USER MANUAL
MODEL 210-C

INDUSTRIAL
CONDUCTIVITY ANALYZER

um-210-C-1.01

IC Controls

CONTENTS

um-210-C-1.01

INTRODUCTION

The model 210-C is IC Controls' 144 mm industrial quality remote operable Conductivity based analyzer, designed to give maximum flexibility, reliability, and ease-of-use. The model 210-C is shipped from the factory with the conductivity input calibrated for measuring 0 to 1000 µS/cm based on a 1.0/cm sensor constant and the output for 4 mA to 20 mA. Calibration for measuring 0 to 1000 µS/cm should not be required. It has two isolated 4 mA to 20 mA outputs, four 5 A relays, plus optional serial communication. The analyzer recognizes specific conductivity standards to auto-calibrate, holds output during calibration, notifies user of diagnosed sensor or analyzer faults.

The 210-C is one of the 210 series of 115/230 VAC process analyzers supplied in a durable corrosion resistant IP66 (NEMA 4X) water- and dust-tight aluminum case. These analyzers are also available for pH, ORP, dissolved oxygen and chlorine. In the case of conductivity, the analyzer measures the sensor signal corresponding to the actual conductivity and temperature. The analyzer conditions and digitizes the signal for maximum accuracy, and then sends it out as a digital output and/or on 4 mA to 20 mA outputs.

Features

The 210-C conductivity analyzer features:

1. Easy-to-use friendly program; instructions are written in memory and interactively pop up when you need them.
2. Selectable conductivity standards and auto-calibration to your selected standard.
3. Self, and sensor, diagnostics.
4. Outputs go on hold during calibration.
5. Two programmable 4 mA to 20 mA outputs, with programmable non-linear characteristic.
6. Four programmable relays.
7. Programmable timer for auto-chemical cleaning or other uses.
8. Three level security to protect settings.
9. Robust industrial 144 mm aluminum enclosure, rated IP66, NEMA 4X corrosion resistant, that is dust-tight and water-tight even if you hose it down.
10. Optional serial digital output, and for remote operation.

Specifications

Measuring Range:

pH	0 to 14 pH units
ORP:	-2000 to +2000 mV
Conductivity:	0.055 μS/cm to 1 S/cm
Resistivity:	0 to 20 MΩ·cm
TDS:	0 to 100,000 ppm or mg/L Total Dissolved Solids
NaOH:	0 to 15 % by weight
NaCl:	0 to 20 % by weight
H_2SO_4:	0 to 25 % or 94 to 100 % by weight
HCl:	0 to 18 % by weight
Salinity:	0 to 42 ppt (‰) or PSU [TC Seawater curve]

Output Scale Expansion:
Zero anywhere from, 0 to 90%. Span anywhere from, 10 to 100%. Zero and Full Scale, reversible.

Accuracy: Standard deviation ± 0.1% of range.
Display Precision: ± 1 digit.
Repeatability: ± 1 digit.
Stability: ± 0.01 % per day.

Temperature Coefficient:
Input: ± 0.003 %/°C.
Output: ± 0.006 %/°C.

Temperature Measurement:
-25 to +260°C (-13 to +437°F), Pt1000 RTD.

Response Time:
90% within 3 seconds (default), function of flow/temperature.
Damping Adjustment: 0 to 99 seconds.

Calibration
pH Calibration: Single buffer and two buffer calibration with auto recognition of IC Controls NIST traceable buffers. Custom value buffer, grab sample calibration.
Conductivity Standardization: Single-standard calibration with auto-recognition of standards. Custom value standard, grab sample calibration, air zero calibration.
Temperature Standardization: Direct entry of temperature correction.

Display: Back-lit Dot Matrix (Graphical)
Process Variable Characters, 1.13 cm (0.45 inch) high, for primary measurement, secondary characters, 0.75 cm (0.3 inch) temperature, efficiency, errors, prompts and diagnostic information.
4 alarms

Signal Outputs:
***Two (2) 4 to 20 mA*,** continuous, assignable, programmable, isolated, max. load 600 ohms.
Each output can be independently programmed for non-linear characteristics. The programmed curve can be displayed graphically. For example, program the first output for acid control using a valve and use the second output for caustic control.

Four (4) relays
1-3 SPST Form A, epoxy sealed ,normally open contact
4 SPDT, Form C, epoxy sealed contacts
Rated 115 V 5 Amps Resistive, 3 Amps Inductive
230 V 5 Amps Resistive, 1.5 Amps Inductive
28 VDC 5 Amps Resistive, 3 Amps Inductive

Relay Functions:
Alarms Three independent, assignable, programmable
Assign to: primary measurement, temperature, timer, ON/OFF control.
Actions: high, low, deviation
Adjustments: Set-point; 0 to 100% of units;
Differential; 0 to 10 % of units.
Delay; 0 to 9999 seconds.
Unit Selection: °C/°F Temperature.
Override: Press "Manual" key, 15 minute OFF.
ON/OFF: Can be set to permanent OFF.
Indication: LCD "flashing" the alarm, relay contact, and serial output.
Fault Alarm One independent, assignable, programmable
Assign to: Sensor and/or Analyzer and/or Process.
Indication: LCD "flashing" the alarm, relay contact, and serial output.
Timer Programmable cleaning or override timer function allows time based automated cleaning of a sensor plus hold of outputs during cleaning and recovery period. Uses one relay.

Advanced Functions:
Intelligence and Real-time Clock
(Communication Protocol Module & Program Recommended)
Internal 1000 point history: Measurement, temp, time, date.
Last 12 calibration history: time, date, calibration record.
Last 20 event record: time, date, power ON/OFF, error &
caution messages, alarm, off-scale.
Real-time Clock: internal year, month, day, hour, minute, second; maintains date even when power is off.
Communication Protocol (optional alternatives)
-21 RS485 (RS232 compatible) for communication with PC

Universal Ratings:
Environment Ratings
Operating Temperature Range: -20 to 60°C (-4 to 140°F)
Relative Humidity: 95% maximum, non-condensing.
Extended Environment Rating: IP66 (NEMA 4X) corrosion resistant.
Pollution Degree: 2
Installation Category: II

Electrical Requirements
115/230 VAC ± 10%, 0.25 Amp., 50/60 Hz, 50 Watts.
20 to 30 VDC, 50 Watts

Electrical Classification - General Purpose

Enclosure: Panel mounts in Standard 138 x 138 mm cutout.
Epoxy Painted white aluminum case and door.
Front Panel orange membrane keypad with tactile feedback.
144 * 144 * 140 mm, DIN size (5.7 * 5.7 * 5.5 inch)

Weight/Shipping Weight: 1.8 kg / 2.2 kg (4 lb / 4.8 lb)

es-210-2.2

INSTALLATION

Analyzer Mounting and Wiring

The conductivity sensor is typically supplied with at least a 1.5 m (5 foot) lead as standard. Conductivity sensors require drive from the analyzer therefore it is recommended that the sensor be located as near as possible to the conductivity analyzer to minimize any effects of drive signal loss or noise interference. The 210-C conductivity analyzer should be kept within the sensor lead length and mounted on a wall, ideally at eye level. Position the analyzer to allow the sensor, still connected to the analyzer, to be removed and the tip placed in a beaker on the floor for cleaning or calibration. Assume the safest place for the beaker is on the floor the service person stands on. Horizontal separation between rows of analyzers should allow for sensor leads which may need periodic replacement, and the electrical conduit. IC Controls recommends a minimum separation of 10 cm (4 in) between rows/columns.

As standard, the 210-C comes with integral panel-mount bezel and four centered taped 1/4-20 holes for surface/panel mounting spaced 76.20 cm (3.0 in) wide and 76.20 cm (3.0 in) high. Case dimensions are 144 cm x 144 cm x 140 cm (w, h, d) or 5.7 in x 5.7 in x 5.5 in (w, h, d) as shown on drawing D4100086. It requires a customer supplied panel cut-out, 138 mm (5.433 in) wide x 138 mm (5.433 in) high.

Panel mounting kit, option -9, P/N A2500272, is shown on drawing D4100086.

Pipe mounting kit, option -8 for 5 cm (2 in) pipe, P/N A2500273, is shown on drawing D4100087. It may also be used to surface mount the analyzer by removing the 2 inch U bolts and using the holes in the mounting plate for wall studs (*using customer-supplied studs*). The mounting plate dimensions are 190 mm x 102 mm x 25 mm (w, h, d) or 7.5 in x 4.0 in x 1.0 in (w, h, d).

Wiring

Power for the 210-C conductivity analyzer is 115/230 VAC ± 10%, single phase 50/60 Hz, and 0.25 A. ***Caution:*** *Line voltage must be wired to the correct terminal prior to applying power either 115 VAC at TB1-1 (Δ2) or 230 VAC at TB1-3 (Δ3), neutral at TB1-2 (Δ4).* Power connections are made at TB1 inside the instrument enclosure; refer to illustration 1 and drawing D5060288. The microprocessor requires a good ground for stable operation. A power line with the third wire connected to earth ground Δ1 should be adequate, however, a local earth rod may be needed. If this ground connection is not made, published specifications may not be achieved, and electrostatic damage to circuit components may result. Supply wiring terminals are designed for 14 AWG conductors. Supply should be protected by an external 15 A branch circuit. CSA certified ½ inch liquid tight fittings should be used to maintain the IP66 rating.

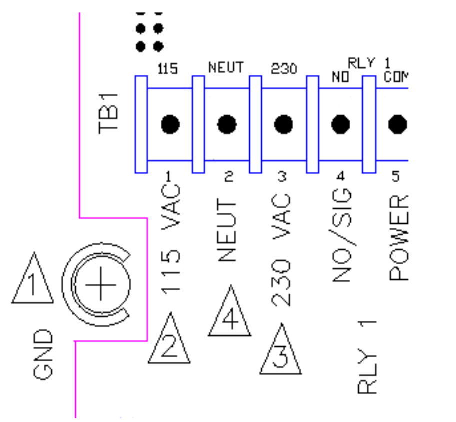


Illustration 1: Power wiring

Caution: *Bonding between conduit connections is not automatic and must be provided as part of the installation.*

Caution: *Signal wiring must be rated at least 300V. The basic wiring scheme for all IC Controls sensors is shown on D5080298. For relay, or 4-20 mA output wiring refer to D5060288. For RS485 Dwg D5100301.*

There are five 2.0 cm (0.875 in) holes suitable for 0.5 inch conduit in the bottom of the enclosure. IC Controls recommends that AC line power be brought in through the rear left-hand entrance and the right entrance for alarms; 4 mA to 20 mA and digital low voltage wiring be brought in through the center entrance, and sensor leads be passed through the front entrances. Conduit should be flexible, watertight, and sealed using a gasket to maintain environmental integrity within the instrument enclosure.

Sensor Mounting and Wiring

Conductivity based sensors require drive from the analyzer. Therefore it is recommended that the sensor be located as near as possible to the conductivity analyzer, to minimize any effects of drive signal loss or noise interference. Alternative use 400 junction box and conductivity extension cable plus consideration of drive signal levels and total distance be involved as part of the installation process. Flow-through sensors can be in any orientation but should be mounted tip down at an angle anywhere from 15 degrees above horizontal to vertical. 15 degrees above horizontal is best because air bubbles will rise to the top and debris will sink, both bypassing the sensor.

Submersion sensors should not be mounted where a lot of air bubbles rise in the tank, they may cause spikes in the sensor readout. If an air bubble is allowed to lodge in the sensing area, electrical continuity between the sensors may be disrupted.

Sensor Wiring

The analyzer has terminals for direct sensor connection input, plus can be used with a 400 conductivity J-box for long lead lengths (conductivity extension cable plus consideration of drive signal levels and total distance be involved as part of the installation process, Dwg D5080298).

1) Popular: Direct connection is convenient and lower cost; if the installation is relatively clean and dry, the conductivity sensor is close by, and the user wants to use the sensor cable (no conduit). It results in an open conduit hole (or cable grommet) in the bottom of the housing.
2) Better: For installation quality maintaining the IP66/NEMA 4X rating, low maintenance and convenience, use a conduit connected 400 J-Box, and keep the sensor close to the 400 J-Box.
3) Best: For long lead lengths, installation quality, lowest maintenance and user convenience, use a conduit-connected 400 J-Box, and keep the sensor close to the 400 J-Box.

Illustration 3 shows an analyzer with a Conductivity sensor direct connected and illustration 2 shows a remote model 400 J-Box hookup.

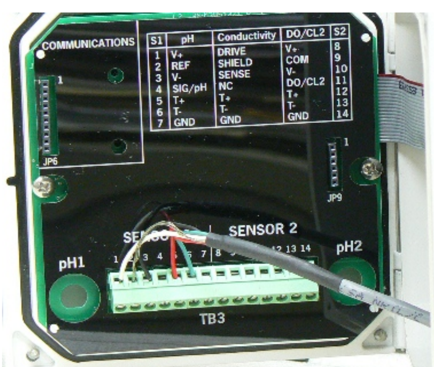


Illustration 3: direct connected input

Illustration 2: Model 400 J-Box, Dwg D5080298

Direct Connecting a Conductivity sensor

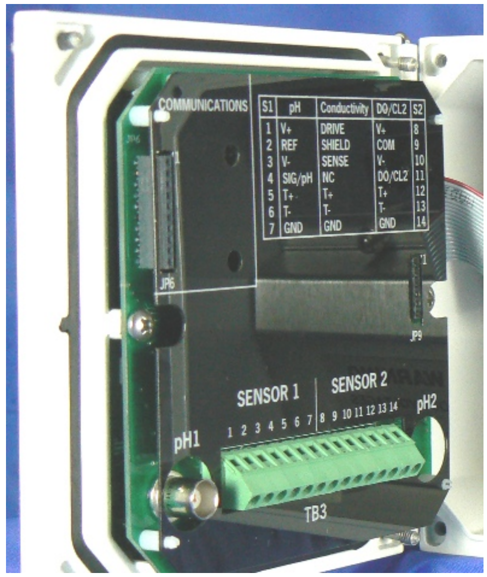


Illustration 4: sensor connection

The 210-C conductivity analyzer can be direct wired.

Connect the sensor to the analyzer as shown in illustration 4. Insert the sensor lead tinned ends into the terminals Drive TB3-1 (White), Shield * TB3-2 (Clear), & Sense TB3-3 (Black); plus TC into, T^+ TB3-5 (Red) & T^- TB3-6 (Green). * Do not tie shield to AC Ground, D5080298.

All low-level sensor signals should be run through a dedicated conduit. Take care to route all signal wiring away from AC power lines in order to minimize unwanted electrical interference. When installing sensor cable in conduit, use caution to avoid scraping or cutting the cable insulation - the resulting short of the cable's internal drive shield will cause errors. Avoid twisting the sensor lead to minimize potential for broken wires. Ensure the sensor connections are clean and tight.

Instrument Shop Test Startup

1. Wire power for either 115 or 230 VAC, **verify power supply and 210-C wire connections are for the same voltage and a good ground is connected,** then power the analyzer. Allow 30 minutes warm-up time for electronics to stabilize.
2. Hook up a 1.0/cm constant conductivity sensor and remove orange protective cap. D5080298
3. If the conductivity sensor is hot or cold allow several hours for it to equilibrate to the shop temperature. Calibrations done with a sensor temperature difference from ambient will include a temperature dependent conductivity error that will be added/subtracted from all future readings.
4. To check for general performance, use the sensor in air. The conductivity should read approximately 0.
5. Using the arrow keys, go to "Calibrate", then "Air zero", to refine the zero. Air Zero calibration will compensate for any signal effects along the sensor cabling.
6. Next run a span (span) calibration with 1000 µS/cm standard.
7. Using the arrow keys, go to "Calibrate", then "select standard", then "1000 µS/cm".
8. Rinse the conductivity sensor in 1000 µS/cm standard and then place in 1000 µS/cm standard.
9. The 210-C should come up reading close to 1000 µS/cm .
10. Perform a standardize calibration │start calibration│ for a reading close to 1000 µS/cm.
11. For the 4 mA to 20 mA output, set high limit and low limit; output characterization curve if desired.
12. Set preference for temperature units as│ metric│ (°C) or│imperial│ (°F) in │ configuration │ units.
13. Configure relays/alarms to set maximum and minimum temperature for the sensor in use, or other needs.
14. Install password security, if desired.
15. Before placing the analyzer into operation, verify settings to ensure that they coincide with the intended setup. Refer to *Appendix C: Default Settings* section. If needed go to configure and make changes.
16. The unit is now ready for field installation.

Model 210-C can be used with a 400 J-Box

When sensor to analyzer separation distance is over 30 meters (100 feet) the conductivity signal can disappear, so IC Controls recommends use of a 400 J-Box with special cable to protect the signal. In noisy industrial environments it is a good practice to use a 400 J-Box and extension cable on installations over 10 meters (30 feet).

Refer to drawing D5080298 for J-Box wiring. This drawing provides all the markings and color codes needed for proper connections to the conductivity sensor, and temperature compensator. At the analyzer, connect the inputs: Conductivity sensor 1 TB3 1 to 7
Conductivity sensor 2 TB3 8 to 14

NOTICE OF COMPLIANCE

NOTICE OF COMPLIANCE

US

This meter may generate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type-tested and found to comply with the limits for a Class A computing device in accordance with specifications in Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in an industrial installation. However, there is no guarantee that interference will not occur in a particular installation. If the meter does cause interference to radio or television reception, which can be determined by turning the unit off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

* Reorient the receiving antenna
* Relocate the meter with respect to the receiver
* Move the meter away from the receiver
* Plug the meter into a different outlet so that the meter and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: *How to Identify and Resolve Radio-TV Interference Problems*. This booklet is available from the U.S. Government Printing Office, Washington, D.C., 20402. Stock No. 004-000-00345-4.

CANADA

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numérique n' émet pas de bruits radioélectriques depassant les limites applicables aux appareils numériques (de la class A) prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

STARTUP

If the analyzer has been installed, all that is required is to attach the sensor to the analyzer and then turn on the power. If the analyzer is new and has not been installed, then follow the procedures described in *Installation,* you may also want to check the section *Configuration of Program* before mounting. Mounting and wiring procedures for new installations vary with equipment options — refer to drawing section for instructions.

The startup procedure will display model number and IC Controls identity while it initializes the analyzer program, performs error checks and then proceed to function normally. All program settings, calibration settings, and default values will have been retained by the analyzer in memory.

Illustration 5: Initialization Display

Analyzer Startup Test

1. Install the analyzer according to the instructions in the *Installation* section.
   Verify power supply has been wired for proper voltage and instrument is suitably grounded.
2. Turn on flow at sample inlet or insert sensor in sample.
3. Power up the analyzer.
4. The startup procedure will run in the background performing electronics and memory tests.
5. If the analyzer passes all the tests then the hardware is functioning properly and the analyzer will proceed to display the conductivity reading.
6. If the analyzer sample displays [overflow], this indicates that the input is off-scale. The message line at the bottom of the display will indicate the type of fault. The fault alarm will flash as long as an input is off-scale. The error can indicate that the sensor is not in solution, is off-scale, or is not connected properly.
7. After completing the above steps, the analyzer is now in normal operational mode. Analyzer settings and parameters can be viewed and/or changed at any time using the keypad.

Start-up Settings

The 210-C analyzer default assumes a properly functioning sensor with no zero. Refer to *Appendix D* for a list of all analyzer default settings.

IC Controls recommends a full chemical calibration after initial startup.

Changing Settings

Analyzer settings and parameters can be viewed and/or changed at any time. Refer to the illustrations starting on the next page. The program settings can be changed by the user; however, if security has been set you may need a password to make changes. Results areas are view-only menus.

EASY MENU

Remembers Where You Were

The analyzer remembers where *SAMPLE* is.

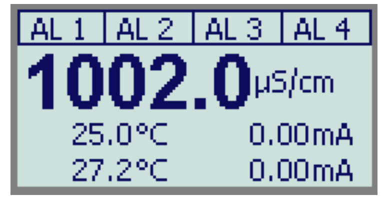


Illustration 6: Sample Display

The "large digit" *SAMPLE* display is home base or default display for the program. The program also remembers which menu selections were used last and loops around making it very easy to use. The menu can be accessed using the arrow keys to find any parameter then press *SAMPLE* to return to the displayed reading. Then using the *Right* arrow key return to exactly where you were before you pressed sample.

