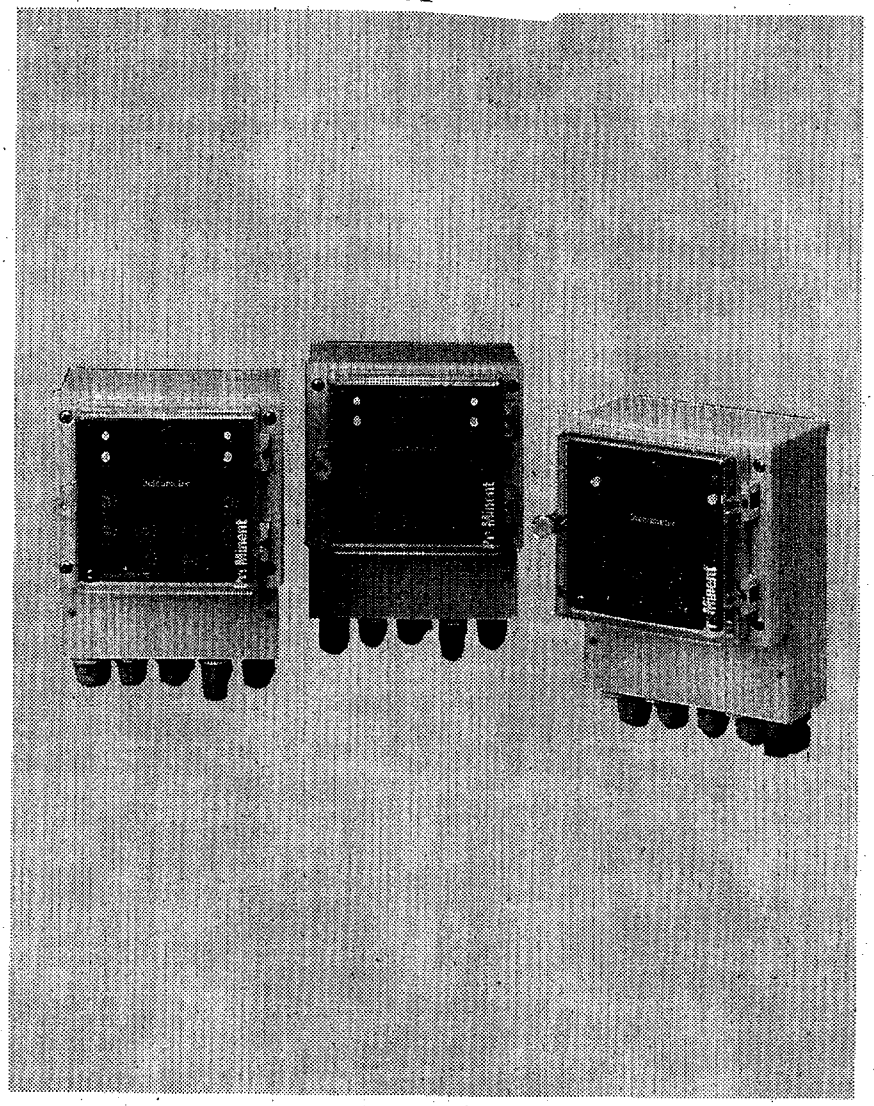
Dulcometer® pH
PHWS 014 Series

Instruction manual

ProMinent®

T. No. 986498.4 e

OBSOLETE
FOR REFERENCE ONLY



Part No.	Type	
	F2K2	92.50.01.0
	TFK2	92.50.02.8
	3P	92.50.04.4
	IL2	92.50.05.1

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Dear user,

You have made a good choice in purchasing this reliable, sturdy and versatile pH measurement and control system.

In order that you may make full use of the benefits the system offers you please follow our advice and

read this instruction manual

throughout **before** you instal the system and start operation. If treated in accordance with the instructions given, the Dulcometer system will reward you with many years of faultless performance.

First of all, please check by means of the packing list whether the shipment is complete.

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1. Applications of Dulcometer® PHWS 014 series

The Dulcometer® PHWS 014 series is used to measure and control pH in the treatment of water and wastewater, in industrial process systems and in the food and beverage industry. A variety of control characteristics adaptable to different process requirements enables the system to pace ProMinent® electronic metering pumps and to actuate solenoid valves, motor valves and servo-motors In conjunction with the Dulcometer® proportional control system, even motor-driven metering pumps of the Meta and MAKRO series are capable of being process-controlled.

