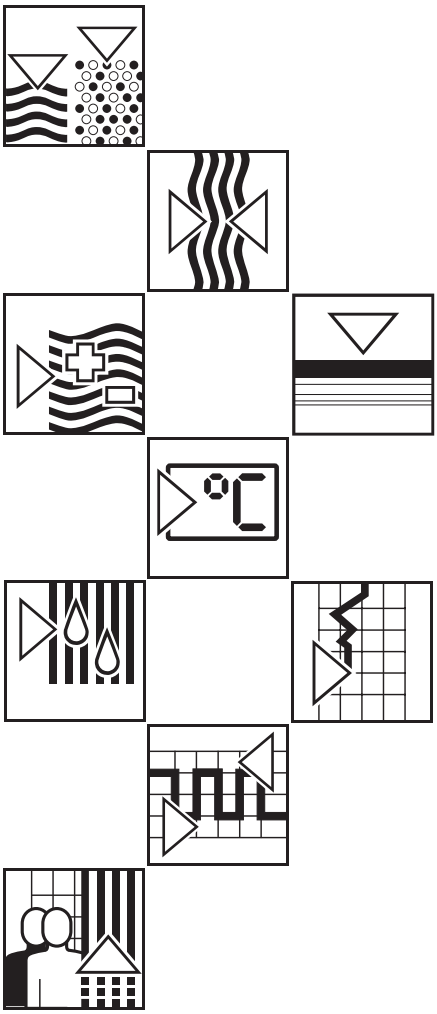
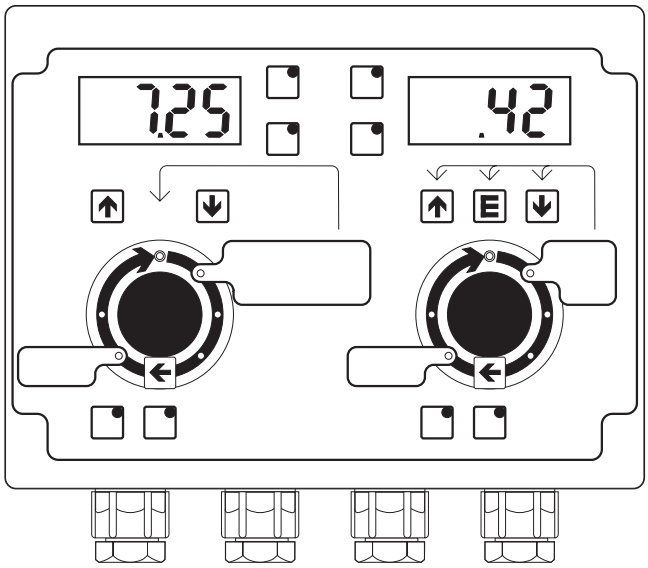
BA 060C/07/en/07.97
No. 50038085

PoolPAC
CCM 360
Chlorine, pH, Redox and Temperature Transmitter, Controller

Operating Instructions





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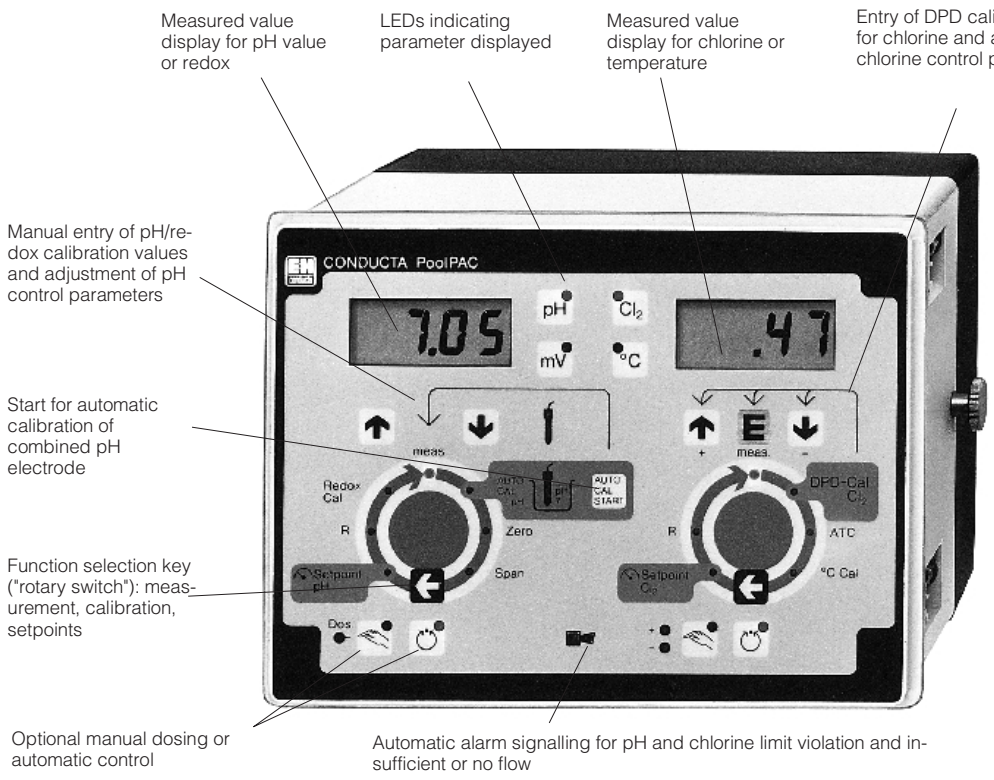

Fig. 1: Front view of fully equipped CCM 360-20 1 unit (some functions may not be operable depending on unit type, e.g. CCM 360-00 8).

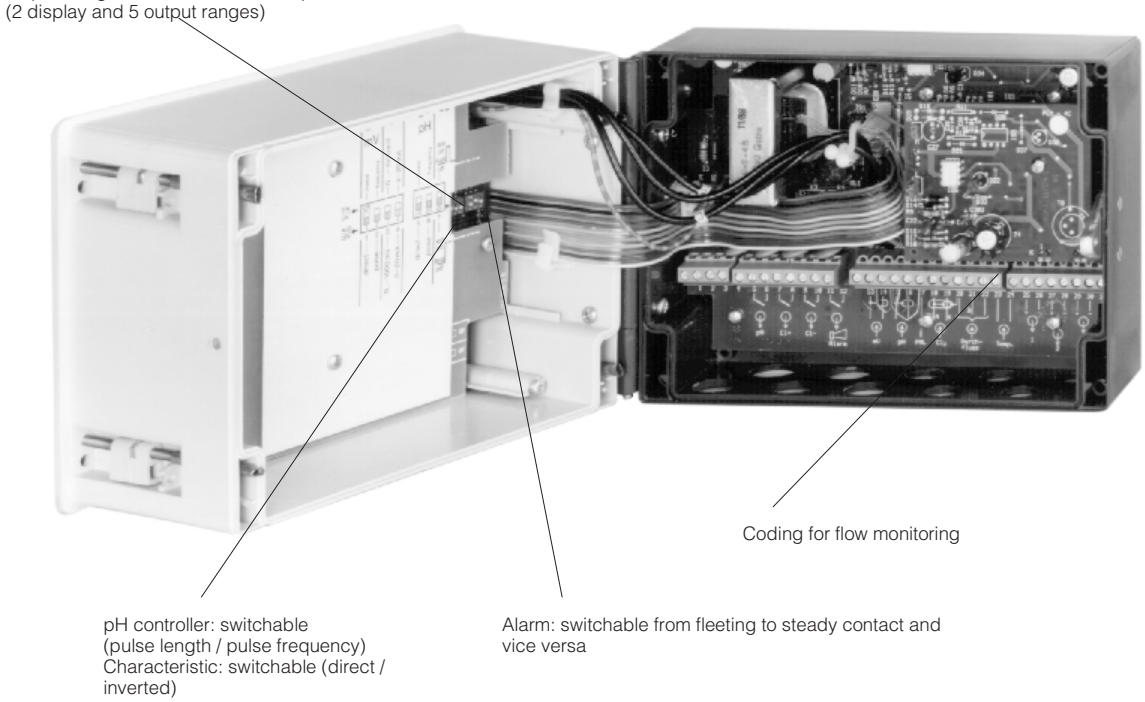

Fig. 2: View of unit with housing opened up

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1. Application

Oxidizing agents such as chlorine, anorganic chlorine compounds or ozone are used to disinfect pool, drinking and service water. Measurement and control of the chlorine concentration, redox potential and pH value are prerequisites for monitoring and guaranteeing the desired level of disinfection.

The PoolPAC is a microprocessor-controlled combination instrument for simultaneous and continuous measurement of pH value, redox voltage (mV) and free effective chlorine in water (mg Cl_2/l) that is also used to control the pH value and chlorine concentration.

The instrument provides the technical functions necessary to meet the requirements of DIN 19643 and the German federal statutes for control of epidemics.

Other typical areas of application
Continuous monitoring and chemical metering
- in process waters,
- in the foodstuffs industry, and
- in drinking water treatment.

1.1 Instrument variants

Table 1 shows the expansion levels of the PoolPAC types.

These operating instructions describe the version CCM 360-201 equipped with all the options. The connection diagrams also reflect the fully equipped instrument.
The input and output terminals of empty card positions have no function.
Additional safety functions as of software version 8.94:
- pH proportional band switching
- Display of software version number (see 8.4.3, Control parameter adjustment)
- Dosing shutoff in the event of a flow alarm (see 8.9)
- Safety shutdown to prevent overdosing (see 8.10)

Instrument	Type designation	Parameters	Variant
PoolPAC	CCM 360-00 8	Cl_2, °C	—
PoolPAC	CCM 360-10 0	Cl_2, pH, °C	—
PoolPAC	CCM 360-20 1	Cl_2, pH, mV, °C	—
PoolPAC	CCM 360-20 1 RD	Cl_2, pH, mV, °C	w. 3-pt. step controller (chlorine)

Table 1: PoolPAC instrument types

2. Measuring system

The complete measuring and control system for water disinfection comprises the following components:
- PoolPAC combination instrument, e.g. fully equipped type CCM 360-201 with all parameters
- Membrane-covered chlorine measuring cell type CCS 140 or CCS 140-N
- Combined pH electrode CPS31-1EC2GSA
- Combined redox electrode CPS32-0PB2GSA
- Chlorine flow assembly type CCA 250-A1
- Chlorine metering device; e.g. solenoid-operated piston pump with external control or stroke adjustment via a three-point step controller (-Rd)
- Metering device for acid or base for pH value control; e.g. solenoid valve or externally controlled solenoid-operated piston metering pump

3. Function

The PoolPAC instrument provides the following functions:
- Simultaneous measurement of parameters pH, mV, chlorine and temperature
- Automatic temperature compensation (ATC) can be enabled for chlorine
- Adjustable current output range for chlorine
- Concurrent, continuous display of two parameters measured
- Two independent control loops for dosing:
  1. for pH value control,
  2. for chlorine concentration adjustment
- Menu-driven functions for instrument operation and adjustment
- Chlorine and acid/base can be dosed in automatic or manual mode
- Parameter monitoring and alarm output
- Automatic flow monitoring