Home Base: Press Sample

From anywhere in the menu, the *SAMPLE* key can be used to return to displaying conductivity. The program will safely abort whatever it was doing at the time and return to displaying the conductivity reading.

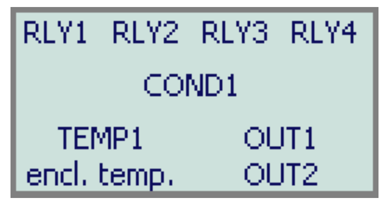


Illustration 7: Measurement Identification

Identification of the measurement source on the display can be viewed by pressing | ENTER. The analyzer's inputs, conductivity and temperature plus an extra input, by default arranged underneath each other at the left-hand side of the display. The analyzer's outputs, 4 to 20 number 1 and 2, are by default arranged underneath each other at the right-hand side of the display. Other possible inputs are Conductivity or case temperature or leave blank, or with dual input version Conductivity2 and temperature 2.

Display Features

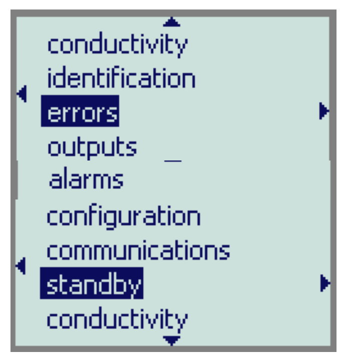


Illustration 8: Main menu

1. The analyzer has a built-in timer which returns the program to sample display screen if no key is pressed for 15 minutes. This time-out has the same effect as pressing the *SAMPLE* key. If security has been enabled, then the time-out will change the access level back to 0 or 1 automatically which gives the user read-only access.
2. The display has an instant "error or alarm" report feature. When errors or alarms occur the bottom line becomes a message line. Errors can be acknowledged and disappear from the message line, but can be viewed with one press of the *Up* or *Down* key.
3. Each display position can be turned off and thereby disappear from the screen if it is turned off in the configuration menu. To change the display configuration, use the *Right* key then the *Up* or *Down* key until [configuration] is displayed. Select [sample display], [position #], [signal], to show the signal source; then press *ENTER*, then select [leave blank] and press *ENTER* again to clear that section of the display.
4. The user can field-customize the *SAMPLE* display to show any of the measurements in any of the 5 locations. To change the display configuration, use the *Right* key then the *Up* or *Down* key until [configuration] etc as in 3, select from list and press *ENTER* again to install new signal.
5. For each signal the desired unit can be selected. Also it is possible to display the same signal in more than one position using different units.

Arrow Keys

The four arrow keys on the keypad are used to move around in the menu.

Example:
Press *SAMPLE* to make sure that display is at home base. Press the *Right* arrow key. Four of the prompts in the column starting with [Conductivity] will be displayed. Use the *Up* or *Down* arrow keys to select the prompt above or below. If the prompt at the top or the bottom is displayed, the program will loop around. Press the *Up* or *Down* key until [alarms] is displayed. Press the *Left* key to return to the sample display. Press the *Right* key again and [alarms] will be displayed.

AUTO and MANUAL Keys

The AUTO and MANUAL keys are used to implement the alarm override feature on analyzers that do not use the PID option. Refer to the *Alarm Override* heading in the *Alarm Functions* section for a description of these key functions.

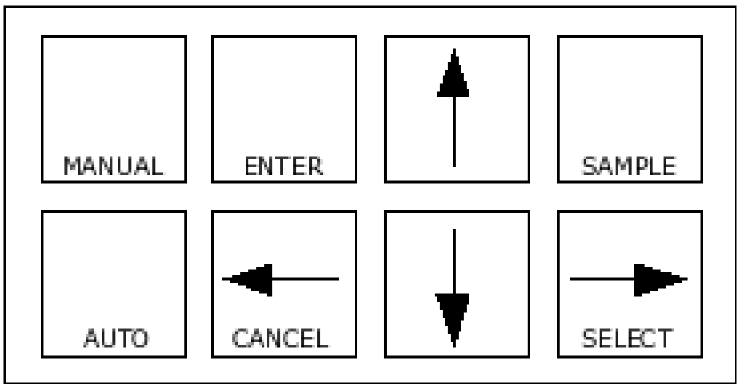


Illustration 9: Analyzer keypad

Standby Mode

In standby, the alarms will not function and the 4 mA to 20 mA outputs will go to 4.00 mA. When *SAMPLE* is pressed, the inputs will show [standby].

The analyzer will not resume normal operations until the analyzer is taken out of standby. While in standby, the entire menu and all of the settings are accessible to the operator as before. None of the settings will take effect until the analyzer is returned to normal operation.

The standby feature is protected by security level 2.

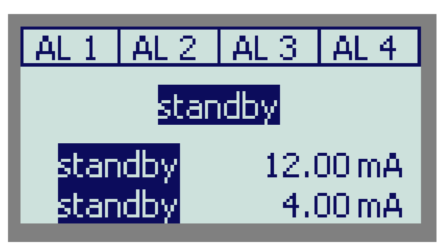


Illustration 10: Standby display

Temperature, Metric °C or Imperial °F

By default, the analyzer will use metric units. This means that temperature will be displayed using degrees Celsius and that the identifier will be °C. The analyzer can also use imperial units. For imperial units, temperature will be displayed using degrees Fahrenheit °F.

To select imperial units for the analyzer, from the │configuration│menu select │unit│, then go into edit mode and change the │metric│ setting to │imperial│.

EDIT MODE

Edit mode is used to change a numeric value or to select between different options.

Editing by Selecting a Setting

Editing a value is like picking an option from a list; only one item on the list can be seen at a time. To change the setting, press *ENTER* to go into edit mode. The display will start blinking. Use the↑*Up* or ↓*Down* arrow key to switch between the possible options and then press *ENTER* again to accept the new setting and leave edit mode.

Example*:* Turn alarm 1 off.

From the menu, select │alarms │alarm 1 │on/off│. The analyzer will now display either │on│or │off│, which are the two choices. To change the setting, press *ENTER* to go into edit mode. The display will start │blinking│. Use the ↑*Up* or ↓*Down* arrow key to switch between the possible options. When │off│ is displayed, press *ENTER* again to accept the new setting and leave edit mode.

Editing a Numeric Value

Numeric values such as an alarm set-point are adjusted by going into edit mode, identified by a blinking cursor under the digits, and then adjusting each digit until the new value is displayed. Use the ←*Left* and →*Right* keys to move the blinking cursor between digits and use the ↑*Up* and ↓*Down* keys to individually adjust each digit.

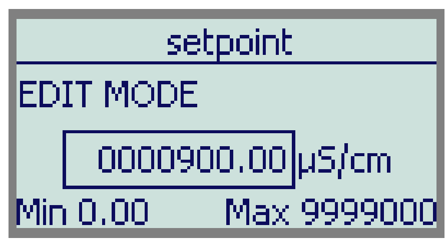
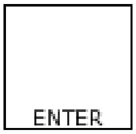


Illustration 11: Editing Numeric Value

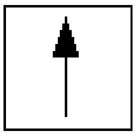
When *ENTER* is pressed to go into edit mode, three things will happen. First, the last digit will start │blinking│ to show that this digit can be changed. Second, any blank spaces will change to zeros. Now each digit can be accessed. Third, Min and Max values will appear.

Press *ENTER* again to leave edit mode. Before the new value is changed, the analyzer will check the new value to make sure that it is within range. If the new value is lower than the lowest value allowed for that frame then the analyzer will use the lowest allowable value instead of the new value entered. Likewise, if the new value entered is higher than allowable then the highest allowable value is used instead. The analyzer will display whatever value it has stored in memory.

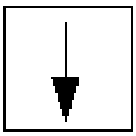
Summary of Key Functions in Edit Mode



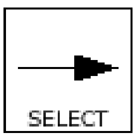
Enters edit mode. The entire display or a single digit will blink to indicate that the analyzer is in edit mode. Press the *ENTER* key again to leave edit mode and accept the new value.



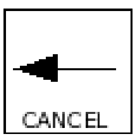
Adjusts blinking digit upward or selects the previous item from the list. If a 9 is displayed then the digit will loop around to show 0.



Adjusts blinking digit downward or selects the next item from the list. If a 0 is displayed then the digit will loop around to show 9.



Numeric values only: move to the right one digit. If blinking is already at last digit, the display will loop to the +/- sign on the left.



Numeric values: move left one digit. If blinking is at the +/- sign then blinking goes to last character.
Settings: restore the initial value if it was changed. Otherwise leaves edit mode without doing anything.

Illustration 12: Edit keys

CONDUCTIVITY MEASUREMENT

What is conductivity?

Electrical conductivity is a measure of the ability of a solution to carry a current. Current flow in liquids differs from that in metal conductors in that electrons cannot flow freely, but must be carried by ions. Ions are formed when a solid such as salt is dissolved in a liquid to form electrical components having opposite electrical charges. For example, sodium chloride separates to form Na^+ and Cl^- ions. All ions present in the solutions contribute to the current flowing through the sensor and therefore, contribute to the conductivity measurement. Electrical conductivity can therefore be used as a measure of the concentration of ionizable solutes present in the sample.

Conductivity Units

Electrical resistivity uses the unit of ohm meter or Ω·m. Electrical conductivity is the reciprocal of electrical resistivity. Rather than use the units $\Omega^{-1}\cdot m^{-1}$, in 1971 the unit "siemens" (symbolized by the capital letter S) was adopted by the General Conference on Weights and Measures as an SI derived unit. The unit for electrical conductivity becomes siemens per meter. The siemens unit is named after Werner von Siemens, the 19th century German inventor and entrepreneur in the area of electrical engineering.

MEASUREMENT	***UNITS***
resistance	ohm
conductance	siemens, mho
resistivity	ohm · m
conductivity	siemens / m

Table 1 Electrical conductivity measuring units

North American practice used to see the use of unit mho/cm to measure conductivity, where the unit "mho" is a reciprocal ohm. The word "mho" is the word "ohm" spelled backwards. Because of the history of conductivity measurements in micromho/cm and millimho/cm, it is common to see these measurements translated to microsiemens/cm and millisiemens/cm because there is a one-to-one correspondence between these units.

What is a Cell Constant?

The volume of the liquid between the electrodes must be exact so that the analyzer can determine how much current will flow through a known amount of liquid. The controlled volume of a conductivity sensor is referred to as its *cell constant*.

A cell constant of 1.0/cm describes a cell with an enclosed volume equal to 1.0 cm^3. A cell constant of 1.0/cm is the easiest constant to work with as conductivity describes the amount of current flow per centimeter.

A cell constant is usually chosen to produce a steady flow of current between the two electrodes. Moderate current and voltage levels can usually be achieved by selecting the proper cell constant. A high cell constant is used for solutions with high conductivity, and a low cell constant is used for solutions with low conductivities.

Measurement Range

The 210-C conductivity analyzer is an auto-ranging analyzer. The input circuit has four ranges and will switch automatically to avoid going off-scale.

The range, e.g. 0 µS/cm to 10,000 µS/cm, is determined by the gain used by the analyzer plus the cell constant of the sensor. Ranges in this manual are based on a cell constant of 1.0/cm.

The analyzer gains are 100, 1,000, 10,000, and 100,000. Table 2, Guide to Cell Constants and their Usable Ranges, indicates maximums for the ranges using available cell constants.

Manual Range Switching

By default, the analyzer is in auto-range mode. To change to manual mode, go to configuration menu; |configuration | inputs | conductivity | manual/auto | Enter; then select | manual | and press Enter to install it. The range can now be manually adjusted by changing the setting in | configuration | inputs | conductivity | range |.

Cell Constant and Range

Changing the cell constant to 0.01/cm, achieves ranges of 1 µS/cm, 10 µS/cm, 100 µS/cm, and 1,000 µS/cm; while 20/cm, achieves 2,000 µS/cm, 20,000 µS/cm, 200,000 µS/cm, and 2,000,000 µS/cm.

If the sensor is replaced with a sensor having a different cell constant, the cell constant needs to be changed in memory. Select | conductivity | cell constant | → | Enter; then ↑↓ edit the cell constant. The program will allow cell constants between 0.001/cm and 99.99/cm to be entered.

Guide to Cell Constant Usable Ranges

CELL CONSTANT cm^{-1}	*DESIGN RANGE* *µS/cm*	*LOWEST RANGE* *µS/cm*	*HIGH RANGE* *µS/cm*	*OVER-RANGE ** *µS/cm*
0.01	0 to 10	0 to 1	0 to 100	0 to 1 000*
0.02	0 to 20	0 to 2	0 to 200	0 to 2 000*
0.1	0 to 100	0 to 10	0 to 1 000	0 to 10 000*
0.2	0 to 200	0 to 20	0 to 2 000	0 to 20 000*
0.5	0 to 500	0 to 50	0 to 5 000	0 to 50 000*
1.0	0 to 1 000	0 to 100	0 to 10 000	0 to 100 000*
2.0	0 to 2 000	0 to 200	0 to 20 000	0 to 200 000*
5.0	0 to 5 000	0 to 500	0 to 50 000	0 to 500 000*
10.0	0 to 10 000	0 to 1 000	0 to 100 000	0 to 1 000 000*
20.0	0 to 20 000	0 to 2 000	0 to 200 000	0 to 1 000 000*
50.0	0 to 50 000	0 to 5 000	0 to 500 000	0 to 1 000 000*

* *Note:* use over-range with caution. Some sensor designs may limit when used on over-range and may not reach the maximum shown.

Table 2 Cell constant usable ranges

CONDUCTIVITY CALIBRATION

The conductivity loop is usually calibrated using standard conductivity solutions. Alternatively, grab-sample analysis on a previously calibrated laboratory reference conductivity meter can be used.

Overall system accuracy is maintained by calibrating the sensor and analyzer together in a standard close to the expected sample concentration. Calibration determines the effective cell constant of the conductivity sensor. The cell constant is affected by the shape of the sensing surface and electrode surface characteristics. The effective cell constant will change over time as deposits form, and anything else that affects either the controlled volume or the effective electrode surface area.

The 210-C features an **output hold**. Output hold goes into effect as soon as a calibration is started. The output hold will stay in effect until;

a) *SAMPLE* key is pressed

b) no key is pressed for 15 minutes

c) the power is interrupted and analyzer reboots

The output hold feature avoids false alarms and erratic signal output caused by a routine calibration.

Selecting a Standard

Conductivity standards provide the simplest and most accurate method for calibrating the analyzer. The analyzer has been programmed to recognize the standards most commonly used for calibration. Simply select the standard you are using at | conductivity | calibrate | select standard | → | Enter; then ↑↓ to select the standard from the list, then Enter to install it. The analyzer will use the correct temperature adjusted value for the standard.

standards recognized by the 210-C are:

100 µS/cm Conductivity standard, part number A1100161
1000 µS/cm Conductivity standard, part number A1100162
146.96 µS/cm ASTM Conductivity standard D, part number A1100232
1408.8 µS/cm ASTM Conductivity standard C, part number A1100231
12,856 µS/cm ASTM Conductivity standard B, part number A1100230
111,342 µS/cm ASTM Conductivity standard A, part number A1100229
Refer to *Appendix E* for ordering information.

Temperature dependence of standards

To achieve greater accuracy, the temperature compensated values for the conductivity standards are calculated by the analyzer. If manual temperature compensation has been selected, then the manual temperature compensation set-point is used as the standard temperature.

Other standards or custom standards

If a "custom value" conductivity standard is to be used, press *SELECT* [Cal] *SELECT* [100], then *ENTER* to edit to the known value. Values entered this way should be the known value at the current temperature as they are not temperature-compensated by the analyzer.

Output Hold

The 210-C features an automatic **output hold**. The output hold feature avoids false alarms and erratic signal output caused by a routine calibration. Output hold goes into effect as soon as *SELECT* is pressed with [calibrate] displayed. The default output hold is at the value on the moment that *SELECT* is pressed, however it can be edited. Edited output hold values are maintained as long as you are in the calibrate section of the menu. On return to sample the output hold is released and the outputs again track the measurement.

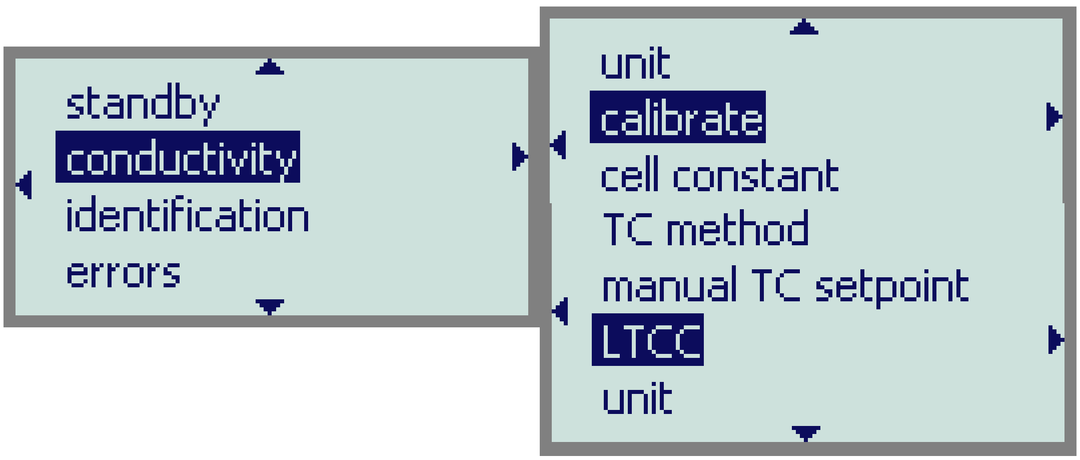


Illustration 13: Conductivity menu

Air-Zero Calibration

It is not necessary to repeat an "Air" calibration every time a regular calibration is performed.

An air calibration should be performed anytime a new sensor is installed. When a sensor is in air, the conductivity measured by the sensor is expected to be zero. It is not uncommon to find some small conductivity signal with the dry sensor in air or even with no sensor connected at all. This measurement may be attributed to background noise, lead wire pickup (antenna effect) or grounding problems. The air calibration is designed to subtract the small errors of this interference signal from the real measurement in order to give a true zero reading.

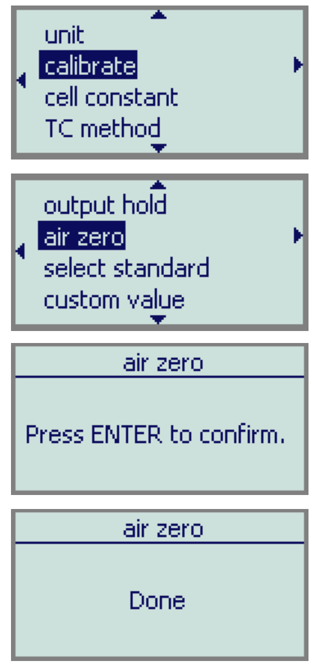


Illustration 14: Air-Zero standard

The sensor span value determined during the last standard calibration will continue to be used.

Press *SAMPLE* to display the Conductivity reading. Press *SELECT* to reach the first menu, then use the *Up* or *Down* arrow keys to display [calibrate].

Press *SELECT* again, then use the *Up* or *Down* arrow keys to display [air zero].

Press *SELECT* again to reach the next menu. We now need to ensure that the sensor is dry before zeroing.

Press the *SELECT* arrow, then when the sensor is ready to be calibrated press *ENTER* to start the zero calibration process. The calibration procedure is fully automatic.

The display will show [Done].

Press sample. With the sensor still dry and in air, the conductivity should read 0.00 µS/cm.

If the analyzer detects or suspects any problems during calibration, an error or a caution message will appear.

If a potential problem has been detected, (eg. there is a large zero error), then the analyzer has successfully completed calibration. The warning message simply informs the user that poor sensor performance is suspected.

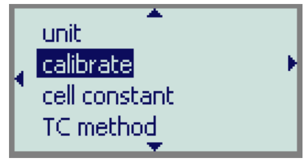
If an error has occurred, the one-point calibration was not successful. The analyzer has kept the values from the last successful calibration. Press any key to acknowledge the error. Take corrective action and retry the calibration. Example check wiring and that the sensor is dry before zeroing.

Press any key to resume normal operation after a warning or error message has appeared.

