MODEL 4310 CONDUCTIVITY METER
OPERATING MANUAL

549 007/REV A/03-96

SAFETY

Please read this information carefully prior to installing or using this equipment.

1. The unit described in this manual is designed to be operated only by trained personnel. Any adjustments, maintenance and repair must be carried out as defined in this manual, by a person qualified to be aware of the hazards involved.

2. It is essential that both operating and service personnel employ a safe system of work, in addition to the detailed instructions specified in this manual.

3. References should always be made to the Health and Safety data supplied with any chemicals used. Generally accepted laboratory procedures for safe handling of chemicals should be employed.

4. If it is suspected that safety protection has been impaired in any way, the unit must be made inoperative and secured against any intended operation. The fault condition should immediately be reported to the appropriate servicing authority.

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SECTION 1

INTRODUCTION

1.1 INSTRUMENT DESCRIPTION

The Model 4310 is a general purpose Conductivity Meter with auto ranging from 0.01µS to 199.9mS. Further expansion of these ranges is possible using the optional X10 and X0.1 cells.

Calibration can be easily performed by adjusting the digital display to the value of the cell constant indicated on the pre-calibrated cell supplied. Readings are automatically temperature compensated over the range of 0 to 100°C when using standard cells.

Selection of reference temperatures of 18, 20 or 25°C can be made via a dip switch located on the rear panel of the instrument. Direct calibration can be performed on 10µS, 1413µS and 12.88mS.

1.2 INSTRUMENT SPECIFICATIONS

RANGE	RESOLUTION
0 to 1999mS	1mS (when used with X10 cell only)
0 to 199.9mS	0.1mS
0 to 19.99mS	0.01mS
0 to 1999µS	1µS
0 to 199.9µS	0.1µS
0 to 19.99µS	0.01µS
-10 to +105°C	0.1°C
+14 to +220°F	1°F

Accuracy: Conductivity: ±0.5% ±2 digits
Temperature: 0.5°C

ATC Range: 0 to 100°C

Temperature Coefficient: Variable 0 to 4.00%/°C

Excitation Frequency: Auto ranging between 40 or 800Hz

Reference Temperature: 18, 20 or 25°C (switchable)

Cell Constant: 0.015 to 19.99 digitally settable

Platinising Socket: 10V pp 0.02Hz

Outputs: Analogue 1mV per digit
Bi-directional RS232

Display: LCD

Power: Power Supply

Size: 275(l) x 240(w) x 150(d)mm

Weight: 1.7Kg

SECTION 2

INSTALLATION

2.1 UNPACKING

Remove the Model 4310 from the packaging and ensure the items contained within the package are as ordered.

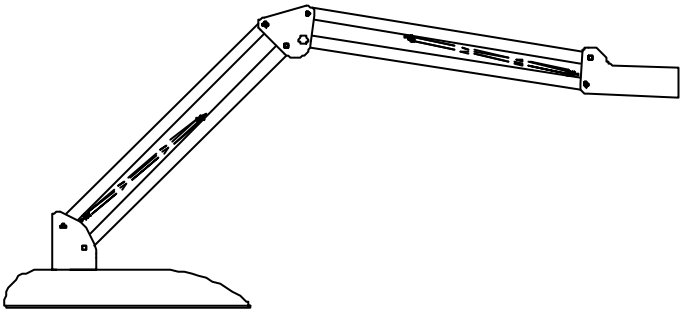
Any shortages or damage should be reported immediately to the Manufacturer or your local Distributor.