4. Order code

Combination measuring instruments PoolPAC CCM 360

Measuring ranges

00 0 ... 1.0 mg Cl_2/l / 0 ... 50 °C
01 0 ... 0.5 mg Cl_2/l / 0 ... 50 °C
02 0 ... 2.0 mg Cl_2/l / 0 ... 50 °C
03 0 ... 5 mg Cl_2/l / 0 ... 50 °C
04 0 ... 10 mg Cl_2/l / 0 ... 50 °C
10 0 ... 1.0 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH
11 0 ... 0.5 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH
12 0 ... 2.0 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH
13 0 ... 5 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH
14 0 ... 10 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH
20 0 ... 1.0 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH / 0 ... 1000 mV
21 0 ... 0.5 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH / 0 ... 1000 mV
22 0 ... 2.0 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH / 0 ... 1000 mV
23 0 ... 5 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH / 0 ... 1000 mV
24 0 ... 10 mg Cl_2/l / 0 ... 50 °C / 5 ... 10 pH / 0 ... 1000 mV
36 1 ... 13 pH / 0 ± 1000 mV (for redox/pH)
99 Special version according to customer specifications

pH/redox measuring range

0 Display 2 ... 12 pH; instrument output 5 ... 10 pH with Cl_2
1 Display 2 ... 12 pH; instrument output 5 ... 10 pH and 0 ... 1000 mV with Cl_2
3 Display range and instrument output 1 ... 13 pH and 0 ... 1000 mV without Cl_2
8 Without pH/redox measurement

Controller

IF Pulse length / pulse frequency for chlorine/pH
RA Pulse length / pulse frequency for redox/pH
RD 3-point controller for Cl, pulse length / pulse frequency for pH
RE Three-point step controller for chlorine
YY Special version according to customer specifications

Power supply

0 230 V, 50 / 60 Hz AC
1 110 V, 50 / 60 Hz AC
6 127 V, 50 / 60 Hz AC
7 240 V, 50 / 60 Hz AC
9 Special version according to customer specifications

Output

0 0 ... 20 mA
2 4 ... 20 mA
9 Special version according to customer specifications

CCM 360 - ⇐ **complete order code**

5. Installation and connection

The PoolPAC can be installed in two ways:

- wall installation
- control panel installation

The packing unit includes:

- 1 PoolPAC instrument
- 5 Pg 11 cable glands
- 5 Pg 9 cable glands
- 6 blank glands
- 1 copy of operating instructions

Blank glands are to be installed in place of cable glands where no cables are installed.

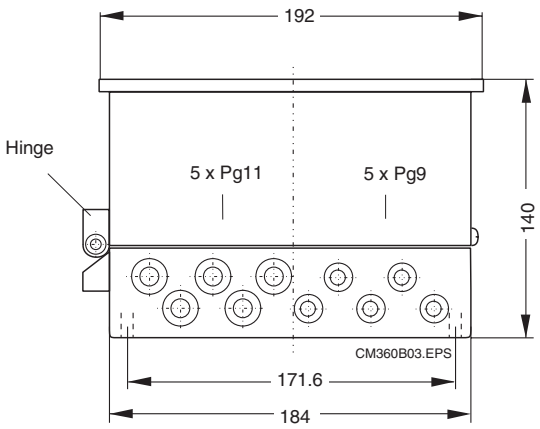


Fig. 3: PoolPAC, dimensions and bottom view

5.1 Wall installation

- Open the instrument front panel. Break out the four key holes in the bottom of the housing from inside using a screwdriver.
- Hold the instrument against the wall and mark the screw positions or determine according to figure 4.
- Screw in the fastening screws until their heads stick out approx. 10 mm.
- Position the instrument over the screws, push down all the way, then tighten the screws.
- Install cable glands and blank glands as required.

5.2 Panel installation

- Make a panel cutout according to figure 5.
- Install the instrument without Pg cable glands.
- Fold out the tensioning brackets with the housing open and tighten.
- Install cable glands and blank glands as required.

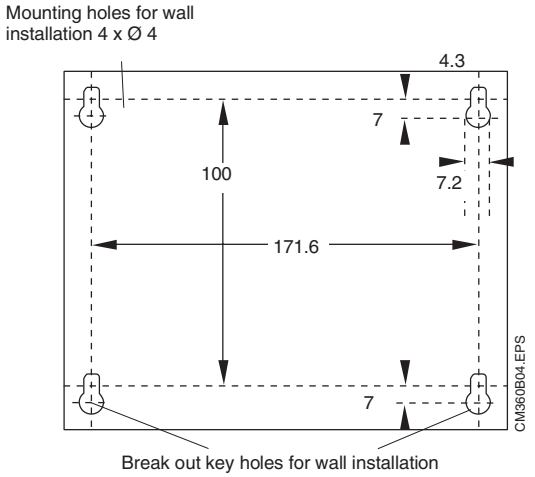


Fig. 4: PoolPAC, screw positions for wall installation

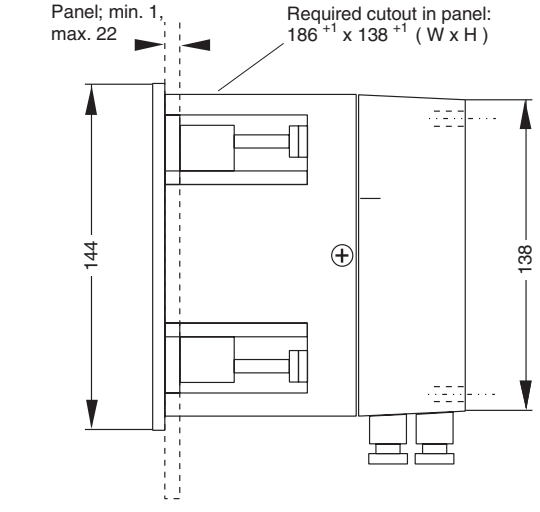
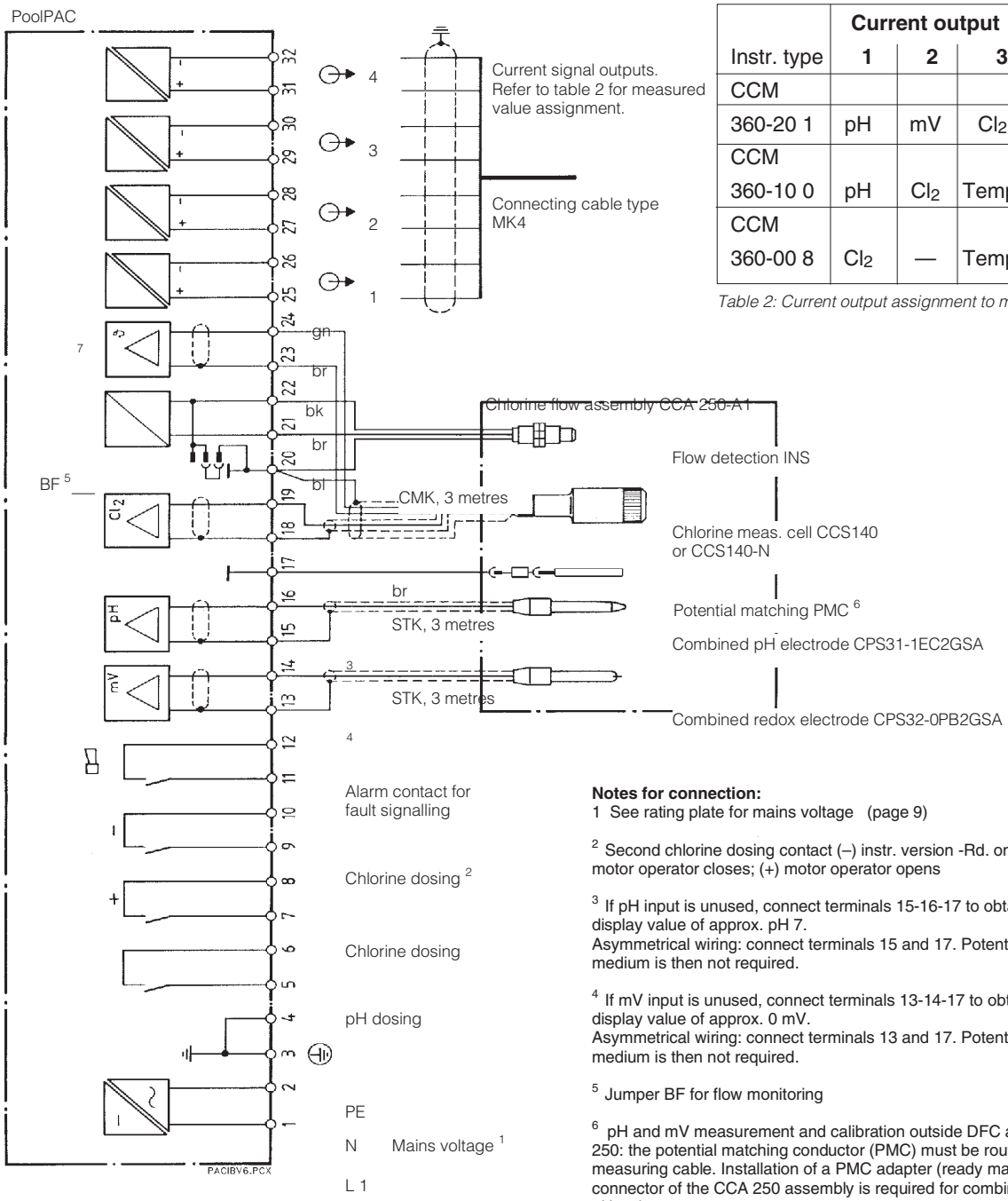


Fig. 5: PoolPAC, side view with cutout in control panel

5.3 Connection diagram of PoolPAC

Fig. 6 shows the connection diagram for direct measuring sensor connection to the PoolPAC.

Larger distances than 3 m require a junction box VBC and cable types CMK, SMK and MK. Refer to the connection diagram shown in fig. 7 in this case.



Instr. type	Current output 1	2	3	4
CCM 360-20 1	pH	mV	Cl_2	Temp.
CCM 360-10 0	pH	Cl_2	Temp.	—
CCM 360-00 8	Cl_2	—	Temp.	—

Table 2: Current output assignment to measured quantity

Notes for connection:

1 See rating plate for mains voltage (page 9)

2 Second chlorine dosing contact (–) instr. version -Rd. only. (–) means motor operator closes; (+) motor operator opens

3 If pH input is unused, connect terminals 15-16-17 to obtain a constant display value of approx. pH 7.
Asymmetrical wiring: connect terminals 15 and 17. Potential matching to medium is then not required.

4 If mV input is unused, connect terminals 13-14-17 to obtain a constant display value of approx. 0 mV.
Asymmetrical wiring: connect terminals 13 and 17. Potential matching to medium is then not required.

5 Jumper BF for flow monitoring

6 pH and mV measurement and calibration outside DFC assembly CCA 250: the potential matching conductor (PMC) must be routed with the measuring cable. Installation of a PMC adapter (ready made) in the PMC connector of the CCA 250 assembly is required for combined chlorine/ pH-redox measurement.