Calibrating – Using a Conductivity Standard

Calibrating the analyzer involves calculating both the zero and the sensor efficiency or span for a particular sensor. The sensor span will be calculated as a percentage.

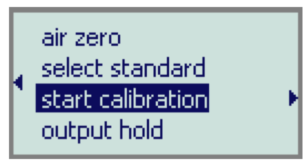
Calibrate the zero by first following the procedure Air-Zero Calibration.



Press *SAMPLE* to display the Conductivity reading. Press *SELECT* to reach the first menu, then use the *Up* or *Down* arrow keys to display [calibrate].

Press *SELECT* again, then use the *Up* or *Down* arrow keys to display [select standard].

Press *SELECT* again to reach the next menu. We now need to select a standard with which to calibrate the analyzer, press *ENTER* to access the list [we will use 1000 µS/cm for this example]. Press *ENTER* again to select it. You can use either a custom value, or one of the listed standards; 100 µS/cm, 1000 µS/cm, 146.96 µS/cm ASTM D, 1408.8 µS/cm ASTM C, 12,856 µS/cm ASTM B, 111,342 µS/cm ASTM A.



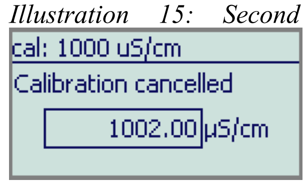
Place the sensor in the standard solution, then press the *LEFT* arrow, then use the *Up* or *Down* arrow keys to display [start calibration].

Press *SELECT* again to start the calibration process. The display will show the standard value selected and a flashing conductivity reading to indicate that the analyzer is reading conductivity and is testing for stability.

The calibration procedure is fully automatic from here on. As soon as the sensor has stabilized, the display will stop flashing, cal completed will appear , the sensor span will be calculated, and the new cell constant will be entered in memory.

It is, however, possible to override the analyzer. The *ENTER* key may be pressed before the sensor has stabilized, forcing the analyzer to calibrate using the current conductivity input.

Illustration 15: Second



Also, the calibration may be redone or started over at any time. Press *CANCEL* to display the selected standard, then *SELECT* to restart the calibration.

If the analyzer detects or suspects any problems during calibration, an error or a caution message will appear.

If a potential problem has been detected, a warning message is displayed, the analyzer has successfully completed calibration. The warning message simply informs the user that poor sensor performance is suspected.

If an error has occurred, the one-point calibration was not successful. The analyzer has kept the values from the last successful calibration. Press any key to acknowledge the error. The analyzer will return to the standard selection menu and display the selected standard, eg. [1000 µS/cm]. Take corrective action and retry the calibration.

Press any key to resume normal operation after a warning or error message has appeared.

Grab Sample Calibration

The grab sample calibration method provides an easy method of standardizing the Conductivity sensor without having to take the sensor out of the sample. The grab sample one-point calibration method requires the user to determine the actual Conductivity of the sample using a different method. For example, if the analyzer is reading 355 µS/cm conductivity and a laboratory analysis determines the actual Conductivity of the sample to be 342 µS/cm conductivity, the grab sample calibration method can be used to adjust the reading so that the previous 355 reading changes to 342 µS/cm Conductivity. The grab sample calibration described below uses the 0 from "Air-Zero calibration".

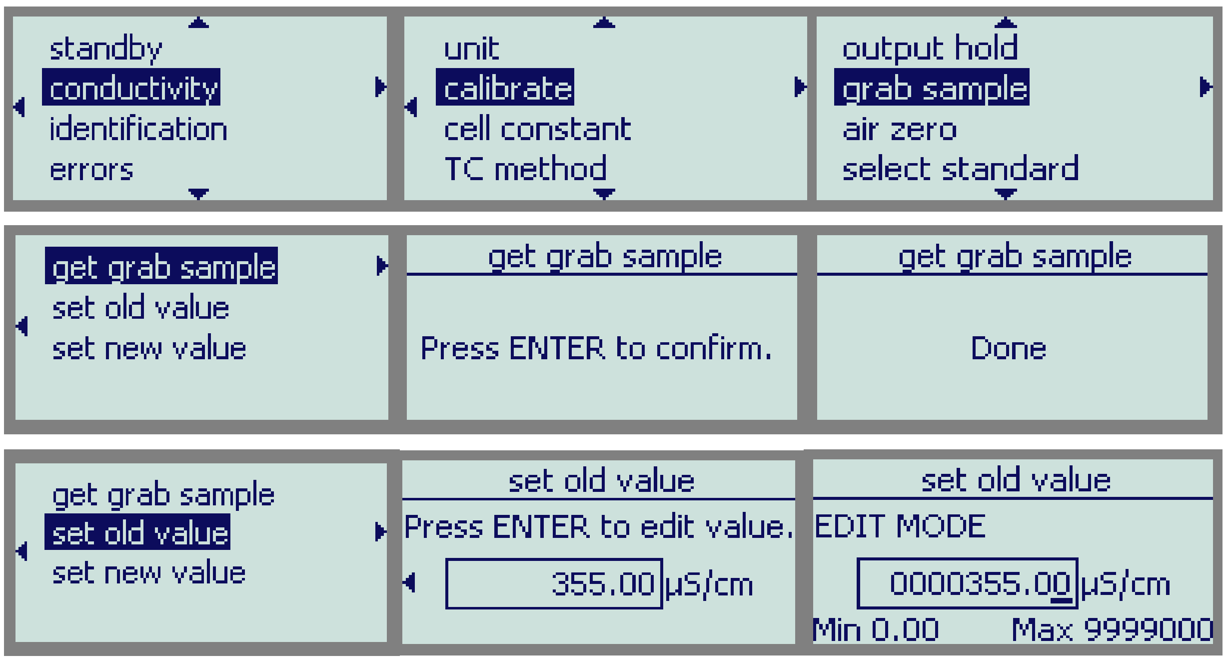


Illustration 16: Grab sample calibration menu

When the grab sample calibration method is used, it is the responsibility of the user to ensure that the grab sample taken and the conductivity value recorded for it (the "OLD" value) are accurate. The analyzer will also accept the supplied new conductivity value as being accurate. The correctness of the one-point calibration using the grab sample method can be only as accurate as the values supplied to the analyzer by the operator.

1. Take a grab sample of the process which is representative of the solution being measured by the conductivity sensor.
2. The current Conductivity value is stored in memory by selecting ***conductivity | calibrate | grab sample | get grab sample*** from the prompts. Press ***ENTER*** at [Press Enter to confirm] at approximately the same time that the grab sample is taken. *It is important that the conductivity value recorded in memory represents the conductivity of the sample. This is easy to accomplish if the analyzer has a stable reading, but difficult if there is a lot of fluctuation in the conductivity reading.* This step can be repeated as often as necessary.
3. It is possible to view or even change the conductivity value recorded in memory.
   Select *conductivity* | *calibrate* | *grab sample* | ***set old value***, then edit if needed and press ***ENTER*** again.

4. Analyze the grab sample to determine the actual conductivity. **For maximum accuracy, it is necessary that the temperature of the sample is exactly the same as it was at the time the old value was recorded using “get grab sample”. A significantly different conductivity will result if there is a temperature difference.**

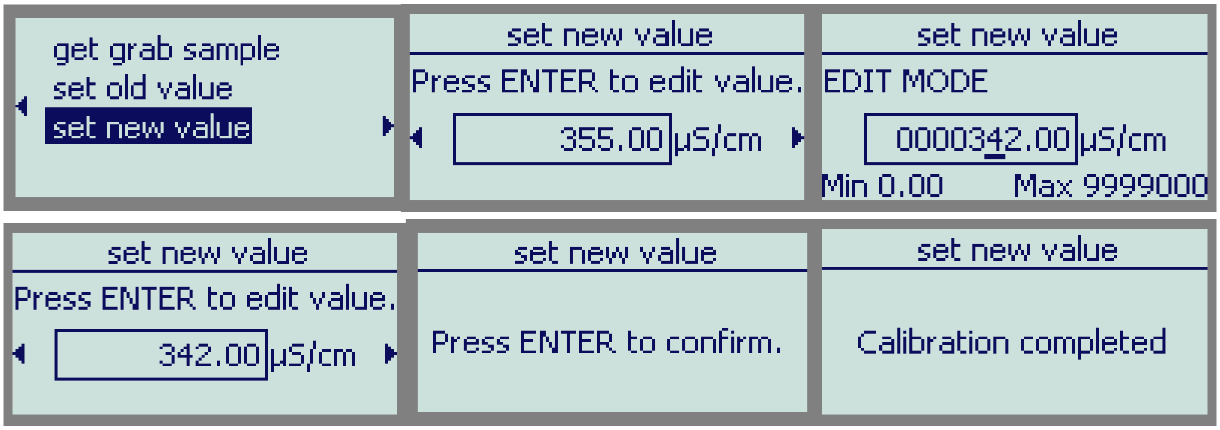


Illustration 17: Grab sample calibration finish

5. Select *conductivity, calibrate. grab sample,* ***set new value***, from the prompts. Edit the conductivity value shown and change it to the new conductivity value determined from the grab sample. Press *SELECT* and then press *ENTER* then adjust when the flashing numbers are displayed. Then press *ENTER* again finish the edit, then SELECT and at [Press ENTER to confirm] press *ENTER* again. The conductivity readings will be adjusted according to the difference between the old and new conductivity values, and **calibration completed** appears.
6. Press SAMPLE to return to displaying the process conductivity (freshly calibrated).

The error checking done for the grab sample calibration is similar to that done for a standard calibration. If the analyzer detects or suspects any problems during calibration, an error or a caution message will appear.

If a potential problem has been detected, a warning message is displayed, the analyzer has successfully completed calibration. The warning message simply informs the user that poor sensor performance is suspected.

If an error has occurred, the calibration was not successful. The analyzer has kept the values from the last successful calibration.

Press any key to resume normal operation after a warning or error message has appeared.

Selecting a standard

Conductivity standards provide the simplest and most accurate method for calibrating the 210-C analyzer and sensor. Generally it is best to select standards that place the measurement of interest somewhere between 10% and 90% of the value of the standard. By using Air-Calibration for 0 to establish the low end it becomes simple to select from the list of recognized standards to cover the high end. A double check at the low end can then confirm the calibration by using the next lower standard.

Depending on the chemical involved, the necessary temperature compensation will vary. The values change from approximately 1% to 3%. Acids typically are 1 to 1.6%, bases 1.8 to 2.2%, salts 2.2 to 3%. Therefore it is possible with a temperature difference of 25 degrees to get a 25% to 75% error.

Some chemicals that are frequently diluted for use have non-linear temperature compensation requirements. As a result, IC Controls has provided special program variations with TC curves in the memory for some common chemicals used in industry such as NaOH, H_2SO_4, HCl , and NaCl , that read out in % concentration. Also included are TDS, Total Dissolved Solids, resistivity, and very low (or condensate) conductivity or high purity water.

Caution: Allow lots of time for the standards and sensor to equilibrate to the same temperature. On line conductivity based sensors have significant mass that may hold heat (or cold) for hours. We suggest letting the sensor and standards equilibrate for 4 hours, before starting calibration.

To achieve greater accuracy calibrations, the 210-C analyzer has been programmed to accurately temperature compensate for any one of the 6 precision KCl based standards most commonly used; 100 µS/cm, 1 000 µS/cm, and 146.96 µS/cm ASTM D, 1408.8 µS/cm ASTM C, 12,856 µS/cm ASTM B, 111,342 µS/cm ASTM A, at 25 °C (77 °F). Simply place the sensor in the standard and the analyzer will use the correct temperature adjusted value for the standard.

Manual Temperature Compensation

If manual temperature compensation has been selected, then the manual temperature compensation set-point is used as the standard temperature. Manual temperature compensation depends on the user having the correct conductivity value of the standard being used at the temperature the user manually set, and that temperature being the equilibrated temperature of the sensor and the standard.

Other standards or custom standards

If a "custom value" conductivity standard is to be used, press | Calibrate | custom value| *SELECT* to get;

then *ENTER* to edit to the known value, then *ENTER* to install it. Values entered **should be the known value at the current temperature** as they are not temperature-compensated by the analyzer.

Temperature Compensated Standards recognized by the 210-C are:

100 µS/cm Conductivity standard, part number A1100161
1000 µS/cm Conductivity standard, part number A1100162
146.96 µS/cm ASTM Conductivity standard D, part number A1100232
1408.8 µS/cm ASTM Conductivity standard C, part number A1100231
12,856 µS/cm ASTM Conductivity standard B, part number A1100230
111,342 µS/cm ASTM Conductivity standard A, part number A1100229

Refer to *Appendix E* for ordering information.

Temperature Compensation (TC)

Ionic movement, and therefore conductivity measurement, is directly proportional to temperature. The effect is predictable and repeatable for most chemicals, although unique to each chemical. The effect is instantaneous and quite large, typically between a 1% to 3% change per degree Celsius, with reference to the value at 25 °C. Many industrial applications encounter fluctuating temperature and thus require automatic compensation. IC Controls' conductivity sensors include a temperature compensator built into the sensor.

The 210-C analyzer uses an *editable* linear temperature compensation method with a *default* setting of 2%/ °C. See below “TC for High Purity Water” or “Setting the Linear TC Constant” plus “Conductance Data for Commonly Used Chemicals” for some of the TC selections you can make. 2%/ °C is an average value commonly found in many water samples containing some dissolved solids. Over wide temperature spans, e.g. 0 °C to 100 °C, the temperature compensation factor often does not remain constant making it difficult to obtain a good value. If the temperature curve of the sample is known, set the linear TC constant to match the curve in the temperature range the analyzer will be measuring in.

Manual Compensation

If automatic temperature compensation is not available, manual temperature compensation may be used. If the temperature of the sample is constant, set the manual TC temperature to reflect the process temperature. If the process temperature varies or is unknown, the default temperature of 25 °C or 77 °F is normally used.

TC for High Purity Water

Pure Water selections include TDS (Total Dissolved Solids), Resistivity, and very low conductivity or high purity water.

Very low conductivity water or “high purity” water is highly temperature-dependent. The presence of trace impurities such as acids, salts, and bases each dramatically and uniquely affect the TC curve required. At low temperatures close to 0°C the change in conductivity is about 7% per degree Celsius.

ASTM 1125 TC Formula is the default curve implemented for high purity water in the 210-C analyzer, or you can also select the later curve published in *ULTRA PURE WATER* December, 1994. The temperature compensation of high-purity water also changes depending on the chemistry of the traces of salts or impurities present in it. To properly correct for this you should select the solute compensation algorithm that best matches the chemistry of the water you are measuring. Examples; a) Cation Demineralizer effluent application would use the Acidic algorithm, b) Boiler water with treatment byproduct ammonia would use the Basic algorithm, c) Mixed bed polisher product water with only traces of salts left would use the Neutral salt algorithm. The 210-C HPW default TC correction is the Pure Water Formula for ASTM 1125, with Chemical Solute Algorithm for NACl (in theory pure water is neutral). Both for high accuracy work and high purity water applications IC Controls suggests the user check the actual chemicals involved and change the solute selection setting if necessary.

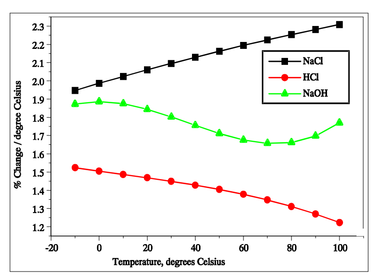


Illustration 18: Non-linear temperature

Setting the Linear TC Constant

Depending on the chemical involved, the value for temperature compensation will vary. The values change from approximately 1% to 3%. Table 3 is a general guide for typical applications.

The formula for the temperature-corrected conductivity value is:

$$conductivity = \frac{K_{cell}}{R} \frac{1}{1+(\alpha/100)*(T-25)}$$

where

conductivity is the temperature-compensated reading in siemens/cm;

K_{cell} = cell constant in cm^{-1} , typically in the range 0.01/cm to 50/cm;

R = measured resistance in ohms;

α = temperature compensation factor as % change per °C, typically close to 2.0;

T = current temperature in degrees Celsius.

The linear TC constant is normally displayed as percent change per degree Celsius. If the units for temperature are changed from °C to °F, then the linear TC constant automatically changes to percent change per degree Fahrenheit.

Some chemicals that are frequently diluted for use have non-linear temperature compensation requirements. As a result, IC Controls has provided pre-program versions with TC curves in the memory for some common chemicals used in industry such as NaOH, H_2SO_4, HCl, and NaCl, that read out in % concentration.

Substance	***% change per °C***
acids	1.0% to 1.6% per °C
bases	1.8% to 2.2% per °C
salts	2.2% to 3.0% per °C
neutral water	2.0% per °C

Table 3Typical temperature response

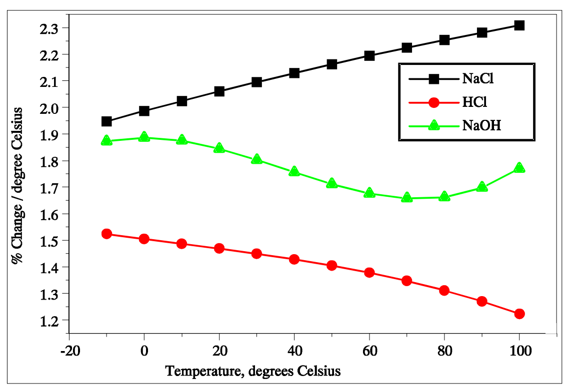


Illustration 19: Non-linear temperature

Conductance of Common Chemicals

Examples of conductance of various materials with changing concentration are shown below. Sodium Hydroxide (NaOH) and others also exhibit quite variable temperature related rates of concentration change, as seen on following page graphs. It is clear from the graph that both Sulfuric Acid, H_2SO_4, and Nitric Acid, HNO_3, have unusual 'conductivity' vs. '% by weight' relationships as well. It clearly shows that there is no "conductivity constant" between chemical combinations.

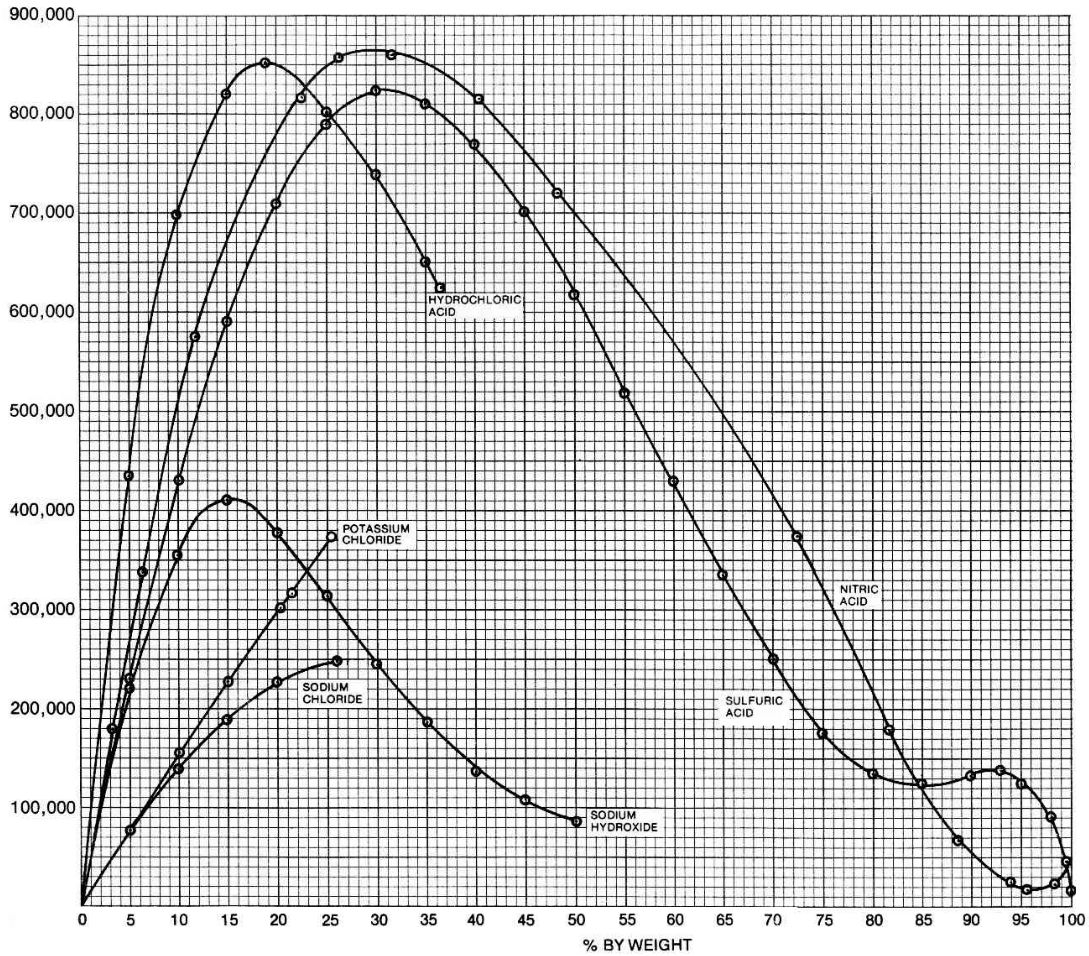


Illustration 20: Conductivity (µS/cm) vs. Chemical concentration

As a result, IC Controls model 210-C conductivity analyzer offers several program selections for measuring various common chemical solutions; NaOH, H_2SO_4, HCl, and NaCl.

