, AND, &	Logical AND
NICHT, NOT, !	Logical NOT
ODER, OR, ¦	Logical OR
XODER, ^, #	Logical XOR
ANSONSTEN, ELSE	Always true (dummy)
(,)	Parenthesis (with interrogations)
<, >, =	Smaller than, greater than, equal to (with interrogations)
:	Go on only if condition is met
;	Go on only if condition is not met
/Fx	Condition is “true”, if transition of flag is from “false” to “true“
\Fx	Condition is “true”, if transition of flag is from “true” to “false“
Commands, upon setting only	

Commands	
+, ON, EIN, SET	Set (can also be omitted) For timers: Resume operation
-, OFF, AUS, RES	OFF, reset, For timers: Set to zero
~, INV, UM, NEG, TOG, CMPL	Toggle
?, IS, IST, EQU	Set according to interrogation condition
*	For timers: Stop operation
Other commands	
%	Separation of program parts (always continue)
$	Comment

5.7.11.6 **Sample switching**

Specialist: System edit: Sample switching

With MCS100E, sample (point) switching is possible by switching cyclically from one sample point to the next. The system is pre-purged for a selectable time with the new sample gas, before the new measured value is accepted.

Settings	
No. of Sample points	Number (max. 16) of sample points
Start time	When starting the MCS100E, the start of sample switching is synchronized to this time.
Sample point number	Number of sample point to be edited
Values hold/zero	Defines whether the values from the inactive (=not being measured) sample point should be held (“Hold”) or set to zero (“Zero Setting”).
Remote control	Inclusion of sample point into sample point switching via digital input. Select number of digital input. (LOGICAL AND by “Internal control”)
Internal control	Inclusion of sample point into sample point switching via flag. Select number of flag. (LOGICAL AND by “Remote control”)
Sample selected minutes	Specifies in minutes for how long the sample point will be active.
Sample selected relay	THIS relay will be set/reset (-) as soon as the sample point is active.
Sample data valid minutes	Defines the pre-purge period. The “last” minutes are “valid”.
Sample data valid relay	THIS relay will be set/reset (-) as soon as pre-purge is terminated and measurement is performed at the sample point.

This menu is identical to the menu option *Main Menu: Configuration: Sample switching*.

5.7.11.7 **Results**

Specialist: System edit: Results

In this menu, option results are calculated, i.e. the raw data are processed according to the formula entered to obtain e.g. values of concentration, absorption, flow rate, volumes etc.

The drift values for QAL3 (→ p. 21, §2.7) can be processed and reset.

The "Results" menu is the basis for other menus which make use of the results ("R") calculated therein. In the latter menus, only a list containing the corresponding result numbers is displayed from which you can make your selection.

Max. 64 results can be selected and activated.

The results are calculated every second.

As a default setting the results 1..24 correspond to the components 1..24. Linearization and interference tables can be applied to these results.

Although the default setting can be modified, this option should only be used if the results exceeding R24 do not suffice for the calculations.

If data are read-in via the serial interface *(Specialist: System edit: Data storage and send to PC)*, then the data are fed to the results (secondary variable S1i with MCS protocol, Ri with ModBus protocol). For a detailed description of the protocols please refer to → p. 126, §9.3.

Key assignment:
Shift F3: Copy from other lines

Settings	
Result	Mark (✓) = result is calculated. The mark cannot be selected, if there is an error in the formula.
Name	Name of component
Unit	Unit of component.
Formula	The calculations are entered in this column. The length of the input buffer is 80 characters.

Arithmetic Operators	
+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Exponentiation
(,)	Parentheses, for bracketing terms
[,]	Brackets, for bracketing indices
,	Comma, to separate variables resp. indices
Primary variables	
ST	(Data storage cycle / Sample Time)
AT	(Actual Time)
Secondary variables:	
Ri	Results (i = 1..64) Default settings are: R1..R14: Sample components 1..14 R15: Flow meter R16: O_2 sensor R17..R24: Analog inputs 1..8 R25..R32: Temperatures[1] Upon receipt via Modbus protocol: (✓) "Results" Ri = "Formula" Ri)
Ali:	Analog input channel (i = 1..32)

Arithmetic Operators	
TPAi, TPNi:	Actual/Nominal temperature/pressure (i = 1..33) Default settings are (x = A,N): TPx01: O_2 sensor TPx02: Detector TPx03: Cell TPx04: Filter wheels TPx05: Heating controller 1 channel 1 TPx06: Heating controller 1 channel 2 TPx07: Heating controller 2 channel 1 TPx08: Heating controller 2 channel 2 etc.
P	At the end of a secondary variable R, K, A, AI means: Previous value
S1i	ith value from serial MCS protocol (i = 1..16)
Ti	Timer (i = 1..116)
Fi	Flag (i = 1..99)
Arithmetic functions:	
SIN	Sine
COS	Cosine
ARCTAN	Arcus Tangens
SQR	Square
SQRT	Square Root
EXP	Exponential function
LN	Natural logarithm
LG	Decadic logarithm
INT	Integer
SGN	Sign change
ABSVAL	Amount
PI	Constant
Special functions	
KONZ, CONC:	Concentration, e.g. CONC [1,2] (Concentration of sample point 1, component 2)
EXT, ABS:	Absorbance, e.g. ABS [1,2] (Absorbance of sample point 1, component 2)
MES:	Measuring signal of a component, e.g. MES [1,2] measured value of sample point 1, component 2
REF:	Reference signal of a component, e.g. REF [1,2] reference value of sample point 1, component 2
TPF1, LPF1:	Low pass of 1st order, e.g. TPF1 (EXT [2.3],20), (filtering of absorption from sample point 2, component 3 with low pass of 1st order of 20 s.)
TPF2, LPF2:	Low pass of second order
CAL:	Mean square fit data, e.g. CAL (R3,1) Calculation with result 3 as input signal for table 1.

1 R25..R32 are equivalent to TPA1..TPA8 (see secondary variable TPAi)

Note: Sample point index “0” means: Active sample points

5.7.11.8 Definition of Components

Specialist: System edit: Definition of Components

As a default setting the results 1..24 correspond to the components 1..24. Linearization and interference tables can be applied to these results.

Result	Default setting
01..14	Sample components 1..14
15	Flow meter
16	O_2 sensor
17..24	Analog inputs channel 1..8 (I/O module boxes)

Setting	Meaning
Is there an aperture at position 8 of filter wheel 1	Yes: MCS100E avoids a filter wheel position where there are 2 subsequent empty apertures (overload of detector) by first positioning filter wheel 2 on a filter and then filter wheel 1 on an empty aperture.
If filter wheel 3 is used for calibration	Yes: Filter wheel 3 is moved to the corresponding filter during calibration of one component.
Wait time until start of integration	Waiting time from swinging in the measurement filter until start of measurement (valid for ALL components). Standard value: 125 ms.

Settings	
No.	Number i equals component i
active	Mark = active (✓) (valid for i = 1..16) Analog inputs always automatically have a mark, as soon as an I/O module box with analog inputs is connected. The marks have to be set for the flow meter (K15) and O_2 sensor (K16).
Name	A list is displayed (based on *Specialist: System edit: Results*). The name of the component that is to be measured can be seen. Default setting is: Result number = Component number.
Unit	Displayed automatically from "*Specialist: System edit: Results*"
Measurement per cycle	Defines how often (1..9 times) the component is to be measured within one cycle. Subsequently, the cycle time is calculated. "0" means: This component will not be measured. Note: The components are measured one after the other, no other components are measured in between.
Time [ms] wait	Wait time until start of measurement for *Reference signal* (sample filter see below) in ms. Default values are presented, scroll with <ENTER>. Standard value: 125 ms.
Time [ms] integ.	Integration time in ms. Default values are presented, scroll with <ENTER>. Standard value: 500 ms.
Reference signal	Position of reference filters
Measuring signal	Position of sample filters
F1, F2, F3	Filter wheel 1, 2, 3. Usually: F1: Interference filter F2: Gas filter F3: Span gas filter or internal standard
Gi	i = amplifier level (i = 1..19) Enter amplifier level manually. For automatic setting go to: *Specialist: Utilities: Service: Control Detector unit Tst5 (Gain calculation)*.
T90	T90 time (0..1200 sec.). Floating mean value.

5.7.11.9 **Linearization tables**

Specialist: System edit: Linearization tables

Linearization tables are used to calculate absorbance into concentration, but also to calculate digits into analog values or scaling of the flow meter, etc.

The linearization tables are assigned to the components in *System edit: Calibration data* and subsequently calculated automatically.

The name of the component that was assigned to the table is stated at the top of the linearization table.

- Default settings:

Component	Linearization table
1	Lin. table 1
2	Lin. table 2
...	Lin. table ...
13	Lin. table 13
14	1:1000 table (for service purposes)
15	Internal throughflow
16	O_2

Modifications to this assignment are free.

Up to 10 pairs of values can be recorded. These are entered in the table where absorbance is assigned to concentration. The values entered can be set active (mark(✓)) or inactive, and will correspondingly be used or not used for calculation.

For the default settings for linearization please refer to your system documentation.

Settings	
Lin-TAB	Number of table. The name is identical to the name of the component which this table is assigned to (in "*System edit: Calibration data*").
Fit point	Fit point 1..10
Mark (✓)	Mark (✓) = calculate. If no mark is set, then the pair of values is inserted at the end of the table and not calculated.
Absorbance	Enter measured absorbance
Concentration	Enter nominal concentration.
Coefficients	Are calculated automatically and entered here

Key assignment::	
Shift F5	Display actual value (in Abs. or Conc.). <ENTER>: Accept displayed value.
F8	Represent linearization curve graphically. The numerical display corresponds to the pairs of values from the table. Key 3: Change scales.

Example for a 4 .. 22 mA analog input:

0 .. 4095 Digits correspond to 0 .. 22 mA
Measured value required: 0 at 4 mA and MaxValue at 20 mA

Table entries	
Absorbance	Concentration
744	0
3724	MaxValue

5.7.11.10 **Interference table**

Specialist: System edit: Interference table

Interference tables (IF-Tables) are used to correct overlapping spectra.

- Additive interference tables (e.g. for overlapping spectra)
- Multiplicative interference tables (e.g. for dilution effects).

The interference tables are assigned to the components in "*System edit: Calibration data*" and automatically calculated - if a mark is set.

4 interference tables per component can be calculated. Default assignment (the assignment can be changed):

Component	IF table
1	IF tables 1..4
2	IF tables 5..8
...	IF tables ...
16	IF tables 61..64

The first 3 tables are used preferably for additive IF, the 4th table is used for multiplicative IF.

Additive interference

The spectra of the components are overlapping. The interference can be calculated by subtraction of the interfering component. For this purpose, the interfering component must be measured at another place of the spectrum which is free from the influence of further interferences. This influence is corrected by the additive IF-Table.

Multiplicative interference

The absorbance coefficient of the sample component is influenced by the interfering component. The interference is compensated by a correction factor. For this purpose, the interfering component must be measured at another place of the spectrum which is free from the influence of further interferences. This influence is corrected by the multiplicative IF-Table.

Settings	
IF-Tab.	Number of table. The name is identical to the name of the component which this table is assigned to (in "*System edit: Calibration data*").
IF-Component	Component number and name (from *Specialist: System edit: Definition of components*) of interference component
IF-Type	additive or multiplicative.
IF-Signal	Absorbance or concentration, dependent upon what is to be entered.
Fit point	Fit point 1..10
Mark (✓)	Mark (✓) = calculate. If no mark is set, then the pair of values is inserted at the end of the table and not calculated.
Absorbance	Absorbance of sample component. Enter manually.
IF-Component	Enter IF-Absorbance/Concentration, depending on what is indicated in "IF-Signal" (see above)

Key assignment:	
Shift F5	Display actual value (in Abs. or Conc., depending on IF Component). <ENTER>: Accept displayed value.
F8	Represent linearization curve graphically. The numerical display corresponds to the pairs of values from the table. Key 3: Change scales.

5.7.11.11 **Limit values**

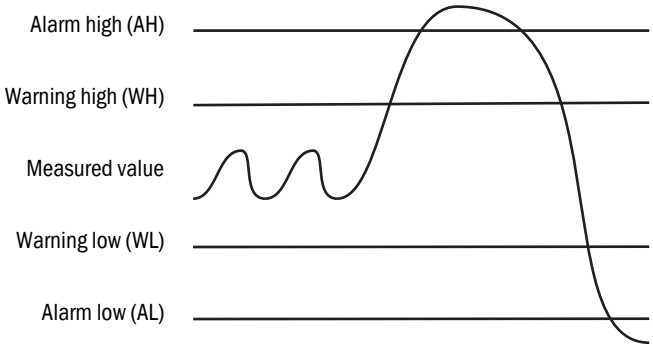
Specialist: System edit: Limit values

In this menu the limits that can be interrogated by Specialist: System edit: Zero/Calib/ Purge programs/other programs are defined. The menu is based on "*Specialist: System edit: Results*".

The limits correspond to the units displayed.

There are two lower and two upper limits.

Figure 19 Limit values



Values falling below or exceeding the limit can be interrogated in *Specialist: System edit: Zero/Calib/Purge/other programs* with the variables AH, AL, WH, WL.