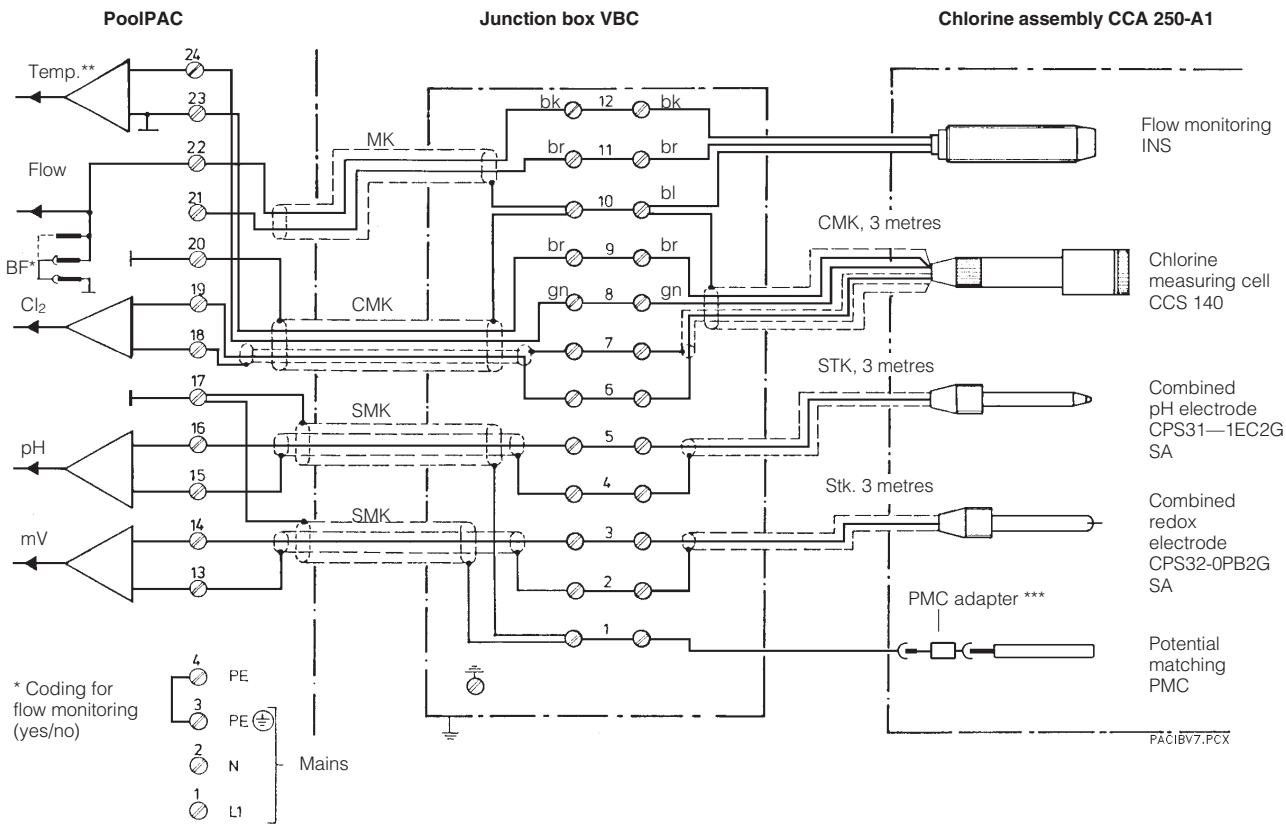
7 If temp. input is unused, bridge terminals 23 and 24 with 10 kΩ (corresponds to 25 °C).

Fig. 6: Wiring diagram for PoolPAC CCM 360-20 1 with flow assembly CCA250-A1 (with INS)

5.4 Connection diagram of PoolPAC with junction box VBC

The sensors built into the chlorine flow assembly CCA 250 come with measuring cables 3 metres in length. Additional measuring cables and junction box VBC are required for longer distances (see chapter 11.2, Accessories).

Note:
Maximum length of CMK cable for chlorine measuring cells CCS140-A and CCS140-N is 30 metres!



** If temp. input is unused, bridge terminals 23 and 24 with 10 kΩ (corresponds to 25°C).

*** Installation of a PMC adapter (ready made) in the PMC connector of CCA 250 assembly is required for combined chlorine/pH-redox measurement.

Fig. 7: Connection diagram of PoolPAC CCM 360-20 1 with flow assembly CCA 250-A1 and junction box VBC

6. Changing instrument settings

Steps to take before changing instrument settings:

- Switch off power
- Loosen locking screw on side
- Open hinged front part of housing

The following adjustments can then be made inside the opened housing (see figures 2 and 8):

- Chlorine measuring range
- Chlorine output current range
- 0 ... 20 mA or 4 ... 20 mA current outputs for all variables measured
- Settings for pH control function
- Alarmrelais-Funktion

Whenever settings are changed **according to chapters 6.1 and 6.2, power must be switched off briefly** in order for the changes to take effect.

6.1 Selection of chlorine measuring and output ranges

(Switches S10 and S1 – S3, see figure 8)

Chlorine measuring and display range (switch S10)	**Current output range**	**Switch positions (switches S1-S3)**
0 – 2 mg Cl_2/l	0 – 0.5 mg Cl_2/l	S1 = off S2 = off S3 = off
0 – 10 mg 0 -2 mg	0 – 1 mg Cl_2/l	S1 = off S2 = on S3 = off
	0 – 2 mg Cl_2/l	S1 = off S2 = off S3 = on
0 – 10 mg Cl_2/l	0 – 5 mg Cl_2/l	S1 = on S2 = on S3 = off
0 – 10 mg 0 – 2 mg	0 – 10 mg Cl_2/l	S1 = on S2 = off S3 = on

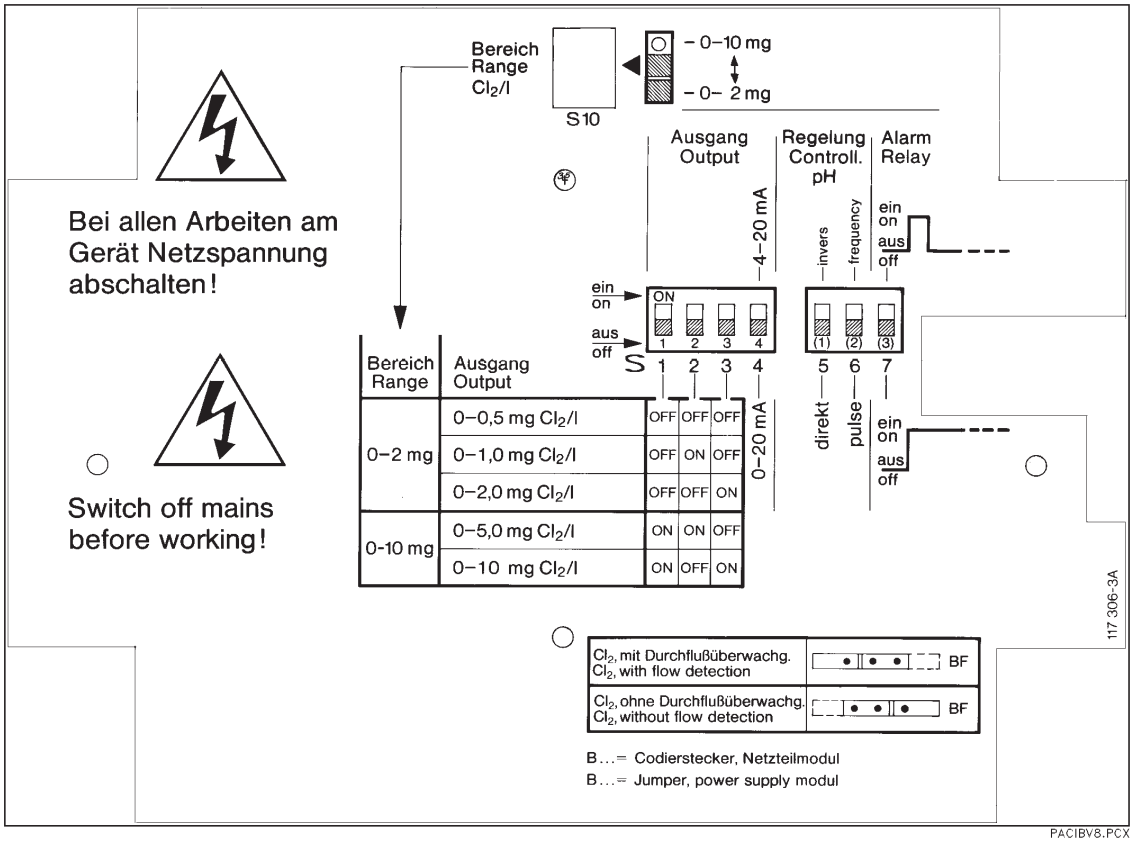
6.2 Current output selection, pH control function adjustment, alarm function

Function	**Switch**	**Notes**
Signal outputs 0 ... 20 mA	S4 = off	Common to all measured value outputs
Signal outputs 4 ... 20 mA	S4 = on	
Max. function of pH controller	S5 = off	Controls setpoint violation
Min. function of pH controller	S5 = on	Controls setpoint violation
pH control with pulse-length controller *(pulse)*	S6 = off	
pH control with pulse-frequency controller *(frequency)*	S6 = on	
Alarm as steady contact	S7 = off	LED indicator is on continuously
Alarm as fleeting contact	S7 = on	

6.3 Coding for flow detection

When connecting the chlorine flow assembly type CCA 250 with the inductive proximity switch INS, the position of jumper BF is to be changed according to the coding diagram shown in figure 8. (Jumper BF is located on the main printed circuit board in the rear part of the PoolPAC housing (see figures 2 and 9).

Caution:
A FLOW alarm condition is signalled if jumper BF is in the "with flow detection" position without proximity switch INS being connected.



Instructions for setting jumper BF. Refer to fig. 9 for jumper location on PCB in rear part of housing.

Fig. 8: Inside view of front part of housing, switches S1 – S10 and jumper BF for instrument adjustment (also see figure 2)

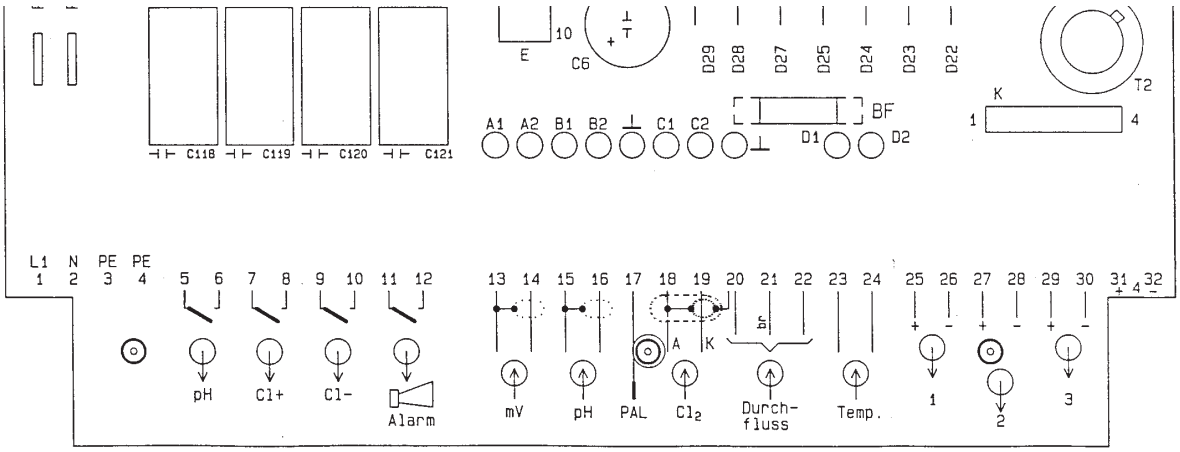


Fig. 9: Inside view of rear part of housing. Connection area with jumper BF (also see figure 2)

6.4 Documentation of range settings

The rating plate provides information on the instrument type and functions. To identify the unit more precisely, the selected range settings should be marked additionally (mark with wipe-resistant pen).

