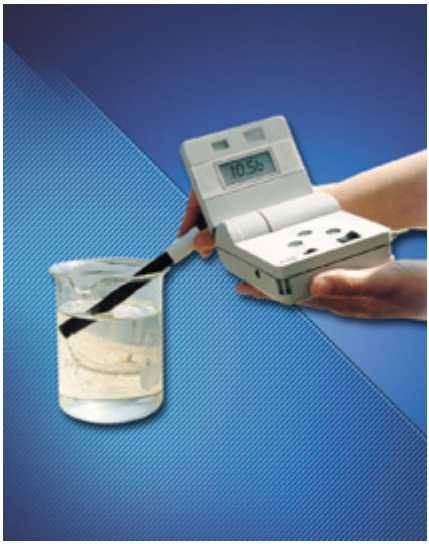
Instruction Manual

IM/2410_6

Hand-Held pH Meter/Simulator

Model 2410



ABB

The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company, and is indicative of our dedication to quality and accuracy.

BS EN ISO 9001:2000

Cert. No. Q5907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Electrical Safety

This instrument complies with the requirements of CEI/IEC 61010-1:2001-2 "Safety requirements for electrical equipment for measurement, control, and laboratory use". If the instrument is used in a manner NOT specified by the Company, the protection provided by the instrument may be impaired.

Symbols

One or more of the following symbols may appear on the instrument labelling:

	**Warning** – Refer to the manual for instructions
	**Caution** – Risk of electric shock
	Protective earth (ground) terminal
	Earth (ground) terminal

	Direct current supply only
	Alternating current supply only
	Both direct and alternating current supply
	The equipment is protected through double insulation

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

CONTENTS

1 INTRODUCTION

The Model 2410 pH meter/simulator is a battery-operated instrument designed for measuring pH, Redox and temperature when used with the appropriate sensors. It can also be used as a simulator for injecting input signals when servicing pH instruments.

The unit can inject any pH value from 0 to 14 pH and any millivolt value from –1000 to 1000 mV in 1 mV increments. A high impedance output ($1x10^9$ Ω) can be switched into the circuit to simulate the resistance of a glass electrode. A 100k Ω reference check is also available for detection of reference to earth leaks.

2 PREPARATION

2.1 Optional Accessories

There are a number of accessories available which are supplied to order dependent on the operating requirements:

7730-160	Kit of test leads
1413-400	Combination pH electrode (epoxy bodied), 1m (3.25 ft), BNC termination
1441-400	Combination Redox (ORP) electrode, 1m (3.25 ft), BNC termination
3055-100	Pt100 temperature probe
1411-400	Combination pH electrode (glass bodied), 1m (3.25 ft), BNC termination
1415-400	Combination spear pH electrode, 1m (3.25 ft), BNC termination
0400-135	Buffer powder kit

* Comprising:
BNC to BNC lead (part no. 7730130)
Earth lead (part no. 7730150)
BNC to tags lead (part no. 0312740)

3 CONTROLS

3.1 Familiarisation with Controls

Instrument controls are as detailed in Fig. 3.1 below.

