MODEL 4200 WATERPROOF CONDUCTIVITY METER OPERATING MANUAL

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4200/REV A/05-95

MODEL 4200 CONDUCTIVITY METER OPERATING MANUAL

INTRODUCTION

The Model 4200 is ruggedly designed and constructed to resist the harshest of field, industrial and laboratory environments. The whole system is rated at IP67 and will float if dropped into water.
The instrument is supplied with a fully integrated Conductivity/Temperature sensor.

SPECIFICATION

Conductivity

Ranges:	0 to 199.9mS
	0 to 19.99mS
	0 to 1.999mS
	0 to 199.9μS
	0 to 19.99μS
Resolution:	0.1mS/0.01mS/0.001mS/ 0.1μS/0.01μS
Accuracy:	$\pm$0.5% $\pm$2 digits

TDS

Ranges:	0 to 200g/l
	0 to 20g/l
	0 to 2000mg/l
	0 to 200mg/l
	0 to 20mg/l
Resolution:	0.1g/l/0.01g/l/1mg/l/ 0.1mg/l/0.01mg/l
Accuracy:	$\pm$0.5% $\pm$2 digits

SPECIFICATION (continued)

Resistivity	
Range:	0 to 20MΩ
Resolution:	0.01MΩ
Temperature	
Range:	-10 to +105°C 14 to 220°F
Resolution:	0.1°C / 1°F
Accuracy:	±0.5°C / ±1°F
Salinity	
Range:	0 to 99.9
Resolution:	0.1
Accuracy:	0 to 35 ±1 35 to 99.9 ±3 of reading
ATC Range:	0 to +100°C
Cell Constant:	Digitally settable 0.015 to 19.99
Reference Temperature:	18, 20, 25°C
Temperature Coefficient:	0.00 to 4.00%/°C linear
Probe(s):	4 plate configuration
Clock:	24 hour, hours/mn/sec or day of month, month and year, leap year corrected
Power:	3 AA cells
Size:	200(l)x80(w)x60(d)mm
Weight:	370g

INSTALLATION

Unpack the instrument and ensure the following items are present:

1. Model 4200 Conductivity Meter (540 001)
2. Conductivity/Temperature Probe (540 520)
3. 3 x AA alkaline batteries (021 007)

Optional accessories which may have been ordered:

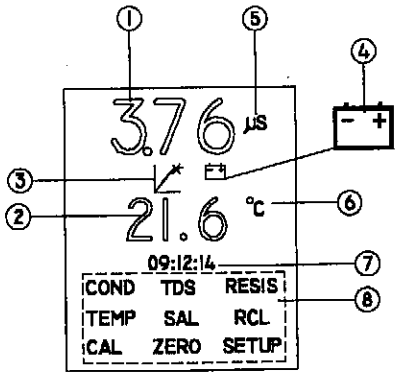
1. Carrying Case (033 174)
2. Interface Cradle (542 001)
3. Interface Cable Kit (542 009)
4. 40 Column Printer (543 001)
5. Paper Roll for Printer (060 287)
6. Printer Ribbon (060 288)
7. 0.01M Conductivity Standard (025 138)

LCD CONTRAST

The LCD contrast can be set at initial power up of the instrument. The LCD contrast potentiometer is accessible with the battery compartment cover removed. This adjustment should only need to be made on receipt of the instrument. After initial adjustment the instrument will automatically adjust the contrast depending on the temperature of the glass.

Remove the battery compartment cover and fit the batteries, taking care to observe the correct polarity, as indicated on the moulding. Re-fit the cover and tighten the screws to achieve a watertight seal.

DISPLAYS



1. Primary display - provides direct readout of conductivity, total dissolved solids (TDS) and resistivity.
   If the primary reading is overrange this display will indicate "1" with all other digits blanked and the error message **OVERRANGE.**
   If the primary reading is underrange this display will indicate "-1" with all other digits blanked and the error message **UNDERRANGE.**

Primary Ranges:

Conductivity	0 to 199.9mS
TDS	0 to 200g/l
Resistivity	0 to 20Mohms

2. Auxiliary display - provides direct readout of temperature in °C or °F and salinity in g/l.
   If the auxiliary reading is overrange this display will indicate "1" with all other digits blanked.
   If the auxiliary reading is underrange this display will indicate "-1" with all other digits blanked.