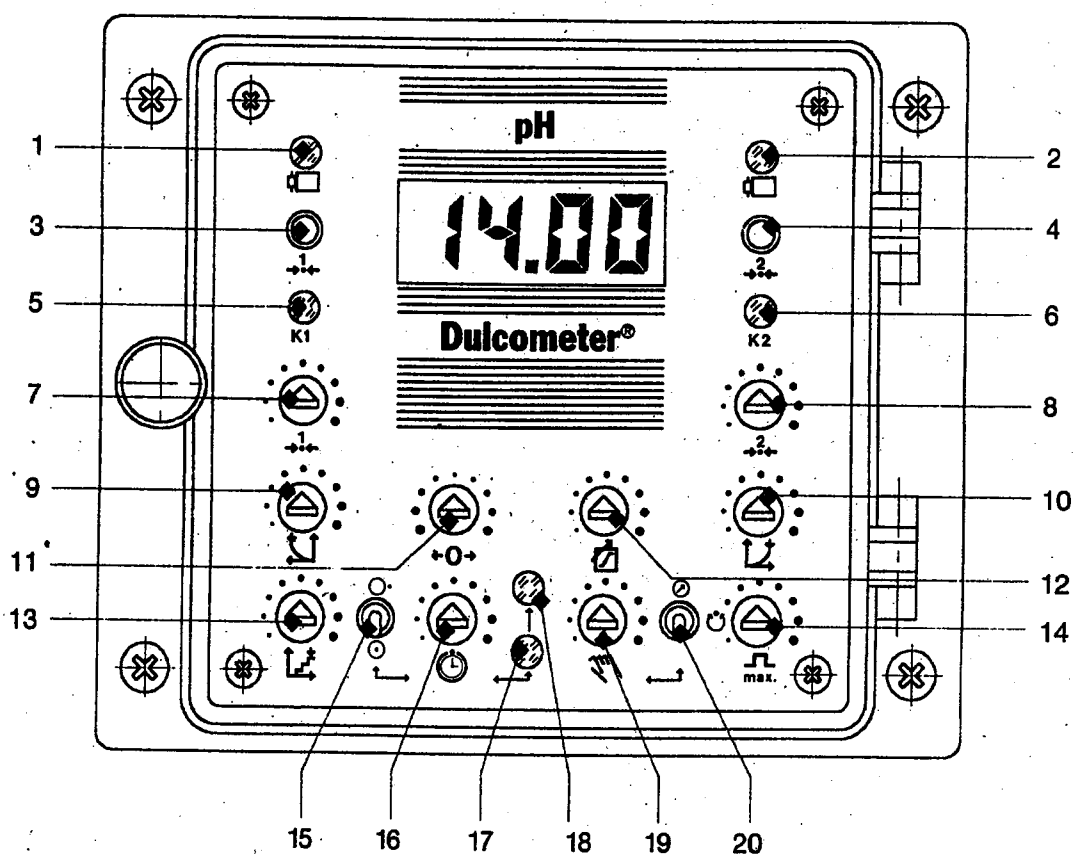
2. Installation

Remove the bezel around the perspex cover by loosening the four Philips head screws. This will provide access to the two wall mounting holes at the left and right at 126 mm centers.

For panel mounting provide a cut-out of 139 x 115 mm (wide x high). The electric connections can be made after the unit is mounted since the terminals are accessible both from the front (wall mounting) and the rear (panel mounting).

2.1 Installation of the probe

pH probes are usually installed in an in-line probe housing (e.g. ProMinent® type DLG III) or an immersion probe housing (e.g. ProMinent® type ETS I) which must be equipped with a stainless steel bar serving as the sample reference potential. The probe should be operated under atmospheric pressure conditions; with in-line probe housings a visible check of the effluent should be possible. To allow maintenance of the probe, in-line probe housings should be provided with isolating valves which at the same time allow an adjustment of the flow rate. The recommended flow rate is 0.5 to 1 l/min and should be as constant as possible.


pH
14.00
Dulcometer®
K1
K2
max.
1
2
3
4
5
6
7
8
9
10
11
12
13
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16
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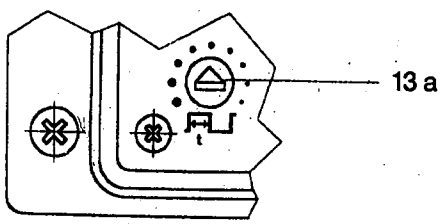

13 a

Front panel controls

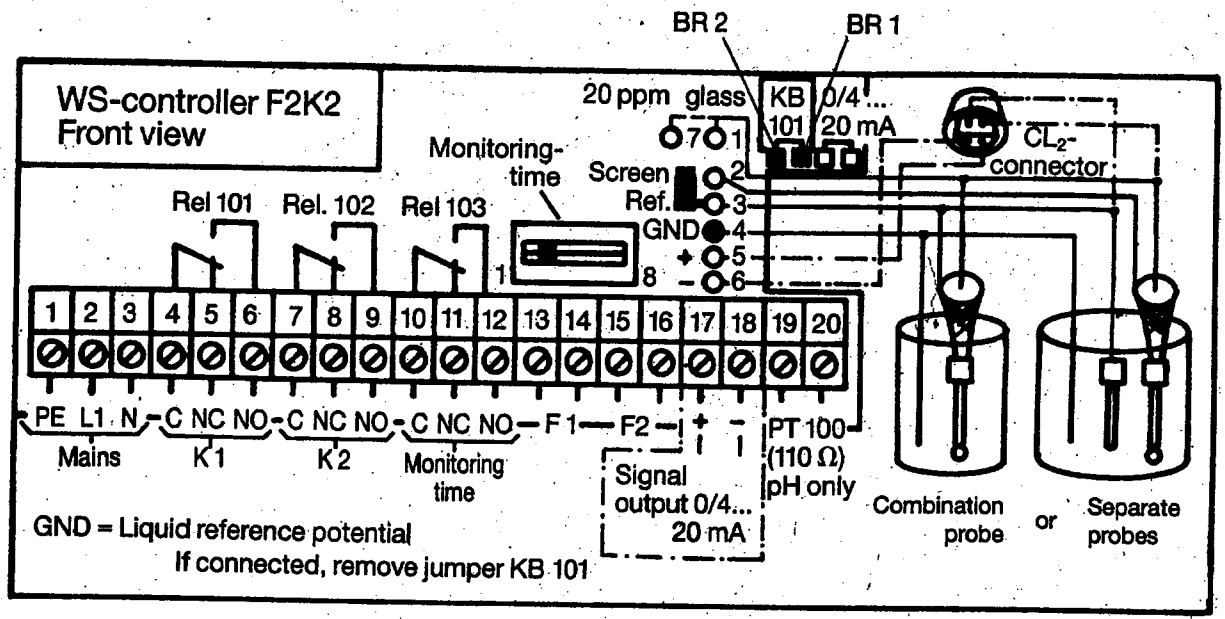
1. Stroke indication (LED, yellow), alkali feeding
2. Stroke indication (LED, yellow), acid feeding
3. Pushbutton key to display lower set value, alkali feeding
4. Pushbutton key to display upper set value, acid feeding
5. State of relay K1 (LED, red)
6. State of relay K2 (LED, red)
7. Adjustment of lower set value, alkali feeding
8. Adjustment of upper set value, acid feeding
9. Adjustment of proportional bandwidth, alkali feeding (types F2K2, 3P and IL2)
10. Adjustment of proportional bandwidth, acid feeding (types F2K2, 3P and IL2)
11. Zero adjustment of the probe (pH 7)
12. Slope adjustment of the probe (e. g. Ph 4 or pH 10)
13. Adjustment of the step rate (type TF only)

13a Adjustment of ON time (type 3P only)

14. Adjustment of maximum pulse rate (type TF only) or manual temperature correction (optional)
15. On/off switch, time check
16. Adjustment of check time
17. Indicator (LED, green), time check running
18. Indicator (LED, red), check time exceeded
19. Adjustment of simulated measured value
20. Mode selector switch: Measurement - Automatic - Manual
    (above) (middle) (below)

3. Electric connections

Remove the front or rear cover of the terminal box. Connect as follows:



Terminal 1: Protective earth PE
Terminal 2: Line L 1
Terminal 3: Neutral N

Terminals 4, 5 and 6: **Output relay 1.** Relay 1 pulls in when the measured value drops below the lower set value (types F2K2 and TF).