There is no hysteresis.

The limits with a mark (✓) are verified.

5.7.11.12 **Temperatures and Pressure**

Specialist: System edit: Temperatures and Pressure

> Changing the temperature affects the measurement operation and can cause instrument damage.

The temperatures and the pressure correction managed by the system control are defined in this menu option.

The heating controllers provide 12 bits (0 .. 4095 digits).

For default settings please refer to the status print-out in your system documentation.

Control function of heating controllers

The control function of the heating controllers is as follows:

- Temperature exceeding Nominal+Hysteresis: Heating off
- Temperature lower than Nominal+Hysteresis: Heating on

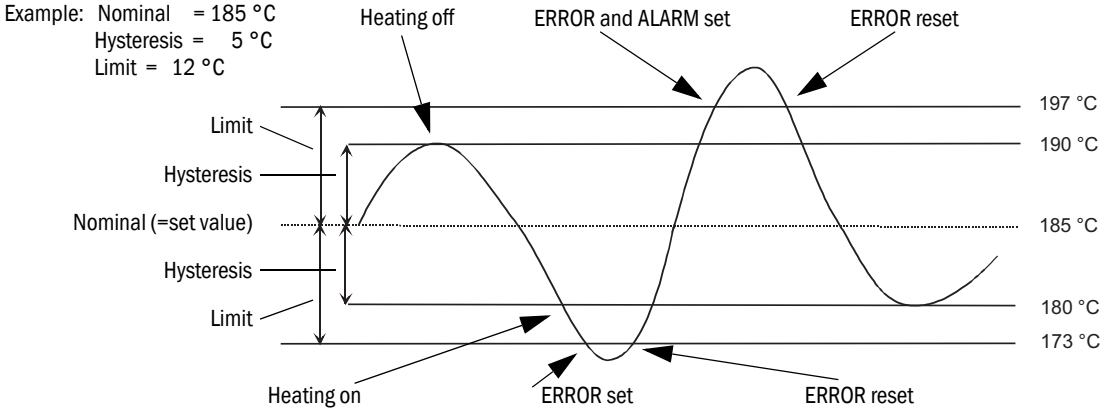
- Temperature lower than Actual Limit low:
  Relay “ERROR” is set.
- If the temperature again exceeds this value, then:
  Relay “ERROR” is reset.

- Temperature exceeding Actual value+Limit high:
  Relays “ERROR” and ALARM are set.
- If the temperature again falls below this value, then:
  Relay “ERROR” is reset; the relay “ALARM”, however, remains set. It must be reset by a RESET.

The relays ERROR and ALARM are edited in Specialist: System edit: Zero/Calib/Purge programs/other programs.

For RESET of the alarms, the error message ER 32 (*Specialist: System edit: Zero/Calib/Purge programs/other programs* is used.

Figure 20 Switching thresholds of the temperature controllers



Settings	
No.	1: Temperature of O_2 sensor 2: Temperature of detector 3: Temperature of cell 4: Temperature of detector unit[1] 5: Temperature of heating controller 1, 1st controller, e.g. sample gas pump 6: Temperature of heating controller 1, 2nd controller, e.g. heating hose 7: Temperature of heating controller 2, 1st controller 8: Temperature of heating controller 2, 2nd controller ... 32: Temperature of heating controller 13, 2nd controller 33: Printer *The temperatures and the pressure can be interrogated in Specialist: System edit: Results* (as of result 25) and in *Specialist: System edit: Zero/Calib/Purge/ other programs* (parameter TPA).
Name	Name of unit to be controlled. A selection list based on *Specialist: System edit: Results*
Actual	Actual value in °C resp. mbar (display, only)
Nominal	Nominal value in °C resp. mbar (can be entered)
Hyster.	Valid for temperature only. The hysteresis (in °C) defines the switching thresholds of the temperature controller Actual > Nominal+Hysteresis => Heating off Actual < Nominal-Hysteresis => Heating on *Caution*: The first 3 heating controllers for O_2 sensor, Detector, Cell, cannot switch a hysteresis. Set "0".
Limit low	Temperature/pressure difference to lower limit in °C resp. mbar for error relay
Limit high	Temperature/pressure difference to upper limit in °C resp. mbar for error and alarm relays
Offset	Temperature = ((Value of Controller) / Factor) + Offset Value is fixed and cannot be changed.
Factor	Scaling factor Temperature = ((Value of Controller) / Factor) + Offset Value is fixed and cannot be changed.
Relay ERROR	Relay number of error relay (inverted possible) 1: Actual > Nominal+Limit high 1: Actual < Nominal-Limit low 0: Limit not exceeded *The relay is interrogated in Specialist: System edit: Zero/Calib/Purge programs/ other programs*.
Relay ALARM	Relay number of alarm relay (inverted possible) 1: Actual value > nominal value+limit high Independent of a temperature decrease (external heating controller 5..32), the relay remains set until RESET is carried out. *The relay is interrogated in Specialist: System edit: Zero/Calib/Purge/other programs*. For RESET the error message ER 32 (*Specialist: System edit: Zero/Calib/Purge programs/other programs* is used.

[1] Only measurement, inputs are not processed

5.7.11.13 **Protocol Definition**

Specialist: System edit: Protocol Definition

This menu option is used to make a print-out (protocol) of the *stored* data.

5 types of protocols can be created and given a name - to ease identification.

Settings	
Protocol type (1..5)	Selection of one of the 5 protocol types
Name	These names are used to ease identification, e.g. at protocol start and stop.
Output to	Only “Printer” possible
Filtering	Yes: Addition over the cycle time, divided by the number of measured values and subsequent output of the value. No: Actually current value is output
Cycle [Min]:	Output cycle time (in minutes) for printing. 0: Per measurement cycle one value is output.
Component selection	Selection of the components that are to be printed. (The list is derived from the menu *Specialist: System edit: Results*). By <ENTER> a list containing the *actual* components is displayed. If a field is selected within this list, then a list containing the *possible* components is presented. xxxxx.xx defines the format for display of the measured values, in this example 2 digits following the decimal point; changeable with <ENTER>.
Characters per line	Number of characters per line dependent on the paper format. Default setting: 80
Lines per page	Number of lines per page dependent on the paper format. Default setting: 72
Decimal separator	Decimal separator Comma or point
Format date	Format of date, change with <ENTER>.
Separator of date	Separator of date: . or /
Separator of time	Separator of time: 14:55:00 or 14-55-00 *Note:* The separators of date and time should be different to enable an evaluation program to find a distinguishing feature.
Separator, column	9: TAB stop Separator for individual measured values. The decimal value of the ASCII character is entered here as these are usually non-printable characters.
Separator, line	13, 10: CARRIAGE RETURN, LINEFEED The entry of 2 characters is mandatory. The decimal value of the ASCII characters is entered here as these are usually non-printable characters.

File extension for the protocol files is ”.txt”. Protocol files can be edited in the usual table calculation programs.

The printer protocol settings *Main Menu: Printer: Print Archive Protocol Definition* and *Specialist: System edit: Protocol Definition* are identical.

5.7.11.14 Data storage and send to PC

Specialist: System edit: Data storage and send to PC

In this menu, the continuous sending of results and signal outputs and the receipt of the data are defined.

- If stored to the internal hard disk (Flash disk) storage mode “active”), the program automatically calculates the length of the files that will be created.
  When pressing F1 while you are in one of the main menu fields, the free disk space remaining is displayed.
- When selecting “PC protocol”, the data are output resp. read-in via the serial interface (*Specialist: Utilities: Service: Environment Configuration* : *Interfaces*). Read-in data will be shown in the results just like measured values (Parameter S1i at MCS protocol, Ri at ModBus) (menu *Specialist: System edit: Results)*.

Settings	
Results	A mark below the result shows when it is chosen. When selecting *Results*, a mask appears.
Storage mode	Active / not active: Data will be stored / not stored on the internal hard disk according to the setting. It can be chosen between “results” and “signal output”. The “results” are stored according to the setting below: “Length of data file”. When “signal outputs” is selected, signals are stored each 60 seconds. One file is generated for each day and each channel. Max. number of days: 1 month, ring buffer function. Name of the file: C:\DATALOG\CHxx\xxdd.dat | | | | | dd= day xx=channel number
Flag “measure”, “calibration”	Valid for Modbus protocol only. These are the numbers of the flags indicating “measure” or “calibration” status. The Modbus master recognizes by the set flag which operating mode is active at present.
Length of data file	Valid for “Storage mode “active“” with “results”, only. Period of time until terminating a measured value file. At the end of the period defined, the file is closed and a new file is opened. From the length of the file and the number of results to be stored, the program calculates the size of the file to be created. *Caution*: Upon failure of the computer (e.g. power failure) all data from a measurement file that is not yet completed will be lost.
Period (Cycle)	Cycle time of data storage and transmission to serial interface.
Device address	Device address (0..200) for identification for external data acquisition systems.
PC Protocol	*Modbus RTU (Slave)*: MCS100E functions like a ModBus Slave. Modbus RTU (Master): MCS100E functions like a ModBus Master. *MCS only on request*: MCS100E sends data to the serial interface on request, only. MCS100E is continuously ready for receiving data. *MCS on request and in cycles*: MCS100E sends data on request and in cycles to the serial interface. MCS100E is continuously ready for receiving data. *Modbus Definition:* The menu that is presented is used for setting the ModBus parameters. This requires detailed knowledge of the ModBus structure. During data transmission the address offset is always added to the start register, resp. only subtracted when data are received, if the start register > address offset. *Modbus Test (Data exchange)*: This menu is designed for service purposes, only, to test the ModBus communication. The data sent and received are presented as hexadecimals.

When making changes in the selection of the results or in the length of the data file: Move the cursor once over the field “length of data file” to trigger a new calculation.

Status bars 1 and 2 are always stored to archive, independent of active/ inactive data storage (→ p. 44, §5.2).

5.7.11.15 Softkey menu definition

Specialist: System edit: Softkey menu definition

The action activated by the function keys is dependent from the user. Therefore it is not handled in this manual. For the functions of the function keys please refer to your system manual.

8 softkey menus can be created and totally 64 menu windows can be assigned correspondingly. When calling-up the menu option, the menu windows are displayed at first. Switch over to the softkey menus by <ESC>.

Assignment of the Figures to the menus is done in the soft key menus. (→ p. 87)

Menu windows

Entries for the 32 menu windows	
Menu number	Numbering
NAME ON	Text, displayed if an action is switched on.
NAME OFF	Text, displayed if a switched-on action is going to be switched-off again.
Confirmation	Yes: The prompt: “Save changes Y/N?” is displayed.
TOGGLE ON/OFF	Yes: It is possible to toggle NAME ON/ NAME OFF (see above).
Enable Flag	Flag number for disabling/releasing the menu (Flag set = released)
Activate flag	Flag number to display/not display the menu (flag set = menu is displayed)
Set flag	Flags that are set (- = reset) if the menu is active.
Sub-menus	Sub-menus displayed, if the menu defined here is active.
Position x	Vertical position of the sub-menu, x = line number
Position y	Horizontal position of the sub-menu y = column
Direction	Vertical or horizontal size of the sub-menu window
Simulated key	Program-internal key assignment (e.g. key <F8> simulates key 8)

An existing menu can be copied to a new one by the means of the keys <F5> or <Shift-F3>.
The question: “Copy from....” appears.

Softkey menus

8 softkey menus are possible:

Pre-assigned menus	
0	Main menu
1	Bargraph display
2	Graphical display
3	Linearization
4	Graphic outputs
5 - 7	free

Settings	
Number	Number of the softkey menu (0..7). Open the menu with <ESC>.
Name	Name of the softkey menu
Key	Key <F3>..<F8> opening the menu window, pre-defined.
No.	Number of the menu window, displayed automatically
Name	When pressing <ENTER>, a list containing the 32 possible menu windows is presented. Select requested window with <ENTER>.

Note: If a sub-menu window is open in the graphic, then the graphics display is not updated.

5.7.11.16 Mean square fit data

Specialist: System edit: Mean square fit data

Mean square fit data are used to calculate arithmetic functions, e.g. to scale or linearize analog inputs. The mean square fit data are read-in by CAL in *Specialist: System edit: Results*.

Totally, 10 tables can be calculated.

The columns “value X” and “value CAL” can be edited resp. modified alternatively. After pressing <ENTER>, the fit point (pair of values X and CAL) is sorted into the table according to the value of the X value.

“Remark” contains explanatory text.

The arithmetic function according to which the fit points are to be calculated, is entered into the line “Formula”. *“Formula” is identical to the formula that can be entered in Specialist: System edit: Results. Instead of the formula, also the identification of a calculation from the tables of Specialist: System edit: Results* or *Specialist: System edit: Signal output* or *Specialist: System edit: Graphic output* can be entered.

Key assignment:	
<F8>	Display curves graphically
<Shift–F5>	In field X or f(X): Display the calculated formula value. <ENTER>: Accept displayed value.

5.7.11.17 Operator's Notebook

Specialist: System edit: Operator's Notebook

The names listed in the operator’s notebook are only used as a memory aid when entering programs or when printing etc.