Auxiliary Ranges:

Temp	-10 to 105°C
	14 to 220°F
Salinity	0 to 99.9g/l

3. Endpoint Detection symbol - this is displayed once a stable reading is detected and is maintained until the input changes.

4. Low Battery Indicator - this will be displayed when a maximum of 5 hours battery life remains.

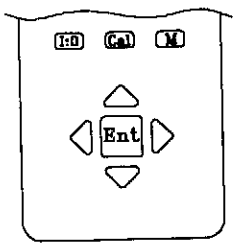
5. Primary mode measurement unit which is being used mS, µS, g/l, mg/l or MΩ.

6. Secondary mode measurement unit °C, °F or g/l.

7. Real Time Clock giving continuous display of hours, minutes and seconds or day, month and year. All logged results are automatically time stamped.

8. Menu - used for selection of modes of operation. The selected mode is reverse highlighted. To select, highlight the appropriate mode of operation using the arrow keys, then press ENT.
NOTE: The menu wraps around.
To exit to another mode, highlight the required mode using the arrow keys and press ENT. To escape from a measurement sequence/mode move to the EXIT option and press ENT. This will return the instrument to the start of the previously selected menu.

CONTROLS



I:O Switches the instrument on and off.

CAL This key is used to perform a 1, 2 or 3 point conductivity calibration.

M The Memory Store key is used to store the displayed readings in any measurement mode.

▲▼ These keys are used to change a parameter.
1. Used when storing a reading to change the stored location index.
2. In recall (RCL) mode these keys are used to change the displayed stored location.
3. The keys are used to move vertically between menu options.
4. In Set-Up mode these keys are used to modify the set up parameters.

◄► 1. These keys are used to move horizontally between menu options. 2. In Set-Up these keys are used to select the part of the parameter required for modification.

ENT The ENT (enter) key is used to select the displayed menu option. It also places stored values in the selected location(s).

INPUTS

PL3 ELECT SOCKET

Connection socket for Conductivity/Temperature probe supplied with the instrument, or an alternative electrode.

OPERATION

Switch the instrument on using the I:O key. The display will show INITIALISING... for approximately 2 seconds. The primary display will then show the conductivity, total dissolved solids (TDS) or resistivity mode, the auxiliary display will then show temperature or salinity. Both will show the mode last used prior to switch off. This will be indicated by the displayed measurement units. The selected primary mode will be reverse highlighted. To change the mode, move to the required mode by using the arrow keys and then press the ENT key.

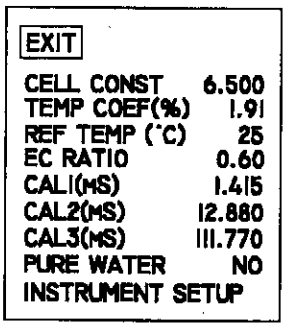
MENU OPTIONS

COND	TDS	RESIS
TEMP	SAL	RCL
CAL	ZERO	SETUP

COND	Conductivity mode
TDS	Total Dissolved Solids mode
RESIS	Resistivity mode
TEMP	Temperature mode
SAL	Salinity mode
RCL	Recall mode for stored readings
CAL	Conductivity calibration mode
ZERO	Conductivity zero offset
SETUP	Used to set up mode specific parameters, instrument and clock set up.

SET UP OPTIONS

1. SET UP MENU

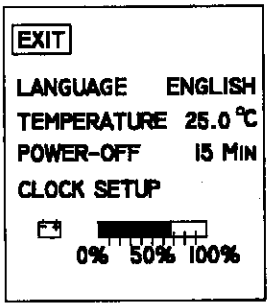


EXIT - menu escape key.
CELL CONSTANT - this is the cell constant applied to the conductivity cell when performing a 1 point calibration.
TEMP COEFF (%) - used to set the temperature coefficient (in units of %/°C) value of the sample under test.
REF TEMP (°C) - used to set the temperature to which the conductivity measurements are referenced to.
EC RATIO - the ratio between Electrical Conductivity (EC) and Total Dissolved Solids (TDS) is a variable dependent upon the electrolyte balance of the solution under test. It is normal for this ratio to be between 0.55 and 0.7. The commonly accepted default value is 0.6.