NOTE: Power Supply 021 033 is supplied with a moulded European plug. If this is not correct for your local supply it should be cut off and a suitable lead connector fitted noting the colours of the internal conductors as follows: Brown - Live Blue - Neutral

2.2 INSTALLATION

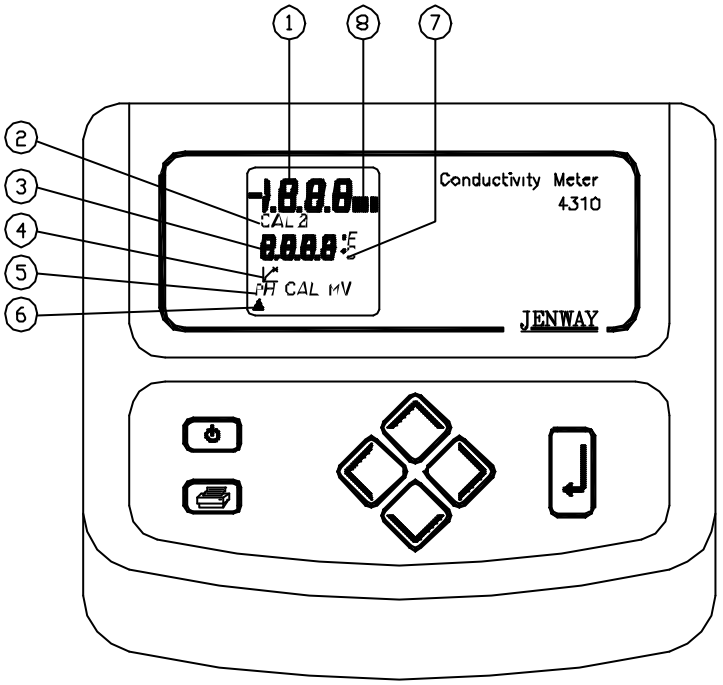
For units supplied with the swing arm electrode holder the following assembly instructions should be carried out:

1.Unpack the assembly and ensure the following items are present:
a) Base block and b) Swing arm. Assemble as illustrated. The moulded pivot is a tight push fit onto the pin.



2. Fit the conductivity cell into the cut-out in the support block. The optional temperature probe, if supplied, should be placed into the small hole in the centre of the block. The cable(s) should be passed through the retaining clip on the holder and connected to the respective socket on the rear panel.

2.3 DISPLAYS



1. Main display - provides direct readout of conductivity of samples and standards. The display will also show OUT OF RANGE (1) symbols if the instrument is reading outside the ranges 0 to 199.9mS or 0 to 1999mS if the X10 cell is used.

2. CAL - pressing ENT with the cursor beneath this option illuminates the CAL annunciator momentarily and then calibrates the instrument to the nearest standard solution (10µS, 1413µS, 12.88mS or 0µS). “Err” is displayed if a cell constant outside the allowed range is calculated and the calibration aborted.

3. Secondary display - provides direct readout of solution temperature in °C or °F (selectable by DIP switch setting). Also provides readout of cell constant (K) and temperature coefficient (%).

4. Endpoint detection symbol - this is displayed once a stable reading is detected, and is maintained until the input changes.

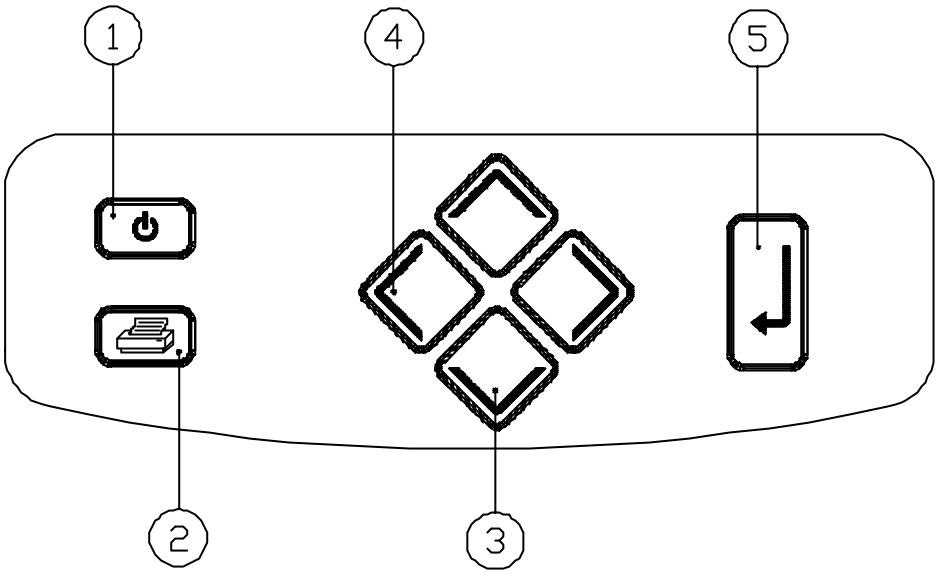
5. Selected mode indicator.