5.7.12 System, select for editing

Specialist: System, select for editing

Here, you can select a system (= measurement sequence) for display/editing.

A list of the directories containing the measurement sequences (corresponding to the existing measurement sequences) is presented. The names of the directories are identical to the names of the measurement sequences (systems).

The *current* measurement sequence is not affected and remains active; i.e. you are free to edit/modify the selected measurement sequence according to your requirements without interfering with the current measurement.

If, subsequently, you want to activate the modified measurement sequence, then select the menu "*Specialist: System, activate for measurement*".

Entries that are only possible during on-line operation (e.g. zero setting, calibration, etc.) can, of course, not be made when editing an inactive system (measurement sequence).

5.7.13 System, create for editing

Specialist: System, create for editing

In this menu option, the active measurement sequence can be copied to a new one with a new name.

This has no effect on the active measurement sequence and the new measurement sequence can be edited in Specialist: System, edit (name) and activated by *Specialist: System, activate for measurement,* if required.

An entry field is presented for creating a new measurement sequence. You can enter the new name (max. 8 letters), here. The program will then automatically create a subdirectory with exactly this name containing the new measurement sequence. Subsequently, all program files will be contained in this sub-directory.

5.7.14 System, activate for measurement.

Specialist: System, activate for measurement.

This menu is used to activate (= start) another system (= another measurement sequence). A list of the directories containing the measurement sequences (corresponding to the existing measurement sequences) is presented. The names of the directories are identical to the names of the measurement sequences (systems).

Upon selection, a safety prompt is displayed. If your answer to the prompt is positive, then the new system (the new measurement sequence) becomes active, and the old system is deactivated automatically.

The system (=measurement sequence) started when calling in the MCS100E program is derived from the configuration file MCSCONF, menu: Directories and Files (→ p. 123, § 9.1.3.4).

If you wish another measurement sequence to be activated upon program start, then you must enter this in the MCSCONF, menu: Directories and Files.

5.7.15 Utilities

Specialist: Utilities

5.7.15.1 Show files

Specialist: Utilities: Files, show

The directories and files of the MCS100E are displayed in this menu.

5.7.15.2 Copy files

Specialist: Utilities: Files, copy

This menu is used to copy files on the hard disk of the MCS100E.

After having marked the files (using the space key) and subsequent confirmation with <ENTER>, you are prompted to enter the “destination path“

for the copy procedure.

Please refer to: *Specialist: Utilities: Files, send to PC* if you want to copy files to an external PC

Note: Directories cannot be copied.

Caution: Make sure not to overwrite program files, unintentionally (File name = Directory name).

5.7.15.3 Erase files

Specialist: Utilities: Files, erase

This menu is used to erase files.

After having marked the files (using the space key) and subsequent confirmation with <ENTER>, a safety prompt is displayed “Erase all tagged files? (Y/N)”.

Caution: Make sure not to overwrite program files unintentionally (File name = Directory name).

5.7.15.4 Send files to an external PC

Specialist: Utilities: Files, send to PC

This menu option is used to send files to an external PC.

In *Specialist: Utilities: Service: Environment Configuration* : *Interfaces,* the PC interface must be configured. The MCS100E measurement program must also be in operation on the external PC.

The following can be sent:

- System data
- Special data

A menu for selection of the desired data is displayed.

After having marked the files (using the space key) and subsequent confirmation with <ENTER>, you are prompted to enter the “destination path”

Enter the destination path of the external PC here.

Directories cannot be copied.

5.7.15.5 **Receive files from PC**

Specialist: Utilities: Files, receive from PC

This menu is used to copy files from an external PC.

In *Specialist: Utilities: Service: Environment Configuration*: *Interfaces,* the PC interface must be configured. The MCS100E measurement program must also be in operation on the external PC.

After having marked the files (using the space key) and subsequent confirmation with <ENTER>, you are prompted to enter the “destination path“

Enter the destination path of the external PC here.

Note: Directories cannot be copied.

Caution: Make sure not to overwrite program files unintentionally (File name = Directory name).

This menu cannot be selected (displayed in light grey) when the ModBus protocol is active.

5.7.15.6 **Files directory**

Specialist: Utilities: Files, directory

Presents the directories and files

5.7.15.7 **Service (TEST)**

Specialist: Utilities: Service (TEST)

This program section is only intended for service and test purposes.

5.7.15.7.1 **Environment configuration**

Specialist: Utilities: Service: Environment configuration

Display Setup

Specialist: Utilities: Service: Environment Configuration : Display Setup

This menu is used to set the display parameters.

Note: The settings are not saved.

Key assignment:	
ARROW RIGHT, ARROW LEFT	Scroll up/down
ARROW UP, ARROW DOWN	Change settings

TEXT file

Specialist: Utilities: Service: Environment Configuration : TEXT file

This menu is used to select the language of the menu texts. The corresponding files are identified as:

M1Exxx.TXT whereby xxx e.g. DEU (German), ENG (English).

After selecting the language, go to the main menu to activate the language.

If you select any other than a .TXT file, then texts can no longer be displayed, and the measurement program ceases to operate.

► Then, perform a RESET and restart the software (1.bat).

If the file was not entered correctly in the MCSCONF:

► Correct in *Directories and Files* (→ p. 123, §9.1.3.4) and subsequently start measurement program anew (1.bat)

The language used when calling in the MCS100E program is derived from the configuration file MCSCONF, menu: Directories and Files (→ p. 123, §9.1.3.4). If you wish another language to be activated upon program start, then you must enter this there.

HELP file

Specialist: Utilities: Service: Environment Configuration : HELP file

This menu is used to select the language of the help texts. The corresponding files are identified as:

M1Exxx.HLP whereby xxx e.g. DEU (German), ENG (English).

The language used when calling in the MCS100E program is derived from the configuration file MCSCONF, menu: Directories and Files (→ p. 123, §9.1.3.4).

If you wish another language to be activated upon program start, then you must enter this there.

Directories

Specialist: Utilities: Service: Environment Configuration : Directories

The structure of the directories of the program can be modified in this menu. The directories for

- Program
- Graphic
- Temporary files are interrogated one after the other.

The structure of the directories used when calling in the MCS100E program is derived from the configuration file MCSCONF, *menu: Directories and Files* (→ p. 123, §9.1.3.4). If you wish another directory structure to be activated upon program start, then you must enter this there.

Set Date and Time

Specialist: Utilities: Service: Environment Configuration : Set Date and Time

Date and time can be set in this menu.

When switching over from summer to winter time (time set back by 1 h), the (saving) times of the data files may become overlapping.

► To avoid that duplicate entries affect the evaluation of stored files, stop data recording (*Specialist: System edit: Data storage and send to PC*) and erase those files that were created in the preceding hour.

Interfaces

Specialist: Utilities: Service: Environment Configuration : Interfaces

The hardware default settings of the interfaces are:

COM1	Detector
COM2	I/O module box (opto-interface)
COM3	Pressure/PC/Modem interface (opto-interface)
LPT1	Internal parallel printer interface

- If data are to be sent to an external PC (send data to PC), you must set
  - the printer to COM- or LPT1
  - the PC to COM3
- If a printer is connected (e.g. for on-line protocol), you must set:
  - the printer to COM3 and
  - the PC to COM-
- If a modem is connected, you must set :
  - the printer to COM or LPT1
  - the PC to COM-

Usually pre-assigned:

Data bits	8
Stop bits	1
Parity	No

Default setting (example) for data to printer:

Detector	COM1	9600 Baud
I/O module boxes	COM2	9600 Baud (opto-interface)
Printer	COM3	4800 Baud (opto-interface)
PC	COM–[1]	9600 Baud

1 – means: Interface is not assigned

Interrupts

Interrupt assignment is a default setting (dependent on the hardware configuration) and has to be modified in certain individual cases.

Default setting:

COM	IRQ
1	7[1]
2	5[12]
3	4
4	3

1 Can also be assigned to LPT 1/2.
If used by COMi: LPTi disable

2 Reserved for I/O module box

5.7.15.7.2 **Control Detector unit**

Specialist: Utilities: Service: Control Detector unit

This menu option contains the display and calibration of the components activated in "*Specialist: System edit: Definition of components*" as well as a variety of tests.

Settings	
REF Meas	Energy of the reference resp. measurement signal in counts, dependent of the gain factor (i.e. counts increase with the gain factor).
ABS raw	Display of absorbance, not corrected.
ABS add	Display of additively corrected absorbance.
ABSORB.	Display of completely corrected absorbance.
CONCENT	Calculated concentration
CALIBRATION	Predefined calibration value
Calibration factor	Upon <ENTER>, the calibration factor is calculated is such a way that the CONCENT. equals the value pre-defined in CALIBRATION.
ZERO SET	Actual value is set to "Zero"
Tst 0	Terminate all switched-on tests.
Tst 1	LPM40 send disable
Tst 2	LPM40 send enable
Tst 3	LPM40 restart
Tst 4	Test signal on. Instead of the detector signal a testsignal is enabled for the pre-amplifier.
Tst 5	Test signal off. Disables the test signal enabled in test 4.
Tst 6	Determine amplification
Tst 7	Send data to LPM40
Tst 8	No synchronization
Tst 9 .. Tst 15	Not used
Status Detector	
0	OK
8	Power failure on LPM40

At the bottom, left, the measurement cycle time and the component that is being measured, are displayed.

5.7.15.7.3 **Dialogue Detector unit**

Specialist: Utilities: Service: Dialogue Detector unit

Dialogue with detector unit: Only for service purposes

ASCII - Hex - switch-over: ALT H

Echo ON/OFF: ALT E

Menu exit: F2 or ALT X

5.7.15.7.4 **Dialogue heat control**

Specialist: Utilities: Service: Dialogue heat control

Dialogue with heat control: Only for service purposes

ASCII - Hex - switch-over: ALT H

Echo ON/OFF: ALT E

Menu exit: F2 or ALT X

5.7.15.7.5 **Dialogue external PC**

Specialist: Utilities: Service: Dialogue external PC

Dialogue with external PC: Only for service purposes

ASCII - Hex - switch-over: ALT H

Echo ON/OFF: ALT E

Menu exit: F2 or ALT X

5.7.15.7.6 **Initialisation of I/O modules**

Specialist: Utilities: Service: Initialisation of I/O modules

Settings			
Progr. existing I/O modules	All addresses of existing and active boards of the I/O module boxes are displayed and can be changed.		
Progr. new I/O modules	All addresses of existing and active boards of the I/O module boxes are displayed and – for new boards – addresses can be added.		
	For analog input, analog output, and heating controller: While choosing an address, the read values are displayed (ACTUAL parameters) as well as recommended default values (NOMINAL parameters). The nominal parameters can be altered and programmed (programming will be prompted while leaving the menu).		
		Possible entry	Meaning
	Function	DO DI AO AI HC	Digital output Digital input Analog output Analog input Heating controller
	Gain	-32768...32767	Default = 0 (K = 1.0)
	Offset	-4096...4095	Default = -102
	Gain/Offset Correction	ON/OFF	Default = ON
	HC mode	H1, T1, B1[1]	Default = H1
	Write protection	ON/OFF[1]	Default = ON
Search existing I/O modules	All I/O module boxes are searched and the addresses found are displayed.		

[1] Only for function HC

You can assign an address to one board at a time, only. All other boards must be switched to the “not active” condition. There is a corresponding message in the menu.

- For assigning addresses to the boards→ “I/O Module Box, User's Manual“

5.7.15.7.7 **STOP, START measure**

Specialist: Utilities: Service: STOP, START measure

Only for service purposes

Upon measurement “STOP”, all interfaces (e.g. internal LPM40, I/O module boxes) are deactivated.

Upon measurement “START”, all interfaces are re-initialized and the measurement sequence is started.

5.7.15.7.8 Measuring signal settings

Specialist: Utilities: Service: Measuring signal settings

In this menu the ZERO and calibration data are set to “first” value (the subsequent drift calculations of zero settings resp. calibrations will be based on these values).

ZERO: Set ACTUAL to FIRST (of all components)

CALIBRATION: Set ACTUAL to FIRST (of all components)

Set pre-amplifier level: Automatic adaptation of amplifier

The actions are started by <ENTER> in the corresponding line. A safety prompt will be displayed.

These actions are recommended to be performed after a service.

5.7.15.7.9 Display numerical values

Specialist: Utilities: Service: Display numerical values

This menu shows the calculated results, analog outputs and curves in numerical values.

Settings	
Channel	R = Result A = Analog outputs K = Curves
Name	Name of component
Value	Value calculated
Unit	Unit of component

5.7.15.8 Display, digital status

Specialist: Utilities: Service: Display, digital status

This menu shows the digital status (digital inputs/outputs, relays, flags, timer) of MCS100E.

Settings	
0	Status “not set”
1	Status “set”

MCS100E

6 Decommissioning

Switch off
Disassembly
Storage
Disposal

6.1 Switch off

WARNING: Hazard resulting from substances remaining in the cell
When switching off the gas supply and depending on the sample gas composition, it is possible that toxic or corrosive gases remain in the cell and the connected pipes. If necessary:

- ► Purge the cell and the connected pipes for at least 1 h with inert gas (e.g.: N_2).
- ► Take suitable protective measures (e.g. working under a vent, wearing suitable protective clothes).
- ► Decontaminate the cell.