CAL 1 (mS) - used to set the conductivity value when performing a 1 point calibration.
CAL 2 (mS) - used to set the second conductivity value when performing a 2 point calibration.
CAL 3 (mS) - used to set the third conductivity value when performing a 3 point calibration.
PURE WATER - used to enable the non-linear temperature coefficient characteristics associated with low conductivity water.

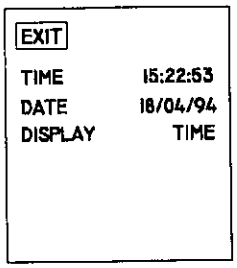
INSTRUMENT SET UP - used to select the next set up menu for instrument parameters.

2. INSTRUMENT SET UP MENU



EXIT - menu escape key
LANGUAGE - used to set preferred language option (English, French, German, Italian, Spanish or Swedish)
TEMPERATURE - used for selection of measurement in °F or °C
POWER-OFF - used to select auto shut off time interval (15, 30, 45, 60 minutes, or disabled)
CLOCK SET UP - used to select clock set up menu
Estimated battery life indicator

3.CLOCK SET UP MENU



EXIT - menu escape key
TIME - real time clock set up
DATE - date set up
DISPLAY- used to select display of time, date or none

CONDUCTIVITY MODE

This gives a direct readout of the conductivity of the sample under test. The auto ranging facility will give the optimum display resolution with units of mS or μS.

TOTAL DISSOLVED SOLIDS MODE

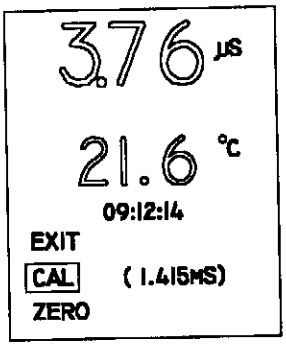
This gives a direct readout of the total dissolved solids (TDS) contained within the sample under test. The auto ranging facility will give the optimum display resolution with units in g/l or mg/l.

RESISTIVITY MODE

This gives a direct readout of the resistivity of the sample under test to a resolution of 0.01MΩ.

CALIBRATION

The 4200 has three methods of calibration available. The method of calibration used is determined by the level of accuracy required.



EXIT - Menu escape key.
CAL - Selecting this option with the ENT key will calibrate the instrument to the conductivity value held within the adjacent brackets.
ZERO - Selecting this option with the ENT key will remove any cell offsets present by calibrating the instrument to zero conductivity. This operation must be performed with the cell in free air.

PREPARATION OF CONDUCTIVITY STANDARDS

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

Method for general purpose conductivity standard

1) Accurately weigh out 0.746 grammes of dried A.R. grade Potassium Chloride (KCl).
2) Dissolve in 1 litre of good quality deionised water.

This produces a 0.01N solution with a conductivity of 1411μS @ 25°C.

Storage

This solution must be stored in a plastic container and the air space 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.

CALIBRATION:
a) WITH KNOWN CELL CONSTANT

This method is the most basic and least accurate.

Prior to entering the calibration routine the known cell constant value, as indicated on the cell body, must be entered. Enter into the SET UP mode by selecting the SET UP menu option and pressing the ENT key.
Select the CELL CONST menu option using the ▲▼ keys. Once highlighted, adjustment of the cell constant proceeds by pressing ENT or the ▶ key. The first part of the parameter is highlighted and can be adjusted to the required value using the ▲▼ keys. If

further precision adjustment is required move the highlighted cursor to the next adjustable position using the ▶ key and adjust as required. Continue moving across the parameter until full adjustment has been made. To confirm set value press ENT or press ◀ key until the CELL CONST menu option is re-highlighted.

Move to the EXIT option using the ▲▼ keys and press the ENT key.

Calibration is performed by either pressing the CAL key or by moving the cursor to the CAL menu option by using the arrow keys and then pressing the ENT key. The screen will then change to show the calibration mode.