6. Cursor - used to select/indicate required mode.

7. Selected unit of temperature (°C/°F), cell constant (K) and temperature coefficient (%).

8. Measurement unit which is being used, µS or mS.

2.4 CONTROLS



Switches the instrument on and to Standby.

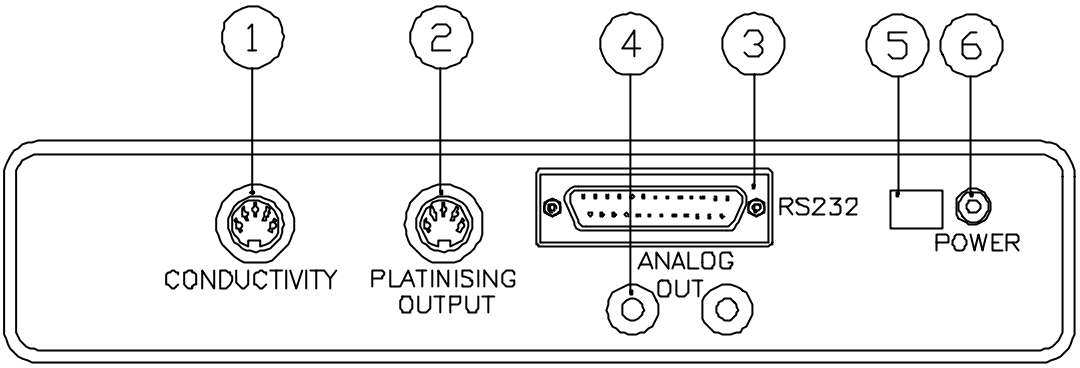
Print Key. Provides a printout of the current reading with an incremental sample number. When pressed for the first time after a calibration, the printout will give calibration information. The incremental sample number will be reset after a calibration or after changing the cell constant (K) and/or temperature coefficient.

These keys are used to change a parameter.
These keys are used to adjust the cell constant or temperature coefficient when displayed.

These keys are used to move the cursor between the menu options.

This key is used to select the displayed menu option.

2.5 INPUTS/OUTPUTS



1.	7 PIN DIN SOCKET	Connection socket for the standard cell supplied with the unit
2.	7 PIN DIN SOCKET	Platinising socket
3.	OUTPUT SOCKET	25 way D type socket for RS232
4.	ANALOG OUT	2 x 4mm sockets. Analogue output 1mV per digit
5.	DIP SWITCHES	Used to select temperature units (°C or °F) and reference temperature 18, 20 or 25°C

SW1 - switch on =°C or °F

SW 3	2	Ref. Temp.
off	off	18°C
off	on	20°C
on	off	25°C
on	on	25°C

6.	POWER IN	2.1 x 5.5mm socket allowing the power supply to be connected to the unit

SECTION 3

OPERATION

3.1 PREPARATION OF CONDUCTIVITY STANDARDS

Suitable conductivity standards are available commercially or these can be made up as required from A.R. grade reagents with reference to relevant physical tables.

Method for general purpose Conductivity Standard
Accurately weigh out 0.746 grammes of dried A.R. grade Potassium Chloride (KCl) and dissolve in 1 litre of good quality water. This produces a 0.01N solution with a conductivity of 1413µS at 25°C.

Storage
This solution must be stored in a plastic container and the air space above the solution should be kept to an absolute minimum. The shelf life of 1 week can be increased by storing below 4°C, but where any doubt exists about the viability of stored solution a fresh batch should be prepared.