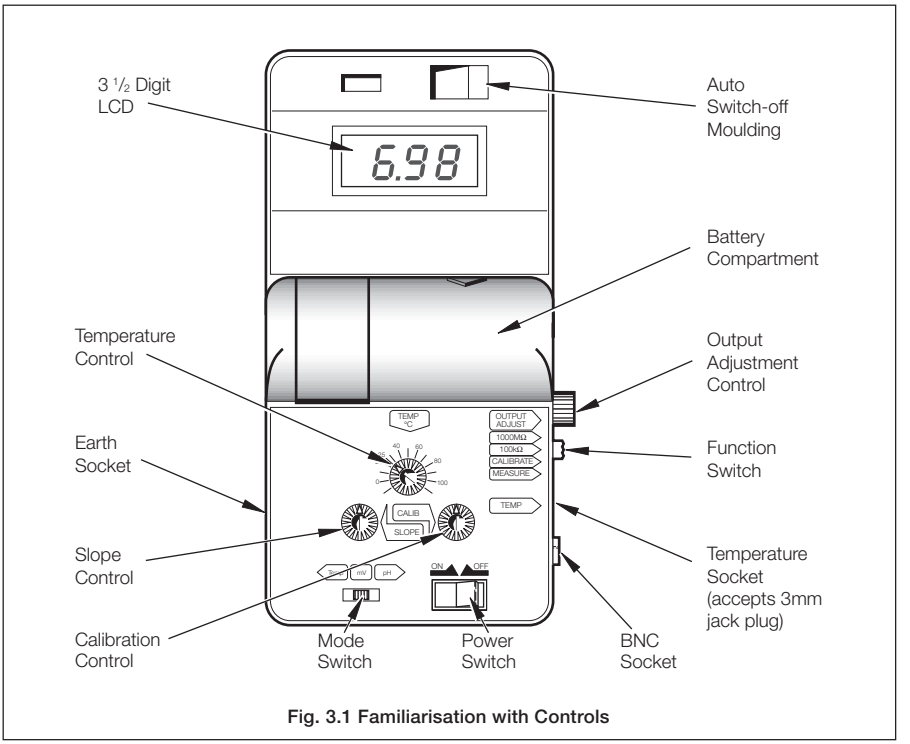


Fig. 3.1 Familiarisation with Controls

4.1 Prepare a pH Analyzer for Testing

a) Ensure that the pH analyzer to be tested is correctly earthed through its power supply earth lead (where applicable), then switch on the power supply (it may be necessary to allow some older types of analyzer to warm up).

b) Set the pH analyzer under test to the CHECK position (where applicable) and disconnect the electrodes from the input terminals (refer to the relevant instruction manual).

c) Connect a suitable lead from the input terminals of the pH analyzer to the Model 2410's BNC connector. If using a lead with tag terminations, connect the core (white) to the glass electrode terminal and the screen (black) to the reference terminal.

d) **Manual temperature compensation** – set the temperature control on the pH analyzer under test to that of the ambient temperature.

Automatic temperature compensation – connect a suitable decade resistance box to the analyzer under test in place of the temperature compensator. Set the resistance box to the value equivalent to one of the temperatures in Table 4.1, e.g. 10°C, 20°C etc.

e) If testing a pH analyzer with differential amplifier (e.g. Models 9180 or 4530/40), connect the earth socket on the Model 2410 (see Fig. 3.1) to the pH analyzer solution earth terminal using the earth wire supplied.

4.2 Prepare for pH Simulation (pH output only) – Fig. 4.1

Before using the 2410 as a pH simulator it is necessary to standardise the output for correct pH units with respect to the voltage (mV) output.

(1) Set the 'Temp °C' control to 25°C.

(2) Set the Function switch to 'CALIBRATE'.

(3) Set the Power switch to 'ON'.

(4) Set the Mode switch to 'mV' and use the 'OUTPUT ADJUST' control to set '000' on the display.

(5) Set the Mode switch to 'pH'.

(6) Adjust the 'CALIB' control to set '7.00' on the display.

(7) Set the Mode switch to 'mV' and use the 'OUTPUT ADJUST' control to set '177' on the display.

(8) Set the Mode switch to 'pH'.

(9) Adjust the 'SLOPE' control to set '4.00' on the display.

The simulator can now be used in either the 'pH' or 'mV' output modes.

> **Note**. If the 2410 is always used as a simulator, the above procedure need only be carried out once, unless the control settings are disturbed.

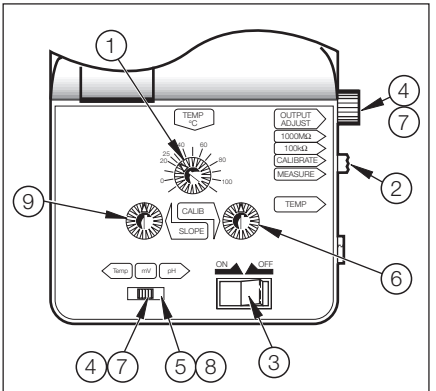


Fig. 4.1 Preparation for pH Simulation

4.3 Calibrating 4500 and 4600 Series Analyzers

4.3.1 Calibration Mode – Fig. 4.2

ABB 4500 and 4600 Series analyzers incorporate buffer values within their memories for automatic calibration. Table 4.1 gives the millivolt value for different temperature values for the five standard buffers stored in the Models 4530/40. Only the 4 and 9 values apply to the Models 4535/45 and 4630/35.

When checking 4500 and 4600 Series analyzers for accuracy, or when determining the correct functioning of the automatic temperature compensation, refer to Table 4.1 to ascertain the required millivolt value equivalent to a pH value at a given temperature.

> **Note**. Before carrying out the following procedure, check the electrode connections – core to glass, screen to reference and earth connection to solution earth of the instrument (Models 4530 and 4540 only).