Terminals 7, 8 and 9: **Output relay 2.** Relay 2 pulls in when the measured value exceeds the upper set value (types F2K2 and TF).
These relays can be used for the remote annunciation of the measured value being out of the allowable range.

Terminals 10, 11 and 12: **Output relay 3.** Relay 3 pulls in when the pre-selected time for the time check has expired. It can be used to annunciate that due to some fault the set value has not been achieved.

The relay terminals are marked as follows:

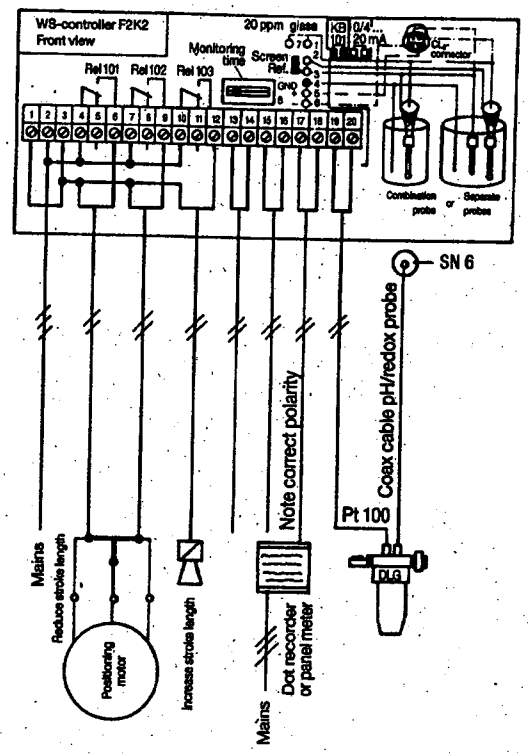
C: Common
NC: Normally closed
NO: Normally open

Contact load:
Max.: 250 V/3A/700 VA
Min.: 24 V/25 mA

Attention: When connecting inductive loads RC networks are to be provided.

Attention:

With type 3P, terminals 4, 5 and 6 of relay K1 and 7, 8 and 9 of relay K2 carry pulse signals for the actuating of a positioning motor. With type IL2, terminals 4, 5 and 6 of relay K1 and 7, 8 and 9 of relay K2 carry pulse signals for the actuating of solenoid valves.



Wiring diagram, type PHWS-3P/IL2

To change the direction of control, interchange terminals 6 and 9 of relays K1 and K2.

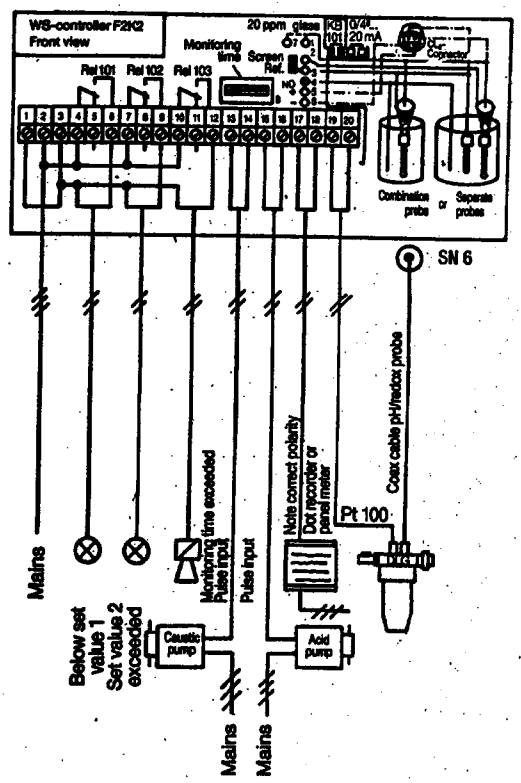
Terminals 15 and 16 carry a pulse train signal to pace a ProMinent® solenoid-driven metering pump for acid feeding (types F2K2 and TF).

Terminals 13 and 14 carry a pulse train signal to pace a ProMinent® solenoid-driven metering pump for alkali feeding (type F2K2).

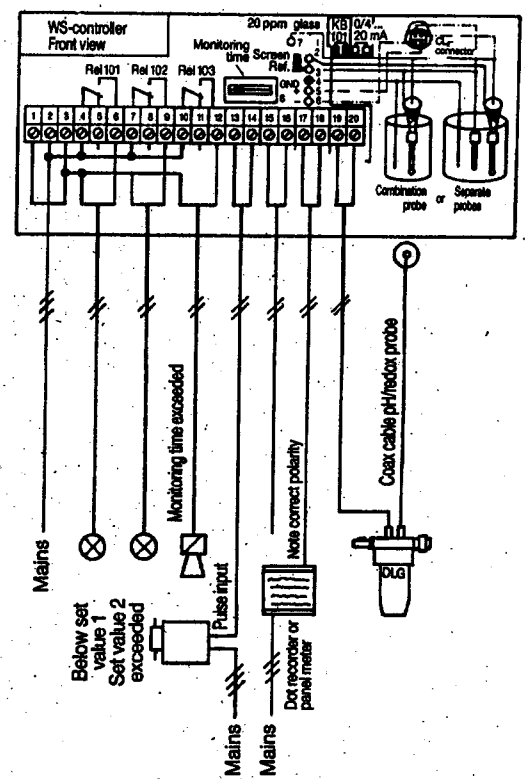
With type 3P/K2 the respective reed relays, terminals 15/16 or 13/14 pull in when the measured value exceeds or drops below the respective set value.

Note: Maximum contact load: 24 V, 50 mA.

As an option, the pulse train outputs F1 and F2 (terminals 13, 14 and 15, 16) of type 3P/IL2 can be activated so that the control system can be operated alternatively, both with a pulse train or a three-position step control actuating signal.



Wiring diagram type PHWS-F2K2



Wiring diagram type PHWS-TFK2

For automatic temperature compensation a resistance temperature detector type Pt 100 can be connected to terminals 19 and 20.