1 Purge the MCS100E with inert gas for min. 1 h.
2 Exit the measurement program (→ p. 46, §5.4.2).
3 If necessary, unplug voltage plug resp. disconnect MCS100E from power supply at all poles.

6.2 Disassembly

► Unscrew the sample gas lines.

WARNING: Hazard by splashing acids
When hose lines are removed there is a hazard of splashing by acids which could still be in the line.
If hose lines are blocked, the acids can be under pressure.

- ► Take suitable safety measures.

► To remove the fiber optics pull at the connector, only.
► Unscrew the MCS100E and transport with care
Protect the MCS100E from shock and vibrations.

6.3 Storage

Storage conditions

- Indoors.
- Ambient temperature: -10 - +60 °C.

Relative humidity: Max. 80% (without condensation)

6.4 Disposal

Observe the relevant local conditions for the disposal of industrial waste.

The following subassemblies could contain substances that have to be disposed of separately:

- *Electronics*: Capacitors, rechargeable batteries, batteries.
- *Display*: Liquid of LC display
- *Sample gas filter*: Sample gas filters could be contaminated by pollutants.

MCS100E

7 Maintenance

Maintenance plan
Maintenance work
Preventative maintenance
Recommended spare parts

7.1 Maintenance intervals

Maintenance plan (operator)	Reference	W[1]	Q[1]	Y[1]
Visual inspection				
Visual check of MCS100E	→ p. 105, § 7.6		x	x
Check measured values for plausibility.	---	x	x	x
Correct display of sample gas flow	→ p. 103, § 7.3		x	x
Analyzer (Photometer)				
Clean or replace fan filter (Analyzer)	→ p. 103, § 7.4		x	x
Check and adjust the flow monitor zero point	→ p. 103, §		x	x
Span gas feeding	→ p. 104, § 7.5		x	x
Maintenance by Customer Service				
Maintenance by Customer Service	---			x[2]

1 w = weekly, q = quarterly, y = yearly

2 Recommended, depending on application

7.2 Visual check of the MCS100E

What is to be checked	Check
Ambient conditions	Installation location, ambient temperature, air humidity, corrosive atmosphere.
Piping	Cracks, porous, brittle?
Enclosure and inside of device	Soiled, corroded? Loose parts? Odor? Unusual noise?
Are service and fault messages shown on the display?	----

7.3 Check sample gas flow

1 View the “bar graph” display (F2 key).
2 View the “flow” bar graph (if necessary, press the “right” cursor key).
3 Compare the flow to the nominal value (application-dependent).

7.4 Check/replace the filter pad in the fan of the analyzer

Spare parts required	Qty.	Part No.
Filter pad for analyzer[1]	1	5309683

[1] As required

The fan is located on the underside of the MCS100E.
It is not necessary to switch the MCS100E off to replace the filter pad.

Risk of soiling.
► Operate the MCS100E without filter pad only for a short period.

1 Pull the cover off.
2 Take filter pad out.
3 Clean the filter pad or insert a new filter pad.
4 Press the cover on.

7.5 Span gas feeding

Feed a test gas with a defined test gas concentration (nominal value) and compare the displayed value with the nominal value.

In case of deviation:

- ► Check the gas path for leak tightness
- ► Adjust the test gas value
  - – If programmed: In the program (start with function button)

  OR

  - – In the *Specialist* menu*: System edit:* Set *Calibration data* xxxx "*Factor*"

  OR

  - – In the *Specialist* menu*: Utilities: Service: Control Detector unit*
- ► When the drift is above the specification (see Technical Data): Please contact SICK Customer Service.

7.6 Programming the Measurement Sequence (Overview)

> ***NOTICE:***
> Wrong entries have a disruptive effect or cause nonfunctioning of the measurement program.
> ► Leave changes of the measurement sequence to trained personnel.

1 Insert a new result
Number of result: –> System documentation.
Menu: *Specialist: System edit: Results*

2 Enter filter wheel positions
Menu: *Specialist: System edit: Definition of Components*

3 Define calibration data
Menu: *Specialist: System edit: Calibration data*

4 Shift and insert linearization tables
Menu: *Specialist: System edit: Linearization tables*

5 Shift and insert IF tables
Menu: *Specialist: System edit: Interference table*

6 Define graphics
State the components and measurement ranges you wish to be displayed on the screen.
Note: Do not simply append the new component at “the rear”. Program the components in the same sequence as defined in “Results”.
Menu: *Specialist: System edit: Graphic output*

7 Define analog outputs
Leave the extension of analog outputs to SICK Customer Service.
Note: Do not simply append the new component at “the rear”. Program the components in the same sequence as defined in “Results”.
Menu: *Specialist: System edit: Signal output*

8 Define data storage and send to PC
Specify the desired components
Menu: *Specialist: System edit: Data storage and send to PC*

9 If you want to calibrate the new component manually: Enter the component in the Softkey menus.
Menu: *Specialist: System edit: Softkey menu definition*

10 Supplement programs
Menu: *Specialist*: *System edit: Zero/Calib/Purge programs/other programs.*

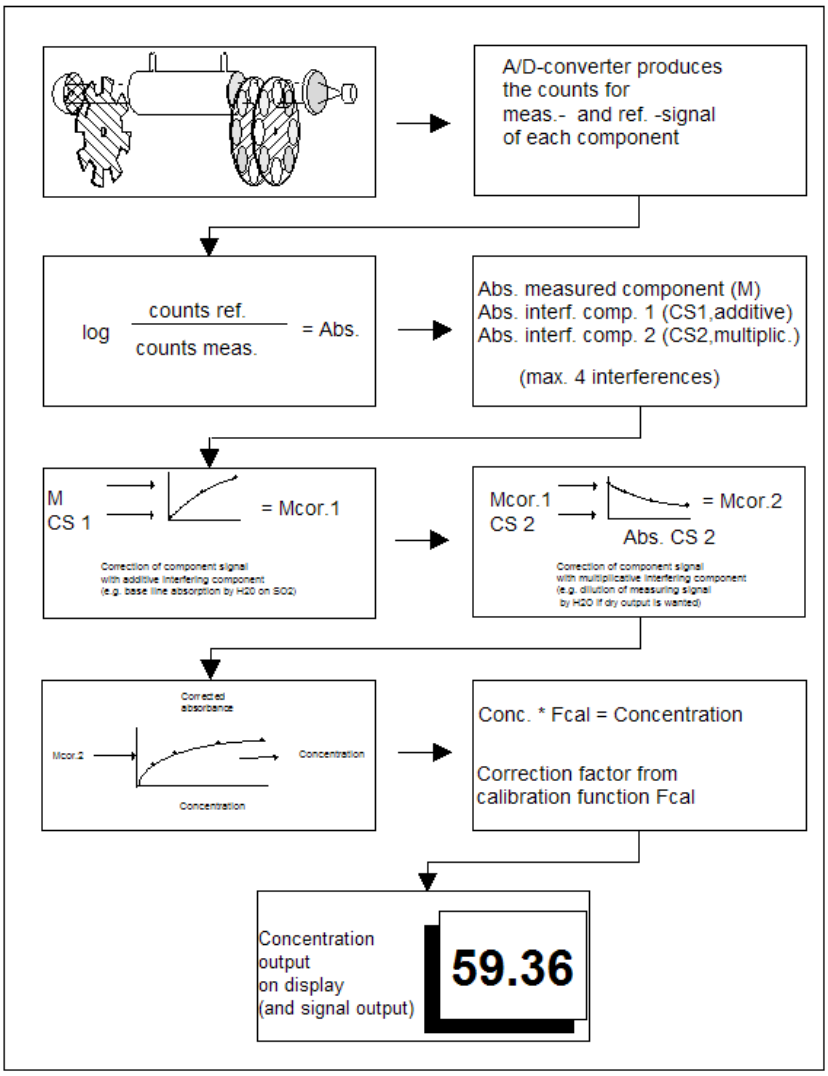
11 If a new span gas valve was fitted: Supplement Operator's Notebook
Menu: *Specialist*: *System edit: Operator's Notebook*
Assign a suitable name to the digital output used for the span gas valve (e.g.: *do11: Y8 Cal Gas NO*)

12 Perform text and relay assignments
Menu: *Specialist: System edit: Messages and corresp. relays*

7.6.1 Concentration Determination

The following diagram shows the concentration determination of MCS100E

Figure 21 Concentration Determination



7.6.2 Definition of Components and Calibrating a System

Usually, a system is defined as follows::

- Define *Name of components* (whereby result number = component number is pre-defined): In *Specialist: System edit: Results*
- *Assign filter wheel positions to components:*
  In *Specialist: System edit: Definition of Components*
- *Record interferences:*
  In *Specialist: System edit: Interference table*
- Perform *linearization* (e.g.: Conversion of absorbance into concentration, digits into analog values, flow meter) In *Specialist: System edit: Linearization table*s
- Perform *calibration*:
  In *Specialist: System edit: Calibration data*
- *Enter calculations* in *Specialist: System edit: Results*: as e.g. Ri: CONC [.,i]: then component i is automatically
  - measured
  - interference-corrected
  - linearized

  and is available as result Ri.
- This result can then be displayed, saved, used for further calculation, etc.

The assignment of some components, results and calculation tables is pre-defined.

Table 1 Pre-defined Assignment of Components, Results and Tables

Component Max. 24	Result Max. 64	Lin. Table Max. 16	IF table Max. 64
1 2 ... 16	1 2 ... 16	1 2 ... 16	1..4 5..8 ... 64
17 ... 24	17 ... 24	free from 1..16 ... free from 1..16	free from 1..64 ... free from 1..64

7.6.3 Addresses and Assignment of the Input Variables

Upon start the measurement program (1.bat) automatically assigns the input variables (see menu *Specialist: System edit: Results or Specialist: System edit: Zero/Calib/Purge/ Other programs)* to the board addresses (that are preset on the boards, ref. “ACQINIT” → p. 124, § 9.2).

The assignment of the addresses of the digital board is invariable (→ Table 2). For the analog boards and subsequently for the heating controllers, the software first searches the addresses of all physically existing boards and then assigns the channel numbers AO1, AO2, etc. to the addresses one after the other. The channel number is thus *independent of the plugged-in board type, its position and the individual board address!*

Example:

“*AIx*” reads the xth analog input *found*.

In the following example “AI2” reads the analog input with the address 33.

Table 2 Default assignment of the addresses in MCS100E

Address (decimal)	Plug-in Board	Channel
0 1 2 3 4 5 etc.	Digital Inputs Digital Outputs Digital Inputs Digital Outputs Digital Inputs Digital Outputs etc.	DI1 .. DI12 DO1 .. DO12 DI13 .. DI24 DO13 .. DO24 DI25 .. DI36 DO25 .. DO36 etc.
16 17 18 etc.	Analog Output Analog Output Analog Output etc.	AO1 AO2 AO3 etc.
32 33 34 etc.	Analog Input Analog Input Analog Input etc.	AI1 AI2 AI3 etc.
48 49 50 etc.	Heating Controller Heating Controller Heating Controller etc.	HC1 HC2 HC3 etc.

The existing assignment is stored.

If, upon a new start, the measurement program finds that there is a change in the addresses (e.g. because a board has been removed or a new one has been added), then a message is generated (→ p. 45, § 5.3).

Example (continued):

If, e.g. the analog input module with the address 32 had been removed:

Upon re-start of the measurement “AI2” will read again the 2nd analog input, but this is now on the module with the address 34 (AI1 on address 33).

Usually the addresses mentioned above are pre-assigned in this way.

► For the assignment of the board addresses of your system please refer to your system documentation.

► Please write down the board addresses, as a board can loose its address in case of a possible fault.

You will find the pre-assigned addresses in your system documentation.

7.7 Parameters at Program Start

> Wrong entries can have a disruptive effect on the measurement sequence and can cause damage of internal and external system components.
> ► Parameters may only be changed by aptly trained personnel.

The following chapter is of interest only, if you want to change parameters in 1.bat.

The 1.bat file calls in the program ACEMCS.EXE.

The parameters for ACEMCS.EXE are:

WDT	internal CPU Watchdog enabled *Note*: When quitting the program the CPU watchdog is not disabled automatically. (→ p. 109, § 7.8")
K	Divert keyboard Int.: LCD contrast control enabled.
L	The LC display is not triggered, if the program is installed on a PC with a monitor
KT	The system will neither by F2 nor after termination of a pre-selected time (10 minutes) go to the graphics presentation.
SI	When entering SI the serial PC interfaces is not monitored (Timeout whether data are received).
TST	Call-in of a test menu for testing PCB LPM 40. (For service purposes, only.)

- Minimum one parameter must be entered.
- The parameters must be separated by a space.
- The parameters can be selected in any desired order.

Default setting:

ACEMCS WDT SI: Watchdog enabled, no monitoring of serial interface

7.8 Watchdogs

The measurement sequence is controlled by 2 watchdogs.