Zero the cell by selecting the ZERO option using the ▲▼ keys. Hold the cell in free air, once the reading has stabilised i.e. the endpoint symbol has appeared, press the ENT key. This will cause the primary display to read zero. Should the instrument detect that the offset required to zero the cell is too great (>2μS) a CAL OUT OF RANGE error will be displayed for approx. 2 seconds and the instrument will not perform the zero calibration.

Move to the EXIT option using the ▲▼ keys and press the ENT key.

b) WITH STANDARD SOLUTION

Prior to entering the calibration routine the standard solution value must be entered. Enter into the SET UP mode by selecting the SET UP menu option and pressing the ENT key.
Select the CAL1(mS) menu option using the ▲▼ keys. Once highlighted, adjustment of the standard solution proceeds by pressing ENT or the ► key. The first part of the parameter is highlighted and can be adjusted to the required value using the ▲▼ keys. If further precision adjustment is required, move the highlighted cursor to the next adjustable position using the ► key and adjust as necessary. Continue moving across the parameter until full adjustment has been made. To confirm set value press ENT or press ◄ key until the CAL1(mS) menu option is re-highlighted.

Move to the EXIT option using the ▲▼ keys and press the ENT key.

Calibration is performed by either pressing the CAL key, or by moving the cursor to the CAL menu option by using the arrow keys, and then pressing the ENT key. The screen will then change to show the calibration mode.

Zero the cell by selecting the ZERO option using the ▲▼ keys. Hold the cell in free air, once the reading has stabilised i.e. the endpoint symbol has appeared, press the ENT key. This will cause the primary display to read zero. Should the instrument detect that the offset required to zero the cell is too great (>20μS) a CAL OUT OF RANGE error will be displayed for approx. 2 seconds and the instrument will not perform the zero calibration.

Select the CAL menu option using the ▲▼ keys. Immerse the conductivity cell into the prepared standard.

Once the reading has stablised, i.e. the endpoint symbol has appeared, press the ENT key. This will cause the primary display to read the value of conductivity contained within the brackets adjacent to the CAL menu option. The standard solution value contained within the brackets will then be updated to the second standard solution value (not used for this calibration).

Move to the EXIT option using the ▲▼ keys and press the ENT key.

Should the instrument detect that the cell constant calculated from the standard solution is outside the limits of 0.015 to 19.99 a CAL OUT OF RANGE error will be displayed for approx. 2 seconds and the instrument will not perform the calibration.

c) WITH STANDARD SOLUTIONS

To achieve optimum linearisation of the cell up to a 3 point calibration can be performed.

NOTE: In order to achieve a successful 3 point calibration it is necessary to set up the calibration standards in increasing order of conductivity.

Prior to entering the calibration routine the standard solution values must be entered. Enter into the SET UP mode by selecting the SET UP menu option and pressing the ENT key.
To enter the first standard solution value select the CAL1(mS) menu option using the ▲▼ keys. Once highlighted, adjustment of the standard solution proceeds by pressing ENT or the ► key. The first part of the parameter is highlighted and can be adjusted to the required value using the ▲▼ keys. If further precision adjustment is required move the highlighted cursor to the next adjustable position using the ► key and adjust as necessary. Continue moving across the parameter until full adjustment has been made. To confirm set value press ENT or press ◄ key until the CAL1(mS) menu option is re-highlighted.

To enter the second standard solution value select the CAL2(mS) menu option using the ▲▼ keys. Once highlighted, adjustment of the standard solution proceeds as per the first standard solution.

To enter the third standard solution value select the CAL3(mS) menu option using the ▲▼ keys. Once highlighted, adjustment of the standard solution proceeds as per the first standard solution.

Move to the EXIT option using the ▲▼ keys and press the ENT key.

Calibration is performed by either pressing the CAL key or by moving the cursor to the CAL menu option by using the arrow keys and then pressing the ENT key. The screen will then change to show the calibration mode.

Zero the cell by selecting the ZERO option using the ▲▼ keys. Hold the cell in free air. Once the reading has stabilised, i.e. the endpoint symbol has appeared, press the ENT key. This will cause the primary display to read zero. Should the instrument detect that the offset required to zero the cell is too great ($>20\mu S$) a CAL OUT OF RANGE error will be displayed for approx. 2 seconds and the instrument will not perform the zero calibration.