Attention: If no Pt 100 is used, the factory-installed precision resistor must stay connected (R = 100 Ω).

3.1 Option WS 01, WS 02 "Standard signal output"

If either option WS 01 or WS 02 "Standard signal output" is included, terminals 17 and 18 carry a 0/4...20 mA standard signal equivalent to pH 2...12 (factory – calibrated). Mind the polarity (terminal 17 +, terminal 18 –) when connecting an indication or recording instrument.

Jumper BR 1 in the terminal box serves to change the output signal from 0-20 mA to 4-20 mA and vice versa. When the jumper is removed the signal will be 0-20 mA, when the jumper is inserted it will be 4-20 mA.

4. Connecting and calibrating the pH probe

Connect the pH combination probe by means of a special signal cable (see accessories, p. 14) by plugging the moisture-protected SN 6 connector into socket. Protect cable and connectors against moisture. Run the special low-noise cable separate from other cables and keep the distance between the point of measurement and the transmitter as short as possible.

To enable a single person to calibrate the probe, the point of measurement should be located within easy reach of the transmitter.

4.1 Calibrating the pH probe

Note: The pH probe must be sufficiently soaked before it can be calibrated. Probes that have been stored dry take at least one hour before they are capable of giving exact readings.

Dry probes should be soaked in a KCl solution, failing this, in tap water.

Do not forget to remove the rubber safety cap!

Calibration is made with the power switched on and the mode selector switch 20 in position "Measurement" (top) or "Automatic" (center).

4.1.1 Adjusting zero ←0→

Place the probe into a pH 7 standardizing solution. When the reading has become stable (after about 10...30 seconds) make the display read pH 7 by adjusting the zero potentiometer 11.

4.1.2 Adjusting slope

The zero adjustment having been completed, rinse the probe with distilled water to prepare it for slope adjustment.

Place the pH probe in a standardizing solution having a pH different from pH 7, e.g. pH 4 or pH 10. When the reading has become stable (after about 10...30 seconds) make the display read the corresponding pH by adjusting the slope potentiometer 12. This being completed install the probe into the probe housing.

In swimming pool applications slope adjustment is of lesser importance since the controlled variable is always in the vicinity of pH 7. An exact zero adjustment, however, is most important!

The intervals between probe adjustments depend on the operating conditions and the required measuring accuracy. General recommendations cannot be made.

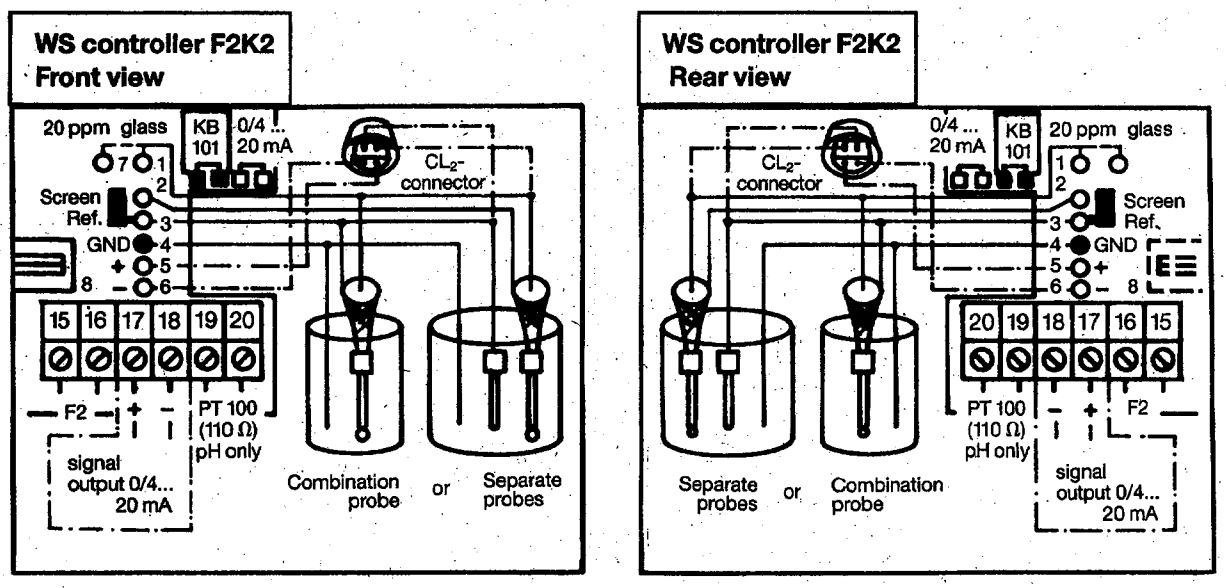
The service life of a combination probe also depends entirely on the operating conditions, such as liquid pressure, temperature or tendency towards fouling. Under favorable conditions, the service life in swimming pool applications should be 1-2 years.

For instructions for handling and servicing pH and redox combination probes refer to Bulletin DM-BA-066.

4.2 Special connectors; connection of separate probes

Option PO 2, Order No. 81.81.33.1, allows the connection of a probe cable with DIN connector. In this version, the transmitter will be provided with a female connector according to DIN 19262, the SN 6 socket being omitted.

If separate probes are used instead of a combination probe the transmitter/controller can be converted as follows:



1 Glass electrode – 2 Screen – 3 Reference electrode – 4 Sample ref. potential.

In order not to endanger the high impedance of the input amplifier this conversion should be made in the factory.

4.3 Sample reference potential

If the reading should be found to drift or leap, connecting the sample reference potential will help to suppress electric noise. To this end, the stainless steel bar in the in-line or immersion probe housing is to be connected with the black pin socket by means of the cable supplied with the transmitter/controller.

Note: When the sample reference potential is connected, jumper BR 2 in the terminal box must be removed.

It is imperative that jumper BR 2 be in place when the probe is put into a standardizing solution (without sample reference potential) for adjustment.

Attention: In the case of a probe failure an incorrect measured value can be read. This can lead to uncontrolled feeding. The customer must therefore ensure that as a result of this no consequential damage can occur.

Possible safety measures are as follows:

pH-measurement

Dirt deposits, ageing, contamination of reference electrodes, moisture in connectors, broken cables or mechanical damage (e. g. rupture of glass) of pH probes can lead to the creation of any signals between pH 0 and 14.