Refer to Fig. 4.2 and:

(1) Set the Function switch to 'CALIBRATE'.

(2) Set the Mode switch to 'pH' or 'mV' (dependent on requirement).

(3) Set the Power switch to 'ON'.

Carry out an automatic pH calibration check using the 4500 and 4600 Series calibration procedure as detailed in the appropriate instruction manual.

(4) Use the 'OUTPUT ADJUST' control to inject the required pH or millivolt value, selected from Table 4.1.

The same procedure can be used to check the instrument in the Manual Calibration mode if required.

> **Note**. Once a successful pH calibration has been achieved, operate the FUNCTION switch on the transmitter and then use the simulator to inject alternative pH values to check the performance of the instrument.

Carry out the impedance tests as described on page 7.

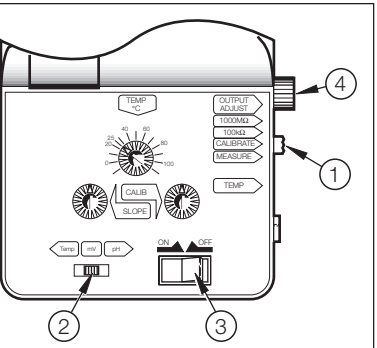


Fig. 4.2 Calibration Mode

	1		4		7		9		10	
t°C	pH	mV	pH	mV	pH	mV	pH	mV	pH	mV
0	1.08	320.8	4.000	162.6	7.10	–5.4	9.475	–134.1	10.270	–177.2
10	1.09	332.0	3.997	168.7	7.05	–2.8	9.347	–131.9	10.154	–177.2
20	1.09	343.8	4.000	174.5	7.00	0	9.233	–129.9	10.045	–177.1
25	1.09	349.6	4.005	177.2	6.99	0.6	9.182	–129.1	9.995	–177.2
30	1.10	354.9	4.011	179.8	6.97	1.8	9.134	–128.4	9.948	–177.3
40	1.10	366.6	4.027	184.7	6.97	1.9	9.051	–127.4	9.866	–178.1
50	1.11	378.3	4.050	189.2	6.97	1.9	8.983	–127.1	9.800	–179.5
60	1.11	389.4	4.080	193.0	6.97	2.0	8.932	–127.7	9.753	–182.0
70	1.11	401.0	4.116	196.4	6.99	0.7	8.898	–129.2	9.728	–185.7
80	1.12	412.0	4.159	199.1	7.03	–2.1	8.880	–131.7	9.725	–190.9
90	1.13	423.0	4.208	201.2	7.08	–5.8	8.840	–132.6	9.750	–198.2
95	—	—	4.235	202.0	—	—	8.890	–138.1	9.770	–202.3

Table 4.1 mV Equivalents for 4500 and 4600 Series Instruments Buffer Values

4.3.2 Checking Temperature Compensation – Fig. 4.3

a) Calibrate the Model 2410 as detailed in Section 4.3.1.

b) Programme the instrument under test for manual temperature compensation and set the temperature to 0°C.

With reference to Fig. 4.3:

(1) Set the Function switch to 'CALIBRATE'.

(2) Set the Mode switch to 'mV'.

(3) Set the Power switch to 'ON'.

(4) Use the 'OUTPUT ADJUST' control to set 163 mV on the Model 2410's display (rounded up from 162.6mV in Table 4.1). The instrument under test should read 4.00.

(5) Use the 'OUTPUT ADJUST' control to set –134 mV on the Model 2410's display (rounded down from 134.1 mV in Table 4.1). The instrument under test should read 9.47.

Note. The instrument under test should read 9.47 as this is the correct value for the 9.00 buffer at 0°C.

Repeat steps 4 and 5 at 50°C and 80°C using the corresponding millivolt equivalent.

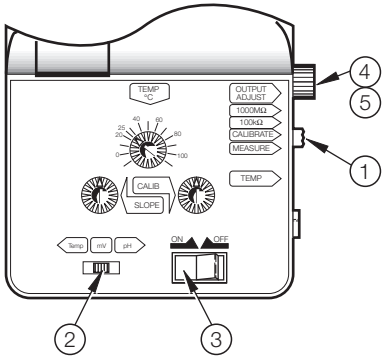


Fig. 4.3 Temperature Compensation and Calibration Mode

4.4 Calibrating Conventional pH Analyzers

4.4.1 Calibration Mode – Fig. 4.3

(1) Set the Function switch to 'CALIBRATE'.

(2) Set the Mode switch to either 'pH' or 'mV' dependant on the calibration required.