Instruments with measuring and output ranges as per order are adjusted at the factory, and the rating plate is marked accordingly.

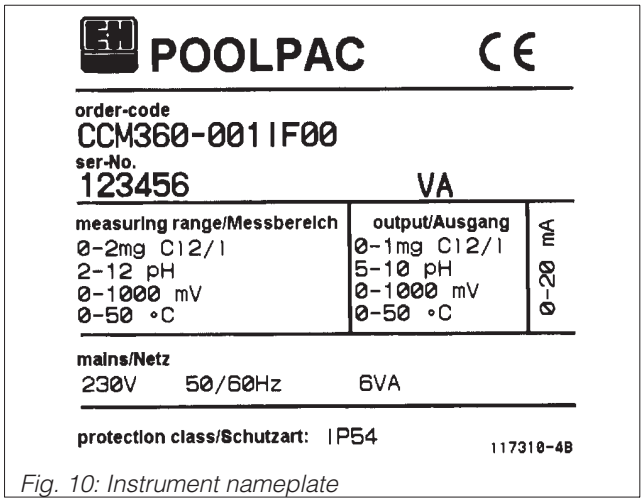


Fig. 10: Instrument nameplate

7. Start-up

Cautions:
- The unit must be grounded before start-up!
- If faults cannot be remedied, the unit must be removed from service and secured to prevent accidental start-up.
- Repair work must be carried out directly by the manufacturer or the Endress+Hauser Service Organization.

Warning:
- The notes and warnings in these operating instructions must be strictly adhered to! Maintenance work may only be carried out by qualified personnel if the instrument remains energised.

Notes:
- Any faults in the instrument may be remedied with the aid of the error list in chapter 9 without requiring intervention in the instrument itself.
- After installing and connecting the instrument and sensors, the entire measuring system must be checked for proper function.

Manufacturer's certification:
- This measuring instrument has been built and tested in accordance with EN 61010-1 and left the manufacturer's works in perfect condition.
- This instrument has been tested for electromagnetic compatibility with industrial environments according to EN 50081-2, 03.94 and prEN 50082-2, 11.94.

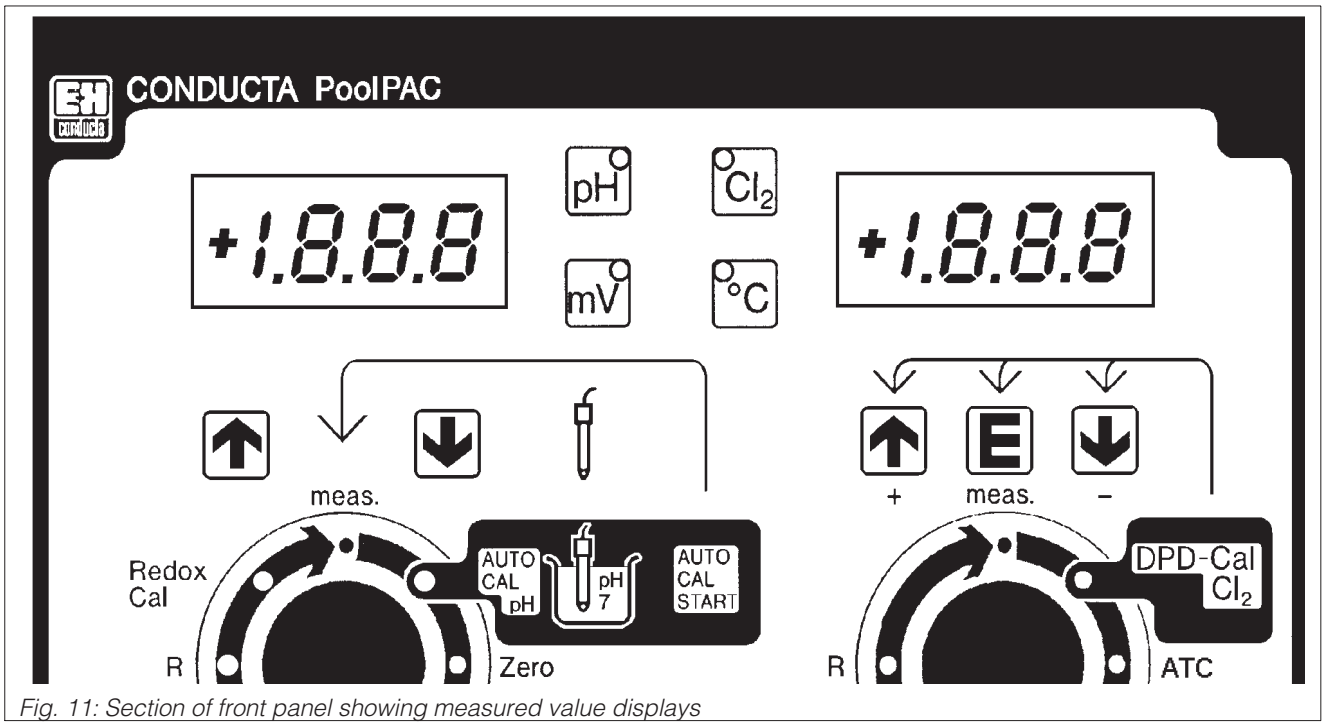


Fig. 11: Section of front panel showing measured value displays

8. Operation

Instrument operation includes the following functions:

- Measured value display
- Automatic / manual dosing
- Calibration
- Setpoint and control parameter adjustment
- Error messages
- Alarm signalling

The instrument is operated using the keys on the front panel. The instrument reacts to key actuation

either immediately after the key is released

or with a delay of approx. 1 second when a key is pressed and held down.

The functions selected are acknowledged by:

the LED that lights up in the corresponding key symbol for the measured

quantities and

manual or automatic dosing

8.1 Measured value display

Parameter	Activation	Response
pH value	pH Normal operating state	LED in pH left-hand ms. value display
mV	mV : automatic return to pH after 1 minute	LED in mV left-hand ms. value display
Chlorine *	Cl_2 Normal operating state	LED in Cl_2 right-hand ms. value display
Temperature	°C : automatic return to Cl_2 after 1 minute	LED in °C right-hand ms. value display
ATC – Cl_2* off	Cl_2 + ← then ↓ ← to meas.	LED ATC display _ _.0 LED meas.
ATC – Cl_2* on	Cl_2 + ← then ↑ ← to meas.	LED ATC display _ _.1 LED meas.

Parameters can only be display or switched when the “meas” LED is on in the corresponding rotary switch symbol.

* Automatic temperature compensation (ATC) is possible for the Cl_2 measurement.

8.2 Dosing

Parameter, dosing type	Activation	Response
pH, automatic	(bottom left)	LED
pH, manual	: (switches to manual)	LED
	Repeat : man. dosing **on**	LED *Dos*
	Repeat : man. dosing **off**	
Return to pH, automatic	if manual dosing **off**	LED

Parameter, dosing type	Activation	Response
Chlorine, automatic	bottom right	
Chlorine, manual	: switches to manual	
	Repeat . man. dosing on	LED
	Repeat man. dosing off	
Return to chlorine, automatic	if manual dosing off	
Instrument types C ... -Rd	: actuator opens : actuator closes	Dosing LED + o Dosing LED – o

The instrument always starts up in the "automatic dosing" mode after power-up or when power is restored after a power failure.

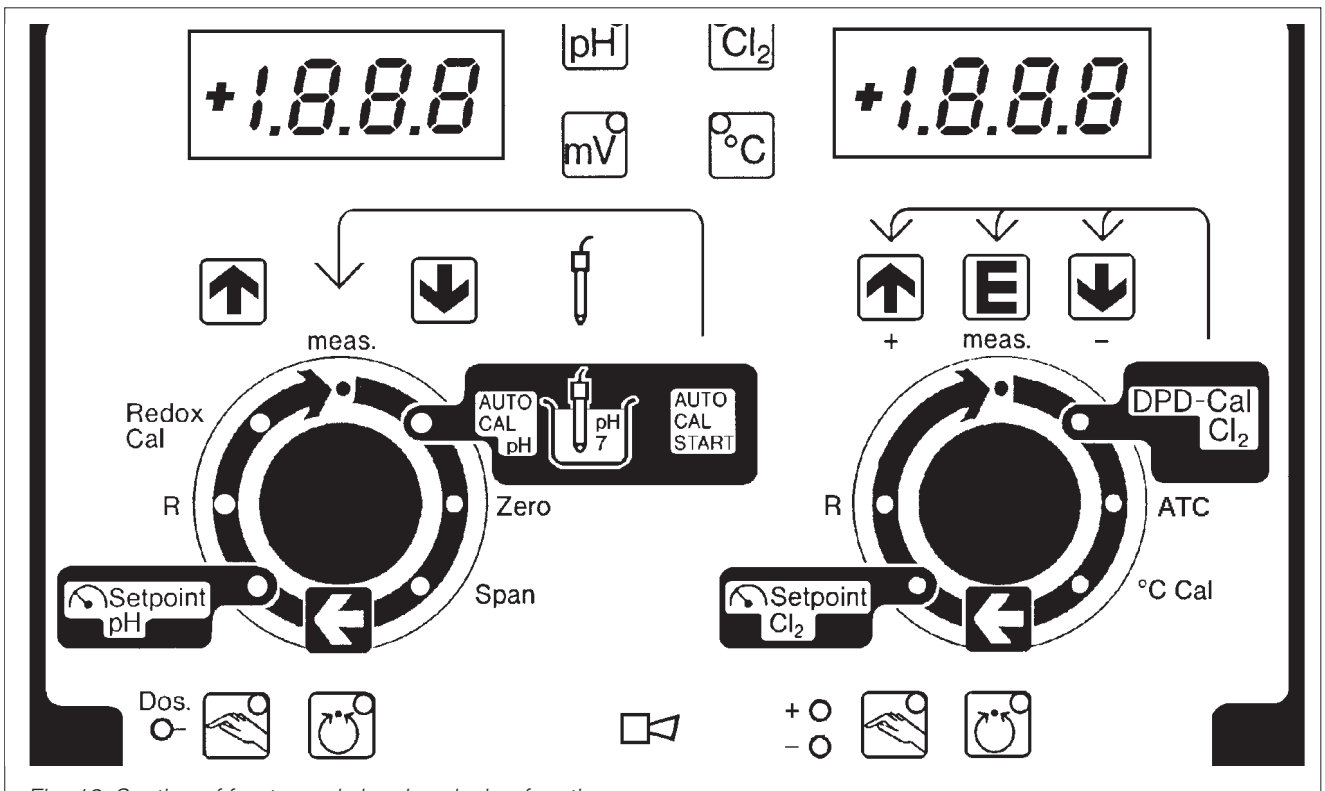


Fig. 12: Section of front panel showing dosing functions

8.3 Calibration

Selecting the "calibration" functions interrupts the following functions:

- Measured value output to signal output (values last measured are maintained)
- The automatic and manual control and dosing functions

Features indicating the "calibration" mode of operation:

- *meas.* LEDs are off
- The decimal point in the measured value display flashes
- One of the following LEDs is on:
  "AUTO CAL", "Zero", "Span", "Redox Cal", "DPD Cal", "°C Cal"

Also refer to the operating instructions for the flow assembly CCA 250 and chlorine measuring cell CCS 140 regarding calibration of the chlorine measuring cell.