Illustrations 21 to 22 on the following pages show the relationship between percent concentration and conductivity at various temperatures programmed into the 210-C for the available chemical concentration selections.

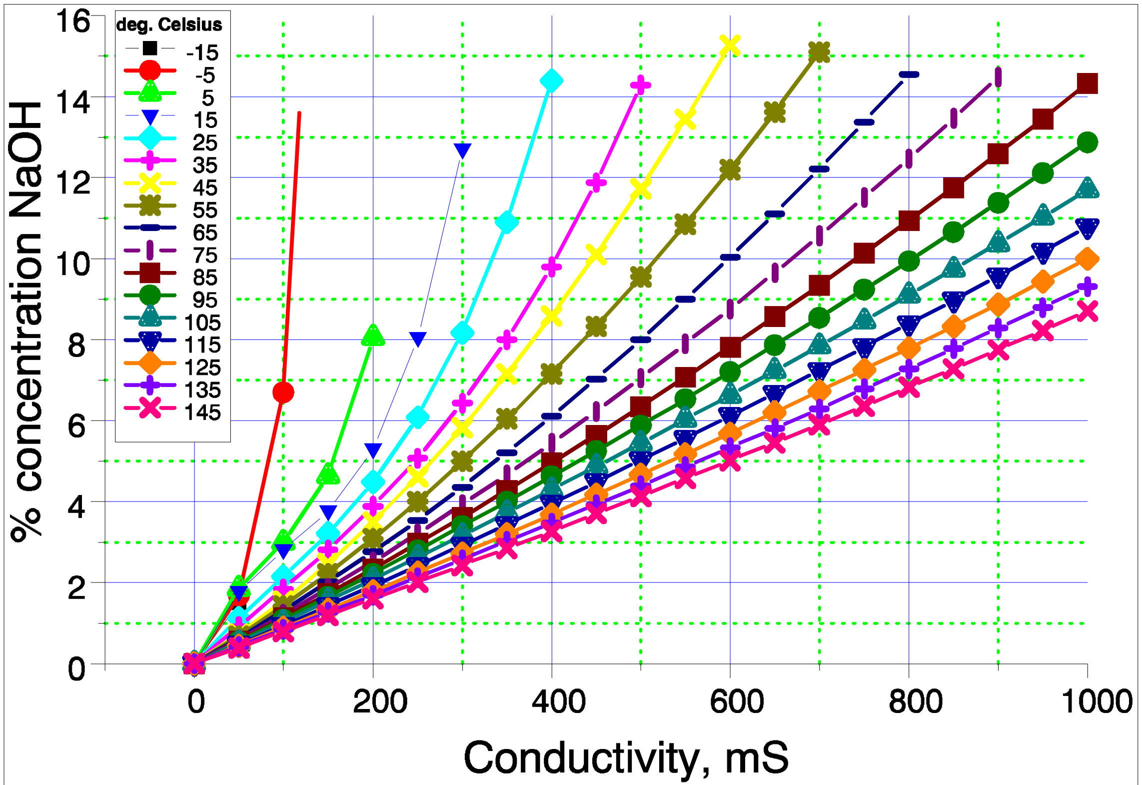


Illustration 21: ***NaOH*** *concentration vs.* ***NaOH*** *conductivity*

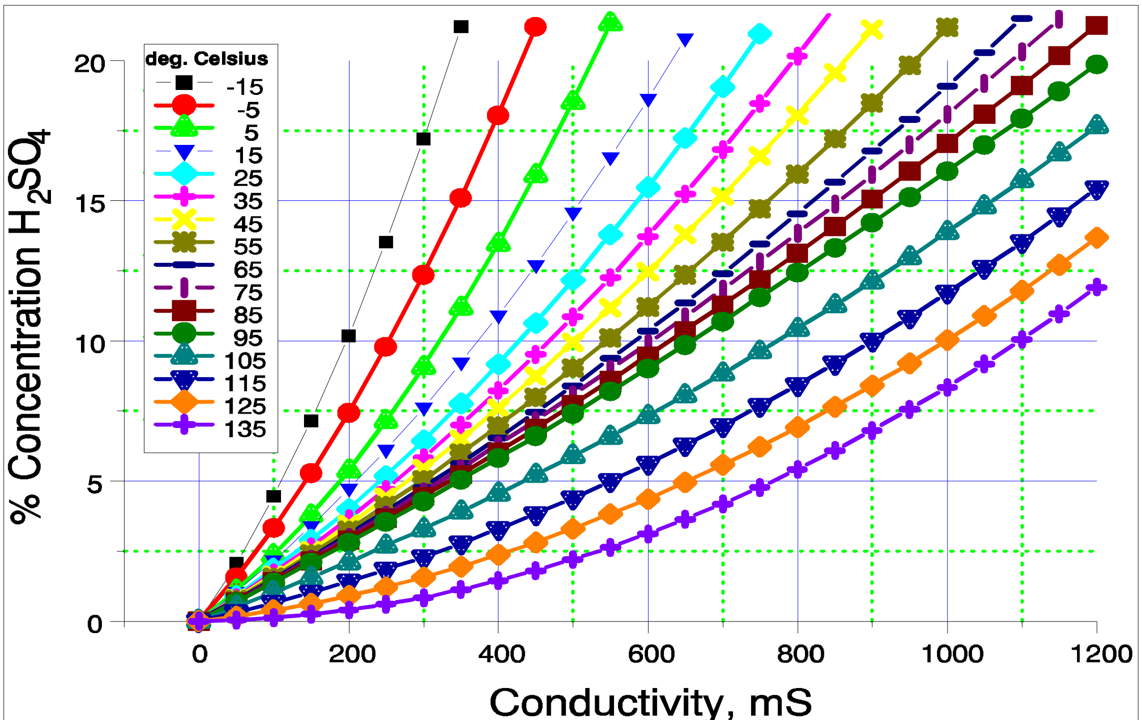


Illustration 22: $\boldsymbol{H_2SO_4}$ *concentration vs.* $\boldsymbol{H_2SO_4}$ *conductivity*

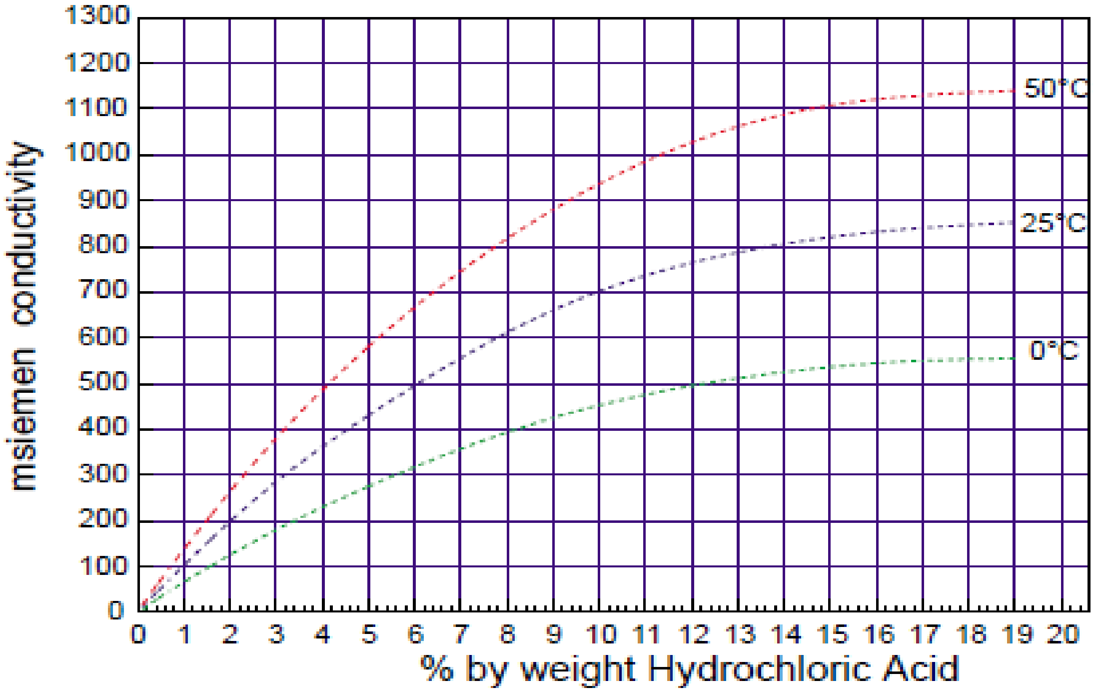


Illustration 23: ***HCl*** *conductivity vs. percent by weight* ***HCl***

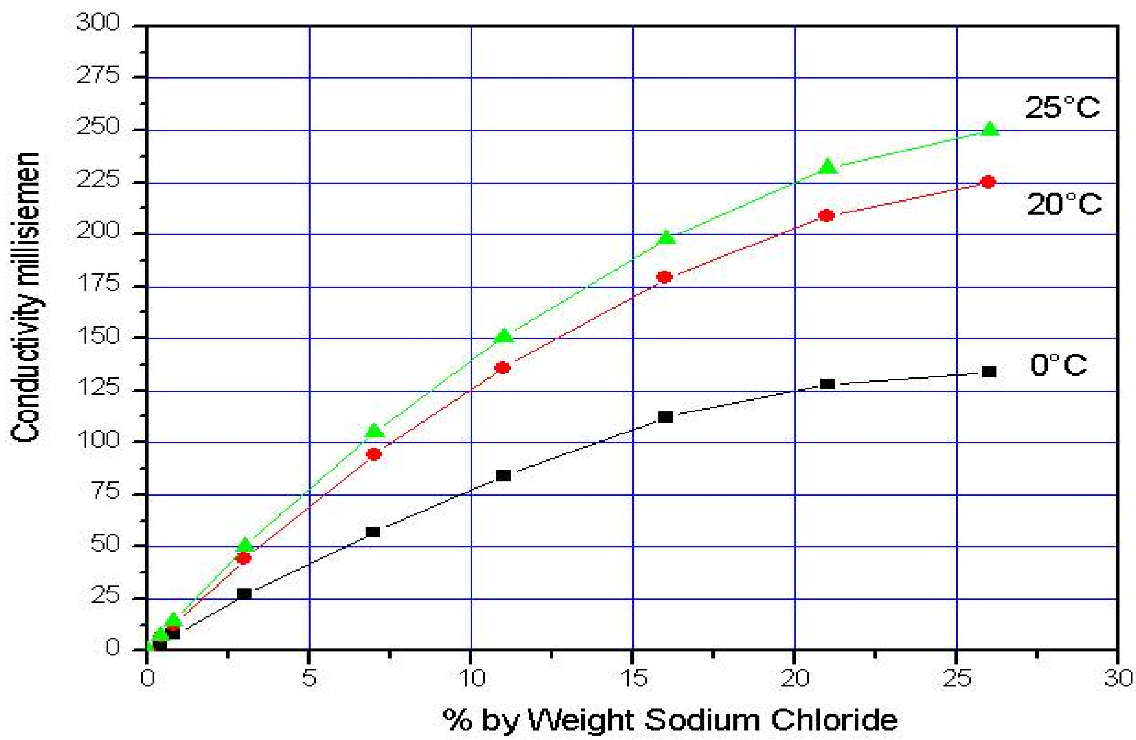


Illustration 24: ***NaCl*** *conductivity vs. percent by weight* ***NaCl***

SENSOR INSTRUCTIONS

Preparation for use

1. Moisten the sensor body with tap water and remove the lower plastic storage cap. Keep the storage cap for future use. Rinse the exposed conductivity elements with tap water.
2. For first time use, or after long term storage, immerse the tip of the sensor in a conductivity standard for 30 minutes. This wets the conductivity electrodes and prepares them for stable readings with test solutions.

NOTE: *IC Controls sensors are shipped dry. These sensors are often ready for use immediately with a typical accuracy of ± 2% conductivity without calibration. It is recommended that the sensor be soaked in standard plus calibrated using an appropriate conductivity standard in order to achieve optimal results.*

Calibration for Conductivity

Overall system accuracy is maintained by calibrating the sensor and analyzer together in a concentration close to the expected sample concentration. The cell and analyzer can generally be calibrated in two of four typical ranges: 0 µS/cm to 100 µS/cm, 0 µS/cm to 1 000 µS/cm, 0 µS/cm to 10 000 µS/cm, and 0 µS/cm to 100 000 µS/cm.

IC Controls has available conductivity calibration kits which conveniently package all necessary calibration supplies. These kits are available as P/N A1400051 (low conductivity; cell constants 0.01/cm and 0.02/cm), P/N A1400052 (medium conductivity; cell constants 0.1/cm to 5.0/cm) and P/N A1400053 (high conductivity; cell constants 10/cm to 50/cm).

Where to Perform Conductivity Calibrations

A suitable place to conduct a calibration is at a counter or bench with a sink in an instrument shop or laboratory. However, IC Controls' conductivity calibration kits are kept small and portable so that they can be taken to installation sites, together with a bucket of water (for cleaning/rinsing) and a rag or towel (for wiping/drying).

NIST Traceable

IC Controls QC's manufactured conductivity standards using NIST (National Institute of Standards and Technology) materials. Certificates of traceability to NIST are available as P/N A1900333.

Sensor Storage

Short term: Rinse the sensor electrodes in deionized water, allow to dry and store dry.

Long term: Rinse the sensor electrodes in deionized water, allow to dry, cover sensor tip with the plastic shipping cap and store dry.

Monthly Maintenance

A monthly maintenance check is recommended by grab sample calibration since the sensor is typically installed in the process and not easy to remove. Whenever possible, calibration using a conductivity standard close to the process conductivity value is suggested.

Follow the appropriate calibration procedure in *Conductivity Calibration* section. Keep a log of the cell constant at each monthly calibration.

Yearly Maintenance

Follow the monthly maintenance procedure. Check the cell constant log. If the cell constant has changed more than 20% over the past year, it may need to be chemically cleaned - follow the *Chemical Cleaning of Sensor* procedure.

O-rings and teflon-sealing ferrules should be replaced on conductivity sensor models 402, 403, 414, and 425.

The condition of electrical connections in 400 junction boxes should be examined for signs of corrosion and tight connections; replace if corroded.

The condition of the safety cables on model 403 sensors should be examined for rust or bent mounting screws. Replace if deterioration shows.

Restoring Sensor Response

Mechanical Cleaning of Sensor

The sensor will require cleaning if sludge, slime, or other tenacious deposits build up in the internal cavities of the sensor. Wherever possible, clean with a soft brush and detergent. General debris, oil films and non-tenacious deposits can be removed in this way.

For flat-surface sensors, use a potato brush and a beaker or bucket of water with a good liquid detergent. Take care not to scratch the electrode surfaces. Internal cavities of standard sensors can be brushed with a soft ¼ inch diameter brush.

Plastic body sensors should be washed using a soft cloth ensuring all wetted areas are cleaned. This will return their appearance to like-new condition and remove sites for buildups to occur.

Check the sensor calibration against a conductivity standard and calibrate if necessary. If the sensor is still not responding properly, proceed to the *Chemical Cleaning of Sensor* procedure, otherwise, return the sensor to the process.

Chemical Cleaning of Sensor

Obtain a supply of IC Controls' conductivity sensor cleaning and conditioning solution, P/N A1100005, or as available in conductivity chemical cleaning kit P/N A1400054.

NOTE 1: *A suitable place to do chemical cleaning is at a counter or bench with a laboratory sink with a chemical drain where waste is contained and treated before release.*

NOTE 2: *IC Controls' kits are kept small and portable so that they can be taken to installation sites, together with a bucket of water (for rinsing) and a rag or towel (for wiping/drying). Waste materials, particularly acid leftovers, should be returned to the laboratory sink for disposal.*

CAUTION: *Use extra caution when handling cleaning solution as it contains acid.* **Wear rubber gloves and adequate facial protection when handling acid.** *Follow all P/N A1100005 MSDS safety procedures.*

a) Set up the cleaning supplies where cleaning is to be performed. Lay out the sensor cleaning brush, syringe, cleaning and rinse solutions, plus the beakers and sensor if already at hand.
   NOTE: *Ensure your cleaning solution beaker is on a firm flat surface since it will contain acid.*

b) Remove the conductivity sensor from the process and examine it for deposits. Use the sensor cleaning brush with tap water to loosen and flush away any deposits within the cell measurement area. Detergent can be added to remove oil films and non-tenacious deposits. Hard scales and other tenacious deposits may require chemical cleaning.

c) **CHEMICAL CLEANING -** Fill a beaker ¾ full of cleaning and conditioning solution P/NA1100005, or for flow-through sensors with internal passages, seal one end to form a container inside the sensor body.

d) Lower the conductivity cell into the center of the beaker until the top hole is submerged, or pour the solution in until the flow sensor is full.

e) Keep removing and re-immersing the sensor until the sensor electrodes appear clean. Stubborn deposits can be worked on with the brush and syringe to squirt cleaner into hard to reach areas.
CAUTION: *Use great care when brushing and squirting acid*. **Wear rubber gloves and facial protection.**

f) Rinse the cleaned sensor thoroughly in tap water and squirt with deionized water to rinse before calibrating.

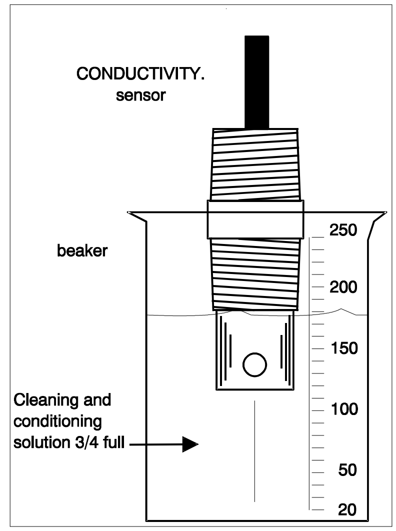


Illustration 25: Chemical cleaning

g) Check the sensor against a conductivity standard near full scale. If the sensor is still not developing the proper cell constant ± 5% (or reading near the standard value), clean again, proceed to troubleshoot or replace the sensor.

h) A clean, rinsed and dried conductivity sensor should read near zero in air. If it does not, troubleshoot the sensor, wiring, and analyzer.

If the sensor cannot be returned to good condition, it may need to be replaced. The cell constant, as calculated by the analyzer, should be within 25% of the original or intended value stamped on the sensor.

NOTE: *If none of the above procedures succeed in restoring your sensor response, it is near the end of its useful life and should be replaced.*

Alternatively, available acids can be used such as nitric acid, hydrochloric acid, or sulphuric acid. Nitric acid is preferred as it has no chlorides to corrode stainless steel. Acid concentrations between 0.5% acid and 10.0% acid (approximately 50% dilution of concentrated acid) can typically be used, depending on the severity of the application.

ERROR MESSAGES

Detected errors and/or cautions are displayed by the analyzer. From the main menu use the ↑ or ↓ keys to display error/caution messages. If there are no error or caution messages, [no unacknowledged errors] will be displayed, otherwise scroll through the error list using the *Up* and *Down* arrow keys.