- CPU watchdog
- Watchdog for internal communication

During normal operation the watchdogs are enabled.

► If any work has to be carried out on the DOS level, these watchdogs have to be disabled first.

7.8.1 CPU watchdog

This watchdog controls the time program for measurement.

Timeout: 5 minutes.

After expiry of the timeout, the measurement sequence program is started again.

Disabling the CPU watchdog

Disable the CPU watchdog after quitting the program with DOS command <WDOG disable> or program <8> (8.bat).

Enabling the CPU watchdog

Enable the CPU watchdog with parameter "WDT" when calling up the program (→ p. 109, § 7.7) or command <WDOG ENABLE>.

7.8.2 Watchdog for Communication

This watchdog controls the internal data communication.

Timeout: 4 minutes.

This watchdog cannot be disabled.

By removing a jumper it is possible to stop enabling the reset to the CPU.

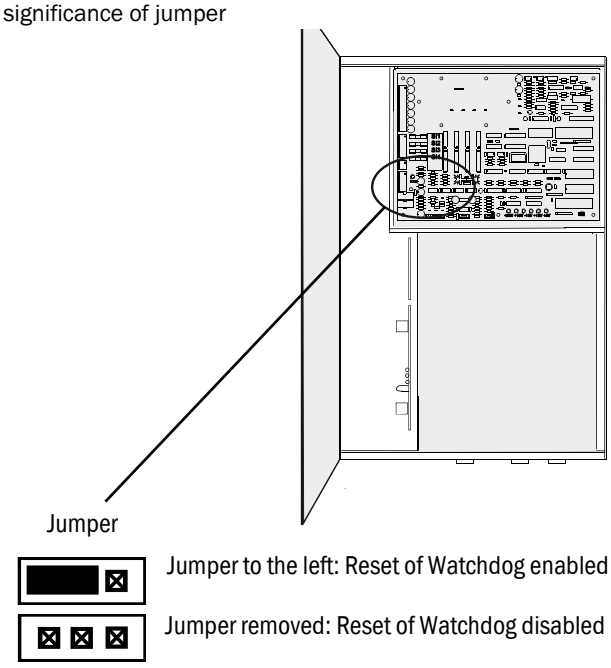
Procedure

- Put the MCS100E out of operation (→ p. 100, §6.1) and disconnect from the power supply.
- Open the MCS100E.

WARNING: Hot surface - risk of burns
The surface of the cell insulation is hot.
⊗ Do not touch the surface of the cell insulation.

- Set the jumper of the watchdog:

Figure 22 Position and significance of jumper



- Close the MCS100E.
- Put the MCS100E into operation again (→ p. 45, §5.3).

Before the new start of the measurement sequence program, set the jumper to the “left” again.

7.9 Load Program from external PC

Loading files, e.g. new software revision:

PC at fiber-optics interface

Connect external PC to the optical interface of the MCS100E. The MCS100E operating program must also be installed on the external PC.

► Copy the files using the menu *Specialist: Utilities: Receive/Send files* from external PC.

PC to parallel interface

(For specially trained personnel, only)

► Connect an external PC to the internal parallel interface of MCS100E using a “DOS-Interlink” cable (connection cable with 11 cores) and copy files by means of a data transfer program.

MCS100E

8 Troubleshooting

General malfunctions
Malfunction messages
Display messages
Measurement errors

8.1 Adjust the monitor

- Adjust the monitor (→ p. 39, §4.4).
- The monitor has a screen saver function.
  The monitor is automatically switched off after approx. 4 h
  ► Press any key on the MCS100E operating panel to switch the screen on again.

8.2 Flow too low

► Check the sample gas inlet and outlet lines.
► Check the flowmeter (→ p. 103, §)
► Cell inlet filter clogged? (Check by SICK Customer Service).

8.3 MCS100E becomes too hot (excess temperature)

► Do not operate the MCS100E when open.
► Check air filter for contamination and, if necessary, clean or replace it (→ p. 103, §7.4).

MCS100E is equipped with a self-resetting thermal circuit breaker, switching the instrument off automatically if a temperature of 60°C is exceeded and switching the instrument automatically on again after a cooling phase.

8.4 MCS100E does not start operation upon power-on

► Check power voltage.
► Check power fuses (→ p. 36, §3.8.1.2).

8.5 Excess temperature switch-off

MCS100E is equipped with a self-resetting thermal circuit breaker that protects the instrument against thermal damage.

If the temperature inside the instrument exceeds T > 60 °C, the thermal circuit breaker switches the instrument off automatically.

- The peripheral devices connected are not longer actuated.
- HC8X heating controller continues to control the connected heating circuits.
- The digital output signals of the I/O module box are switched to idle position (relay).
- The analog output signals of the I/O module box no longer output a current value.

As soon as the temperature has significantly decreased (by min. 15 K), the instrument is automatically switched on again.

8.6 Cell and photometer are not heated properly

► Check power voltage.
► Check the set power voltage (→ p. 35, §3.8.1).

8.7 No contact with printer/PC resp. I/O module boxes

- ► Make sure the fiber optics connections were not mixed-up by mistake(→ p. 26, §3.2.3.1).
- ► Check whether the fiber optics are damaged.
- ► Check the interface settings (see menu *Specialist: Utilities: Service: Environment Configuration*: *Interfaces*).

8.8 Fuses, jumpers and LEDs

WARNING: Electrical hazard

When the MCS100E is in operation, line power voltages are present within the instrument.

Before performing work inside the MCS100E:

- ► Unplug power plug resp. disconnect instrument from power at all poles.
- ► Verify whether the instrument is voltage-free.
- ► Secure the MCS100E against any unauthorized or unintentional operation.

WARNING: Hot surface - risk of burns

The surface of the cell insulation is hot.

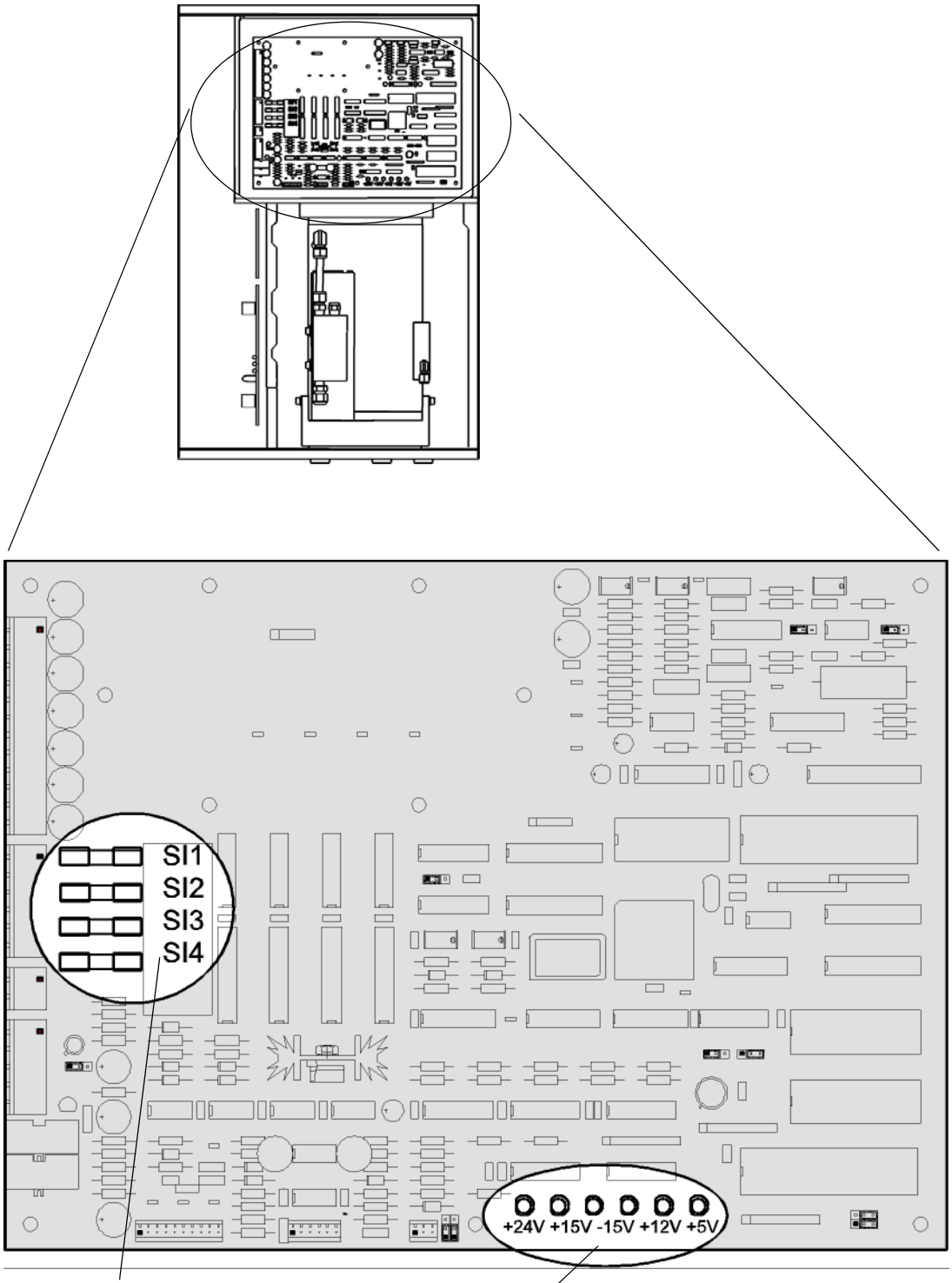
⊗ Do not touch the surface of the cell insulation.

Instrument damaged caused by incorrect fuses.

- ► Use only fuses with the required current rating and of the specified type for replacement.
- ► Do not use makeshift fuses.
- ► Do not short-circuit the fuse holder.

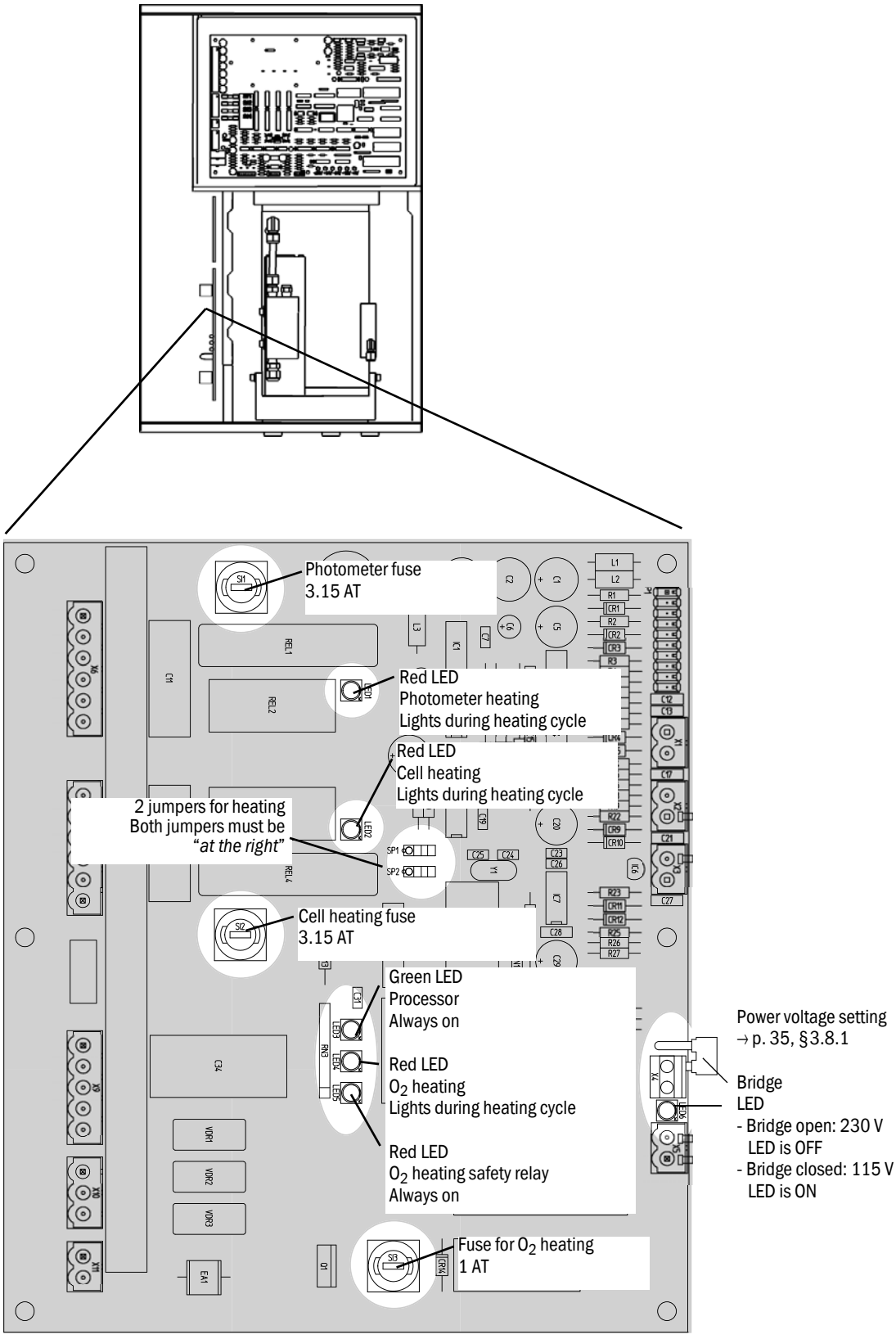
8.8.1 Internal voltage control (LPM40)

Figure 23 LEDs and fuses (LPM40)



8.8.2 Heating controller (LPM42)

Figure 24 LEDs and fuses (LPM42)



8.9 Error messages on the screen

Many functions of the MCS100E are controlled by its internal computer. Error messages are displayed in plain text on the screen.