Select the CAL menu option using the ▲▼ keys. Immerse the conductivity cell into the first prepared standard.

Once the reading has stablised, i.e. the endpoint symbol has appeared, press the ENT key. This will cause the primary display to read the standard solution value

contained within the brackets adjacent to the CAL menu option. The standard solution value contained within the brackets will then be updated to the second standard solution value.

Rinse the conductivity cell in deionised water.

Immerse the conductivity cell into the second prepared standard.

Once the reading has stablised, i.e. the endpoint symbol has appeared, press the ENT key. This will cause the primary display to read the standard solution value contained within the brackets adjacent to the CAL menu option.

The standard solution value contained within the brackets will then be updated to the third standard solution value.

Rinse the conductivity cell in deionised water.

Immerse the conductivity cell into the third prepared standard.

Once the reading has stablised, i.e. the endpoint symbol has appeared, press the ENT key. This will cause the primary display to read the standard solution value contained within the brackets adjacent to the CAL menu option and returns the instrument to the previously selected menu.

At any point during the calibration, should the instrument detect that the linearised slope calculated from the standard solutions is outside the limits of 0.015 to 19.99 a CAL OUT OF RANGE error will be displayed for approx. 2 seconds and the instrument will not perform the calibration.

Calibration mode can be exited at any time by moving to the EXIT option using the ▲▼ keys and pressing the ENT key.

STORING RESULTS

The M key (Memory Store) is used to store the displayed readings in any measurement mode. When the M key is pressed the display will show the main and auxiliary readings, the previous menu options will be replaced by a new set containing the menu option ABORT NN (NN is the first available free location for the displayed reading).

To store the displayed reading at the current index number the ENT key should be pressed. If no key is pressed within 5 seconds the reading will be automatically stored in this location. The instrument will then return to the previously selected mode.

If the reading is not to be stored, moving to the ABORT option using the arrow keys and pressing ENT will return the instrument to the previously selected mode without storing the reading.

To store a reading in a specific location use the ▲▼ keys to select the required location and then press ENT. If no other key is pressed within 5 seconds the reading will be automatically stored in this location. The instrument will then return to the previously selected mode.

NOTE: **Automatic storage after 5 seconds is only instigated after the last key press. If a key is pressed and held down the timer is disabled until the key is released. At this stage the 5 second timer is re-initialised.**

The non-volatile storage area has the facility to store 100 readings. If, however, an attempt is made to store a reading with all locations full, the highlighted message MEMORY FULL will be displayed for approx. 2 seconds, returning the highlighting to the ABORT option. If it is necessary to store the reading the location will have to be selected within the index option using the arrow keys.

NOTE: **Storing a reading when the memory is full will overwrite any previous data stored in selected location.**

RECALLING STORED READINGS

To recall a stored reading select the RCL menu option by using the arrow keys and then pressing ENT. The display will update

to the stored reading and the stored index number will be shown at the bottom of the display.
If no stored reading is present the display will give the message NO RECORD STORED.

To select a specific stored reading, select the INDEX: option using the arrow keys and press ENT. To select the required location use the ▲▼ keys. The display will update to the selected reading. To exit the RCL mode select the EXIT option and press ENT. The instrument will return to the previous display.

CLEARING STORED READINGS

To clear an individual stored reading select the RCL mode using the arrow keys and press ENT. Select INDEX: by using the arrow keys and press ENT. Select the specific location to be deleted using the ▲▼ keys. Move to the DELETE menu option by using the arrow keys and press ENT. The display will clear and then update to show the message NO RECORD STORED, returning the highlighting to the location number.

Selecting the EXIT option and pressing ENT will return the instrument to the previous display.

To clear all stored readings select the CLR/ALL menu option using the arrow keys

and then pressing ENT. The display will momentarily display the message DELETING... The display will then update to show the message ALL RECORDS DELETED.

Selecting the EXIT option and pressing ENT will return the instrument to the previous display.