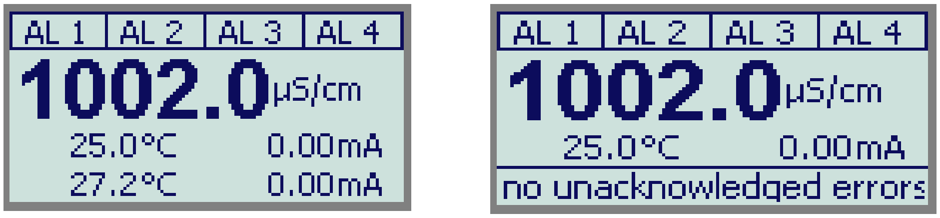


Illustration 26: Sample screen error display

Errors and cautions cannot be removed from this list directly; each error or caution will be removed automatically when appropriate, eg. errors associated with improper calibration will be cleared after a successful calibration.

Prefix	***Description***
E	ERROR
C	CAUTION
M	MESSAGE

Input	***Source***
1	Conductivity
2	Temperature
3	
9	System
11	Alarm 1
12	Alarm 2
13	Alarm 3
14	Alarm 4

Table 4: Input values for error/caution messages

Error messages are numbered. Errors 1 through 5 are identified as [error] where *n* is the input number and e is the error number. Messages 6 and up are less serious and are identified as cautions instead.

Off-scale condition is identified as [overflow] and [underflow], depending on whether the input is at the top or the bottom of the scale. The off-scale is displayed as [overflow] or [underflow] instead of the sample reading.

Acknowledging an Error Message

Error message indicators can be annoying when one has already been made aware of them.

Select [errors] from the main menu. Use the ↑ or ↓ arrow key until the error message to be acknowledged is displayed. Press *ENTER* to go into edit mode. Use the ↑ or ↓ arrow key to select acknowledged, then press *ENTER* again to change the status. The error message will disappear from the message line, but still show in the error menu list.

An acknowledged error message is cleared for one occurrence of the error only. If the error reappears, the message line warning re-appears and the error message must be acknowledged again.

Error and Caution Messages for Conductivity

Error	*Description*	*Causes*	*Solutions*
E1.1	Sensor has not stabilized after 5 minutes of calibration.	Poor sensor performance; sample is not stable; interference.	Check sensor and setup until stable reading is achieved; redo calibration.
E1.2	Effective cell constant would be less than 0.001/cm. Previous cell constant retained.	Incorrect or contaminated standard used for calibration.	Redo calibration using correct or fresh standard. Refer to *Troubleshooting* section.
E1.3	Effective cell constant would be greater than 100/cm. Previous cell constant retained.	Incorrect or contaminated standard used for calibration.	Redo calibration using correct or fresh standard. Refer to *Troubleshooting* section.
E1.4	Range-switching error.	Gap between ranges.	Electronic calibration adjustment needed. Turn automatic range-switching off; manually switch between ranges.
E1.5	Temperature compensator (TC) is off-scale.	Sample outside of TC operating range of -25 °C to 260 °C (437 °F).	Use manual temperature compensation. Check TC connections or install TC.
E1.6	Input is at maximum.	The internal A/D (analog-to-digital) converter is at the top of the scale. The analyzer cannot measure higher at this range.	If conductivity input is in manual range switching, change to automatic range switching so that the analyzer can automatically shift up to the next input range. If conductivity input is already on range 4, then the analyzer is at the limit of its measuring capability. Use a different sensor with a higher cell constant.
E1.7	Conductivity shows negative value.	Linear temperature compensation constant (LTCC) is set to high.	Determine a lower LTCC to use to correctly compensate for temperature. A typical value is 2.00 (for 2% change per °C).

Messages for Temperature Input

Error	*Message*	*Causes*	*Solutions*
E2.10	**min limit** Temperature reading is off-scale. Temperature is less than -25 °C.	Temperature is < -25 °C.	Verify process and sensor location.
		Electronic temperature calibration necessary.	Follow procedure in *Hardware Alignment* section.
E2.11	**max limit** Temperature reading is off-scale. Temperature is greater than 260 °C. (437 °F)	Temperature compensator is not attached.	Attach temperature compensator. Verify process and sensor location.
		Temperature is >260°C. (437°F).	Verify process and sensor location.
		Electronic temperature calibration necessary.	Follow procedure in *Hardware Alignment* section.

Caution Messages for Alarms

Caution Number	*Description*
C11.1	Alarm 1, low alarm
C11.2	Alarm 1, high alarm
C11.3	Alarm 1, deviation alarm
C11.4	Alarm 1, fault alarm
C12.1	Alarm 2, low alarm
C12.2	Alarm 2, high alarm
C12.3	Alarm 2, deviation alarm
C12.4	Alarm 2, fault alarm
C13.1	Alarm 3, low alarm
C13.2	Alarm 3, high alarm
C13.3	Alarm 3, deviation alarm
C13.4	Alarm 3, fault alarm
C14.1	Alarm 4, low alarm
C14.2	Alarm 4, high alarm
C14.3	Alarm 4, deviation alarm
C14.4	Alarm 4, fault alarm

System Messages

Message Number	*Description*
M9.1	Alarm override

OUTPUT SIGNALS

Two assignable 4 mA to 20 mA output channels are provided. The user may configure the analyzer to determine which input signal will be transmitted by each 4 mA to 20 mA output channel. Each output channel can be independently configured to transmit any available input signal, example a conductivity and a temperature signal, or 2 conductivity signals, or a conductivity and a case temperature, or a conductivity and an (optional) PID, etc.

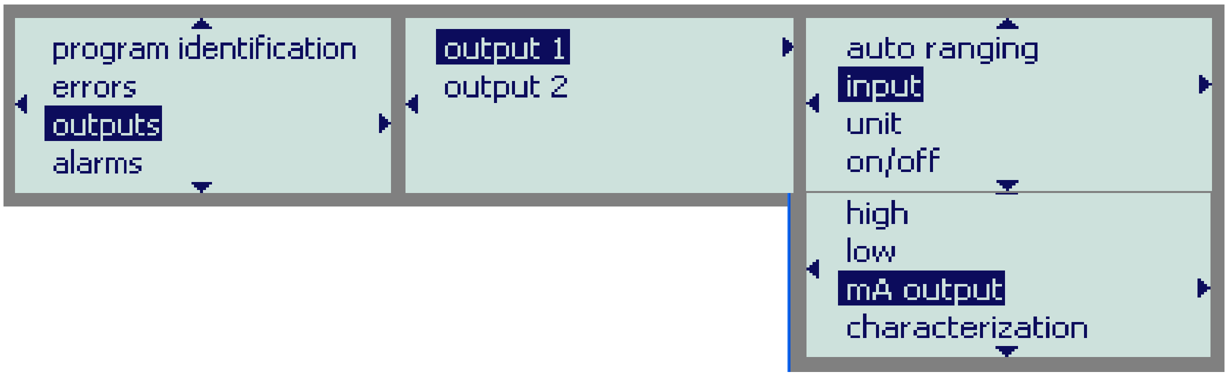


Illustration 27: Dual 4 -20 mA Output menu

The 4-20 mA output channels function independent of each other. Each output channel can be assigned to any input signal, has unit selection, a separate on/off switch, and adjustable low and high span (or scale) adjustments. This makes it possible, for example, to transmit two Conductivity signals, each using separate high and low adjustments.

To adjust the output span or output window for Conductivity or temperature signals, set [low] to correspond to the low end of the scale or 4 mA output, and set [high] to correspond to the high end of the scale or 20 mA output. The analyzer will automatically scale the output according to the new settings.

Units for Outputs

The output menu will be using different units for its settings, depending on the input selected. Select [unit] from the output menu to display the units in use for this output. To change units, press *ENTER* to access edit mode, select the desired units from the available list either [µs/cm] or [mS/cm] and press *ENTER* again to install the new units.

Reversing the 4 mA to 20 mA Output

The low scale setting will normally be lower than the high scale setting. It is possible to reverse the output or "flip the window" by reversing the settings of the low and high scale.

Example:
Define an output window from 1 µs/cm to 100 µs/cm Conductivity with 100 µs/cm corresponding to 4 mA output and 1 µs/cm corresponding to 20 mA output. Set [low] to 100 and set [high] to 1.

mA Output (simulating for tests)

Select [mA output] from the menu to display the output current in mA that is presently being transmitted by this output signal. The display will be updated as the output signal changes based on the input signal and the low/high settings. This is useful for verifying program settings and for testing downstream hardware calibration.

To simulate a different 4 mA to 20 mA output signal between 3.5 and 22 mA press *ENTER* to access edit mode. Edit the displayed mA value to display the desired output needed for testing the output signal. Press *ENTER* to select the displayed value. The output signal will be adjusted to put out the desired current. This process can be repeated as often as necessary.

The output signal is held at the displayed level until the program leaves this part of the menu.

Output Characterization

The 210-C analyzer has output characterization capability that is user-programmable and can be viewed on it's display (see Illustration 25: Output Characterization Curve). Output characterization could be used to provide more accurate control over an output device such as a non-linear ball-valve, to meet the needs of your chemical curve, or modify the output to your recorder to meet your specific application needs. The 21 point output table allows the user to specify the behavior of the output in increments of 5% of the uncharacterized output signal. The table links uncharacterized output values to specific output values, allowing a wide variety of linear and non-linear behaviors to be described with high resolution.

By default the output module does not characterize its output. Whenever the [characterization] setting in the output menu is set to [OFF], the characterization table [table] is bypassed so that the 4 mA to 20 mA output is linear.

If the [characterization] setting in the output menu is set to [on], the output is characterized according to the curve defined in the characterization table. For output values which do not fall exactly on a 5% boundary, the table output is extrapolated so that the characterization is continuous.

Each of the two outputs has its own independent characterization capability. This makes it possible to define a different behavior for each output.

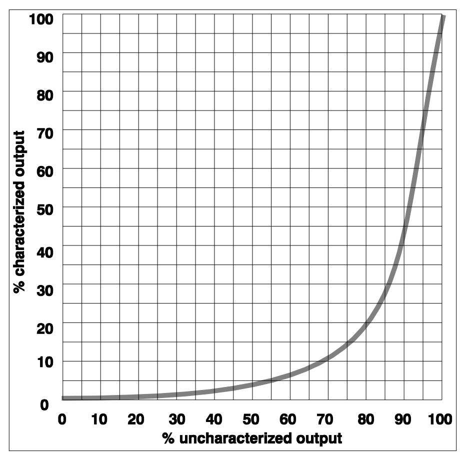


Illustration 28: Characterization of ball-valve

Characterization Example: Tri-linear output for Recorder

The basic functionality of the output characterization can best be described by way of an example. Goal: to record the low conductivity of condensate normally between 5 & 15 µS/cm but still be able to see the conductivity if it is between 0 µS/cm and 100 µS/cm conductivity; however give 80% of the scale to the area between 5 µS/cm and 15 µS/cm. The purpose of this arrangement is to give maximum recorder resolution to the main area of interest, which is 5 to 15 µS/cm, yet still maintain a record of the times that the conductivity goes out of this region.

If output characterization were not available, one could still set [low] and [high] to 0 µs/cm and 100 µs/cm respectively, but the area of interest from 5 to 15 µs/cm would occupy only 10% at the scale. To achieve this the region of interest will be "expanded", and the outside areas will be "shrunk".

To achieve the desired output, the 21-point characterization table and the high and low settings need to be defined as follows:

1. Set the overall boundaries for the conductivity output which are:

[low] = 0 µs/cm
[high] = 100 µs/cm

Set the characterization table to automatically characterize the output so that:

0% = 0 µs/cm (a); 5% = 5 µs/cm (c); 85% = 15 µs/cm (d); 100% = 100 µs/cm (b)

2. It is probably easiest to draw or sketch the characterization curve before entering any table values. A blank worksheet has been provided in *Appendix B*. This worksheet can be copied and can serve as documentation for analyzer setup.
3. Once the points of interest are identified, plot them on the graph and connect them with straight lines.
4. A characterization curve for condensate conductivity is shown in this illustration 29.

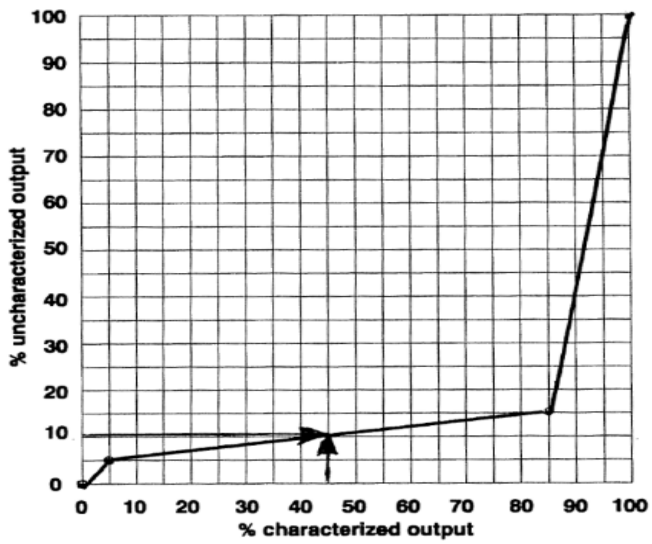
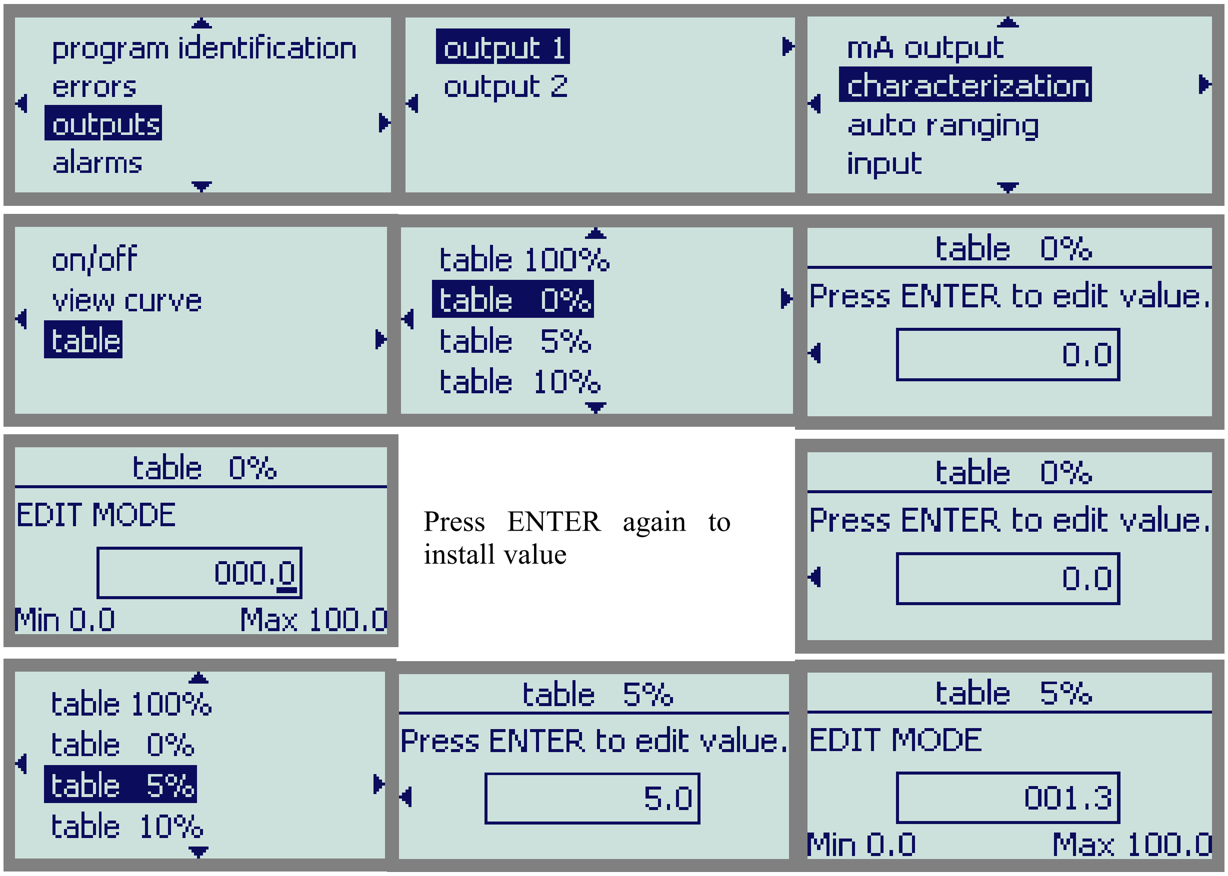


Illustration 29: Tri-linear (condictivity) output example

5. For conductivity example above, the conductivity values corresponding to the uncharacterized output are shown at the left hand side of the scale. There are four points that are of most interest.
   a) "Normal" 0% output corresponds to the [low] setting of 0 µS/cm and 4.00 mA output (a).
   b) "Normal" 100% output corresponds to the [high] setting of 100 µS/cm and 20.00 mA output (b).
   c) At 5 µS/cm, one requires 5% output; 5 µS/cm corresponds to 5% of the horizontal scale (c).
   d) At 15 µS/cm, 85% output is required; 15 µS/cm corresponds to 85% of the horizontal scale (d).
6. In the table below (2nd page), the shaded column marked "% characterized output" can now be filled in by reading the coordinates off the graph. For example, to find the required table value for "10", find 10 on the vertical scale, follow the line up until it hits the curve. The table value is the value on the horizontal axis, in this case 45. Refer to arrows in illustration 29.
7. Once the shaded column in the table has been completed, enter the table values in the program. See 30 All 21 points must be entered; it is not possible to skip values. The completed table for the example is shown in table 5.
8. To activate output characterization, in the characterization menu set on/off to [on].



Repeat for each segment to install full table

Illustration 31: 4 -20 mA caracterization

9. To view finished curve and verify your work, in the characterization menu *SELECT* view curve.

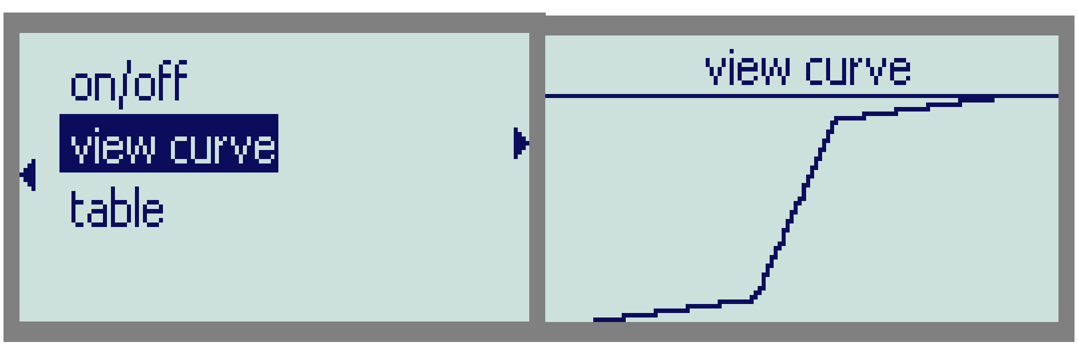


Illustration 32: Output Characterization Curve

% uncharacterized output	***4 mA to 20 mA output***	***% characterized output***	***corresponding Conductivity µS/cm***	***corresponding 4 mA to 20 mA output***
0	4.00	0.00	(LO) 0.00 (a)	4.00
5	4.80	5.00	5.00 (c)	4.20
10	5.60	5.65	5.65	4.40
15	6.40	6.25	6.25	4.60
20	7.20	6.87	6.87	4.80
25	8.00	7.50	7.50	5.00
30	8.80	8.12	8.12	5.20
35	9.60	8.75	8.75	5.40
40	10.40	9.37	9.37	5.60
45	11.20	10.00	10.00	8.80
50	12.00	10.65	10.65	12.00
55	12.80	11.25	11.25	15.20
60	13.60	11.87	11.87	18.40
65	14.40	12.50	12.50	18.60
70	15.20	13.25	13.25	18.80
75	16.00	13.75	13.75	19.00
80	16.80	14.37	14.37	19.20
85	17.60	15.00	15.00 (d)	19.40
90	18.40	43.33	43.33	19.60
95	19.20	71.66	71.66	19.80
100	20.00	100.00	(HI) 100.00 (b)	20.00

Table 5: Analyzer table values for tri-linear output characterization example

ALARM FUNCTIONS

Four alarms are a standard feature. Each alarm can have a relay contact associated with it which can be used for remote alarm indication or for control functions. The four alarms function independently of each other. They can monitor the conductivity, sensor temperature, enclosure temperature input, or faults.