In most cases you will not be able to remedy these errors yourself. If necessary, contact the SICK customer service.

8.9.1 Message: CAUTION! MOD-IO boxes changed

Upon start the measurement program first searches all plug-in boards of the I/O module boxes and assigns the input variables as described in Chapter “Addresses and Assignment of the Input Variables” (→ p. 108, § 7.6.3) (see menu *Specialist: System edit: Results* or *Specialist: System edit: Zero/Calib/Purge/Other programs*) one after the other to the addresses found.

If, upon start a change is detected in comparison with the previous assignment, then a warning is displayed:

CAUTION! MOD-IO boxes changed

- Keep previous configuration

- Accept new configuration

- Search again

The numbers listed thereafter in columns represent the old and the new addresses,

e.g.: 32 - 16 (OLD - NEW). 255 stands for: “not assigned”.

- Keep previous configuration
  Independent of the changes occurred, the *previous* channel assignment is kept. The internal error ER19 is set and the following message is displayed in the status bar: “MOD-IO box error”.
- Accept new configuration
  A new assignment of the channels is performed.
  Caution: Upon a new start, e.g. after one board has been removed, this means that the assignment of input variables – related hardware (ref. Chapter “Addressing and assigning the input variables”) (→ p. 108, § 7.6.3)) may change.
  Select this menu point, only, if you are sure that the addressing of the boards is correct!
- Search again
  The addresses of the I/O module boxes is checked once more.

If you do not select any of these menu points, then the verification is repeated after approx. 30 sec. and the message may be displayed once more.

After 4 attempts the program is started anew with the option *Keep previous configuration*.

If you wish to change the board addresses, it is recommended to select the menu point *“Keep previous configuration”* and change the address in menu option *Specialist: Utilities: Service: Init of modular I/O system*.
As an alternative, you can also quit the program, go to the DOS level and use the ACQINIT program (→ p. 124, § 9.2) and thereafter restart the measurement program (1.bat).

If an error occurs at one of the I/O module boxes during measurement, then the internal error ER19 generates a message (see menu: *Specialist: System edit: Zero/Calib/Purge programs/other programs.*)

MCS100E

9 Utility programs and protocols

MCSCONF
ACQINIT
PC protocol
Modbus protocol

9.1 MCSCONF

The configuration program contains default settings for operation of the MCS100E software. Usually, the program is supplied in a factory-installed state.

> Wrong entries have a disruptive effect or cause nonfunctioning of the measurement program.
> ► Leave changes of the MCSCONF to trained personnel.

The configuration software is in the same directory as the MCS100E software.

The operation of the configuration program is equivalent to that of the MCS100E measurement program.

9.1.1 Start of the configuration program

To start the configuration program:

- Select the directory that contains the MCS100E measurement program (e.g. C:\MCS100E).
- MCSCONF <ENTER>.
- The configuration menu is loaded and displayed.
- Upon confirmation with <ENTER>, the Main Menu is displayed.

9.1.2 Terminating the configuration program

- Terminating of MCSCONF: <ESC> key
- The prompt “Exit Y/N” is displayed and when entering “Y”: “Keep changes Y/N?”.
  Upon entering <Y> , the new (changed) configuration will be saved. This entry is confirmed by <ENTER>.
- If you have made changes in the menu “Directories” during configuration, then the screen prompt “Create directories? Y/N” will be displayed.
  When entering <Y>, the creation of the individual directories is presented on the screen and confirmed by <ENTER>.

9.1.3 Menus

9.1.3.1 Runtime Parameters

Serial buffer size

Default setting of serial buffer: 1024 bytes.

Maximum size that can be set: 64 Kbytes.
If the buffer memory reserved is exceeded during measurement, then MCS100E:

- Generates an acoustic warning signal.
- The message “Faulty sequence” is presented in the menu option “Messages”.

Data saving period

The menu option “Data saving period” is used to define a time after which the data files created are saved periodically on the silicon disk/hard disk.

As soon as this period has elapsed (min. 60 sec) the program saves the data, even if the maximum file size was not yet reached.

If the maximum file size is reached before the end of the selected data saving period, then the program stores the data file at an earlier time.

The default setting for the data saving period is 3000 sec.

Number of sortable files

When calling-up the menu for listing the data files, the names of the files stored in a directory are read into a buffer and presented on the screen.

The menu option “Number of sortable files” can be used to specify the maximum number of files that can be organized in the buffer. Default setting is 127 files. The buffer size can be varied within a range between 63 to 511.

Valid places in number representation

Number of significant places for numeric output of the measured values in bar graph representation (in time history the display shows always the complete sequence of digits following the decimal point).

Default setting: 6 significant places.

Possible setting: 1 ... 10 significant places.

This setting can be changed in the operator menu in the graphic representation *Main Menu: Configuration: Graphic output*.

Password (definition of passwords)

Four passwords per level can be defined.

Passwords	Remark
1 ..4	– Valid for: - “Configuration menu” level – The pre-set password is: 88709
5 ..8	– Valid for: - “Specialist menu” and - quitting the program – The pre-set password is only available for trained personnel.

Even if just one password is missing, there is *no* password protection.

- ► For password protection it is therefore necessary to enter all 8 passwords (even if these are identical).
- ► For the specialist menu: Contact SICK Service.

If no password is entered: Skip the password prompt with <ENTER>.

9.1.3.2 Text Mode

The “Text mode” menu option is used to adapt the cursor to the different types of graphics (graphics card and monitor). (For service purposes, only.)

9.1.3.3 Graphics

Buffer size for measurement

Buffer size for archive

Both the “On-line” and “Archive” graphic buffers are organized as ring buffers, i.e. the oldest data are overwritten when new files are saved.

The time range that can be represented as graphics is dependent on:

- Size of the graphic buffer
- Measurement frequency.

The size of the graphic buffers is defined in points.

One point corresponds to 56 bytes and is capable of storing the measured values of 8 calculations.

Default setting:

- Graphic buffer of current file 500 points (28 Kbytes)
- Graphic buffer for archived files 1000 points (56 Kbytes).

The graphic buffers are organized on the hard disk (see Chapter “Directories and Files” (→ p. 123, §9.1.3.4)) and can be increased depending on the available storage capacity. However, it does not make sense to specify a graphic buffer size that exceeds the size of the current file to be stored.

Automatic pan devisor value

As soon as the display of measured values reaches the right-hand margin of the screen, the partial view of the graphic display is moved by the nth part of the screen display.

Default setting: 4. This means, the partial view is moved towards the left by the fourth part of the total screen page.

Max. Numbers of axis points to be marked

Scales the graphic. The axes of the graphic display are divided by a selectable factor.

Default setting: Factor 7. The axes are divided by 7.

Adjustable: 6 ... 11.

Annotation of the axes is automatically carried out in increments of one, two or five, depending on the selected range to be displayed and the division of the axes.

Dead time of graphic cursor

In order to determine the curve values of the current measurement, the graphics cursor can be moved across the screen by using the cursor keys. If the cursor is not moved within the selected dead time while the current measured values are displayed, it automatically jumps to the end of the graphics display.

Default setting: 10 seconds.

9.1.3.4 **Directories and files**

This menu option is used to specify the directories in which the used files can be stored.

Max. length of directory names: 8 characters.

If the directory is to be stored in a disk drive other than the present drive, then the name of the drive must precede the directory name (e.g E:\tmp\).

- *Directories must* always end with \ (e.g. d:\)
- *File names must never* end with \ (e.g. M1DEU.TXT).

Actual system

The system (= measurement sequence) specified here is used upon start of the MCS100E measurement program.

The system can temporarily be changed in the MCS100E measurement program (*Specialist: System, activate for measurement).*

Text file

The language specified here is used upon start of the MCS100E measurement program.

The corresponding files are identified as:

M1Exxx.TXT whereby xxx e.g. DEU (German), ENG (English).

The language of the text file can temporarily be changed in the MCS100E measurement program. (*Specialist: Utilities: Service: Environment Configuration* : *TEXT file)*

Help file

The language of the help file specified here is used upon start of the MCS100E measurement program.

The corresponding files are identified as:

M1Exxx.HLP whereby xxx e.g. DEU (German), ENG (English).

The language of the help file can temporarily be changed in the MCS100E measurement program *(Specialist: Utilities: Service: Environment Configuration* : *HELP file).*

System directory

This directory contains the files with measurement configurations, measurement sequences, etc. MCS100E starts with the default setting specified here.

Default setting is .\ (actual directory).

The structure of the directory can temporarily be changed in the MCS100E measurement program *(Specialist: Utilities: Service: Environment Configuration*: *DIRECTORIES).*

Graphic directory

This directory contains the files with the data for graphic evaluation of the measurements. Default setting is d:\.

MCS100E starts with the default setting specified here.

The structure of the directory can temporarily be changed in the MCS100E measurement program *(Specialist: Utilities: Service: Environment Configuration*: *DIRECTORIES).*

Temporaries

This directory contains the temporary files in which measured values are stored intermediately before being written onto the hard disk. Default setting is d:\. MCS100E starts with the default setting specified here.

The structure of the directory can temporarily be changed in the MCS100E measurement program *(Specialist: Utilities: Service: Environment Configuration*: *DIRECTORIES).*

9.2 ACQINIT

ACQINIT allows to change the parameters of the I/O module box.

Instrument damage caused by incorrect parameters.
All parameters were preset in the factory.
► Leave changes of the parameters to trained personnel.

Description of program ACQINIT → Operating Instructions “I/O Module Box”.

Exemplary configuration

1 Go to the DOS level at MCS100E. (→ p. 46, § 5.4.2).
2 Disable watchdogs (→ p. 109, § 7.8)
3 Set *all* I/O module boxes to the “inactive” mode.
For this purpose press each pin switch for approx. 1 sec (for the temperature controller: Approx. 5 sec).
The green LEDs are now flashing 1*.
These boards are in the “not active” condition.
4 Press pin switch of the board *that is to be configured* once again.
Its green LED is now flashing 2*.
This board is now ready for configuration and all of the following actions have an effect on just this very board.
Caution: Please observe that just *one* board may be configured. Thus, only *one* green LED 2* may be flashing. *All other* green LEDs must be flashing 1*.
5 Enter via external keyboard:
ACQINIT /C2 /I5 <ENTER> (Note: Space preceding /)
The actual configuration of the board is presented.
With a temperature controller, e.g. the temperature setting is stated in the line: TCtrl : 185
To *set the temperature to 100 °C,* type: ACQINIT /C2 /I5 /T100 <ENTER>
“T100” sets the temperature to 100 °C and the values of the re-configured board are presented.
To *set a (new) board address* , type: ACQINIT /C2 /I5 /A31 <ENTER>
“A31” sets the address to 31 and the values of the re-configured board are presented.
To enter a new *remark*, use the DOS command SET:
“SET ACQINIT=temperature controller for heated tube 1” <ENTER>
Upon ACQINIT /C2 /I5 /S <ENTER>, the text “temperature controller for heated tube 1” is presented.
Note:
Parameters that have NOT been entered remain UNCHANGED. For boards that are not used, standard values will be set automatically.
6 Press the pin switch of the configured temperature controller once again.
The green LED is now on, continuously
7 The board has its new configuration
8 Configure next board, if required
9 As soon as the last board is configured: Press the individual pin switches of the remaining boards one after the other two times for 1 sec. each (temperature controller: Approx. 5 sec).
Now, these green LEDs are also on, continuously.