As a safety measure the limit values as well as the control time can be used. Maximum safety can however only be attained with a pH difference measurement (second gauge head).

In general regular maintenance is required for the probe (visual and functional checks, adjustment).

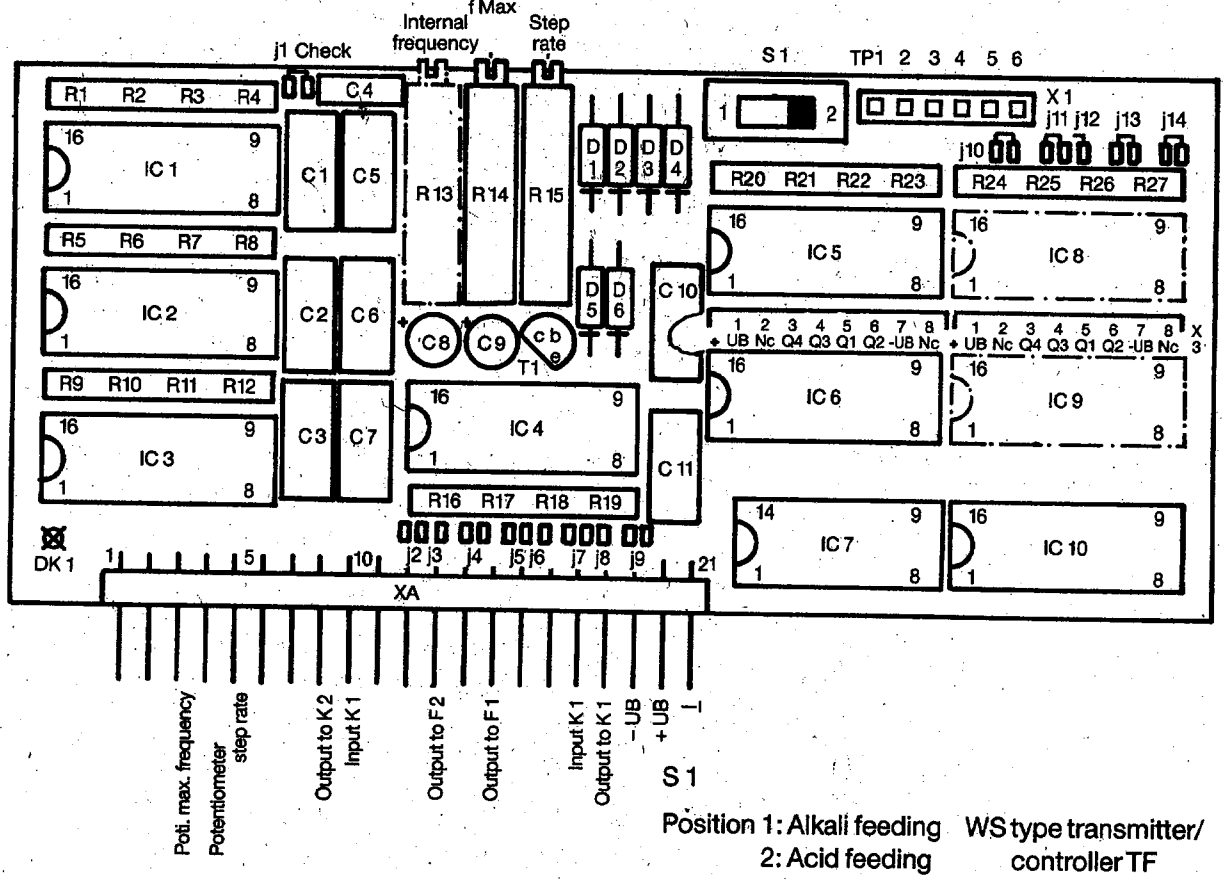
5. Start-Up

5.1 Direction of control: Acid or alkali feeding

With type F2K2 the direction of control is determined by the respective pulse train output (terminals 15 and 16: acid feeding, terminals 13 and 14: alkali feeding).

Type TF is factory-set for acid dosing. The direction of control can be inverted as follows:

Open perspex cover, loosen the four Philips head screws in the display field, remove front plate, unscrew the 4 hexagon head screws (5 mm spanner) underneath and lift the circuit board out carefully. Then, the direction-of-control switch S on the ancillary circuit board TF will be accessible and can be switched over.



Position 1: Alkali feeding
2: Acid feeding

WS type transmitter/ controller TF

With types 3P und IL2 the direction of control can be reserved by interchanging the connections to terminals 6 and 9 (see illustration of terminal box).

5.2 Setting set values

All PHWS series systems allow the selection of an upper and a lower set value.

Pressing the pushbutton key 3 will cause the lower set value to be displayed, which can then be set by means of potentiometer 7.

The upper set value can be displayed by means of pushbutton key 4 and set by means of potentiometer 8.

5.3 Functions of the individual transmitter/controller types

5.3.1 PHWS 014 F2K2

Type F2K2 offers two separate pulse-train outputs to pace two ProMinent® solenoid-driven metering pumps, and two relay outputs to actuate two other devices.

Acid feeding

When the input signal exceeds the upper set value, relay 2 will pull in, the red LED 6 will be lit and the voltage-free pulse-train output (terminals 15 and 16) will emit pulses proportional to the error signal. The pulses will be indicated by LED 2.

Alkali feeding

When the input signal drops below the lower set value, relay 1 will pull in, the red LED 4 will be lit and the voltage-free-pulse-train output (terminals 13 and 14) will emit pulses proportional to the error signal. The pulses will be indicated by LED 1.

By using both pulse-train outputs of type F2K2 one can realize a two-way pH control in the most simple manner.