Each alarm features an adjustable set-point, user-selectable alarm type (or function), and an adjustable differential (also called hysteresis). Alarms can be set anywhere between 0 and 100% of the conductivity input or -25 °C(-13 °F) and 294 °C(561 °F) for the temperature input. The differential is adjustable from 0 minimum up to 50 % of scale maximum of the conductivity input.

Setting Alarm Function

The alarm functions which are available are high, low, deviation, and fault. Select [function] then press *ENTER* to show the action functions available. Use the ↑*Up* and ↓*Down* keys to highlight the desired function, then press *ENTER* again to configure the alarm.

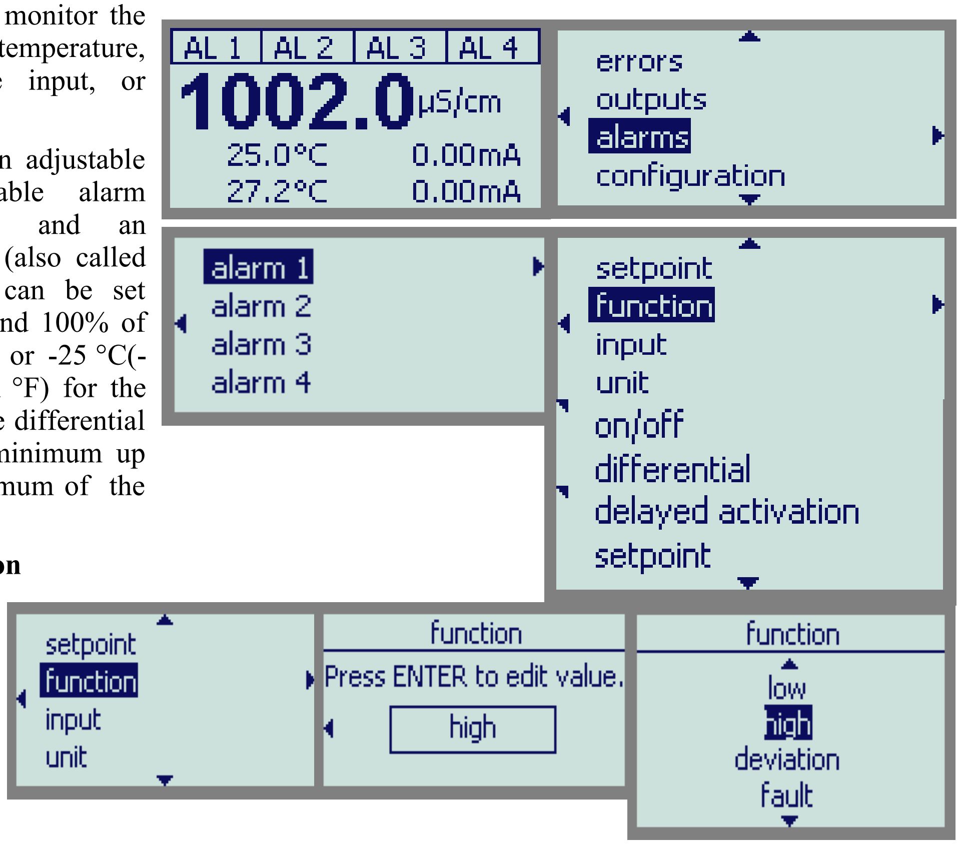


Illustration 34: Setting Alarm Function

Setting Alarm Input

The alarm input signals which are available are Conductivity1, TEMP1, and enclosure temp. In addition the fault alarm is activated directly by the micro. Select [input] then press *ENTER* to show the action functions available. Use the ↑*Up* and ↓*Down* keys to highlight the desired function, then press *ENTER* again to configure the alarm.

Illustration 35: Setting Alarm Function

Units for Alarms

The alarm will be using different units, depending on the input selected. Select [unit] from the alarm menu to display the units in use for the alarm. Select [unit] then press *ENTER* to show the units in use. Then press *ENTER* again to see other units available. To change units use the ↑*Up* and ↓*Down* keys to highlight the desired units, then press *ENTER* again. Alarm units function independently from separate configuration units.

The temperature input will use different units depending on whether metric or imperial units are selected for the analyzer. The choice between metric or imperial units is made in the configuration menu. Refer to the *Configuration of Program* section in this manual for details.

Alarm Indication

The SAMPLE display shows the current state of each relay contact. If an alarm is assigned to the relay its status is shown too. This way the operator can quickly determine which alarm caused the alarm condition and the type of alarm.

Each alarm will simultaneously generate a error number in the error menu and a message in the display message window. Alarm messages can be acknowledged which removes them from the display message window, but not the error menu. Refer to *Error Messages* section for the meaning of each alarm. To view alarms use the *Up* or *Down* arrow key to scroll through the list of errors, if any.

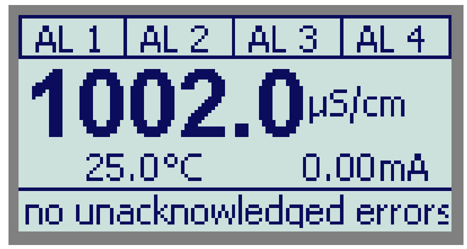


Illustration 36: Alarm status indication

Alarm Override (Silence Klaxon)

For normal operation the alarms operate in auto-mode. If the operator wishes to temporarily intervene and switch off the alarm relay contacts while attending to a problem, the alarms can be switched to manual override using the *MANUAL* key. Alarm override also generates the message | M9.1 alarm override | in the message window.

In MANUAL mode: The relay contacts are deactivated, but the alarms continue to indicate alarm condition(s), also the message | M9.1 alarm override |is displayed. Press the *MANUAL* key again to return to AUTO mode immediately and reactivate the relays. If no key is pressed for 15 minutes, the 15-minute timeout will return the alarms to AUTO mode.

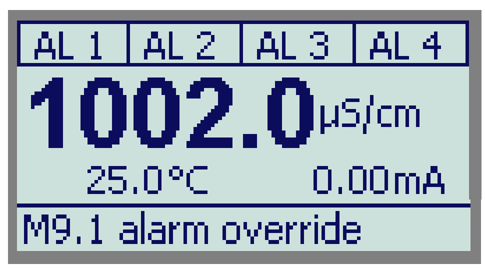


Illustration 37: Alarm override status

Wiring and NO/NC Contacts

By default, the analyzer assumes all 4 alarm contacts are wired normally open. The relay contacts for alarm 4 may be wired as normally open or normally closed. A normally open alarm contact will be inactive if there is no alarm condition and will be active when there is an alarm condition. If the program configuration and the wiring do not match then the incorrectly configured contact will generate an alarm when there is no alarm condition and vice versa.

Refer to the **CONFIGURATION OF PROGRAM** menu. Select [configuration] [relays] [relay #] [NO/NC] *ENTER,* from the menu select open or closed.

Delayed Activation

Alarm activation, by default, is immediate upon alarm condition, or may be delayed. Delay gives the operator a chance to correct alarm situations before the relay contacts activate, or can eliminate alarms based on temporary or spurious change in the process.

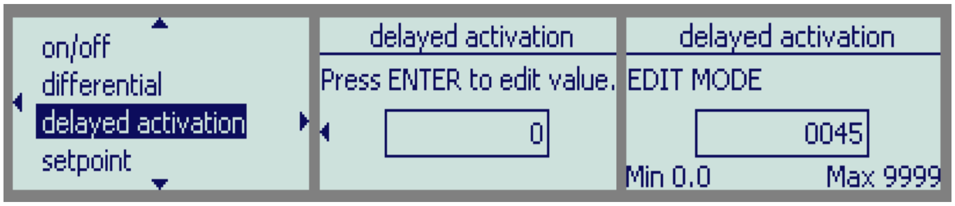


Illustration 38: Setting Delayed Activation

The delay time is programmable by the operator. To change or view the delay time, select [delayed activation] from the alarm menu. The default value of 0 seconds is for immediate contact activation. The delay time can be set from 0 s to 9 999 s.

Deviation Alarm

A deviation alarm is practical when the process is expected to stay within a certain range. An alarm will be set if the input deviates too far from a set-point. ***Please note that the [deviation] frame only shows up in the menu after the alarm function has been changed to deviation alarm, since it would have no effect for a high, low, or fault alarm.***

Example*:*
If the conductivity is expected to stay between 500 µS/cm and 900 µS/cm, then we would set [input] to [conductivity], [function] to [deviation], [setpoint] to 700 µS/cm, and [deviation] to 200 µS/cm. Effectively, a high alarm at 900 µS/cm and a low alarm at 500 µS/cm has been set.

The differential setting will continue to function as for high and low alarms.

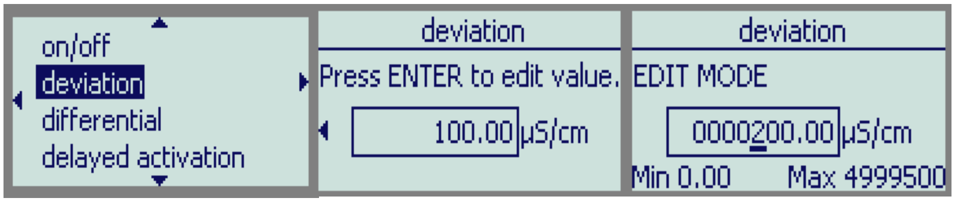


Illustration 39: Setting Alarm Deviation

High or Low Alarm

A high alarm is set when the value of the Conductivity or temperature rises above the setpoint and is cleared when the Conductivity or temperature drops to below the set-point minus the differential (refer to illustration 40). A low alarm is set when the value of the Conductivity or temperature drops below the setpoint and is cleared when the Conductivity or temperature rises to above the setpoint plus the differential (refer to illustration 41). The differential has the effect of setting the sensitivity of the alarm. The differential provides a digital equivalent of a hysteresis.

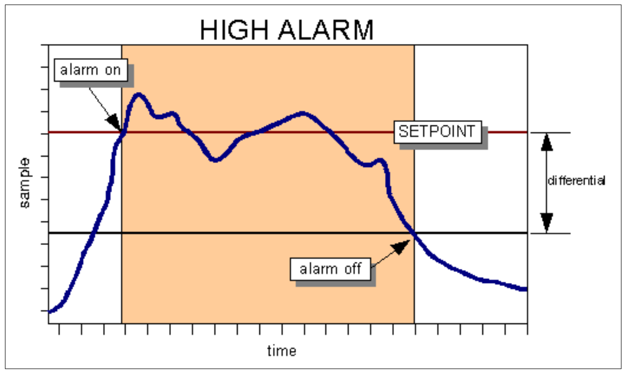


Illustration 40: High alarm

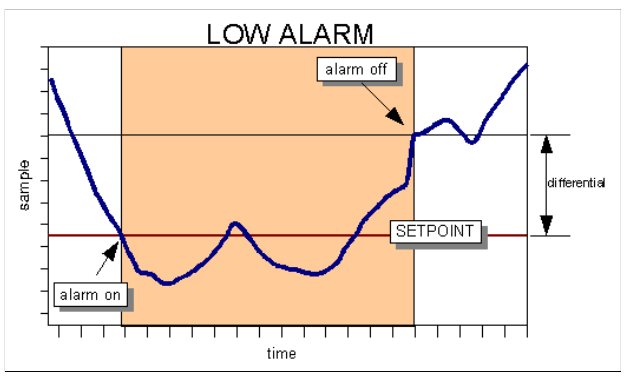


Illustration 41: Low alarm

A two-stage alarm can be implemented by choosing the same alarm function, ie. high or low alarm, for both alarms, but selecting different setpoints.

Example:
The Conductivity of a critical process may not drop to below 200 µS/cm Conductivity. Use alarm 2 as a low alarm set at 200 µS/cm and use alarm 1 as an advance warning device by configuring it as a low alarm set at 250 µS/cm. When alarm 1 is activated there is still time left to take corrective action.

Fault Alarm

A fault alarm for an input will be set when anything goes wrong with that input. Something is wrong with an input if the input is off-scale or an unacknowledged error message exists for that input. Caution messages do not cause a fault alarm.

To use an alarm as a fault alarm, select [function] from the alarm menu, then select [fault]. To enable the alarm, make sure the on/off switch is set to [on]. Also, set the input in the alarm menu to the desired input, either Conductivity or temperature, etc.

The setpoint and differential for the alarm have no effect when the alarm is used as a fault alarm.

Using Alarms for On/Off Control

The alarms can also be used for process control; the alarm contacts will then function as on/off signals for switches controlling a valve, pump, motor, etc. The setpoint determines the control point of the system and the setting of the differential controls the amount of corrective action before a controlled shut-off occurs. Examples of high and low control using the alarms are shown in the illustrations below.

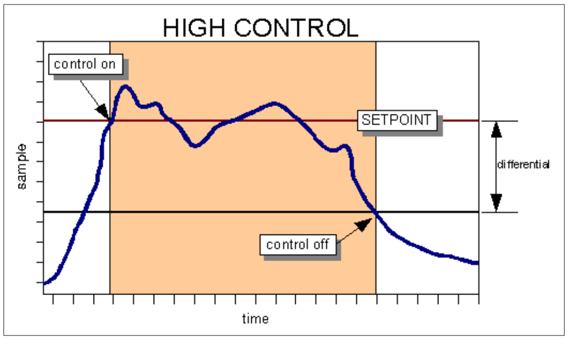


Illustration 42: High control

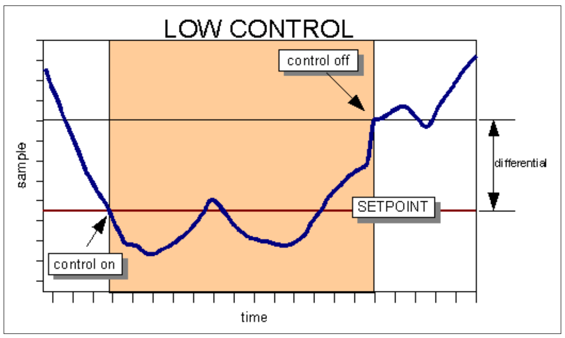


Illustration 43: Low control

TIMER ELECTRODE CLEANER

Overview

A timer function is available that is designed to control a cleaner for the sensor.

The timer is a configurable program option only and does not require any modifications to be made to the analyzer electronics. The timer can use any relay contact. When a timer is configured the relay assigned is owned by the timer function and is not available for other uses.

IC Controls offers equipment packages for the sensor that work with this function; as optional cleaner packages, include pump, tubing, fittings, spray nozzles, etc. These packages vary with the needs of the sensor and are found as sensor options.

Configuration of a Relay Contact as a Cleaner

Model 210 has 4 relays all of which can be configured. Select the relay you want to use, for example relay 1. Press *SAMPLE* to display measured reading. Press *SELECT→* to access main menu. Use ↑*Up* or ↓*Down* arrow key to go to |configuration| section of the menu.

Illustration 44: Relay owner display

From the configuration menu use → then ↑ or ↓ arrow key to go to |relays| section of the menu. Use → then ↑ or ↓ arrow key to go to |relay 1|; then → then ↑ or ↓ arrow key to go to |owner|; then → then ↑ or ↓ arrow key to go to the relay owner display.

From the relay owner display press *ENTER* to be able to edit the choice then ↑ or ↓ arrow key to go to |timer| option. Use → or press *ENTER* again to configure the relay for use with the timer.

Illustration 45: Main Menu Timer Appears

With Timer Function:

The Relay 1 contact is now "owned" by the timer. No other relay function can use the relay when it is configured as a Cleaner Timer.

Once a relay has been configured as the "timer" relay, the Timer function will appear in the main menu. Press *SAMPLE* to display measured reading. Press *SELECT→* to access main menu. Use ↑*Up* or ↓*Down* arrow key to go to |timer| section of the menu.

Setting the Timer

The following adjustments can be made to the timer:

Status shows the current condition of all variables.

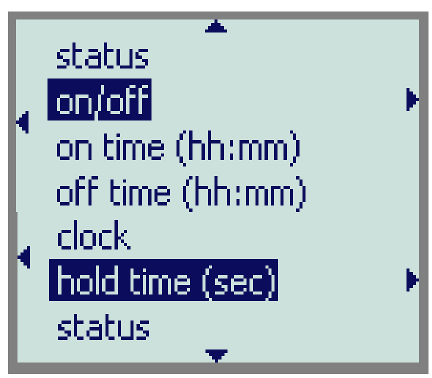


Illustration 46: Timer Menu

The default settings are a 24 hour off-cycle and 1 minute of cleaning. The analyzer will turn on the contact for one minute at the same time each day. Default output hold is the "on time" plus 10 additional seconds. All settings are editable over the full adjustable digit range from 00.01 to 99.99.

The hold time is to allow the sensor electrodes to stabilize after cleaning.

Interaction with Other Analyzer Functions

Automatic Output Hold

The 4 mA to 20 mA outputs will not change and the alarms will be off temporarily as long as the timer is in it's on-cycle. After the analyzer has completed its on-cycle, the analyzer program will give the electrode some additional time to stabilize before updating the output signal levels and enabling the alarms again. Set the length of the additional hold time in seconds in the │hold time (sec)│ of the timer menu.

Timer Interaction With Calibration

The timer will not start an on-cycle while a calibration is in progress, nor can a calibration be started while the timer is in it's on-cycle. The timer is generally connected to an electrode cleaner. The analyzer can not clean and calibrate a sensor at the same time.

When Cleaning

During the on-cycle of the timer a calibration cannot be started. If a calibration is attempted, the analyzer will flash │clean│ twice to show that the timer is now in its on-cycle.

When Calibrating

If the off-cycle is completed during a calibration then the on-cycle will not start until after the calibration has finished. Also, as a safety and process-integrity feature, the timer will wait at least 5 minutes after a calibration has been completed before starting the on-cycle automatically. To avoid having the cleaning cycle start soon after a calibration, it is good practice to turn the timer off temporarily or to increase the time of the current off-cycle in the timer status selection.

Manual Operation

The timer can be operated manually by changing the timer clock. Changing the timer clock does not affect the programmed on-cycle and off-cycle times. To change the clock status to get a manual cleaning now go into the │clock│, press *ENTER* to get edit mode, use the ↑ or ↓ arrow key to increment the digits to 0 then the → or ← to move between digits, leave 1 minute then press *ENTER* to have the change go into effect.

Alternatively; in edit mode, use the clock setting to toggle the relay directly by toggling the ± sign. "-" is OFF, "+" is ON.

Sensor Cleaning

IC Controls offers equipment packages for the sensor that work with this function; as optional cleaner packages, include pump, tubing, fittings, spray nozzles, etc. These packages vary with the needs of the sensor and are found as sensor options. Instructions for the sensor cleaning packages are provided as addendums to the particular sensor manual involved.

CONFIGURATION OF PROGRAM

The 210-C analyzer has been designed with ease-of-use in mind. The analyzer has been configured to the most common specification at the factory so typically no configuration of the analyzer is necessary. However, several hardware and software options are available and if they are different the program configuration settings may need to be set accordingly for the program to function properly. Other program adjustments which are normally made infrequently or when installing the analyzer are located in the configuration menu.

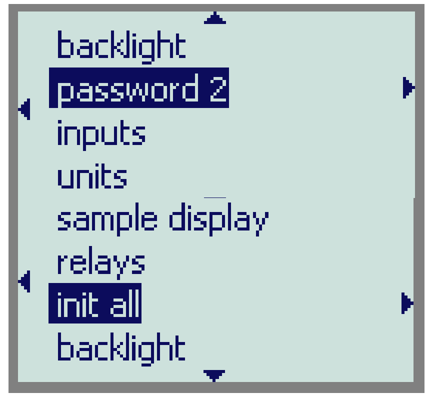


Illustration 47: Configuration Menu

Configuration Menu

The 210-C is very flexible, virtually all analyzer functions can be assigned to any input. Press *SAMPLE* to display measured reading. Press *SELECT→* to access main menu. Use ↑*Up* or ↓*Down* arrow key to go to |configuration| section of the menu. To access configuration → to get |password 2|. Passwords are user programmable, so IC Controls does not know what the password would be. If a password has been installed you will need to enter the password here to proceed.