8.3.1 pH calibration*

The pH calibration can be performed in two ways:
1) Automatically using the *AUTOCAL pH* function, or
2) manually using the manual pH operating function: Zero/Span.

Note: Observe note 6 in fig. 6 for external calibration outside the assembly CCA 250.

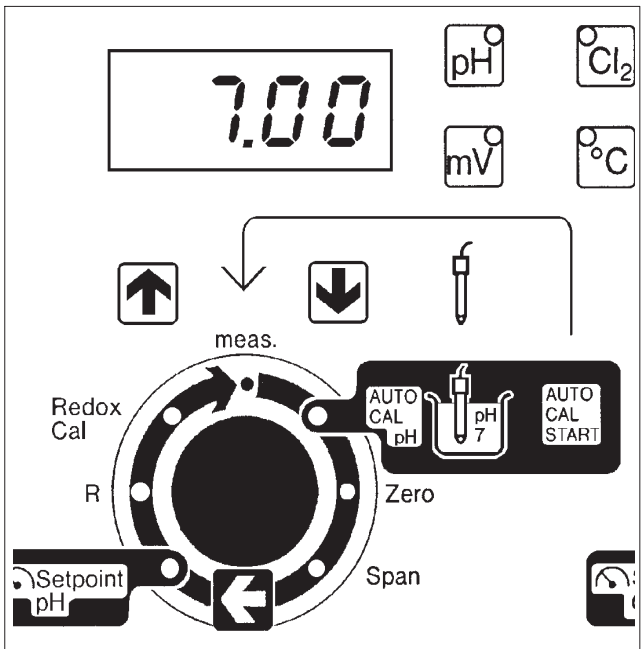


Fig. 13: Operating field "AutoCal pH"

* Not available on PoolPAC type CCM 360-0x8

8.3.1.1 pH calibration via AUTOCAL

The operating function *AUTOCAL pH* performs a "one-point calibration", i.e. it adapts the instrument to the combined pH electrode at the pH value of 7.

This assures satisfactory accuracy in the pH range from 6.5 to 7.5. The calibration is performed automatically:

Parameter calibrated	Activation	Response
AUTOCAL pH	← to select *AUTOCAL pH*	The decimal point in the display flashes. LED *AUTOCAL pH.* The 2 electrode symbols flash alternately (lower symbol for pH 7 is on longer)
	Fill pH 7.00 buffer into calibration vessel and immerse pH electrode	
	AUTO CAL START The calibration with the electrode is performed automatically	The lower electrode symbol is on continuously (pH 7) during the calibration process
		Calibration is complete. The 2 electrode symbols flash alternately (upper symbol is on longer)
	← to *meas.*	LED *meas.* LED pH

8.3.1.2 Manual pH calibration

Extended measuring operation in the range from pH 5 to pH 10 requires a “two-point calibration”, i.e. the instrument is adapted to the combined pH electrode at pH 7 and, for example, pH 4.

Independent of the manual calibration sequence, the *Zero* and *Span* operating functions represent an additional means to query the characteristics of the combined pH electrode determined by the instrument during calibration.

Zero operating function: Press the *“pH”* key to display the zero value (asymmetry potential) of the measuring chain as a pH value.

Span operating function: Press the *“pH”* key to display the actual slope in per cent referred to the theoretical value (100 % = 59.16 mV/pH at 25 °C).

The manual pH calibration is performed using the *Zero* and *Span* menu sequences:

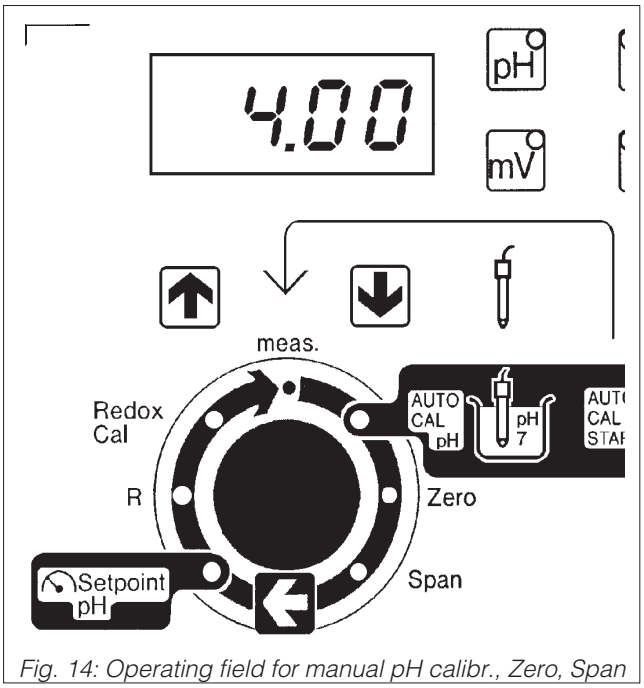


Fig. 14: Operating field for manual pH calibr., Zero, Span

Parameter calibrated	**Activation**	**Response**
Manual pH: *Zero*	← from *meas.* to *AUTOCAL pH*, then	LED pH LED “AUTOCAL”
		LED *Zero*
		← and pH simultaneously
	pH (display only)	Previous zero value in display pH (asymmetry potential)
	Fill “zero” buffer, e.g. pH 7.00, into calibration vessel, immerse electrode and wait for display to stabilise	Measured pH value in display pH
	↑ or ↓	Set display value to buffer value, e.g. pH 7.00
	(*Span* function: see next parameter or press ← to go to *meas*	

Parameter calibrated	**Activation**	**Response**
Manual pH: *Span*	From *Zero* pH and ← simultaneously	pH LED *span*
	pH (display only)	Previous slope value in % in display pH (100 % = 59.16 mV/pH at 25 °C)
	Fill buffer, e.g. pH 4.00, into calibration vessel, immerse electrode and wait for display to stabilise	Measured pH value in display *pH*
	↑ or ↓	Set display value to buffer value, e.g. pH 4.00
	← to *meas.*	LED *meas.* pH

8.3.2 mV calibration*

The *Redox Cal* operating function is used to adapt the instrument to the combined redox electrode reference voltage.
Normally, a 470 mV redox buffer is used for this purpose.
The calibration is performed using the *Redox Cal* menu sequence:

Parameter calibrated	Activation	Response
mV *Redox Cal*	mV and ⇐ simultaneously Fill buffer solution, e.g. 470 mV, into calibration vessel, immerse redox electrode and wait for display to stabilise. ↑ or ↓ ⇐ to *meas.*	mV LED *RedoxCal* Measured redox value (mV) in display *mV* Set display to buffer value (if measured val. deviates), e.g. 470 mV LED *meas.* pH

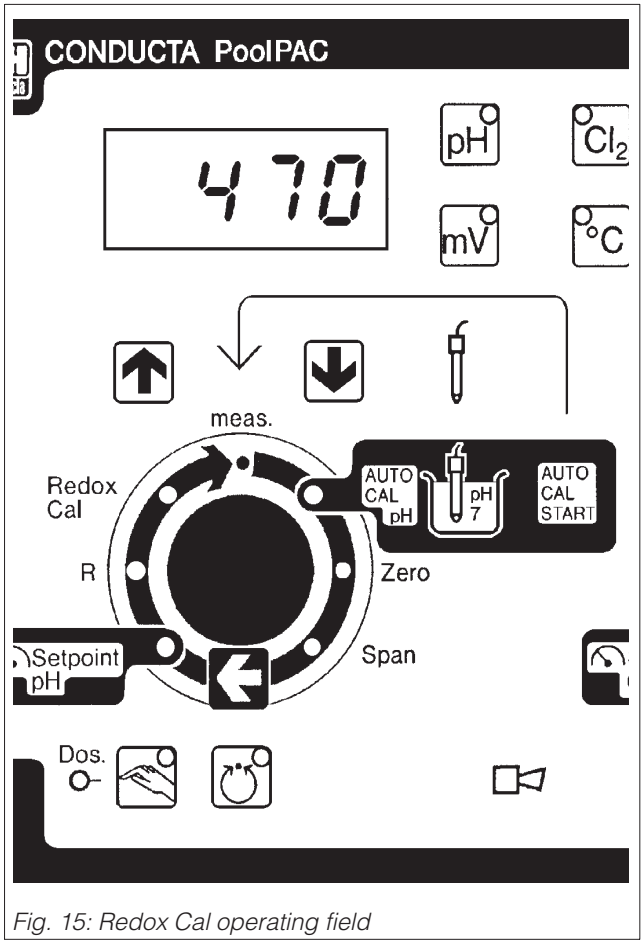


Fig. 15: Redox Cal operating field

*) Not available on PoolPAC
types CCM 360-0x8 and CCM 360-1x0

8.3.3 Chlorine calibration

The *DPD-Cal Cl_2* operating function is used to adapt the instrument to the current working point of the chlorine measuring cell.

- **Reference measurement according to DPD method**
  To calibrate the chlorine measuring system, a comparative colorimetric measurement according to the DPD method must be performed. Free chlorine reacts with diethyl-p-phenyl-endiamine (DPD) by forming a red colourant, with the intensity of the colouring increasing in proportion to the chlorine concentration.
  While the measured value was usually determined in the past by visually comparing the measuring solution to a colour scale, affordably priced hand photometers, e.g. the CCM 181 photometer, are available today that guarantee objective and precise determination of the chlorine concentration.

  With the DPD method, the measuring water is always buffered to a pH value of approx. 6.3, which is why this method is independent of the pH value of the measuring water.

Caution:
The DPD method cannot be used in conjunction with organic chlorination agents, e.g. sodium dichloroisocyanurate. In this case, it renders measured values that are higher than the actual free effective chlorine content (cf. note in DIN 38408, part 4, section 5).