DOWNLOADING STORED READINGS

NOTE: To perform the downloading function ensure the Interface Cradle (542 001) and relevant interface cables are correctly installed to the receiving terminal. Please refer to separate installation/operating instructions supplied with the Interface Cradle.

To download stored readings select the RCL mode using the arrow keys and press ENT. Select TX DATA by using the arrow keys and press ENT. This will start the downloading process, automatically returning the instrument to the previous display.

REAL TIME CLOCK SET UP

Real time clock set up is performed by entering into the INSTRUMENT SET UP mode, selecting CLOCK SET UP using the ▲▼ keys and pressing the ENT key.

Select the real time clock parameter to be changed using the ▲▼ keys, once highlighted, adjustment of the parameter proceeds by pressing ENT or the ► key. The first part of the parameter is highlighted and can be adjusted to the required value using the ▲▼ keys. If further adjustment is required move the highlighted cursor to the next adjustable position using the ►key and adjust as required. Continue moving across the parameter until full adjustment has been made. To confirm new time or date press ENT or press ◄ key until the selected parameter is re-highlighted.

AUTO SHUT OFF

This can be achieved by setting the required shut off time (15, 30, 45, 60 or disabled) in the Instrument Set Up menu.

GOOD PRACTICE GUIDELINES

1. The presence of particulate matter in the sample can lead to unstable and non-reproducible results. If necessary filter, or allow the particles to settle prior to immersion.

2. Ensure no air bubbles are trapped in the measuring cell. Gentle agitation of the cell should ensure that bubbles are purged.

3. The entire plate area must be immersed in the solution under test. The slots in the side of the sensor should be below the surface.

4. Whilst the 4-plate construction minimises the effect of fouling it is still advisable to clean the sensor if contamination is evident. This should be approached in a progressive manner, beginning with deionised water and progressing to other solvents or a soft air brush if the deposits persist. The carbon plates can be damaged and should not come into contact with anything which is likely to abrade their surface.

5. The temperature coefficient is very dependent on the solution being measured and its concentration level. The effect of temperature change on conductivity can be very significant, and if the temperature coefficient is not known it is wise to measure all samples at the same temperature.

6. Both the salinity and TDS modes display results which have been calculated from the measurement of conductivity. The salinity mode assumes that the major constituent responsible for the conductivity of the solution is sodium chloride. If significant quantities of other conductive species are present then the displayed results could be inaccurate. Likewise, the TDS mode assumes some knowledge of the electrolyte balance of the analyte. The EC ratio parameter found in the set up routine allows selection of a factor suitable for the solution under test. Most analysers which do not offer this option use a default value of 0.6.

BATTERY REPLACEMENT

The battery symbol will be displayed to the right hand side of the display to indicate a maximum of 5 hours battery life remains. An approximation ($\pm 2\%$) of remaining battery life can be achieved by viewing the battery life indicator displayed within INSTRUMENT SET UP mode.

NOTE: Stored results are retained in non-volatile memory and will not be lost during battery replacement. Re-adjustment of the real time clock will be required.

To fit new batteries; remove the battery compartment cover, remove and carefully discard the used batteries. Fit the new batteries, type R6, AA or AM3, ensuring the correct polarities are observed, as indicated on the moulding. Refit the battery compartment cover, ensuring that the fixings are secured into place, but are not overtightened.

ELECTRODE REPLACEMENT

To replace the electrode switch the model 4200 off and disconnect the faulty electrode by first carefully unscrewing the locking ring counter-clockwise and withdrawing the connector from the receptacle.

Fit the new electrode by reversing the above method, ensuring that the polarising keyway is correctly aligned and the locking ring is tightened to prevent the ingress of moisture.

OPTIONAL ACCESSORIES

The following list of items are available for use with the Model 4200:

033 174	Carrying Case
542 001	Interface Cradle
542 009	Interface Cable Kit
543 001	40 Column Printer
060 287	Printer Paper Roll
060 288	Printer Ribbon

SPARES

540 520	Conductivity Cell K = 1

EC Declaration of Conformity

JENWAY Model 4200 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

Thank you for reading this data sheet.

For pricing or for further information, please contact us at our UK Office, using the details below.

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