5.3.1.1 Setting proportional bandwidth

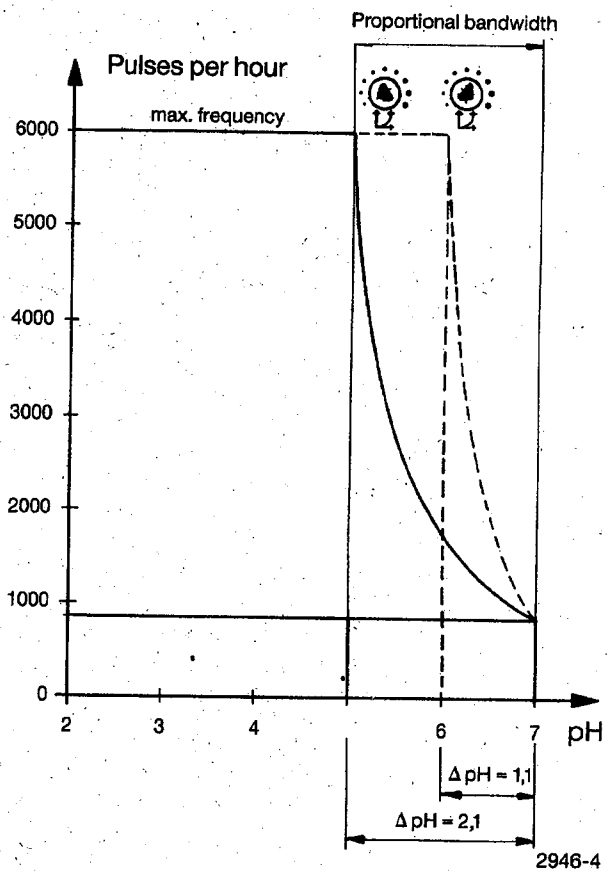
The proportional bandwidth for alkali feeding can be set by means of potentiometer 9, for acid feeding by means of potentiometer 10.

The term "proportional bandwidth" is used to express the ratio of the final controlling signal to error signal; in other words that deviation of the error signal from the set point that causes the pulse rate to reach its maximum of 6000 pulses per hour.

If potentiometers 9 and 10 are turned fully anticlockwise, the maximum pulse rate will be generated when the measurement value has departed from the set point by 2.1 pH, if they are turned fully clockwise when it has departed by 1.1 pH.

By varying the proportional bandwidth one can suit the control characteristics to the process in an optimum manner, that is, oppose the disturbance as quickly as possible and yet avoiding overshooting of the set value.

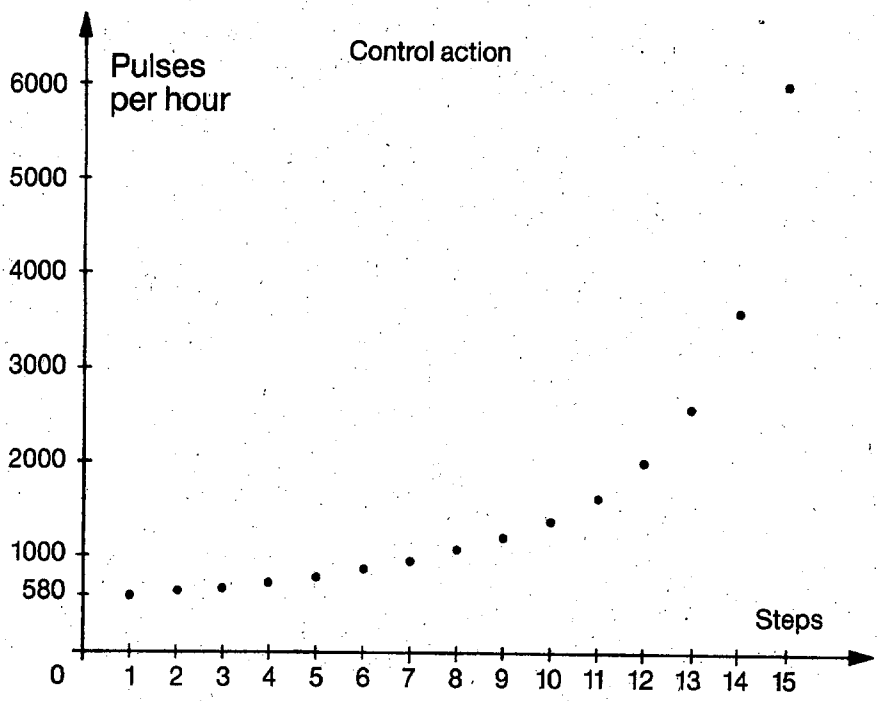
The procedure recommended for bringing the system into operation is to start with the maximum proportional bandwidth (potentiometer turned fully clockwise) and, as overshooting occurs, to decrease the proportional bandwidth until there is no more overshooting.



5.3.2 Type PHWS 014 TF

This is a single-speed floating control system developed to pace ProMinent® solenoid-driven metering pumps, particulary in swimming pool application. In a more general way, this type can be used for all continuous processes. It is characterized by the fact that within a neutral zone between the two set values the pulse train continues with the pulse rate last attained, thus providing a feed rate covering the basic demand.

The transmitter/controller varies the pulse rate in 15 fixed steps from the minimum pulse rate of 580 pulses per hour to the maximum pulse rate of 6000 pulses per hour.



Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
T(ms)	6200	5800	5400	5000	4600	4200	3800	3400	3000	2600	2200	1800	1400	1000	400+200
pph	580	620	666	720	783	860	950	1060	1200	1385	1636	2000	2570	3600	6000

When switched on, the transmitter/controller starts with step 1, that is the lowest pulse rate. At a preselectable fixed step rate (see 5.3.2.1), the system advances one step, thus increasing the pulse rate. The system advances from step to step until the measured pH value enters the neutral zone.

In the neutral zone the system continues to generate a constant pulse train at a rate corresponding to that of the last step. If the measured value passes through one of the set points, the system steps up or down until the measured value reenters the neutral zone.

The pulse output will be discontinued when, at the lowest pulse rate, the measured value remains below the lower set value. The system will continue to generate the maximum pulse rate if at the highest pulse rate the upper set value is not achieved.

Note: The control action is to be inverted for alkali feeding (inverse direction of control).

The pulse rate will be indicated by the two yellow LEDs 1 and 2 flashing synchronously. The pulled-in state of relay 1 (measured value below lower set value) will be indicated by the red LED 5, that of relay 2 (measured value above upper set value) by the red LED 6.

5.3.2.1 Setting step rate, type TF

The step rate must be suited to the process. It depends mainly on the response time of the process system.

The interval between two steps can be varied by means of potentiometer 13 between 9 seconds (turned fully clockwise) and 420 seconds (turned fully counterclockwise). Accordingly the transmitter/controller requires from 135 seconds to 105 minutes to go through all 15 steps.