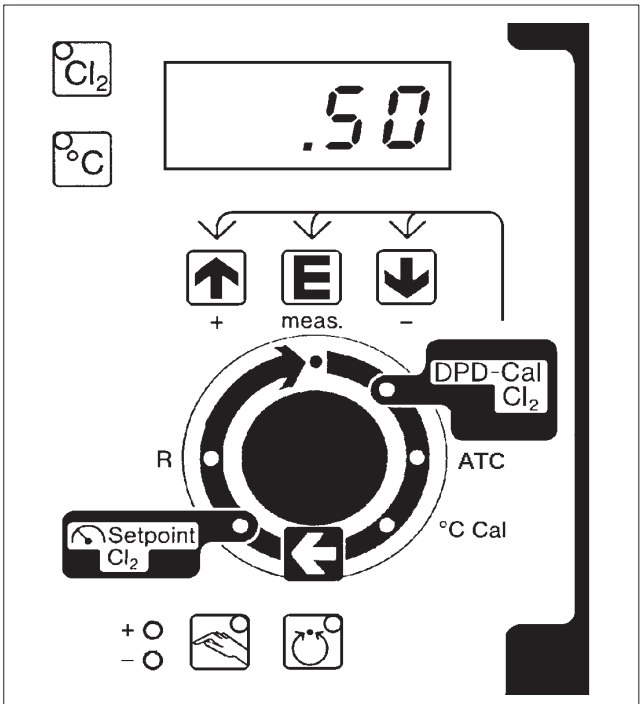


Fig. 16: Operating field "DPD-Cal Cl_2"

The calibration is performed using the DPD-Cal *Cl_2* menu sequence:

Parameter calibrated	Activation	Response
	Determination of chlorine concentration of the water flowing by the chlorine measuring cell according to the DPD method	
Chlorine *DPD-Cal Cl_2* (in conjunction with chlorine measuring cell type CCS 140). Please note operating instructions for chlorine meas. cell CCS 140!	◄ to *DPD-Cal Cl_2*	LED *DPD-Cal Cl_2*. Old DPD value in display Cl_2
	Set DPD value determined ▲ or ▼	Newly adjusted value in display Cl_2 determined according to DPD method
	E Accept *DPD* value *) or retain old value	LED *meas* LED Cl_2
	◄ to *meas*	LED *meas* LED Cl_2

*) Flashing display indicates DPD-*Cal* error message; see chapter 8.6.2

8.3.4 Temperature calibration

The °C Cal operating function is used to adapt the instrument to the temperature sensor installed in the chlorine measuring cell type CCS 140-N.
Calibration is performed at the factory.
The absolute deviation of the temperature measurement is +/- 0.2 °C.

Proceed as follows to recalibrate:

Parameter calibrated	Activation	Response
	Measure water temperature with a thermometer (see above)	
Temperature in °C	°C then °C + ← simultaneously ↑ or ↓ Either accept E the temperature value or ← retain the old value	Current temperature value in display °C LED °C Cal fig. 18 Set the display to the temperature measured with the thermometer LED *meas.* LED *meas.*

8.4 Setpoint and control parameter adjustment

This operating function is used to adapt the instrument to the process and existing metering devices.
Characteristics of this operating state:

- *meas.* LEDs are off
- Decimal point in the measured value display flashes
- *Setpoint* or *R* LEDs are on

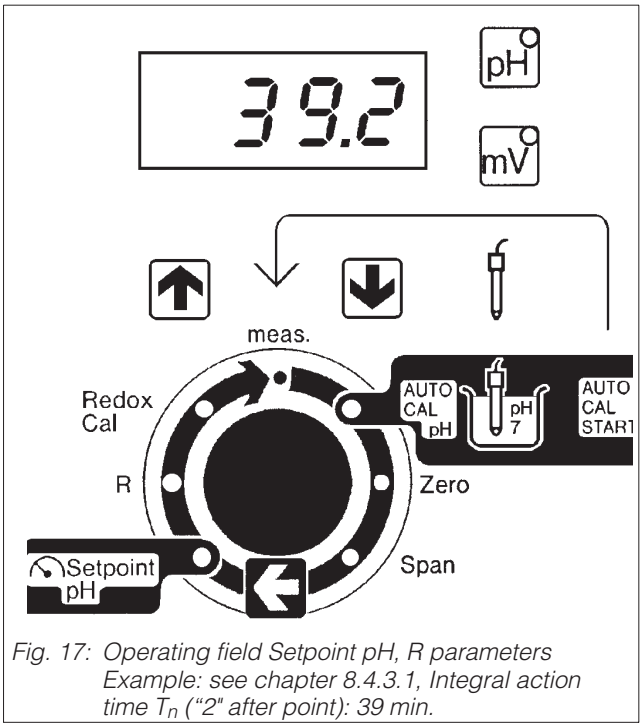


Fig. 17: Operating field Setpoint pH, R parameters Example: see chapter 8.4.3.1, Integral action time T_n ("2" after point): 39 min.

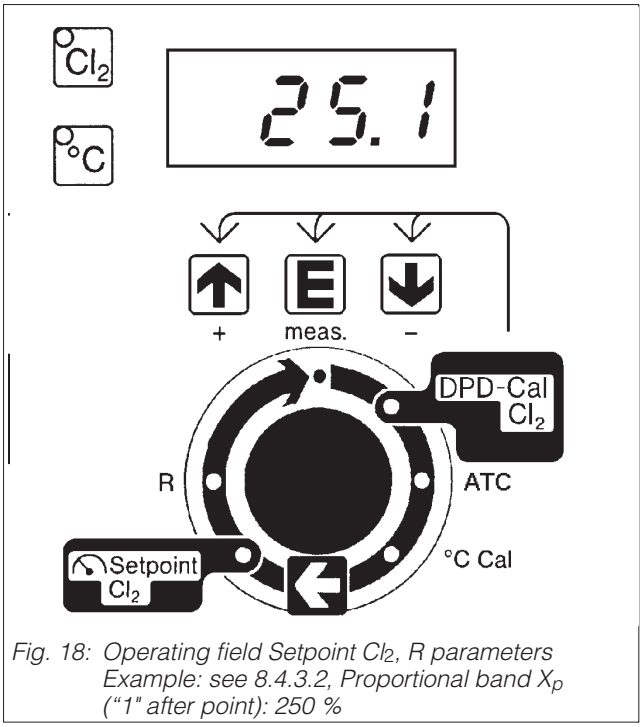


Fig. 18: Operating field Setpoint Cl_2, R parameters Example: see 8.4.3.2, Proportional band X_p ("1" after point): 250 %

8.4.1 Setpoint adjustment

8.4.1.1 pH setpoint*

The *Setpoint pH* operating function is used to adjust the setpoint for the pH control loop.
This function can be accessed directly from the *meas.* mode or from the operating functions *AUTOCAL pH, Zero, Span* according to the *Setpoint pH* menu sequence:

Setpoint parameter	Activation	Response
pH setpoint	Starting from *meas.* press ◀ 2 x	LED *Setpoint pH*
	▲ or ▼	Set display to the desired setpoint (in pH 2-12 range)
	◀ to *meas.*	LED *meas.*

8.4.1.2 Cl_2 setpoint

The *Setpoint Cl_2* operating function is used to adjust the setpoint for the Cl_2 control loop.
This function can be accessed directly from the *meas* mode or or from the operating function *DPD-Cal Cl_2,* according to the *Setpoint Cl_2* menu sequence:

Setpoint parameter	Activation	Response
Cl_2 setpoint	Starting from *meas.*, press 2 x	LED *Setpoint Cl_2*
	▲ or ▼	Set the display to the desired setpoint (possible range 0-2 mg Cl_2/l or 0-10 mg Cl_2/l)
	◀ to *meas*	LED *meas*

* Not available on PoolPAC type CCM 360 0x8

8.4.2 Factory settings

The instrument is shipped with the following settings of R control parameters (0-2 mg Cl_2/l measuring range):

Parameter	pH	Cl_2
Setpoint	7.00	0.4 mgCl_2/l
DPD difference value		0.5 mg Cl_2/l
ATC for chlorine (T option)	–	1

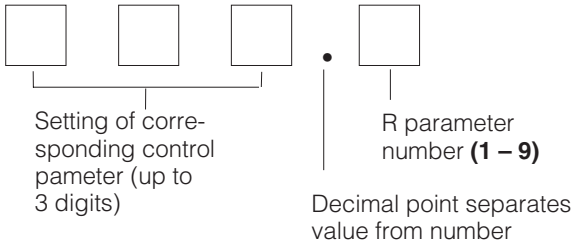
R parameter	Controller type activated*		
	Pulse length	Pulse frequency	-Rd option
X_P (proportional band)	100 %	100 %	
T_n (integral action time)	99 min	99 min	99 min
T (max. pulse period)	10 s	–	–
t_{emin} (min. on-time)	0.3 s	–	–
f_{max} (max. pulse frequency)	–	80/min	–
T_M (max. motor operating time)	–	–	60 s
X_{GL} (base load dosing)	0 %	0 %	–
t_{AS} (alarm delay time)	1 min		
t_{AF} (flow alarm delay time)	60 s		
X_{AS} (alarm threshold)	±10 %		

* Factory setting: pulse frequency

8.4.3 Control parameter adjustment

The *R* (control parameter) operating function for pH value and chlorine is used to adjust up to 13 control parameters and special monitoring functions; see table below.
These functions are used to adapt the instrument to the process and metering devices at the place of installation.
Refer to chapter 8.4.2 for the factory settings.

The parameters are assigned sequential parameter numbers; see table 3.



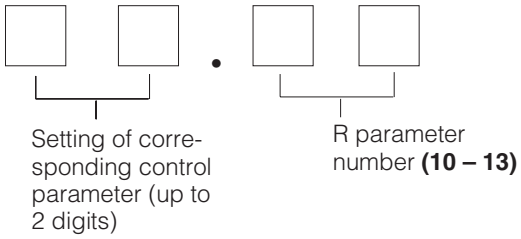


Table 3: **Overview of R (control) parameters*) :**

Control parameter number	**pH control parameters**		**Chlorine control parameters**		
	Controller type				
	Pulse length	**Pulse frequency**	**Pulse length**	**Pulse frequency**	**Rd option**
1 Proportional band	X_P	X_P	X_P	X_P	X_P
2 Int. action time for I function	T_n	T_n	T_n	T_n	T_n
3 Control function	P/PI	P/PI	P/PI	P/PI	-
4 Period p. frequency	T	f_{max}	T	f_{max}	T_M
5 Minimum on-time	t_{emin}	-	t_{emin}	-	t_{emin}
6 Base load dosing **)	-	-	X_{GL}	X_{GL}	X_{Sh} neutral zone s. chapter 11
7 Alarm delay time	t_{AS}	t_{AS}	t_{AS}	t_{AS}	t_{AS}
8 DPD calibration monitoring	-	-	Max. perm. DPD difference	Max. perm. DPD difference	Max. perm. DPD difference
9 Display of Cl_2 sensor signal	-	-	yes	yes	yes
10 Flow alarm delay time	-	-	t_{AF}	t_{AF}	t_{AF}
11 Switch pulse length / pulse frequency	-	-	yes	yes	-
12 Alarm threshold	X_{AS}	X_{AS}	X_{AS}	X_{AS}	X_{AS}
13 Switch proportional band	0/1	0/1	–	–	–
Software version	e.g., 8.94				

*) Different R parameter numbers are activated depending on the controller type selected (pulse length, pulse frequency or three-point step controller).