APPLICATION selections; measure as:

Conductivity, (factory default)
Condensate or Pure Water Conductivity,
Resistivity of Ultrapure Water,
TDS (Total Dissolved Solids),
% Concentration, (% NaOH, % NaCl, % H2SO4, % HCl)
Salinity of Water

The default application is conductivity for normal applications (50 µS/cm to 500,000 µS/cm). If you wish to measure using one of the other application modes, reconfiguration is easy.

To select an alternative application mode, after entering your password, use ↑*Up* or ↓*Down* arrow key to go to |inputs| section of the menu. To access inputs → to get |conductivity| → and ↑*Up* or ↓*Down* to get |application| → to get |normal|. Press *ENTER* to edit then use the ↑ or ↓ arrow key select the desired application from the list. Press *ENTER* to install the application mode. Next go back and make any selections needed for the application selected (the configuration menu is application sensitive, adding/changing available menu selections as needed by different applications). Example: after installing |% concentration|, under |application| a new option appears |% conc option|. Use→ to get| NaOH 0-15%|, then press *ENTER* to edit, then use the ↑ or ↓ arrow key to select from NaOH 0-15%; H_2SO_4 0-20%; H_2SO_4 96-100%; HCl 0-18%; NaCl 0-20%. Press *ENTER* to install the measurement desired. New options also often appear under unit selection.

Reference Temperature

The default value is 25 ºC. To change go to |inputs| → to get |conductivity| → and ↑*Up* or ↓*Down* to get |TC reference temperature| → to get| 25 ºC|. Press *ENTER* to edit then use the ↑ or ↓ arrow keys set the desired reference temperature. Press *ENTER* to install it. Common alternative reference temperatures are 20 ºC and 18 ºC; however the 210-C can be set to any reference temperature you desire.

Damping

The Conductivity and Temperature measurements can be damped to provide the user with a means to alleviate rapidly-varying or noisy signals. The available damping range is 0 seconds to 127 seconds; with 0, there would be no damping and each reading the analyzer made would be used to directly update the display and 4 to 20 mA output. The factory default of 5 seconds adds the previous four seconds worth of readings to the last and divides by five; this provides a fast response. Selecting 127 seconds adds the readings for 127 seconds and divides by 127, providing smooth damping out of turbulent readings. Any selection between 0 seconds and 127 seconds can be made.

Select |configuration|inputs| from the menu. Use the ↑ or ↓ arrow keys to select the input to be adjusted, then use the → and ↑ or ↓ arrow key to select the |damping| frame. Press *ENTER* to edit the damping then use the↑ or ↓ arrow key select the desired seconds. Press *ENTER* to save and to leave edit mode.

Temperature Calibration

The temperature compensator in the conductivity sensors will sometimes show some variance in their zero (effective zero). To make the sensor read correctly use the following procedure. Let the sensor equilibrate to the ambient temperature for a day. The ambient temperature and "as measured by the temperature sensor", needs to be known. Subtract the two temperatures to get the difference or zero. Select |configuration |inputs |temperature |zero| from the menu. Press *ENTER*, then change the zero to what the difference was. Press *ENTER* again to leave edit mode. Check that the temperature now reads correctly, if the zero doubled, go back and reverse the polarity of the zero.

Sensors may also show differences in their readings do to temperature differential between the "in process" part and the "exposed" part of the sensor. To make the sensor read correctly use the following procedure. The "actual" process temperature, plus the "as measured by the temperature sensor", needs to be known. If the sensor is in the process, the known temperature of the process can be used. Subtract the two temperatures to get the difference. Select |configuration |inputs |temperature |calibrate | from the menu. Press *ENTER*, then change the displayed temperature to the temperature that the sensor should be reading. Press *ENTER* again to leave edit mode. Press *SELECT* to go to the calibration screen where the current temperature is displayed. When it is stable press *ENTER* to set the new temperature.. The displayed temperature will be adjusted to the specified temperature and the temperature calibration is completed.

Units, Metric or Imperial

By default the analyzer will use metric units. This means that temperature will be displayed using degrees Celsius. The analyzer can also be made to use imperial units as the preferred unit. Using imperial units temperature will be displayed using degrees Fahrenheit in the sample menu.

To select imperial units for the analyzer, select |units| from the configuration menu, then go into edit mode and change the |metric| prompt to |imperial|.

Sample Display: Turn ON/OFF or move measurements

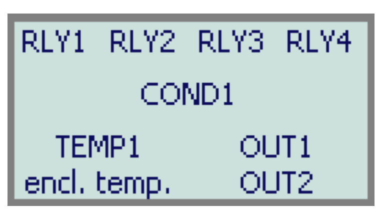


Illustration 48: Signal Identification

The **"large digit"** ***SAMPLE*** **display is the default display** for the analyzer. The analyzer's inputs, conductivity and temperature plus an extra input, by default arranged underneath each other at the left-hand side of the display. The analyzer's outputs, 4 to 20 number 1 and 2, are by default arranged underneath each other at the right-hand side of the display. Other possible inputs are NO signal (OFF location) or enclosure temperature, or with dual input version conductivity2 and temperature2. Identification of the signal source on the display can be viewed by pressing *ENTER*.

Each of the 5 display position can be turned off and thereby disappear from the screen. To change the display configuration, use the → key then the ↑ or ↓ key until │configuration│ is displayed. Select │sample display│position #│ signal│, to show the signal source; then press *ENTER*, then select │**leave blank**│ and press *ENTER* again to clear that section of the display.

The user can **field customize the display to show any of the measurements in any of the 5 positions**. To change the display configuration, use the → key then the ↑ or ↓ key until │configuration│ is displayed. Then enter the position desired and select from the available settings. You can also edit the units displayed this way.

The **main signal**, ie. the input that is displayed **using large digits** when the *SAMPLE* key is pressed, **can be changed**. By default the main signal is │Conductivity 1│. Change the default in │Configuration │sample display │position 1│signal│, similar to above.

Relays

Each relay **can be assigned to any desired function in the configuration menu**. To change the assigned configuration, use the → key then the ↑ or ↓ key until │configuration│ is displayed. Select │relays│relay #│ owner│, to show the signal source; then press *ENTER*, then the ↑ or ↓ key until the desired function is displayed. Press *ENTER* again to make that function the new owner of that relay.

Normally Open or Normally Closed Relay Contacts

By default the 210 program assumes all 4 relay contacts are wired normally open. The relay contacts for relay 4 may be wired as normally open or normally closed allowing for fail safe on power failure. A normally open relay contact will be inactive if there is no alarm condition and will be active when there is an alarm condition. If the configuration and wiring for each relay do not match then the incorrectly configured relay contact will generate an alarm when there is no alarm condition and vice versa.

To change the assigned configuration, use the → key then the ↑ or ↓ key until │configuration│ is displayed. Select │relays│relay #│ NO/NC│; then press *ENTER*, then the ↑ or ↓ key until the desired action is displayed. Press *ENTER* again to make that action the configuration of that relay.

Init All

WARNING ! "Init All" will wipe out ALL user installed configuration. Complete re-building of your settings is then required. Write them down first, so you have a record.

It is rarely desirable to reinitialize all of the program's settings to bring them back to factory defaults. Executing the initialization procedure will cause the analyzer to reset all the program variables, settings, preferences, and input calibrations to factory defaults. Press *ENTER* to confirm, the analyzer will display │Done│.

After the analyzer program has been initialized, you will need to re-enter the output signal settings, alarm settings, as well as the program configuration if it was different from the factory default settings.

Backlight is adjustable

The 210 Analyzer has a backlight which can be set to; continuous ON, or on demand ON.

To change the lighting, use the → key then the ↑ or ↓ key until │configuration│ is displayed. Select │backlight│; then press *ENTER*, then the ↑ or ↓ key until the desired action is displayed. Press *ENTER* again to make that lighting take effect.

TROUBLESHOOTING

When trying to determine what the problem is with a conductivity loop, there are a few simple steps to follow:

Isolating the Problem

FIRST: Write down the symptoms.

a) conductivity reading

b) temperature reading

c) conductivity cell constant in analyzer

d) sensor cell constant on the label

SECOND: Separate the sensor from the analyzer so that the problem can be isolated.

Disconnect the sensor from the analyzer at the terminal block - it is much easier to test and determine if the problem is in the conductivity sensor or in the analyzer this way.

THIRD: See if the analyzer reads correctly without the sensor.

a) With sensor leads removed, the analyzer should read 0 µS/cm or mS/cm, depending on units selected, or close to zero.

b) Insert a 1 000 ohm, 1% resistor across the sensor cell connection and a second one across the sensor TC connections.
NOTE: *If the temperature reading is approximately 0 °C (or 32 °F), then the analyzer looks OK.*

c) Change the analyzer cell constant setting to 1.00 and TC to manual, set at 25 °C.
NOTE: *If the conductivity reading is approximately 1 000 µS/cm (or 1.00 mS/cm), then the analyzer looks OK.*

d) If the reading is far from 1 000 µS/cm, perform a calibration to 1 000 µS/cm and note the calculated conductivity cell constant in the analyzer. Expect a reading of 1.00/cm approximately.

e) When finished, set TC back to auto and remove both resisters.

FOURTH: Problem isolated

If the cell constant is within 0.90/cm and 1.10/cm, then the analyzer appears OK. If the analyzer is OK, then the problem is likely with the sensor. If the cell constant is greater than 10% away from 1.00/cm, the problem may be in the analyzer.

Troubleshooting Hints

Slow Response
Typically due to excessive sample line length and low flow, producing long sample transport lags. Resolve by adding a fast-flow loop with the sensor in a short side stream, or by shortening the line.

Slow response can also be caused by a buildup of dirt in the sample line. In this case, the problem may be alleviated by changing the take-off point or by installing a knock-out pot. Alternatively, a dirty-water sample system may be needed.

Readings consistently low or spike low
Characteristic of bubbles in the sample line passing through the sensor or hanging up in the sensor. Review the installation instructions provided with the conductivity sensor.

Readings gradually falling
The analyzer can no longer be calibrated properly. This problem is typical of scale or sludge/slime deposits in the sensor - the sensor will need to be cleaned. Refer to the *Yearly Maintenance* procedure in the sensor manual.

Readings at maximum
"overflow" message under all conditions. First verify that the analyzer is displaying conductivity using mS/cm units. The analyzer will display "overflow" if conductivity is above 9 999 µS/cm with µS/cm units selected for the display.

If unit selection is not the problem, then either the sensor is shorted or there is a problem with the wiring/analyzer setup. Test for shorts by disconnecting the sensor from the analyzer (at the analyzer) and checking impedance between black and white leads with the sensor in air and dry. Insulation value should exceed 1 MΩ (megohm) if sensor is OK.

If the sensor is OK, then substitute resistors for the sensor (at the sensor end) to test the wiring and the analyzer. If the problem persists with the resistors in place then it is an analyzer problem. Use the following formula or consult the table below for resistance values to use.

$$resistance(\Omega) = \frac{cell\ constant \times 10^6}{\mu S/cm\ of\ solution\ at\ 25\,°C}$$

If the sensor tests OK, i.e. no shorts as per above test procedures, and the analyzer and wiring work OK with substitute resistors as in table 6, but the "overflow" message still occurs when the analyzer and sensor are hooked up and placed in service, then the conductivity is too high for the cell constant used. Resolve by determining the actual conductivity and selecting a new conductivity sensor with the correct cell constant.

Elevated readings on low conductivity

The analyzer reads high at the low end of the range. In some cases, the analyzer will give a low reading even with the conductivity sensor in air. Large zero signals are indicative of a wiring problem. Look first at shielding between leads and ensure the shield is connected to the analyzer shield terminal rather than electrical ground. Other known causes include incorrect cable or cable lengths too long for the application.

Where the elevated zero is small, it is likely due to cable resistance/capacitance and can be zeroed out using the air zero calibration procedure.

Conductance (µS)	***Resistance (Ω); 1.0/cm cell constant***	***Resistance (Ω); 0.1/cm cell constant***
1	1 000 000	100 000
10	100 000	10 000
100	10 000	1 000
1 000	1 000	100
10 000	100	10
100 000	10	1
1 000 000	1	0.1

Table 6: Resistance values for simulation

REPAIR and SERVICE

Field Service is dispatched in Canada from the home office of IC Controls. In North America, cal 1-800-265-9161, or 519-941-8161. Outside of North America consult your authorized IC Controls distributor, or www.iccontrols.com.

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HARDWARE ALIGNMENT

The electronics go through factory alignment to set up default conditions. It should not normally be necessary to make any field adjustments.

Proper field wiring for hookup is shown on drawings D5060288 and D5060298. These instructions assume 115 VAC or 230 VAC power is hooked up, the analyzer electronics are operable, and field wiring is in place.

Alignment of Conductivity Input Circuit

Input for measurement zero open circuit at connector, refer to illustration 2 or 4.
NOTE: *For Conductivity open circuit is 0.0 µS/cm Conductivity. However, you can use the Air Zero calibration proceedure to adjust the zero. There is no span adjustment for the Conductivity input circuit; the chemical calibration adjusts the Conductivity span to suit the sensor; however inserting a 1000 ohm 0.1% resistor will show the analyzer's swing from approximately 0 to full scale Conductivity, assuming a 1.0 sensor constant.*

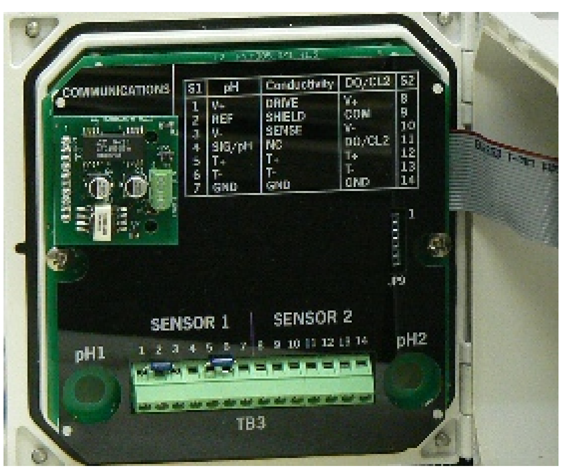


Illustration 49: Alignment with precision resistors installed

Alignment of Temperature Input Circuit

The temperature input can be adjusted by having the program compensate for differences in zero. The temperature input of the 210-C microprocessor analyzer requires 1000 ohm RTD in the sensor. The 210-C analyzer is configured at the factory for use with 1000 ohm RTD.

Adjusting Electronic Calibration

1. Remove any zero calculated by a previous software calibration of the temperature input. Select │configuration │inputs │temperature │zero│ and edit the zero to read 0.0.
2. Use the "T-" sensor connection; TB3, terminal 6, as common, illustration 4. Place a 1000 Ω 0.1% (or 1%)

resistor across T+ and T- terminals. The display should read 0.0 °C ± 0.1 °C. If it does not press [edit] and adjust the numbers as needed to achieve 0.0 ± 0.1, press │enter│ to save and │sample│ to return to the input display. The display should read 0.0 °C ± 0.1 °C.

3. Place a 1385 Ω 0.1% (or 1%) resistor across T+ and T- terminals. The display should read 100.0 °C ±0.1°C.

Software Calibration

Software zero calibration for the sensor and its leads, the sensor needs to be connected and the correct temperature needs to be known. Allow at least 1 day for sensor and its leads to equilibrate to ambient.

1. The sample display will show the actual temperature as measured by the temperature sensor. Select │configuration │inputs │temperature │calibrate│ then Select again. Edit the displayed value to add or subtract to get the "known correct temperature". Press *enter* to leave edit mode. Then *select* again to start the calibration. The sensor temperature will be displayed flashing, when it stabilizes press *enter* again to finish the calibration. Press *sample* to return to the sample display and check the calibration.
2. The corrected temperature will be shown on the display. The displayed value should be the same "known correct temperature" that you previously edited to. If not the software zero for the temperature input can be adjusted as needed to get the exact temperature.
3. The "known correct temperature" software zero can be edited in │zero │to tweak the final result.

Verification testing of 4 mA to 20 mA Outputs

Outputs are isolated from main circuit, therefore measurements are made with common at Output 2, terminal, TB2 terminal 3.

Self Calibration

Select │mA output│ from the menu to display the present output current in mA. The display will be updated as the output current changes based on the input signal and the program settings.

To simulate a different 4 mA to 20 mA output signal, press *enter* to enter edit mode. Use the arrow keys to display the desired output needed for testing the output signal. Press *enter* to select the displayed value. The output signal will be adjusted to put out the desired current. This process can be repeated as often as necessary.

The output signal is held at the displayed level until the program leaves this part of the menu.

Faster Calibration

A faster calibration approach requires a measurement input circuit that is already calibrated and a resistance source for inputs. Select │mA output│ from the menu to display the present output current in mA. The display will be updated as the output current changes based on the input signal and the program settings. Input a megohm signal (or open circuit) to cause analyzer to indicate │0.00 µS/cm│; the analyzer will output 4.00 mA. Input a high 100 ohm signal to cause the analyzer to indicate │1000 µS/cm│; analyzer will output 20.00 mA.

Tip: *Both outputs can be simultaneously calibrated if you assign both to same input in configuration.*

Another way of doing this calibration, if your receiving instrument can read below 4 mA and above 20 mA, is to Input a below 0 signal to cause analyzer to indicate │underflow│; the analyzer will output 3.50 mA. Change the input to a higher than 100% signal to cause the analyzer to indicate │overflow│; the analyzer will output 22.00 mA

Once both outputs are correct, return analyzer to normal by selecting the desired inputs for the outputs to track and then press sample.

Testing of Relay Outputs

No calibration is necessary beyond checking for actual operation. To check actual operation, check for contact closure; continuity at each relay. To activate relay go into configuration section and follow │configuration │relays │relay 1 │owner │alarm 1│ press *ENTER* and use the arrow keys to select │cycle test│ then press │*enter*│ again to install the selection. The relay will now cycle its contact open and closed. To Exit use the ← arrow key to return to│owner│ followed by ↑ or ↓ arrow key to display [alarm 1] or (whatever you want to operate it) then press *enter* followed by *Sample*.

Repeat for each relay.

Another way to test is to use │owner │manual│then *select* to display │active│ or │inactive│ and switch between the two.

To return all configurations and analyzer settings to default run │init all│ in the configuration menu.

GLOSSARY

Cell constant describes enclosed volume between electrodes in the conductivity sensor. Units are cm^{-1}. Higher cell constants produce higher analyzer ranges; lower cell constants produce lower ranges.

Conductivity the amount of electrical current that flows through a liquid. Generally reported as microsiemens per centimeter (µS/cm) or millisiemens per centimeter (mS/cm).

EPROM
Erasable/Programmable Read Only Memory. The EPROM chip holds the program which determines the functioning of the 210 analyzer. Replacing the EPROM chip with a chip containing a new or an updated program changes the way the analyzer functions. The EPROM chip is programmed by the manufacturer.

Hysteresis
The reading at which an alarm is turned on is not the same reading at which the alarm is turned off again. This phenomenon is referred to as the hysteresis.

LED
Light Emitting Diode. A LED is used as a indicator on the microprocessor board of the 210.

LTCC (Linear Temperature Compensation Constant) The default LTCC of 2.0 adjusts the conductivity reading by 2.0 % per degree Celsius so that the effective conductivity at 25 °C can be displayed.

mho the reciprocal of ohm; ohm spelled backwards. The siemens is the modern naming for this unit.

microsiemens per centimeter (µS/cm) unit of conductivity. Micro is the metric prefix meaning *one millionth.*

$$\mu S/cm = \frac{1}{10^6\, ohm \cdot cm} = 10^6\, siemens/cm$$

millisiemens per centimeter (mS/cm) unit of conductivity. 1 millisiemens/cm = 1 000 microsiemens/cm. Milli is the metric prefix meaning *one thousandth.*

Microprocessor
An integrated circuit (chip) which executes the program on the EPROM chip and controls all the input/output functions.

NC, Normally Closed **Normally Closed** Each of the alarm contacts can be wired and configured as normally open or normally closed. A circuit which is wired normally closed will be closed, ie. the external device wired to it is turned on, when the analyzer is not powered.