(3) Set the Power switch to 'ON'.

(4) Use the 'OUTPUT ADJUST' control to obtain an appropriate calibration value on the digital display of the Model 2410, e.g. 7 pH (if pH units selected).

Adjust the reading on the pH analyzer under test to 7.00 pH using the adjust buffer, standardise or calibrate control on that instrument, as applicable.

(5) Use the 'OUTPUT ADJUST' control to give 0, 2, 4, 6, 8, 10, 12 and 14 pH to check the accuracy of the pH analyzer.

Alternatively, if mV units are selected, adjust to the corresponding millivolt equivalents from Table 4.2.

4.4.2 Checking Temperature Compensation – Fig. 4.3

a) Calibrate the Model 2410 as detailed in Section 4.4.1.

b) Set the manual temperature control on the instrument under test to 10°C.

Refer to Fig. 4.3 and:

(1) Set the Function switch to 'CALIBRATE'.

(2) Set the Mode switch to 'mV'.

(3) Set the Power switch to 'ON'.

(4) Use the 'OUTPUT ADJUST' control to set the appropriate millivolt outputs for 4, 7 and 9 pH (at 10°C) on the Model 2410 display from Table 4.2.

Check the reading on the pH analyzer under test for each value.

Repeat the check with the temperature control set to 50°C and 100°C.

pH / t°C	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
–20	351.63	301.40	251.16	200.93	150.69	100.46	50.23	0	–50.23	–100.46	–150.69	–200.93	–251.16	–301.40	–351.63
–10	365.52	313.30	261.08	208.87	156.65	104.43	52.22	0	–52.22	–104.43	–156.65	–208.87	–261.08	–313.30	–365.52
0	379.41	325.21	271.01	216.80	162.60	108.40	54.20	0	–54.20	–108.40	–162.60	–216.80	–271.01	–325.21	–379.41
10	393.30	337.11	280.93	224.74	168.56	112.37	56.19	0	–56.19	–112.37	–168.56	–224.74	–280.93	–337.11	–393.30
20	407.19	349.02	290.85	232.68	174.51	116.34	58.17	0	–58.17	–116.34	–174.51	–232.68	–290.85	–349.02	–407.19
30	421.08	360.92	300.77	240.62	180.46	120.31	60.15	0	–60.15	–120.31	–180.46	–240.62	–300.77	–360.92	–421.08
40	434.97	372.83	310,69	248.55	186.41	124.28	62.14	0	–62.14	–124.28	–186.41	–248.55	–310.69	–372.83	–434.97
50	448.86	387.73	320.61	256.49	192.37	128.24	64.12	0	–64.12	–128.24	–192.37	–256.49	–320.61	–387.73	–448.86
60	462.75	396.64	330.53	264.43	198.32	132.21	66.11	0	–66.11	–132.21	–198.32	–264.43	–330.53	–396.64	–462.75
70	476.64	408.54	340.45	272.36	204.27	136.18	68.09	0	–68.09	–136.18	–204.27	–272.36	–340.45	–408.54	–476.64
80	490.53	420.45	350.38	280.30	210.23	140.15	70.08	0	–70.08	–140.15	–210.23	–280.30	–350.38	–420.45	–490.53
90	504.42	432.36	360.30	288.24	216.18	144.12	72.06	0	–72.06	–144.12	–216.18	–288.24	–360.30	–432.35	–504.42
100	518.03	444.26	370.22	296.17	222.13	148.09	74.04	0	–74.04	–148.09	–222.13	–296.17	–370.22	–444.26	–518.03
110	532.19	456.17	380.14	304.11	228.08	152.06	76.03	0	–76.03	–152.06	–228.08	–304.11	–380.14	–456.17	–532.19
120	546.08	468.07	390.06	312.05	234.04	156.02	78.01	0	–78.01	–156.02	–234.04	–312.05	–390.16	–468.07	–546.08

Table 4.2 Millivolt Equivalent of pH v Temperature

4.5 Checking Input Impedance of a pH Analyzer – Fig. 4.4

All pH measuring instruments require an extremely high input impedance (greater than 10^{12}) to operate corr ectly. If the input impedance is degraded (due to contamination of the connection block or connection cable) the instrument may function correctly with a low impedance signal, but gives incorrect readings (low or high or, in some cases, off-scale) when connected to an electrode pair.

The Model 2410 has the facility to check the input impedance of the glass electrode using the 1000M Ω position of the Function switch and the reference electrode input using the 100K Ω position.