**) Constant base load dosing independent of actual value, e.g. to counteract natural chlorine consumption in a pool.

8.4.3.1 pH control parameter sequence*

R parameter for pH	Activation	Response
Start parameter entry	Press ← 2 x starting from *meas.*, then ← and pH simultaneously	LED *Setpoint pH* LED *R*
Xp: 0 – 500 % Setting Xp to 0% acts as a limit contact (on/off controller). Continue with R parameter no. 7: t_{AS}, i.e. skip nos. 2 – 5 if Xp 0%	Xp adjustmt. with ↑ or ↓ Continue with	Display _XX.1 (Xp value is **10 times display value XX, switchable w. R parameter no. 13 to X_p value = XX)**
T_n: 1 – 99 min	Tn adjustmt. with ↑ or ↓ Continue with	Display _XX.2
P or PI control function	I comp. on ↑ or I comp. off ↓ Continue with	Display __1.3 Display __0.3
f_{max}: 60 - 120 pulses/min (max. pulse frequency for pulse frequency controller)	f_{max} adjustmt. with ↑ or ↓ Continue with	Display XXX.4
T: 1 – 99 s (for pulse length controller)[1])	T adjustmt. with ↑ or ↓ Continue with	Display XXX.4
t_{emin}: min. 0.3 s max. 15 s or max. $^1/_3$ T[1])	t_{emin} adjustmt. ↑ or ↓ Continue with	Display XXX.5 (pulse duration value t_{emin} is **0.1 x display val. XXX)**
t_{AS}: 0 – 99 min	t_{AS} adjustmt. with ↑ or ↓ Continue with	Display _XX.7
X_{AS}: ± 5 % ±10 % - ±50 % of setpoint	X_{AS} adjustmt. ↑ or ↓ Continue with	Display _X.12 (X_{AS} is **10 x display value X)** Display __.12 corr. to ±5 %
Switch proportional band X_p: 0 – 500 % X_p: 0 – 50 %	Adjustmt. with ↑ or ↓ Continue with	Display .13 1.13
Display software version		Display, e.g. 8.94
	repeat starting with _XX.1 always ← *meas.*	LED *meas.*

* Not available on PoolPAC type CCM 360-0x8

[1]) Switch S6 in “pulse” or “off” position: “pulse length controller” mode is selected (see chapter 6.2)

8.4.3.2 Chlorine control param. sequence

R parameter for chlorine	Activation	Response
Start parameter entry	Press ◀ 2 x starting from *meas.*, then ◀ and Cl₂ simultaneously	LED *Setpoint Cl_2* LED *R*
Xp: 0 – 500 % % setting of Xp 0% acts as a limit contact (on/off controller). Continue with R parameter no. 7:	Xp adjustmt. with ▲ or ▼ Continue with ✎	Display _XX.1 (Xp value is **10 x display value XX)**
	Caution: Pulse frequency contr. type: X_p range only 10 to 500 %	
Tn: 1 – 99 min	Tn adjustmt. with ▲ or ▼ Continue with ✎	Display _XX.2
P or PI (control function)[1]	I comp. on ▲ or I comp. off ▼ Continue with ✎	Display __1.3 Display __0.3
f_{max}: 60 – 120 pulses/min (max. pulse frequency for pulse frequency controller)	f_{max} adjustmt. with ▲ or ▼ Continue with ✎	Display XXX.4
T: 1 – 99 s Pulse period for pulse length contr. [2]	T adjustmt. with ▲ or ▼ Continue with ✎	Display XXX.4
T_M: 10 – 999 s Motor operating time for three-point step controller (-Rd option)	T_M adjustmt. with ▲ or ▼ Continue with ✎	Display _XX.4 (motor operating time is **10 x display value XX)**
t_{emin}: min. 0.3 s max. 15 s or max. $^1/_3$ T [2]	t_{emin} adjustmt. with ▲ or ▼ Continue with ✎	Display XXX.5 (pulse duration value is **0.1 x display value XXX)**

[1] Omitted on instruments with 3-point step controller.

R parameter for chlorine	Activation	Response
X_{GL}: 0 – 80 % (or Cl_2 setpoint) Base load dosing [3]	X_{GL} adjustmt. with ▲ or ▼ Continue with ✎	Display _XX.6
t_{AS}: 0 – 99 min alarm delay time	t_{AS} adjustmt. with ▲ or ▼ Continue with ✎	Display _XX.7
Max. permis. DPD difference: 0.01 – 0.90 mg/l (max. Cl_2 difference to last DPD calibration)	Adjustment with ▲ or ▼ Continue with ✎	Display _XX.8 (DPD difference value is **0.01 x display value XX)**
Sensor signal: 0 – 199 display units (analogue sensor current from CCS 140)	Continue with ✎	Display XXX.9 1 unit X corresp. to 0.2 nA for 0 – 2 mg Cl_2, to 1 nA for 0 – 10 mg Cl_2 meas. range
t_{AF}: 0 – 190 s delay time for flow alarm	Adjustment with ▲ or ▼ Continue with ✎	Display XX.10 (t_{AF} value is **10 x display value XX)**
Switches controller type: pulse length or pulse frequency	Adjustment with ▲ pulse length controller or ▼ pulse freq. controller Continue with ✎	Display _.11 Display 1.11
X_{AS}: ± 5 % ±10 % - ±50 % of setpoint	X_{AS} adjustmt. with ▲ or ▼ Continue with ✎	Display _X.12 (X_{AS} value is **10 x display value X)** Display __.12 corr. to ±5 %
Display software version		Display, e.g. 8.94
	repeat starting with _XX.1 always ◀ after *meas.*	LED *meas.*

[2] If R parameter no.11 is set to 'pulse length controller' mode (see table on p.18).

[3] "Neutral zone X_{Sh}" for 3-point step contr.: see chapter 11

8.5 Power failure handling

Following a power failure (even short-term), the instrument automatically starts up in the normal *meas.* mode when power is restored.
The status of the pH, chlorine and flow alarms (see chapter 8.7) is stored.
The control functions are set to automatic, the I and D components of the controllers are set to zero.

8.6 Error messages

8.6.1 pH calibration operating function*

Message	Cause	Measures/ activation
Err↔pH value (altern. display), AUTOCAL *pH* LEDS and lower electrode symbol flash (after *AUTOCAL* function, 8.3.1.1)	No stability with *AUTOCAL pH*	1. AUTO CAL START Press *AUTOCAL START,* calibration is repeated 2. ← after *meas. Auto-CAL pH* LED continues flashing if unchanged for warning 3. ← and pH simultaneously; manual calibration acc. to 8.3.1.2
Err↔pH Zero value (altern. display) after zero calibration (8.3.1.2)	Zero range limit exceeded ± 100 mV	1. ← after *meas.* Old zero value is reused or 2. repeat calibration or 3. check/clean/ replace electrode
Err↔pH Span (altern. display) after span calibration (8.3.1.2)	Outside slope range of 48 – 65 mV/pH	1. ← after *meas.* Old zero value is reused or 2. repeat calibration or 3. check/clean/ replace electrode

* Omitted on instruments without pH measurement

8.6.2 Chlorine calibration oper. function

Message	Cause	Measures/ activation
LED *DPD-Cal* Cl_2 flashes after E key is pressed. Display shows difference between previous and new DPD value	Difference to old DPD value is larger than in R menu (R parameter no. 8) (see chapter 8.4.3.2)	1. Press E key once more; new value is accepted 2. ← Continue using old value. Check the measuring cell and DPD method, repeat calibration

8.7 Alarm messages for pH, chlorine, flow alarm

Message	Cause	Measures
LED pH + LED ⚑ flash rapidly in turn	Alarm delay time t_{AS} for pH setpoint exceeded	Check metering devices and chemical supply
LED Cl_2 + LED ⚑ flash rapidly in turn	Alarm delay time t_{AS} for chlorine setpoint exceeded	Check metering devices and chemical supply
Meas. value *Cl_2 ↔ FLOW* (altern. display) + LED ⚑ flash rapidly in turn	Alarm delay time t_{AF} for flow exceeded Measuring water flow is insufficient. Sensor cable broken. Incorrect position of jumper *BF*.	1. Check DFC flow assembly and valves 2. Check lines and plug-in connections (4 and 5)
In the case of alarm messages according to 8.7, alarm relay contact 11 – 12 (see fig. 9) picks up		

8.8 Alarm clearance and acknowledgement

Parameter	Activation	Response
Alarm clearance	Automatic when cause of alarm ceases to exist	LED ⚑ goes off and LED pH or Cl_2 is on continuously
Alarm acknowledgement	Manual: with ⬇ in pH operating field with ⬇ in Cl_2 operating field	LED ⚑ + setpoint LED flash slowly in turn. Alarm relay contact 11 – 12 (see fig. 9) goes to normal position Setpoint LED only goes off when cause of alarm ceases to exist

8.9 Dosing shutoff in the event of a flow alarm

When the flow rate drops below 30 l/h or the flow stops completely, a flow alarm is signalled if the proximity switch INS is connected. This alarm becomes effective after expiration of flow delay time t_{AF} (chlorine R menu parameter 10) and is cleared without delay as soon as the required flow rate is restored.

The instrument automatically stops dosing of the chemicals for pool water chlorination and pH control (the relay contacts are disabled in the case of the pulse frequency/ pulse length controller or the Cl- relay contact is closed in the case of the three-point step controller).

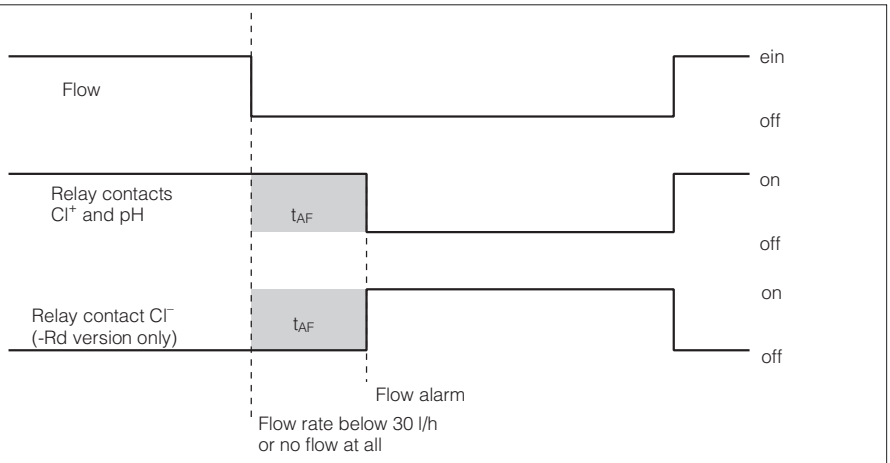


Fig. 19: Dosing shutoff caused by flow alarm

8.10 Safety shutdown to prevent overdosing

When the instrument is used for automatic controlling with the PI controller enabled, short-term chemical dosing is possible in spite of setpoint violation if a large I component has accumulated (since this is a normal control function). To prevent any impermissible overdosing caused by this, a **unilateral** safety dosing shutdown function has been assigned to alarm threshold X_{AS} (chlorine and pH control parameter 12).

This shutdown goes into effect independently for chlorine and pH and is only cleared when the value drops below the setpoint. The relay contact behaviour is identical to the dosing shutoff in the event of a flow alarm (see fig. 19).