During start-up the response time between the point of injection and the point of measurement should be estimated, or measured by means of a dye test, and the step rate adjusted accordingly.

5.3.2.2 Setting maximum pulse rate

If overshooting occurs even at the lowest step rate, the maximum pulse rate can be reduced by potentiometer 14 from 6000 pulses per hour (turned fully clockwise) to 2000 pulses per hour (turned fully counterclockwise). It is recommended to start with the maximum pulse rate.

5.3.3 Type PHWS 014 3P

This is a duty-factor control system to actuate servo-motors, stroke-positioning motors or motor-driven valves relative to process demand.

The duration of the pulse actuating the motor when the measured value exceeds or drops below the set value can be varied between 1 second and 10 seconds by means of potentiometer 13a. The interval is proportional to the error signal and is automatically varied between 10 seconds and 500 seconds.

The pulled-in state of the two output relays will be indicated by the red LED's 5 and 6.

5.3.3.1 Setting proportional bandwidth

To suit the PHWS 3P to different process requirements the proportional bandwidth can by adjusted by means of potentiometer 9. If it is turned fully clockwise the minimum interval of 10 seconds will be generated when the measured value has departed from the set point by 1.1 △ pH; if it is turned fully counterclockwise, when the measured value has departed from the set point by 2.1 △ pH. Thus, the speed of, e. g. a stroke positioning motor, can be varied.

5.3.4 PHWS 014 IL 2

Type IL 2 is also used for stepping stroke-positioning motors and solenoid valves.

However, the pulse duration is related to the system deviation. At maximum system deviation the working time will be 20 seconds and the idle time 5 seconds.

At the minimum system deviation the ratio of working time to idle time is 2.5:150 seconds. This results in excellent control dynamics which can be additionally tuned to the process by means of potentiometers 9 and 10.

Electric connections are to be made analogically to type 3P.

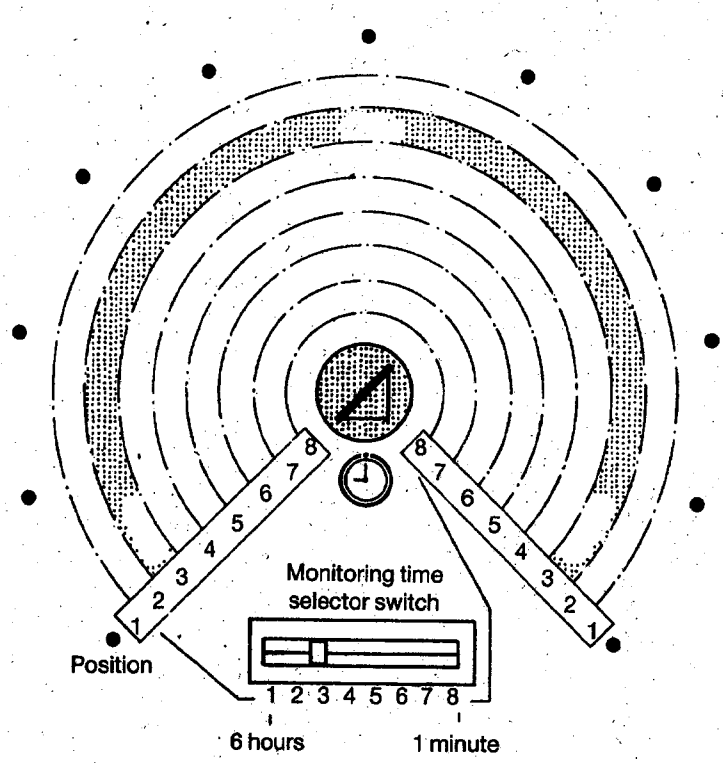
6. Time check

As a standard the type WS transmitter/controller are equipped with an automatic time check. The time check is started when the measured value exceeds the upper set value or drops below the lower set value (switch 15 in "ON" position). The green LED 17 indicates that the time check is running. If the measured variable does not pass through the respective set value within the pre-selected time, LED 17 will be extinguished and the red LED 18 will indicate that the pre-selected check time has been exceeded. Simultaneously the alarm relay REL 103, which can be used for remote fault annunciation, will pull in. The final controlling elements (metering pump, solenoid valve, etc) will cease to operate. They can be restarted by means of switch 15 (off-on).

6.1 Setting check time

Opening the terminal box provides access to a 8-position time range selector switch. The factory setting is in position 3, which covers a time range from 32-90 minutes.

The fine adjustment is made by means of potentiometer 16. By way of demonstration, its relative position may be taken from the illustration below.



7. Probes and consumable material

		Order No
Standardizing solution pH 7	50 ml	50.62.53.4
Standardizing solution pH 7	1000 ml	50.62.58.3
Standardizing solution pH 4	50 ml	50.62.51.8
Standardizing solution pH 4	1000 ml	50.62.56.7
Standardizing solution pH 10	50 ml	50.62.55.9
Standardizing solution pH 10	1000 ml	50.62.60.9
pH-combination probe type PHE, pH 1...12, T = 0...60 °C		30.50.54.9
pH-combination probe, refillable, type PHEN pH 1...12, T = 0...60 °C		30.50.90.3
pH-combination probe type PHEX 112 SE, pH 1...12, T = 0...100 °C P max. = 16 bar (25 °C), 6 bar (100 °C)		30.50.96.0
Resistance thermometer, type Pt 100 SE, 0 °...+ 100 °C		30.50.63.0
Dulcotest® signal cable with type SN 6 connectors:		
0,8 m		30.50.77.0
2 m		30.49.55.8
5 m		30.49.56.6
10 m		30.49.57.4

8. Safty instructions

Danger

Measuring and control systems and their peripheral equipment may only be connected by trained personnel and qualified electricians. Contact your customer service responsible.

Disposal of Old Parts

Please note:

Plastic and electronic waste are classified as special waste and must be recycled!

Waste Disposal Law

Waste (old parts) is to be disposed of in an orderly manner for the common good especially the protection of the environment. Therefore old parts have to be disposed of in accordance with the order on the (German) Waste Avoidance and Waste Management Act or recycled in accordance with the (German) Waste and Residual Materials Monitoring Act.