10 Before starting the MCS measurement program make sure that *all* of the green LEDs are lit continuously.

11 Reconnect the jumper of the watchdog at the “left” (→ p. 110, § 7.8.2).

12 Enter via the MCS100E keyboard: 1 <ENTER>.
The MCS100E measurement program starts again.

9.3 Modbus protocol

Menu: *Specialist: System edit: Data storage and send to PC*

```
MCS100E program revision 1.42
Modbus RTU protocol

Definition which registers are sent and received from the external PC

+-------------------------------------------------------------------------------+
¦Address¦             Register offset             ¦coil offset digital ¦       ¦
¦Offset ¦Block1¦Block2¦Digit.¦Compon¦System¦DatLog¦OUTPUT¦INPUT ¦FLAG  ¦       ¦
¦ 0     ¦0     ¦100   ¦68    ¦200   ¦1400  ¦1500  ¦0     ¦96    ¦192   ¦       ¦
¦first byte send         : high                                               ¦
¦Result,Comp.data type   : 32bit floating point 2 register                    ¦
¦16 bit data factor      : 100                                                ¦
¦Julian date offset      : 578041     default: 578041                         ¦
¦Modbus master settings: (Function,Start register/coil,No. register/coil)     ¦
¦SlaveAddr:0   ¦SlaveAddr:0   ¦SlaveAddr:0   ¦SlaveAddr:0   ¦SlaveAddr:0   ¦   ¦
¦Fnc¦Start¦No. ¦Fnc¦Start¦No. ¦Fnc¦Start¦No. ¦Fnc¦Start¦No. ¦Fnc¦Start¦No. ¦   ¦
|1  |1    |8   |1  |0    |0   |0  |0    |0   |0  |0    |0   |0  |0    |0   |   ¦
|3  |5    |12  |15 |0    |0   |0  |0    |0   |0  |0    |0   |0  |0    |0   |   ¦
|15 |97   |16  |3  |0    |0   |0  |0    |0   |0  |0    |0   |0  |0    |0   |   ¦
|16 |105  |12  |16 |0    |0   |0  |0    |0   |0  |0    |0   |0  |0    |0   |   ¦
|0  |0    |0   |0  |0    |0   |0  |0    |0   |0  |0    |0   |0  |0    |0   |   ¦
|0  |0    |0   |0  |0    |0   |0  |0    |0   |0  |0    |0   |0  |0    |0   |   ¦
¦                                                                               ¦
¦Timeout for new Modbus message (*55ms)  :   2                                  ¦
¦                                                                               ¦
+-------------------------------------------------------------------------------+
```

Datatransfer MCS100E <---> PC with serial interface and Modbus RTU protocol

```
Start the message with a silent of at least 3.5 character times
 Byte
 1       address
 2       function
 3       data
 :
 last-1  LSB CRC-check
 last    MSB CRC-check


Address Offset
! The Address Offset is
!added to Start Register by sending always
!and subtracted by receiving only when Start Register > Address Offset.


Modbus Master:
   function
   01 : Read  multiple coil
        Demand of digital I/O/FLAG from Slave
   15 : Force multiple coil
        Send   of digital I/O/FLAG to  Slave
   05 : Force single coil
        Send  one digital I/O/FLAG to  Slave
   03 : Read  multiple register
        Demand of Results,Component values,Modbus-Systemparameter
   16 : Write multiple register
        Send   of Results,Component values,Modbus-Systemparameter

   with the definition from above
   demand   : Results      R1,R2,R3,R4,R5,R6
              digital OUT  DO1,DO2,DO3,DO4,DO5,DO6,DO7,DO8
   send     : Results      R33,R34,R35,R36,R37,R38
              digital INP  DI01..DI16
  digital OUT  DO1


Modbus Slave:
Exception response if illegal data address
```

```
Floating point format
  One floating point register is two consecutive 16bit registers

  32bit =4byte
  S = sign     (0=positive)
  E = exponent (two´s complement biased by 127)
  M = matissa  (1.matissa)

  byte3(MSB) byte2      byte1      byte0(LSB)
  SEEE EEEE  EMMM MMMM  MMMM MMMM  MMMM MMMM

  Transmission sequence (1.byte=high (MSB)):
  byte1,byte0,byte3,byte2


Format for digital I/O and FLAGS by func=01,15
  One digital condition is one bit.
  A logical 0 means OFF, a logical 1 means ON,
  One data byte (=8 bits) include the conditions of 8 digital I/O/FLAG.
  Bit0 = lower  digital I/O/FLAG.
  Bit7 = higher digital I/O/FLAG.

Send registers (Results,DigOut,DigInp,Flag) to PC on demand

  Dataformat:(slave)
  PCOut[01] : adr       - Device address
       [02] : func      - function 01,02,03
       [03] : n2        - No of Bytes
       [04] : Rn1       - MSB first register
       [05] : Rn1       - LSB first register
              :
       [xx] : Rnl       - MSB last register
       [xx] : Rnl       - LSB last register
       [xx] : CRC       - LSB CRC
       [xx] : CRC       - MSB CRC


Demand on Register (Results,DI,DO,FLAG,)

  Dataformat:
  PCOut[01] : adr       - Device address
       [02] : 03H       - function Register
       [03] : n1        - MSB Start Register - 1
       [04] : n1        - LSB Start Register - 1
       [05] : n2        - MSB No of Registers
       [06] : n2        - LSB No of Registers
       [07] : CRC       - LSB CRC
       [08] : CRC       - MSB CRC

Set one digital OUT/INP/FLAG (force coil)

  Dataformat:
  PCOut[01] : adr       - device address
       [02] : 05H       - function Register
       [03] : ahi       - MSB D_addr
       [04] : alo       - LSB D_addr
       [05] : dhi       - MSB data
       [06] : dlo       - LSB data
       [07] : CRC       - LSB CRC
       [08] : CRC       - MSB CRC

  D_addr=  1.. 96 : digital OUT  1..96
  D_addr=097..192 : digital INP  1..96
  D_addr=193..392 : digital FLAG 1..200

  dhi=ff,dlo=00 : DO/DI/FLAG = ON (=1)
  dhi=00,dlo=00 : DO/DI/FLAG = OFF(=0)


Func=3     : Read  multiple Register
Func=10hex : Write multiple Register

Start Register(decimal):
 0001 .. 0099Result Block 1 : Result 01..32
 0101 .. 0199    Result Block 2 : Result 33..64
 0201 .. 1400     Component data block
 1401 .. 1421Modbus system parameter block
 1501 .. 2945Datalog block
```

```
Func=1 : Read multiple Digital OUT/INP/FLAG (coil)
 Start Register(dec):
 0001 .. 0096     Digital Out  01..96
 0097 .. 0192     Digital Inp  01..96
 0193 .. 0392     Digital Flag 01..200

 Func=5hex : force single digital output/input/flag (coil)
  Data format:
  PCOut[01] : adr       - device address
       [02] : 05H       - function Register
       [03] : ahi       - MSB D_addr - 1
       [04] : alo       - LSB D_addr - 1
       [05] : dhi       - MSB data
       [06] : dlo       - LSB data
       [07] : CRC       - LSB CRC
       [08] : CRC       - MSB CRC

  D_addr(dec) =   1.. 96 : digital OUT  1..96
  D_addr(dec) =  97..192 : digital INP  1..96
  D_addr(dec) = 193..392 : digital FLAG 1..200

  dhi=ff,dlo=00 : DO/DI/FLAG = ON (=1)
  dhi=00,dlo=00 : DO/DI/FLAG = OFF(=0)


Func=0fhex : force multiple digital output/input/flag (coil)
  Data format:
  PCOut[01] : adr       - device address
       [02] : 0fH       - function Register
       [03] : ahi       - MSB D_addr - 1
       [04] : alo       - LSB D_addr - 1
       [05] : nhi       - MSB No of Registers
       [06] : nlo       - LSB No of Registers
       [07] : no byte   - No of data bytes
       [08] : data      - data

       [xx] : CRC       - LSB CRC
       [xx] : CRC       - MSB CRC

  D_addr(dec) =   1.. 96 : digital OUT  1..96
  D_addr(dec) =  97..192 : digital INP  1..96
  D_addr(dec) = 193..392 : digital FLAG 1..200


Func=10hex : write registers (only master)
  Start Register like func=3
  Data format:
  PCOut[01] : adr       - Device address
       [02] : 10H       - function Register
       [03] : n1        - MSB Start Register - 1
       [04] : n1        - LSB Start Register - 1
       [05] : n2        - MSB No of Registers
       [06] : n2        - LSB No of Registers
       [07] : no byte   - No of data bytes
       [08] : data      - data

       [xx] : CRC       - LSB CRC
       [xx] : CRC       - MSB CRC
```

Register mapping:

Start	End	Data Type	Description	Remarks
			Register block 1	register offset Block 1 = 0
0001	0002	U32	Date Stamp	algorithm 199
0003	0004	U32	Time Stamp	ms at midnight
0005	0006	Float	Result 1	
0007	0008	Float	Result 2	
0009	0010	Float	Result 3	
0011	0012	Float	Result 4	
0013	0014	Float	Result 5	
0015	0016	Float	Result 6	
0017	0018	Float	Result 7	
0019	0020	Float	Result 8	
0021	0022	Float	Result 9	
0023	0024	Float	Result 10	
0025	0026	Float	Result 11	
0027	0028	Float	Result 12	
0029	0030	Float	Result 13	
0031	0032	Float	Result 14	
0033	0034	Float	Result 15	
0035	0036	Float	Result 16	
0037	0038	Float	Result 17	
0039	0040	Float	Result 18	
0041	0042	Float	Result 19	
0043	0044	Float	Result 20	
0045	0046	Float	Result 21	
0047	0048	Float	Result 22	
0049	0050	Float	Result 23	
0051	0052	Float	Result 24	
0053	0054	Float	Result 25	
0055	0056	Float	Result 26	
0057	0058	Float	Result 27	
0059	0060	Float	Result 28	
0061	0062	Float	Result 29	
0063	0064	Float	Result 30	
0065	0066	Float	Result 31	
0067	0068	Float	Result 32	
0069	0074	U16	Digital Outputs	Do01 - Do96 : Coils 00001 - 00096
0075	0080	U16	Digital Inputs	Di01 - Di96 : Coils 00097 - 00192
0081	0092	U16	Digital Flags	F001 - F192 : Coils 00193 - 00392
0093	0100	Reserved		

Start	End	Data Type	Description	Remarks
			Register block 2	register offset Block 2 = 100
0101	0102	U32	Date Stamp	algorithm 199
0103	0104	U32	Time Stamp	ms at midnight
0105	0106	Float	Result 33	
0107	0108	Float	Result 34	
0109	0110	Float	Result 35	
0111	0112	Float	Result 36	
0113	0114	Float	Result 37	
0115	0116	Float	Result 38	
0117	0118	Float	Result 39	
0119	0120	Float	Result 40	
0121	0122	Float	Result 41	
0123	0124	Float	Result 42	
0125	0126	Float	Result 43	
0127	0128	Float	Result 44	
0129	0130	Float	Result 45	
0131	0132	Float	Result 46	
0133	0134	Float	Result 47	
0135	0136	Float	Result 48	
0137	0138	Float	Result 49	
0139	0140	Float	Result 50	
0141	0142	Float	Result 51	
0143	0144	Float	Result 52	
0145	0146	Float	Result 53	
0147	0148	Float	Result 54	
0149	0150	Float	Result 55	
0151	0152	Float	Result 56	
0153	0154	Float	Result 57	
0155	0156	Float	Result 58	
0157	0158	Float	Result 59	
0159	0160	Float	Result 60	
0161	0162	Float	Result 61	
0163	0164	Float	Result 62	
0165	0166	Float	Result 63	
0167	0168	Float	Result 64	
0169	0169	U16	Result 49	Result 49..64 in integer for Timer

0170	0170	U16	Result 50
0171	0171	U16	Result 51
0172	0172	U16	Result 52
0173	0173	U16	Result 53
0174	0174	U16	Result 54
0175	0175	U16	Result 55
0176	0176	U16	Result 56
0177	0177	U16	Result 57
0178	0178	U16	Result 58
0179	0179	U16	Result 59
0180	0180	U16	Result 60
0181	0181	U16	Result 61
0182	0182	U16	Result 62
0183	0183	U16	Result 63
0184	0184	U16	Result 64
0185	0200	Reserved	

Start	End	Data Type	Description	Remarks
			Component data block	
			Component 1 Values:register offset Compon = 200	
0201	0202	U32	Date Stamp last Calibration	
0203	0204	U32	Time Stamp last Calibration	
0205	0206	Float	Actual Concentration	PKnz
0207	0208	Float	mExt add. and mult. correction	PExtCor
0209	0210	Float	mExt additive correction	PExtAdd
0211	0212	Float	mExt with ZERO-correction	PExtRawN
0213	0214	Float	mExt without ZERO-correction	PExtRaw
0215	0216	Float	Reference Signal [0..100%]	PRef
0217	0218	Float	Measure Signal [0..100%]	PMes
0219	0220	Float	Calibration Value	PCalV
0221	0222	Float	First Calibration Value	PCal1
0223	0224	Float	Last Calibration Value	PCalLast
0225	0226	Float	Actual Calibration Value	PCalAct
0227	0228	Float	First Zero Value	PNul1
0229	0230	Float	Last Zero Value	PNulLast
0231	0232	Float	Actual Zero Value	PNulAct
0233	0234	Float	Extra Offset [Absorb]	Poffset
0235	0236	Float	Extra Factor	Pfactor
0237	0238	Float	Cal.Factor	PCalF
0239	0240	Float	Cal.Factor internal Standard	PCalFi
0241	0242	Float	Cal.Value internal Standard	PCalVi
0243	0243	U16	Gain Level Reference Signal	GiRef
0244	0244	U16	Gain Level Measure Signal	GiMes
0245	0246	Float	Measure Range 1	RngUp[1]
0247	0248	Float	Measure Range 2	RngUp[2]
0249	0250	U16	Reserved	

:
:

Start	End	Data Type	Description	Remarks
			Component 15 (=FLOW) Values	
0901	0902	U32	Date Stamp last Calibration	
0903	0904	U32	Time Stamp last Calibration	
0905	0906	Float	Actual Concentration	PKnz
0907	0908	Float	mExt add. and mult. correction	PExtCor
0909	0910	Float	mExt additive correction	PExtAdd
0911	0912	Float	mExt with ZERO-correction	PExtRawN
0913	0914	Float	mExt without ZERO-correction	PExtRaw
0915	0916	Float	Analog Input Signal [0..100%]	PRef [0..4095digit]
0917	0918	Float	Measure Signal [0..100%]	PMes
0919	0920	Float	Calibration Value	PCalV
0921	0922	Float	First Calibration Value	PCal1
0923	0924	Float	Last Calibration Value	PCalLast
0925	0926	Float	Actual Calibration Value	PCalAct
0927	0928	Float	First Zero Value	PNul1
0929	0930	Float	Last Zero Value	PNulLast
0931	0932	Float	Actual Zero Value	PNulAct
0933	0934	Float	Extra Offset [Absorb]	Poffset
0935	0936	Float	Extra Factor	Pfactor
0937	0938	Float	Cal.Factor	PCalF
0939	0940	Float	Cal.Factor internal Standard	PCalFc
0941	0942	Float	Cal.Value internal Standard	PCalVc
0943	0943	U16	Gain Level Reference Signal	GiRef
0944	0944	U16	Gain Level Measure Signal	GiMes
0945	0946	Float	Measure Range 1	RngUp[1]
0947	0948	Float	Measure Range 2	RngUp[2]
0949	0950	U16	Reserved	

Start	End	Data Type	Description	Remarks
			Component 16 (= O2) Values	
0951	0952	U32	Date Stamp last Calibration	
0953	0954	U32	Time Stamp last Calibration	
0955	0956	Float	Actual Concentration	PKnz
0957	0958	Float	mExt add. and mult. correction	PExtCor
0959	0960	Float	mExt additive correction	PExtAdd
0961	0962	Float	mExt with ZERO-correction	PExtRawN
0963	0964	Float	mExt without ZERO-correction	PExtRaw
0965	0966	Float	Analog Input Signal [0..100%]	[0..4095digit]
0967	0968	Float	Input Signal [mV -250..250]	
0969	0970	Float	Calib.value [Conc] gas1 nominal	
0971	0972	Float	first CAL [Conc] gas1	
0973	0974	Float	last CAL [Conc] gas1	
0975	0976	Float	actual CAL [Conc] gas1	
0977	0978	Float	first CAL [Conc] gas2	
0979	0980	Float	last CAL [Conc] gas2	
0981	0982	Float	actual CAL [Conc] gas2	
0983	0984	Float	Calib.value [Conc] gas2 nominal	
0985	0986	Float	Extra Factor	Pfactor
0987	0988	Float	Cal.Factor	PCalF
0989	0990	Float	Cal.Factor internal Standard	PCalFc
0991	0992	Float	Cal.Value internal Standard	PCalVc
0993	0993	U16	Gain Level Reference Signal	GiRef
0994	0994	U16	Gain Level Measure Signal	GiMes
0995	0996	Float	Measure Range 1	RngUp[1]
0997	0998	Float	Measure Range 2	RngUp[2]
0999	1000	U16	Reserved	
:				
:			Component 24 Values	
1351	1352	U32	Date Stamp last Calibration	
1353	1354	U32	Time Stamp last Calibration	
1355	1356	Float	Actual Concentration	PKnz
:				
1399	1400	U16	Reserved	

Modbus system parameter block
register offset = 1400

Start	End	Data Type	Description	Remarks
1401	1401	U16	DevAddr	Device Address
1402	1402	U16	AddrOffset	Address Offset
1403	1407	U16	RegOffset[1..5]	Register Offsets
1408	1410	U16	CoilOffset[1..3]	Coil Offsets
1411	1411	U16	DataLogOffset	Register Offset DataLog
1412	1412	U16	RegMode	Dataformat Results,Comp.
1413	1413	U16	RegFactor	16 Bit Datafactor
1414	1415	U32	DateOffset	Julian Date Offset
1416	1416	U16	DataLogFlagMeasure	Flag "MEASURE"
1417	1417	U16	DataLogFlagCalib	Flag "CALIBRATION"
1418	1421	U16	Reserve[1..4]	Reserve

Datalog block
register offset = 1500

Start	End	Data Type	Description	Remarks
1501	1501	U16	Analogchannel(1..32)	read and write
1502	1502	U16	day (1..31)	read and write
1503	1503	U16	hour (0..23)	read and write
1504	1504	U16	Reserve	
1505	1505	U16	1.value hour:00	read only
1506	1506	U16	2.value hour:01	read only
:	:		: :	:
1564	1564	U16	60.value hour:01	read only

MCS100E

10 Specifications

Declaration of conformity
Approvals
Parameter lists
Technical Data

10.1 Conformity

The technical design of this instrument complies with the following EC directives and EN standards:

- EU Directive LVD 2006/95/EC
- EU Directive EMC 2004/108/EC

Applied EN standards:

- EN 61010-1, Safety requirements for electrical equipment for measurement, control and laboratory use
- EN 61326, Electrical equipment for measurement technology, control technology and laboratory use - EMC requirements

For MCS100E in the emission measuring system MCS100E HW:

- EN 14181, Calibration of continuously operating emission measuring devices
- EN 15267-3: Certification of automatic measuring systems - Part 3

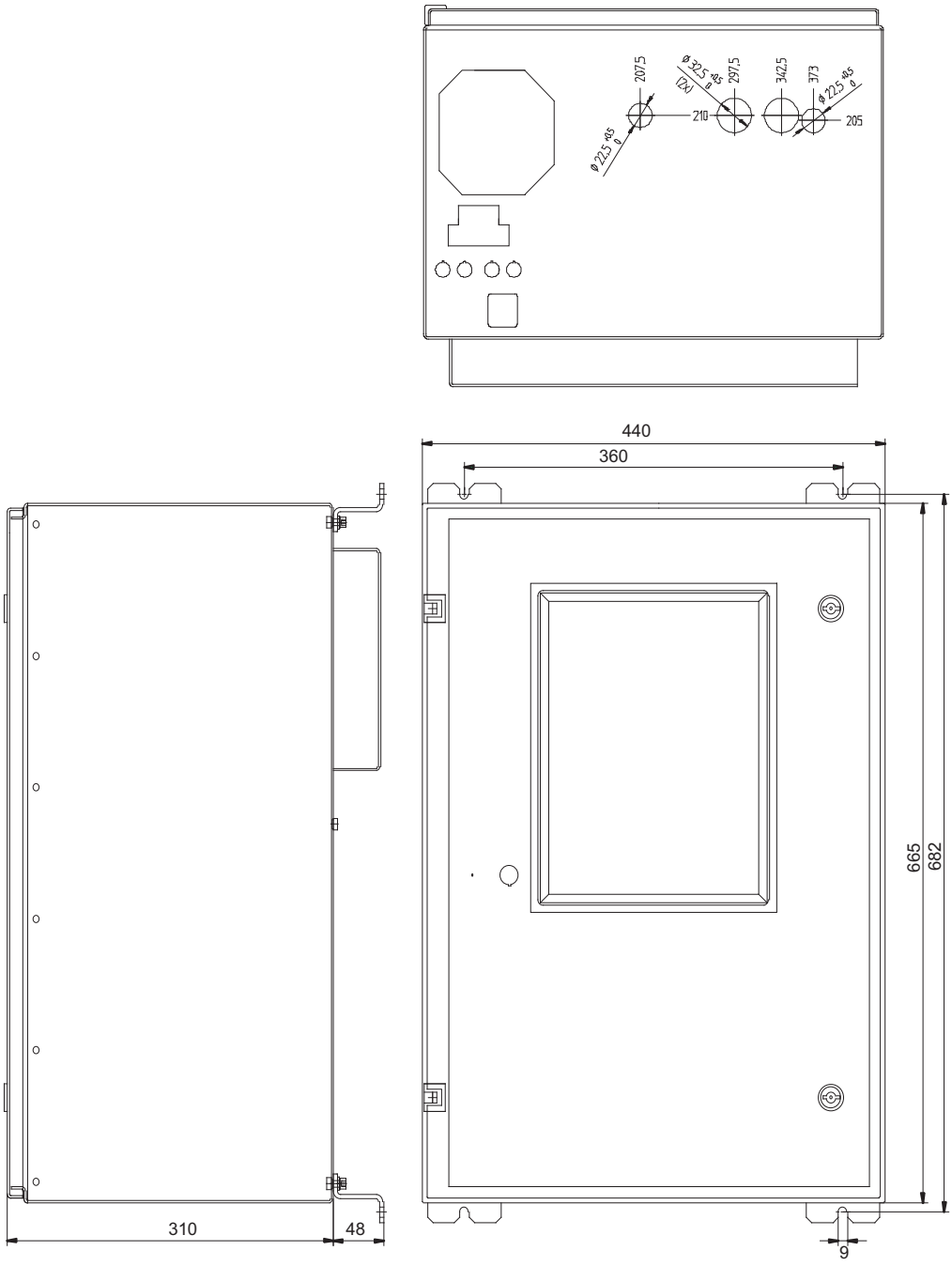
10.1.1 Electrical protection

- Insulation: Protection class 1 according to EN 61010-1.
- Insulation coordination: Measuring category II according to EN 61010-1.
- Contamination: The instrument operates safely in an environment up to contamination level 2 according to EN 61010-1 (usual, non-conductive contamination and temporary conductivity by occasional moisture condensation).
- Electrical power: The wiring system to the power source of the system must be installed and fused according to the relevant regulations.

10.2 Technical Data

10.2.1 Dimension drawing

Figure 25 Dimension drawing



10.2.2 Operating data

The MCS100E equipment depends on the application. Please see the system documentation enclosed with the MCS100E for the configuration

Measured value recording	
Measuring principle	Infrared photometer Dual frequency and gas filter correlation method
Spectral range	1 .. 16 µm
Number of measuring components	Max. 8 + O_2
Number of measurement ranges	2, automatic measurement range switch-over (adjustable)
Typical measuring components	NH_3; HCl; H_2O; SO_2; CO; NO; NO_2; N_2O; CO_2; NH_4 O_2 (ZrO_2)
Interference compensation	Max. 4 disturbance variables (also external disturbance variables)
Detection limit	< 2% of respective measurement range
Zero drift	< 1 % of the full-scale value / month
Sensitivity drift	< ± 2 % of the full-scale value / month
Temperature effect	< 2% of respective measurement range / 10 K
Setting time t_{90}	Application-dependent
Limit values	2 limit values per measured component

Device features	
Enclosure dimensions	(665 x 440 x 350) mm (HxWxD)
Enclosure material	Steel plate, coated
Enclosure color	RAL 7035 (light gray)
Weight	approx. 70 kg
Window material	CaF_2 (standard); Option: BaF_2, IG2
Seal material	Gas inlet: PTFE Cell body: Viton Option: Kalrez Cell window: Viton with FEP sheath; Option: Kalrez
Optical path length (cell)	3, 6, or 12 m
Sample gas volume (cell)	approx. 2 l
Heating temperature (cell)	typ. 100 °C or 185 °C, max. 200 °C
Sintered metal filter	Pore size 10 µm
Internal sensitivity check	Max. 3 (option)
Sample switching	Max. 12 measuring points

Ambient conditions	
Ambient temperature	+5 ... +35 °C
Storage temperature	–20 ... +60 °C
Relative humidity	Max. 80% (non-condensing)
IP classification	IP 52
Barometric correction	0.7 .. 1.2 bar ambient pressure (option)

Operation and interfaces	
User levels	2 user levels (user levels for specialist is password-protected)
Display	7.4" black/white LC display (640*480 pixels)
Input	Membrane keyboard (numeric, cursor buttons, function buttons) Connection of an external keyboard is possible.
Data interfaces	2 serial optical (e.g.: plug connector Hirschmann OVK S 2.2) Sender LED: 660 nm Recommended fiber optical cable: Polymer fiber optical cable 980/1000 µm 1 serial electric (optional) 1 parallel electric (optional)[1] 1 serial Ethernet (optional)[2] Modem (optional)
Telediagnostic	Via the Ethernet/internet connection and/or Modem connection (RS232) (optional)

1 Not possible in combination with Ethernet interface

2 Not possible in combination with parallel interface

Sample gas (requirements)	
Composition	Only the sample gas composition designed for the MCS100E (→ system documentation)
Temperature	Application-dependent Thermostatically controlled to cell temperature Max. temperature: 200 °C
Operating pressure	Outlet open against ambient pressure
Flow rate	Recommended: 200 ... 600 l/h
Cleanness	Free from dust and condensed components

Utility gas	
Instrument air	Particle size max. 1 µm, oil content max. 0.1 ppm, Dew point -30°C.

Gas connections	
Sample gas inlet	6 mm fitting with ferrule (standard)
Sample gas outlet	10 mm fitting with ferrule (standard)

Electrical data	
Supply voltage	1~115/230 V ±10 %; 50-60 Hz
Power input	Max. 850 VA

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8009504/YWA7/V3-1/2018-01

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