Refer to Fig. 4.4 and:

(1) Set the Function switch to 'CALIBRATE'.

(2) Set the Mode switch to 'pH'.

(3) Set the Power switch to 'ON'.

(4) Use the 'OUTPUT ADJUST' control to set an appropriate pH value, e.g. 10 pH.

(5) Set the Function switch to '1000M Ω'.

After an initial 'spike', the reading on the pH analyzer under test should return to within 0.1 pH of 10.00 pH. If the change in the reading is greater than 0.1 pH the input impedance is too low.

(6) Repeat step 5 but setting the Function switch to '100k Ω'.

For **laboratory analyzers**, the most likely cause of the above is the coaxial input cable or the BNC socket on the instrument under test.

For **industrial systems**, the cause is likely to be attributed to:

the junction box in the electrode system

the wall mounting junction box

the interconnection cable

the instrument (less likely).

5 OPERATION AS A METER

5.1 Calibration for pH Measurements – Fig. 5.1

For optimum measurement accuracy the calibration procedure should be carried out at frequent intervals.

Prepare 4 pH and 9 pH buffer solutions.

(1) Connect the electrode to the BNC socket.

(2) Set the Function switch to 'MEASURE'.

(3) Set the Mode switch to 'pH'.

(4) Set the 'TEMP °C' control to the temperature of the buffer solutions.

(5) Set the Power switch to 'ON'.

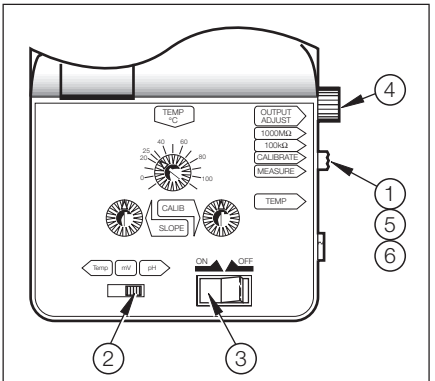


Fig. 4.4 Checking the Input Impedance

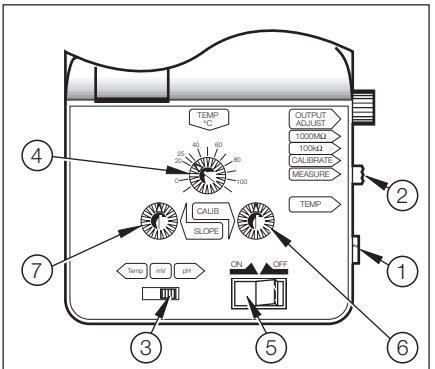


Fig. 5.1 Calibration for pH Measurement

Immerse the combination pH electrode in the 4 pH buffer solution and allow the displayed reading to stabilise.

(6) Adjust the 'CALIB' control to achieve a 4 pH reading on the digital display.

Remove the electrode from the buffer solution and wash the electrode using demineralised water. Carefully wipe the excess water from the electrode using a soft tissue.

Immerse the electrode in the 9 pH buffer solution and allow the displayed reading to stabilise.

(7) Adjust the 'SLOPE', control to achieve a 9pH reading on the digital display.

Repeat (6) and (7) to obtain the best accuracy.

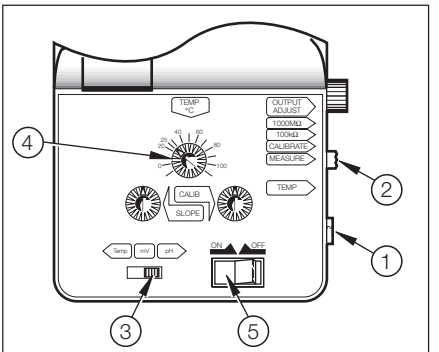


Fig. 5.2 pH Measurement

5.1.1 pH Measurement – Fig. 5.2

(1) Connect the electrode to the BNC socket.

(2) Set the Function switch to 'MEASURE'.

(3) Set the Mode switch to 'pH'.

(4) Set the 'TEMP °C' control to the temperature of the sample solution.

(5) Set the Power switch to 'ON'.

Immerse the combination pH electrode in the sample solution and note the pH value when the display has stabilised.

5.1.2 Temperature Measurement – Fig. 5.3

(1) Set the Function switch to 'MEASURE'.

(2) Set the Mode switch to 'TEMP'.

(3) Connect the temperature probe to the temperature socket (3mm jack plug).

(4) Set the Power switch to 'ON'.