3.2 CALIBRATION WITH KNOWN CELL CONSTANT

1. Connect a standard pre-calibrated cell to the unit.

2. Select the required reference temperature by setting the DIP switches on the rear panel to the appropriate temperature as detailed below:

SW 3	2	Ref. Temp.
off	off	18°C
off	on	20°C
on	off	25°C
on	on	25°C

3. Move the cursor beneath the K menu option and press the  key. The secondary display will show the current cell constant, K.

4. Use the  keys to adjust the display to indicate the value of the cell constant as marked on the probe being used. The main display will show the adjusted conductivity reading.

   The standard X1.0 cell has a cell constant range from 0.8 to 1.20 and is generally calibrated to 2 decimal places. The display should be set to indicate this figure exactly.

   The standard X10 cell has a cell constant range from 8.0 to 12.0 and is generally calibrated to 2 decimal places. The display should be set to indicate this figure.

5. Move the cursor beneath the COEFF menu option and press the key. Note that this menu option toggles the secondary display between temperature coefficient (0 to 4%/°C) and temperature. With the temperature coefficient displayed, the keys can be used to adjust the temperature coefficient.

NOTE: The unit has battery back-up to ensure all parameters are retained in non-volatile memory. When re-using the instrument it is recommended that the parameters previously set should be checked to ensure the values set are relevant to the tests being carried out.

6. Prior to use on the 20µS range the cell should be thoroughly rinsed in deionised water, shaken to remove internal droplets, and the outside wiped dry. Pressing the key with the cursor beneath the CAL menu option when the display reads less than 2µS will illuminate the CAL annunciator for 1 second, and then zero the display.

3.3 CALIBRATION WITH STANDARD SOLUTION

Calibration of the unit and cell with standard solutions will only be necessary if:

1) The cell constant is unknown.
2) The cell constant has changed due to replatinising, wear or damage to the plates.
3) An ATC slope other than 2%/°C is required (refer Special Calibration).

General Calibration

1) Immerse the conductivity cell into the prepared standard.

2) Move the cursor beneath the CAL menu option.

3) Press . The unit will calibrate to the nearest standard.

Special Calibration

When using conductivity as a method for determining or monitoring the concentration of a specific species in solution, and when the temperature coefficient (slope) is unknown, it will be necessary to prepare a standard solution of known concentration containing only the species to be measured. The standard must be maintained at the chosen reference temperature throughout calibration. Move the cursor beneath the K menu option and adjust the display to read the conductivity value of the chosen standard using the arrow keys. Samples should also be measured at the reference temperature and, if required, the concentration can be determined from a calibration curve or suitable physical tables (ensure these are based on the same reference temperature used for the measurement).

3.4 CALCULATING CELL CONSTANT

After completing the calibration with standard solutions the probe should remain in the standard solution with the main display set to the value of this solution.

Moving the cursor beneath the K option and pressing the key will provide a direct readout of the cell constant.

Note that pressing with the cursor beneath this menu option toggles the secondary display between cell constant (0.015 to 19.99) and temperature. With the cell constant displayed, the arrows can be used to adjust the cell constant which changes the conductivity reading using:

Displayed conductivity = K x Measured Conductivity

3.5 SAMPLE MEASUREMENT

General

Conductivity is a temperature dependent measurement. All substances have a conductivity coefficient which varies from 1% per °C to 3% per °C for most commonly occurring substances. The automatic temperature compensation on the 4310 defaults to 2% per °C, this being adequate for most routine determinations. Conductivity readings varying with temperature may be due to the substances under test having a coefficient other than the typical value of 2% per °C. To eliminate this variation it is necessary to maintain all samples at the reference temperature by use of a thermostatic water bath or equivalent.

Adjustment may be made by moving the cursor beneath COEFF option and pressing the key. The reading can then be adjusted to the required value (0.00 to 4.00) by using the keys.