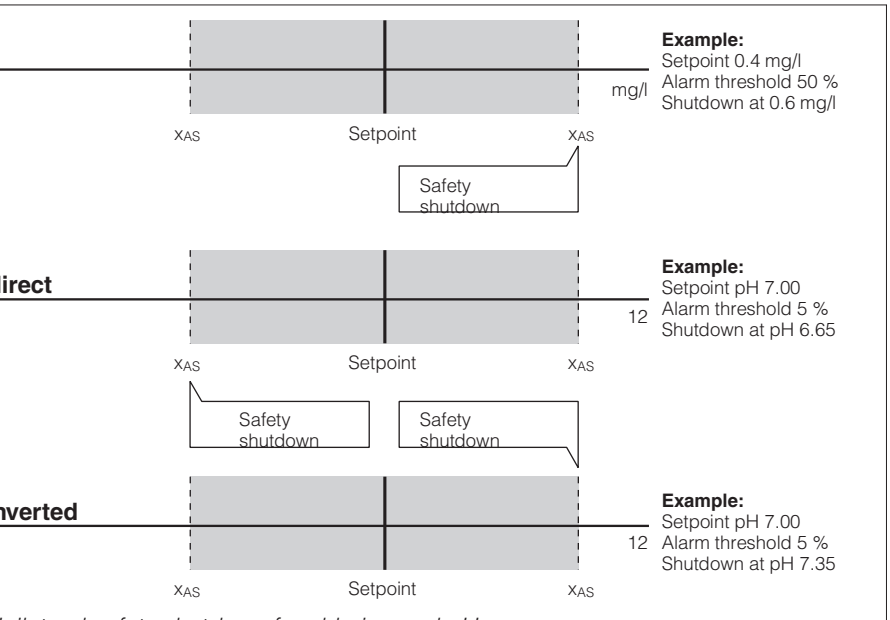


Fig. 20: Unilateral safety shutdown for chlorine and pH

9. Troubleshooting

9.1 General instrument problems

Error	Possible cause	Remedy
No display, no response to key actuation	No power	Check power cord

9.2 pH value measurement*

Error	Possible cause	Remedy
Display value is too small / cannot be calibrated, slope value is too small (<80 %), constant pH 7 display	Measuring electrodes soiled pH electrode too old; glass breakage in pH electrode Short circuit in cable or connector	Shunt, clean pH electrodes Replace pH electrodes Check cables and plug-in connectors for moisture and soiling, replace
pH 7 calibration cannot be performed	Measuring cable broken; reference system problem	Check cable; test with new combined pH electrode or pH simulator
pH display value unstable, pH calibration not possible, slope outside permissible range (see 10.1)	No potential matching	Check potential matching conductor, connect if necessary

*) Not available on instruments without pH measurement

9.3 mV measurement*

Error	Possible cause	Remedy
Display value too small, redox working point cannot be calibrated	Redox electrode soiled Shunt, measuring cable broken Reference system problem	Clean electrode Check cables and plug-in connectors for moisture and soiling Check cable, test with new combined redox electrode or with mV simulator

*) Not available on instruments without redox measurement

9.4 Chlorine measurement

Error	Possible cause	Remedy
Display value always “0"	Measuring cable broken	Check line and connections
Display value continuously too low	Membrane of chlorine measuring cell CCS 140 defective	Replace membrane cap* or sensor
	Membrane not flat, air bubbles und. membrane	Replace membrane cap*)
Display value too high	Polarisation of measuring cell incomplete after power-up	Wait approx. 5 min, observe measured value, wait for polarisation phase to complete
	Short circuit or shunt in measuring line or connectors	Check lines, connectors, terminals for soiling and moisture
Sluggish display	Air bubbles in front of sensor or on membrane	Verify that mounting position is correct
	Membrane soiled	Clean*)
	Electrolyte used up	Regenerate*)

*) See operating instructions for chlorine sensor type CCS 140

9.5 Temperature measurement

Error	Possible cause	Remedy
Display value 50 °C	Measuring cable short-circuited	Check cable and connectors
Display value 0 °C	Measuring cable broken	Check cable and connectors
	Temperature sensor in measuring cell CCS 140-N defective	Test of temperature sensor: NTC sensor can be tested with an ohmmeter (brown and green wires). Guide values for: 0 °C = 33 kohm 10 °C = 20 kohm 20 °C =12.5 kohm 30 °C = 8 kohm

9.6 Flow detection

Error	Possible cause	Remedy
Message on display Measured value ↔ flow (alternating display)	Flow rate too low	Check flow
	Line broken	Check line and connections
	Jumper “BF” not closed if measuring without flow detection	Connect jumper (see connection diagram, fig. 6, and instrument connection area, figs. 8 and 9)

10. Technical data

10.1 pH measurement*

Meas. range = display range	2 - 12 pH
Signal output range	5 – 10 pH
Adjustment range of measuring chain zero	5 – 9 pH
Slope adjustment range	48 – 65 mV/pH
Reference value for slope (25°C)	59.16 mV/pH
Zero adjustment range	± 1.5 pH
Input impedance for measuring and reference electrode connection (acc. to DIN 19265)	> 0.5 x 10^{12} ohm
Input wiring	symmetrical high-impedance

Outp. summ. error (acc. to DIN IEC 746) ± 0.5 % of MR

10.2 mV measurement**

Meas. range = display range	0 – 1000 mV
Signal output range	0 – 1000 mV
Zero adjustment range (Redox Cal)	± 100 mV
Slope adjustment	± 10 % at factory only
Input impedance	> 0.5 x 10^{12} ohm
Output summation error	± 0.5 % of MR

10.3 Chlorine measurement

Sensor	type CCS 140-A or type CCS 140-N
Measuring range = display range	
Range 1	0 – 2.0 mg Cl_2/l
Range 2	0 – 10.0 mg Cl_2/l
Possible signal output range for 1	0 – 0.5 mg Cl_2/l 0 – 1.0 mg Cl_2/l 0 – 2.0 mg Cl_2/l
for 2	0 – 5.0 mg Cl_2/l 0 – 10.0 mg Cl_2/l
Automatic temperature compensation (ATC)	can be enabled
Cl_2 ATC range	10 °C – 45 °C
Reference temperature	25 °C
pH reference value	7.2
Output summation error	± 0.5 % of MR

10.4 Temperature measurement

Sensor	NTC thermistor detector, 10 kohm at 25 °C
Measuring range	0 – 50 °C
Signal output range	0 – 50 °C
Slope calibration	± 20 % of upper range value
Output summation error	± 0.5 % of MR

10.5 Flow detection

Sensor	inductive proximity switch type INS
Measuring function	detection of minimum position of a float flowmeter
Fault signalling	via group alarm contact

10.6 pH value control*

Control function	P/PI controller
Setpoint adjustment	0 – 100 % ≙ 2 – 12 pH
Proportional band X_p	0 – 500 % in 10 % steps or 0 – 50 % in 1 % steps Xp = 0 %: → black/white controller
Integral action time T_n	1 – 99 min
Control characteristic	normal or inverted, switchable
Manipulated variable output	quasi-continuous as a potential-free relay contact (make contact)
Manipulated variable function	optionally:
	a) Pulse frequency proportional controller f = 60 – 120 p/min
	b) Pulse length proportional controller T = 1 – 99 s
	c) Black/white controller (limit switch)

*) Does not apply to instruments without pH measurement
**) Does not apply to instruments without redox measurement

10.7 Chlorine control

Control function	P/PI controller, 3-point step controller (PI) (-Rd option)
Setpoint adjustment	0 – 100 % of selected chlorine measuring range
Proportional band X_p	0 – 500 %, adjustable in 10 % (10 – 500% for pulse frequency)
Integral action time T_n	1 – 99 min
Base load dosing	0 – 80 % of setpoint
Manipulated variable function	P/PI controller: same as pH. Three-point step controller: motor actuator control with 2 relay contacts. Actuator oper. time T_n for 100 % adjustable from 10 – 990 s
Neutral zone X_{Sh}	0 – ± 10 % of setpoint (-Rd option)

10.8 Alarm function

Function	group alarm pH, Cl_2 setpoints and flow
Alarm trigger threshold X_{AS}	±5 %, ±10 % to ±50 % of setpoint, adjustable
Max. permissible difference for DPD-Cal Cl_2	adjustable from 0.01 – 0.90 mg/l
Alarm delay setpoint t_{AS}	0 – 99 min, adjustable
Alarm delay flow t_{AF}	0 – 190 s, adjustable in 10 s steps
Contact function	steady contact, switch-able to fleeting contact
Contact active status	on (standard) off as safety function (option)
Alarm flashing frequency	freq. 1: approx. 1 Hz freq. 2: approx. 0.5 Hz after alarm acknowl.

10.9 Signal outputs

Output range	0 – 20 mA or 4 – 20 mA, switching affects all measured variables
Measuring range assignment	fixed for pH, mV and temp., adjustable for Cl_2
Max. load	500 ohm
Max. perm. isolation voltage	650 V_{RMS}

10.10 Display

Measured value displays	2 LCDs, 3 1/2 digits, height of digits 13 mm
Status indicators	red LEDs

10.11 Contact outputs

Max. number	4 contact outputs:
Functions	Base/acid dosing for pH control loop. Chlorine dosing for Cl_2 control loop (+/- for -Rd option). Group alarm
Contact rating	max. 250 V AC max. 3 A AC max. 500 VA
Potential connection	floating
Measures for spark quenching	built-in

10.12 Power supply

Auxiliary energy	110/127/230/240 V –15 to + 10 % (internal, codable), 48 – 62 Hz
Power consumption	approx. 2 VA plus 1 VA max. per signal output (min. approx. 3 VA, max. approx. 6 VA)

10.13 Data storage

Programme storage	EPROM
Storage for variable parameters	EEPROM

10.14 Physical data

Dimensions	192 x 144 x 140 mm (W x H x D)
Housing material	ABS
Connections	screw terminals, max. 2.5 mm^2
Cable entry	PG cable glands
Front panel	PC foil with integrated keys and LED indicators
Ingress protection	IP 54
Max. permissible ambient temperature	–10 to +55 °C
Storage and transport temp.	–40 to +70 °C
Weight	approx. 1.6 kg

11. Appendix

11.1 Control parameter adjustment

Chlorine control parameter, -Rd option, param. number 6

R parameter for chlorine	Activation	Response
Neutral zone X_{Sh} 0 – ± 10 % of setpoint for three-point step controller (-Rd option) [1]	X_{Sh} adjustmt. with ↑ or ↓ Continue with	Display _XX.6

[1] There is no manipulated variable output (ƒ relay contacts) in the case of a control deviation within the neutral zone.

11.2 Accessories

- **Photometer CCM 181**
  Microprocessor-controlled photometer for chlorine or chlorine dioxide determination according to DIN method.
  (Order no. CCM 181-1)

- **VBC**
  Junction box for CMK measuring cell cable for line extension. Ingress protection IP 65.
  (Order no. 50005181)

- **CMK**
  Special measuring cable for chlorine measuring cells CCS 140/141 or chlorine dioxide measuring cells CCS 240/241 for extension of line to measuring instrument.
  (Order no. 50005374)

- **SMK**
  Special extension cable for combined pH and redox electrodes.
  (Order no. 50000598)

- **INS**
  Inductive proximity switch for assembly CCA 250 for flow detection.
  (Order no. 50005179)

- **MK**
  Signal line, 2 wires, with additional shield and PVC insulation. Preferable for transmission of measuring transmitter output signals or for line extension for inductive proximity switch INS. Not assembled (minimum length 5 m).
  (Order no. 50000662)

- **PMC adapter**
  Required for combined chlorine/pH-redox measurement.
  (Order no. 50052258)

- **Extension cable types for:**

Combined pH electrode CPS31-1EC2GSA	Type SMK (Order no. 50000598)
Combined redox electrode CPS32-0PB2GSA	Type SMK (Order no. 50000598)
Chlorine measuring cell CCS140-A or CCS140-N	Type CMK (Order no. 50005374)
Induct. proximity switch INS	Type MK (Order no. 50005179)

Caution:
Maximum length of CMK cable for chlorine measuring cell CCS140-A or CCS140-N is 30 metres!

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