Immerse the probe approximately 1 inch below the surface of the sample solution.

Note the temperature when the display has stabilised.

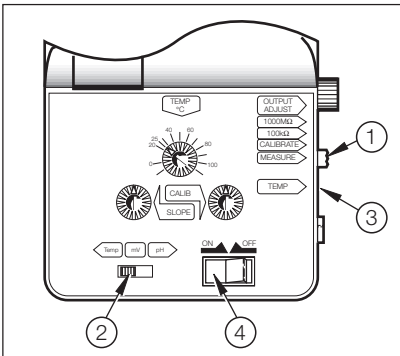


Fig. 5.3 Temperature Measurement

5.1.3 mV/Redox (ORP) Measurement – Fig. 5.4

(1) Set the Function switch to 'MEASURE'.

(2) Set the Mode switch to 'mV'.

(3) Set the Power switch to 'ON'.

(4) Short circuit the BNC socket and verify the instrument reads zero.

(5) Remove the short circuit and plug in the Redox (ORP) electrode.

Immerse the probe in the solution.

Note the reading when the display has stabilised.

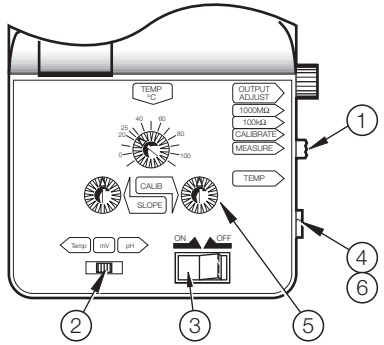


Fig. 5.4 mV/Redox (ORP) Measurement

6 MAINTENANCE

6.1 Replacing the Battery – Fig. 6.1

After a prolonged period of use the battery may require replacement (battery type 6LR61 or equivalent).

(1) Open the case fully.

(2) Release the battery cover using a small flat-bladed screwdriver or similar.

(3) Remove the cover.

Replace the battery and fit cover.

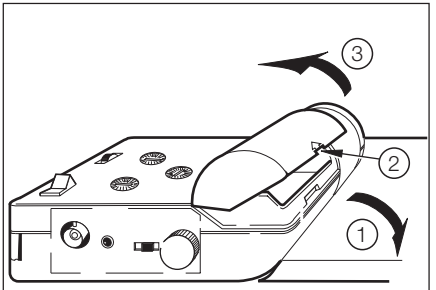


Fig. 6.1 Replacing the Battery

7 SPECIFICATION

General

Display viewing angle	Adjustable from 90° to 180°
Electrode connection	BNC for pH and Redox 3.5mm jack plug for temperature probe

Measurements

pH range	0 to 14.00pH
pH accuracy	±0.1pH
mV range	–1000 to 1000
mV accuracy	±0.1%
Temperature range	0 to 100°C
Temperature accuracy	±0.5°C
Resolution	0.01pH, 1mV, 0.1°C
Temperature compensation	0 to 100°C manual
Input impedance	> $1x10^{12}$ Ω

Calibrator

pH output	0 to 14pH in 0.01 steps
mV output	–1000 to 1000 in 1mV steps
Output impedance	Low ($1x10^{5}$ Ω) or high ($1x10^{9}$ Ω) switch selectable
Accuracies	±0.02 pH, ±0.1% mV

Connections

A kit of three leads can be supplied (part no. 7730M-160) comprising:

- BNC to BNC Part no. 7730130
- Earth lead Part no. 7730150
- BNC to tags Part no. 0312740

Power

9V battery giving 100 hours continuous life –

Alkaline 6LR61

Dimensions

96 x 108 x 45mm (3.78 x 4.25 x 1.94 in.) when folded

Weight

0.34kg (0.15 lb) with battery

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NOTES

PRODUCTS & CUSTOMER SUPPORT

Products

Automation Systems

- ***for the following industries:***
  - Chemical & Pharmaceutical
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- ***Temperature***
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- ***Actuators***
- ***Positioners***

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- ***pH, conductivity, and dissolved oxygen transmitters and sensors***
- ***ammonia, nitrate, phosphate, silica, sodium, chloride, fluoride, dissolved oxygen and hydrazine analyzers.***
- ***Zirconia oxygen analyzers, katharometers, hydrogen purity and purge-gas monitors, thermal conductivity.***

Customer Support

We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

United Kingdom
ABB Limited
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

United States of America
ABB Inc
Tel: +1 775 850 4800
Fax: +1 775 850 4808

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.
Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

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The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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