Sample Measurement

After calibration the measurement of samples is carried out by immersing the cell in the samples, allowing the readout to stabilise, and recording the result. The cell should be rinsed in deionised water between each sample to avoid contamination, shaken to remove internal droplets, and the outside wiped prior to immersion in the next sample.
On completion of sample measurement the cell should be thoroughly rinsed in deionised water.

Storage

Short Term the cell should be immersed in deionised water to keep the plates wetted.
Long Term the cell should be thoroughly rinsed in deionised water, the exterior body wiped and then stored dry.

NOTE: When preparing the cell for storage the plate area MUST NOT be wiped dry. When using a dry cell initial stability on re-use may be impaired until the cell plates become re-wetted.

To obtain optimum performance refer to Section 3.6 - Good Practice Guidelines.

3.6 GOOD PRACTICE GUIDELINES

1. For greatest accuracy ensure no particulate matter is suspended in the solution under test. If necessary, filter or allow the particles to settle prior to use. Do not allow the cell to come into contact with any sediment which may be present.

2. Ensure no air bubbles are trapped in the cell area between the plates.

3. Ensure the cell plates are completely immersed in the solution under test.

4. Thoroughly rinse the cell plates in deionised water after use, and for short term storage immerse the cell in deionised water. Although it is not essential to store the conductivity cell with the plates in a wetted condition, if they are allowed to dry out completely, initial stability on re-use may be impaired until the cell plates become re-wetted.

5. Do not attempt to clean the cell plates as this will remove the black platinization and alter the calibration and accuracy of the probe. If the cell plates become worn or damaged the plates should be re-platinised and the cell constant recalculated.

6. Ensure no salt deposits or particulate matter are allowed to build up around the cell plates or on the probe body as this may produce a conductivity path lower than that through the solution. It is recommended that such deposits be removed by soaking the cell in deionised water. No attempt should be made to wipe off these deposits as this may cause damage to the cell plates.

7. Ensure the correct reference temperature is selected for the operating procedures being used.

SECTION 4

MAINTENANCE

4.1 GENERAL

The Model 4310 is designed to give optimum performance with minimum maintenance. It is only necessary to keep the external surfaces clean and free from dust. To give added protection when the unit is not in use the unit should be disconnected from the mains supply and covered with the optional dust cover (544 008). For longer term storage or re-shipment it is recommended that the unit be returned to the original packing case. All conductivity cells should be thoroughly rinsed after use and stored in deionised water. Do not attempt to clean the surface of the plates as this could result in damage to the black platinised surface.

4.2 PROBE RE-PLATINISATION

Probe types 027 012 and 027 028 have a black platinum film on the cell plates. Deterioration of this film will be apparent either visually or functionally by causing a low reading to be obtained, particularly on conductive solutions.
Should this occur the following procedure should be carried out:

WARNING - THE CHEMICALS USED IN THIS PROCEDURE ARE CORROSIVE. ALL NORMAL SAFETY PRECAUTIONS SHOULD BE OBSERVED.

Solution
1.5 grammes Chloroplatinic Acid
0.015 grammes Lead Acetate
Deionised Water

The chemicals should be placed in a suitable container and made up to 50ml using the deionised water.

PROCEDURE

1) Connect the probe to the rear panel platinising socket.

2) Rinse the cell thoroughly in deionised water to ensure it is clean and free from contamination. In extreme cases rinsing in Chromic Acid may be necessary.

3) Completely immerse the plates in the platinising solution.

4) The probe should be left in the solution for a period of no greater than 10 minutes. At the end of this time the plates should have an even black appearance.

5) Carefully remove the cell from the platinising solution and wash in deionised water.

6) Completely immerse the plates in a 1M Sulphuric Acid solution and leave for a period of 10 minutes.

7) Rinse the probe in deionised water and recalibrate the probe.