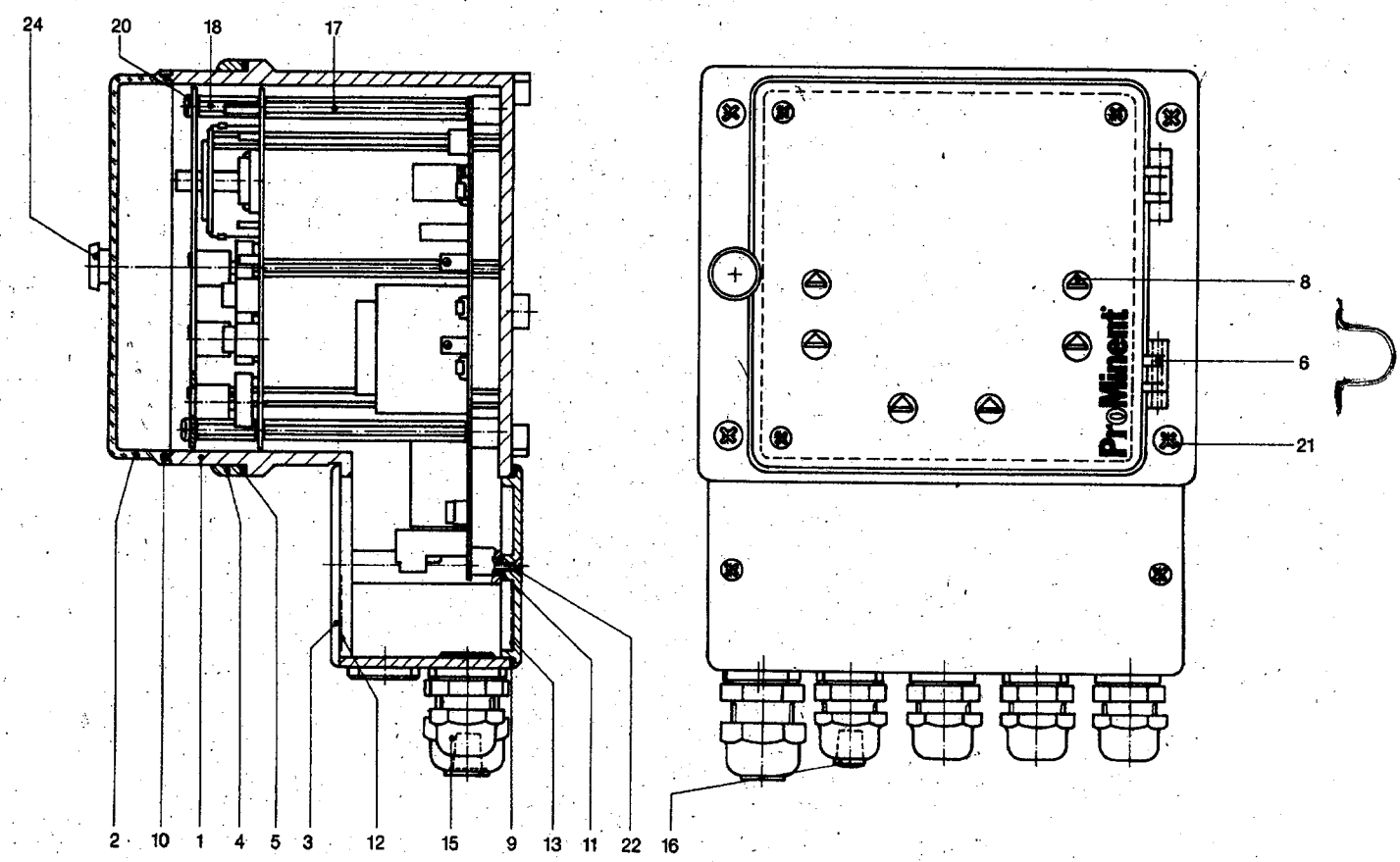
Taking back old parts

The municipal collection points for small quantities of the towns and municipalities accept plastic and electronic waste.

If you should not find any appropriate collection point **the ProMinent® subsidiary or representative responsible for you will be take back your old parts for a small fee!**

9. Spare parts list – PHWS

Item	No.	Description	Order No.
1	1	Housing (without fastening material)	141146.1
2	1	Perspex cover „ProMinent"	141149.5
3	2	Cover	141147.9
4	1	Bezel	141148.7
5	1	Seal (for bezel)	483532.8
6	2	Cylindrical pin d 2.5 m 6 × 18	460704.0
8	6	Control knob d10 × 12.5	703524.9
9	2	Seal for cover	484012.0
10	1	Seal for perspex cover	484013.8
11	4	Retaining washer d 5 × 2.5 × 0.5	483950.2
12	1	Terminal plan, front	606304.4
13	1	Terminal plan, rear	606305.1
15	5	Cable gland PG9 Skintop grey	703883.9
16	5	Plug IL4-073	140448.2
17	4	Spacer M 3 × 60 female/male	460106.8
18	4	Spacer M 3 × 18 female/male	460107.6
20	4	Raised c'sk. hd. screw M 3 × 6	468602.8
21	4	Raised c'sk. hd. screw M 4 × 12	468615.0
22	4	C-sk. hd. screw M 3 × 10	468706.7
24	1	Knurled screw M 3 × 20	466213.6
	1	Housing assembly (items 1-24)	814996.5
	1	Front plate F2K2	606401.8
	1	Front plate TFK2	606402.6
	1	Front plate 3P	606409.1
	1	Front plate IL2	606441.4
	1	SN6 socket	818398.0
	1	DIN socket	704224.5
	1	Main circuit board	819027.4
	1	Signal processing circuit board	819029.0
	1	Display circuit board	819028.2
	1	Extra circuit board TF II	819036.5
	1	Extra circuit board 3P	819030.8
	1	Extra circuit board IL2	819030.8
	1	Signal output WS 01	914949.3
	1	Signal output potential-separated WS 02	914932.9
	1	Jumper strip	713995.9
	1	Pin socket black	704228.6



Names and addresses of authorised distributors will be gladly furnished by the manufacturer:
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Im Schuhmachergewann 5-11 · D-69123 Heidelberg
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Tel. + 49 (6221) 842-0 · Telex 461697 · Telefax +49 (6221) 842-419