SECTION 5

OPTIONAL ACCESSORIES

5.1 OPTIONAL ACCESSORIES

The following list of items are available as optional accessories for use with the Model 4310:

903 200	Electrode stand with swing arm electrode holder
027 024	Temperature probe/ATC
021 030	Power Supply (UK Version)
021 031	Power Supply (European Version)
021 032	Power Supply (US Version)
021 033	Power Supply (230V leaded)

NOTE: Power Supply 021 033 is supplied with a moulded European plug. If this is not correct for your local supply it should be cut off and a suitable local connector fitted noting the colours of the internal conductors as follows: Brown - Live Blue - Neutral

544 008	Dust Cover
43 001	40 Column Printer
050 002	Jensoft
542 009	Interface Cable Kit

Conductivity Cells

027 013	Conductivity Cell K=1
027 113	Conductivity Cell K=0.1
027 114	Conductivity Cell K=1 (plastic covered)

NOTE: The cells listed below are glass free and epoxy bodied.

027 211	Conductivity Cell with ATC K=0.1
027 212	Conductivity Cell with ATC K=1
027 213	Conductivity Cell with ATC K=10

Calibration Standards

025 138	1413µS Standard (500ml)
025 156	12.88mS Standard (500ml)
025 164	84µS Standard (500ml)
025 139	10µS Standard (500ml)
025 165	1382ppm TDS Standard (500ml)

SECTION 6

INTERFACING

Analogue

All units are provided with 2 x 4mm sockets, marked as ANALOG OUT, on the rear panel. An analogue output voltage of 1mV per least significant digit is available from these sockets.

RS232

The Bi-directional RS232 interface is available on the rear panel 25 way D type connector.

The connections are as follows:

TXD 2	- INPUT TO 4310
RXD 3	- OUTPUT FROM 4310
RTS 4	- LINKED TO CTS
CTS 5	- LINKED TO RTS
DSR 6	- OUTPUT FROM 4310
DCD 8	- OUTPUT FROM 4310
DTR 20	- INPUT TO 4310 (must be active)
GND 7	

Suggested interconnections are detailed below:

4310		**IBM PC XT (25 way "D")**	
TXD 2	———	2	TXD (From PC)
RXD 3	———	3	RXD (To PC)
RTS 4	———	4	RTS (From PC)
CTS 5	———	5	CTS (To PC)
DSR 6	———	6	DSR (To PC)
DCD 8	———	8	DCD (To PC)
DTR 20	———	20	DTR (From PC)
GND 7	———	7	GND

4310		**IBM PC XT (9 way "D")**	
TXD 2	———	3	TXD (From PC)
RXD 3	———	2	RXD (To PC)
RTS 4	———	7	RTS (From PC)
CTS 5	———	8	CTS (To PC)
DSR 6	———	6	DSR (To PC)
DCD 8	———	1	DCD (To PC)
DTR 20	———	4	DTR (From PC)
GND 7	———	5	GND

INTERFACING (continued)

The RS232 communications parameters on the computer or printer need to be set to match those of the Model 4310, as detailed below:

1200 Baud
7 Data Bits
Odd Parity
1 Stop Bit

The Model 4310 supports both hardware (DTR/DSR) flow control and software XON/XOFF flow control.

Pressing the PRINT key outputs from the RS232 interface.

Sending an ASCII “D” to the 4310 causes a printout of the current displayed reading plus sample number.

Sending an ASCII “C” causes a printout of the last calibration parameters. (same as printout after performing a calibration).

EC Declaration of Conformity

JENWAY Model 4310 Conductivity Meter complies with the following European Standards:

EN 50081-1:1992 Electromagnetic compatibility - Generic emission standard

EN 50082-1:1992 Electromagnetic compatibility - Generic immunity standard (Performance criterion B)

EN 61010-1:1993 Safety requirements for electrical equipment for measurement, control and laboratory use

Following the provision of:

EMC Directive - 89/336/EEC and Low Voltage Directive - 73/23/EEC

Martyn J. Fall
Managing Director, Jenway Limited
Gransmore Green, Felsted, Dunmow,
Essex, CM6 3LB, England