NO, Normally Open. **Normally Open** A circuit which is wired normally open will be open, ie. the external device wired to it is turned off, when the analyzer is not powered.

On/off Control
Control response in which the contact is either fully on or fully off.

Siemens per centimeter (S/cm) unit of conductivity.

$$S/cm = \frac{1\, ohm}{cm}$$

RAM
Random Access Memory. Memory in a RAM chip can be both written to and read from. The contents of RAM will disappear as soon as the RAM chip loses power. The RAM chip has a battery backup device which preserves the contents of the RAM chip for a considerable time even if the analyzer is turned off. Some settings are stored in EEPROM, some in RAM.

TC, Temperature Compensator.

Temperature Compensation
Correction for the influence of temperature on the sensing sensor. The analyzer reads out concentration as if the process were at 25 °C, regardless of actual solution temperature.

Appendix A — Security (Passwords)

The analyzer has a built-in password protection system. This security system is disabled by default and does not need to be enabled if no password protection is necessary. If you choose not to enable the password protection system then the user will have unrestricted access to all analyzer settings available through the menu as described in this manual.

With security enabled anyone can view readings and settings anywhere in the program.

When you try to make a change, but do not have proper access rights, the program will display:

Illustration 50: Access denied display

Access-level	*Description*
0	**View only access** No changes to to settings
1	**Operator** Access to all settings except for configuration menu. **Usage:** operator access, no changes can be made to configuration and passwords cannot be changed.
2	Access to all settings. **Usage:** installation, function change. Passwords can be changed.

Table 7: Security access levels

indicating that a proper password must be entered before being allowed to proceed.

This appendix contains instructions for setting passwords in the configuration section of the menu. Daily usage of the analyzer by the operator does not require knowledge of setting passwords in the configuration section since all passwords are entered by selecting │password│ directly from the main menu.

ENTERING A PASSWORD

With security enabled, select │password│ from the main menu. The analyzer will display │0000│. Use the arrow keys to display your level 1 or level 2 password, then press *ENTER*. The program will display:

Illustration 51: Access level 1 display

Illustration 52: Access level 2 display

then return to the main menu.

You will now have level 1 or level 2 access for as long as you are working with the analyzer. The access level will automatically be restored to level 0, view only access, after no key has been pressed for 15 minutes. This 15-minute timeout will also return to display the main sample.

It is good practice to return the analyzer to level 0 access (or level 1 access if password 1 is set to "000") when you have finished using the analyzer. This is accomplished by selecting │password│ from the configuration menu, then pressing *ENTER* with │0000│ displayed.

ENABLING PASSWORD SECURITY

When security is disabled, both password 1 and password 2 are set to “0000.” Security is enabled by setting password 2 to a non-zero value.

Level 2

Select │configuration │password 2│ from the menu. The analyzer will display │0000│. Use the arrow keys to change the display to the desired password for level 2. You can press *SAMPLE* at any time to safely cancel password entry. Press *ENTER* to enter the password into memory and to enable password security. The analyzer program automatically returns to the configuration menu.

With only password 2 set to a non-zero value, level 2 access is required to make changes in the configuration menu but all other settings are unprotected. Effectively the user will always have at least level 1 access.

Level 1

At this point, password 1 is still “000.” You may optionally enable operator access control or level 1 security by changing the level 1 password from “000" to a non-zero value. Change the password by selecting │configuration │password 1│ from the menu, then entering an appropriate 3-digit password.

RECORDING YOUR PASSWORDS

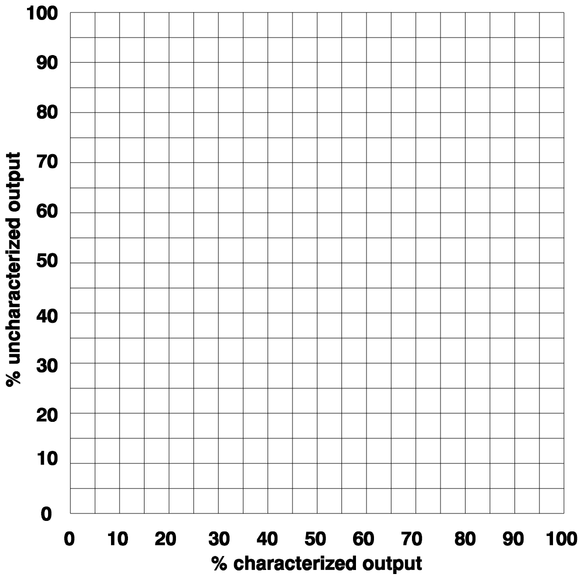
You may want to write down the passwords you set and store them in a secure place. Once a password has been set, there is no way to redisplay it. Since passwords are set in the configuration menu, level 2 access is required to change either password. If you have forgotten the level 2 password, there is no simple way to regain access to the analyzer. Contact the factory if you find yourself locked out of the analyzer.

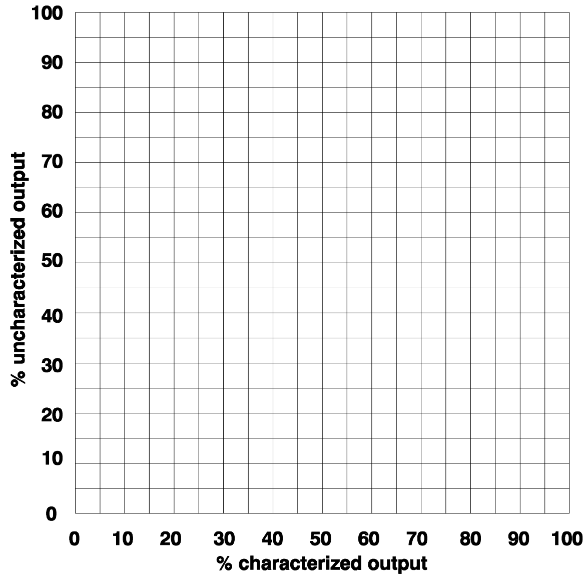
DISABLING PASSWORD SECURITY

Password security can be disabled by setting the level 2 password to “0000.” In order to change the password you must first have level 2 access to the program.

Select │configuration │password.2│ from the menu, then press *ENTER* when the program displays │0000│. Both passwords 1 and 2 are set to “0000" and security is now disabled. The main menu will be changed to exclude the │password│ frame , and the configuration menu will no longer have the [password 1] frame.

Appendix B — Output Characterization





% Uncharacterized Output	***% Characterized Output***	***Input units eg. (pH, mV, µS/cm , °C)***	***4-20 mA output***
0		LO	4.00
5			4.80
10			5.60
15			6.40
20			7.20
25			8.00
30			8.80
35			9.60
40			10.40
45			11.20
50			12.00
55			12.80
60			13.60
65			14.40
70			15.20
75			16.00
80			16.80
85			17.60
90			18.40
95			19.20
100		HI	20.00

Appendix C — Default Settings, Conductivity

The following program settings are the default settings for the analyzer. New analyzers will have these settings unless the setup has already been customized for your application.

Alarms

	alarm 1	**alarm 2**	**alarm 3**	**alarm 4**
input	Conductivity1	Conductivity1	Conductivity1	Conductivity1
unit	µS/cm	µS/cm	µS/cm	µS/cm
on/off	off	off	off	off
deviation	20.0 µS/cm	20.0 µS/cm	20.0 µS/cm	20.0 µS/cm
differential	10 µS/cm	10 µS/cm	10 µS/cm	10 µS/cm
delayed activation	0 s	0 s	0 s	0 s
setpoint	900 µS/cm	100 µS/cm	930 µS/cm	130 µS/cm
function	high	low	high	low

Application: normal (conductivity 50 to 500,000 µS/cm)

Outputs

	output 1	**output 2**
input	Conductivity1	TEMP1
unit	µS/cm	°C
on/off	on	on
high	1000 µS/cm	100.0 °C
low	0.0 µS/cm	0.0 °C

Global units metric/imperial: metric (example: temperature in degrees Celsius)

Relays . . . . ownership

NO/NC: normally open

Relay 1	Alarm 1
Relay 2	Alarm 2
Relay 3	Alarm 3
Relay 4	Alarm 4

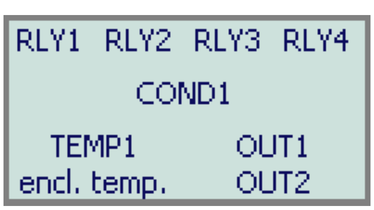
Security

not enabled

Temperature compensation method for Conductivity

Automatic TC using temperature input, reference temperature 25 ºC

Display configuration



Position	Signal	unit
1	COND1	µS/cm
2	TEMP1	ºC
3	OUT1	mA
4	Encl. Temp.	ºC
5	OUT2	mA

Appendix D — Parts List

Part Number	*Description*	*Reference Drawing Number*
210-C Conductivity Analyzer		
A9051064	Assembly; 210 power PCB	D5060288
A9051065	Assembly; 210 micro board	D5060289
A9051067	Assembly, 210 Conductivity input one module	
A9141032	Assembly; 210 case, complete	
A9201052	20-wire interconnector cable, two-end	
A9160024	0.25 A microfuse	
A9160035	3 A microfuse (used with option -51; timer)	
A3200124	Hardware set, 210 front panel;	
A3200125	Hardware set, 210 power panel;	
A2500272	Panel mounting kit; 210	D4810086
A2500273	Pipe/wall mounting kit; 210	D4810087
A2500274	Liquid tight enclosure plug IP66 NEMA 4X, set of 3	
A2500275	Liquid tight ½ inch conduit connector IP66 NEMA 4X	
A2500279	Liquid tight PG 13.5 conduit connector IP66 NEMA 4X	
400 J-Box Conductivity, Wall Mount Type		
A9120050	Terminal block 6 CKT	D5080298
A2101514	Weather proof, wall mount J-Box (only)	
Interconnect Cable, 400 J-Box to Analyzer		
A9200000	Conductivity cable, 5-conductor with shield	D5080298
400-78XP J-Box, Pipe Top, Explosion Proof Type		
A9120098	Terminal strip 6 CKT	D5080298
A2101513	Explosion-proof J-box (only)	
Consumable Supplies		
A1100161	100 µS/cm Conductivity standard, 500 mL (A11001611-6P for 6-pack)	
A1100162	1000 µS/cm Conductivity standard, 500 mL (A1100162-6P for 6-pack)	
A1100232	146.96 µS/cm ASTM Cond. standard, 500 mL (A1100232-6P for 6-pack)	
A1100231	1408.8 µS/cm ASTM Cond. standard, 500 mL (A1100231-6P for 6-pack)	
A1100230	12856 µS/cm ASTM Cond. standard, 500 mL (A1100230-6P for 6-pack)	
A1100229	111342 µS/cm ASTM Cond. standard, 500 mL (A1100229-6P for 6-pack)	
A1400051	Conductivity calibration kit, 1 year supply, cell constant 0.01 to 0.2/cm.	
A1400052	Conductivity calibration kit, 1 year supply, cell constant 0.1 to 5.0/cm.	
A1400053	Conductivity calibration kit, 1 year supply, cell constant 10.0 to 50/cm.	
A1400054	Conductivity chemical cleaning kit.	
A1100192	Deionized rinse water, 500 mL (A11000192-6P for 6-pack)	

Appendix E — Communications

RS485 can be used to send ASCII format serial Conductivity and temperature (default frequency is 1 second), or as a two-way communication port for remote operation if an interface format program is available. Multiple units with RS485 can be connected together on the same wires when used with a RS485 computer communication port and program. A portable computer with an RS232 port can collect the data fram a single unit with a RS232 to RS485 converter. No special software is needed on the computer to receive only ASCII data as CSV (Comma-Separated Values), only an ASCII terminal program such as Hyperterminal on MS Windows systems. The ASCII data port function can be turned on/off and controlled from the communications menu.

CSV data logging

- "CSV" identifies the format of the output as CSV: Comma-Separated Values. CSV is a common data format where values in different columns are separated by commas. Programs such as Excel, OOo Calc, and DPlot recognize files with the CSV extension as containing ASCII text representing columns of data. Text in the first row is typically recognized as containing column headers.
- All regular inputs are transmitted, for 210-C this includes Conductivity1, output1, TEMP1, enclosure temperature.
- First column is incrementing index number.
- The first line has column labels which assist in data identification and can be imported as column headers in spreadsheets. Labels are same as used for identification on sample display.
- Index number is reset to 1
  - at bootup
  - when serial communications is turned on
  - when CSV data logging function is selected
- For temperature inputs, units observe the global "configuration > units" setting.

- Example of CSV output is shown below.

Index,	Conductivity1,	output1,	TEMP1,	enclosure temp.
1,	5217,	19.09,	59.68,	73.85
2,	5217,	19.09,	59.68,	73.85
3,	5217,	19.09,	59.68,	73.85
4,	5217,	19.09,	59.69,	74.08
5,	5217,	19.10,	59.69,	74.08
6,	5219,	19.16,	59.69,	74.08
7,	5219,	19.16,	59.69,	74.08
8,	5219,	19.16,	59.69,	74.08
9,	5219,	19.16,	59.69,	74.08
10,	5220,	19.22,	59.69,	74.08

RS485 Wiring and Enabling

1) It is good practice to first turn off the analyzer and the computer before connecting a serial cable.
2) Bring the RS485 cable into the analyzer through the left front hole. Wire the RS485 cable into the terminal block TB1 located on the communications board. Connect the RED to terminal A, Black to terminal B, and the clear to EARTH. Refer to illustration 54. Connect shield to earth at analyzer end only!
3) For multiple analyzers, similarly bring the RS485 cable onward to the next analyzer through the left

front hole. Wire the RS485 cable into the terminal block TB1 located on the communications board. Connect the RED to terminal A, Black to terminal B, and the clear to EARTH. Refer to illustration 54. Connect shield at each analyzer. At the last analyzer insert a jumper at JP2 to hook up a termination resistor.

4) Turn on the analyzer and the computer.

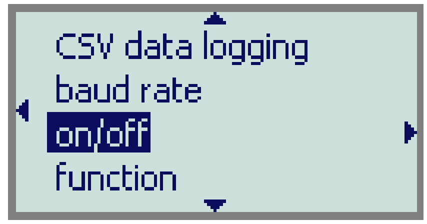


Illustration 53: communications menu

5) Configure the analyzer for communication. Select |communications|baud rate| from the menu. Baud rates from 1200 to 9600 baud can be selected, the default is 9600 baud. For RS485 systems with automatic send data control the best baud rate is 9600.
6) To enable data communication by the analyzer, set the |on/off| switch to ON.
7) To turn on a data format; select |function| and select from the list. Your selection will now show up in the communications sub menu. The default send rate is every second, helpful to confirm data receipt in your computer.
8) After data stream is confirmed, you can go to your function in the memory and set any available variables. Example: |communications|CSV data logging|interval, seconds| press *enter* and edit as needed.
9) With noisy environments it may be desirable to insert a jumper at JP3 on the communication boards modify the slew rate to deal with the noise.

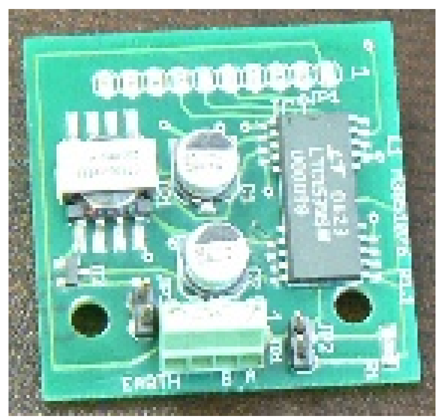


Illustration 54: RS485 wiring

Portable Laptop Hookup

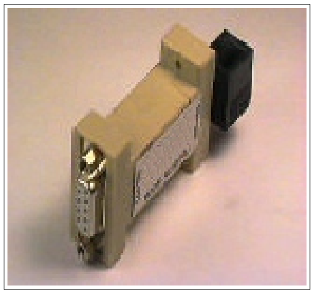


Illustration 55: Port-powered RS232 to RS485 converter

RS232 to RS485 Converter

The P/N A7900015 is a port-powered, half-duplex RS232 to RS485 converter. The unit supports two-wire RS485 communications. The converter handles the enabling and disabling of the transmitter. This works regardless of the operating system or program you are running. The RS232 side has a DB9 female connector. The RS485 side has a six-position RJ11 connector.

Material List:

- P/N A7900015, RS232 to RS485 converter
- P/N A2500192, 10 foot cable with RJ11 connector at one end, data wires at other end

Installation:

1) It is good practice to first turn off the analyzer before connecting a serial cable.
2) Bring the RS485 cable into the analyzer through the left front hole. Wire the RS485 cable into the terminal block TB1 located on the communications board. Connect the RED to terminal A, Black to terminal B, and the clear to EARTH.
3) Connect the converter to a free COM port on your laptop computer.
4) Insert the cable's RJ11 connector into the converter.

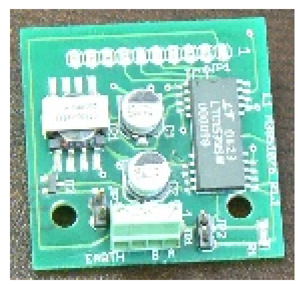


Illustration 56: Wiring RS485

Making a Custom Cable:

A cable has been provided with the adapter. If this cable is not long enough, use the following information to create your own cable. Connect shield at one end only.

Converter Signal	*RJ11 Pin Number*
Data A (-) RED	2
Data B (+) BLK	5
Signal Ground	4

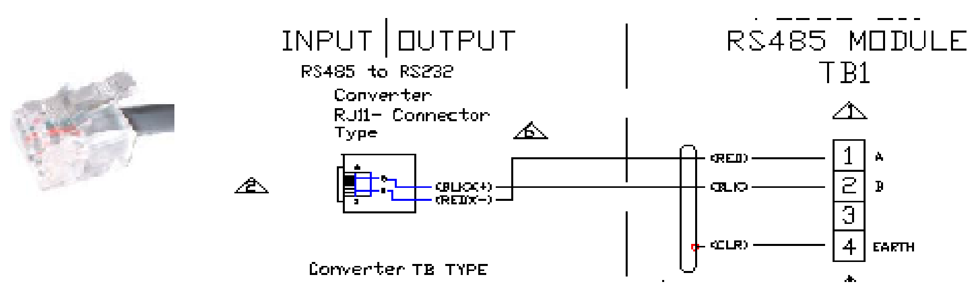


Illustration 57: Wiring RS485 cable

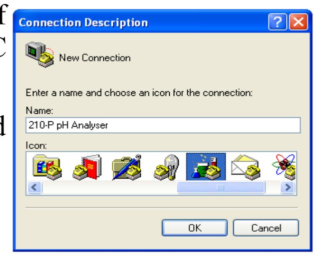
Collecting your data in a windows based portable.

Example: Use Windows 95/98/NT/XP Hyperterminal

To illustrate the capturing of data on a computer, the following is the description for loading and setting up the *Hyperterminal* program, versions of which come with Windows 95, Windows 98, and Windows NT, and XP. Vista and later versions require the addition of Hyperterminal,you can get HyperTerminal from Hilgraeve, the company that Microsoft licensed the application through.

You could also use the old XP Hyper terminal. Just extract two files hypertrm.dll and hypertrm.exe. You can put them anywhere on the disk, no installation required. Of course, for that you need to have XP to extract files from.

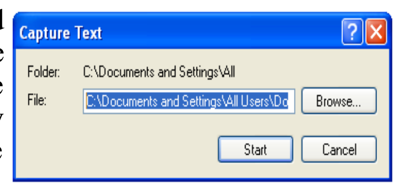
1) From the Start menu, select Programs | Accessories | Communications | Hyperterminal (Win95/98) or Programs | Accessories | Hypterterminal (WinNT), then click on the Hyperterminal program icon.
2) For a new communications setup, you will be prompted for the name of the connection. Give the connection a descriptive name, e.g., "210-C Conductivity analyzer", then click on OK.



3) In the "Connect To" dialog box click on the "Connect using:" list and select the COM port to which the 210 is connected, e.g., select COM1.
4) In the "COM1 Properties" dialog box use the following settings:

   Bits per second: 9600 (baud rate)
   Data bits: 8
   Parity: None
   Stop bits: 1
   Flow control: None

   Click on OK. To return to this dialog box later, for example to change the baud rate, from the menu select File | Properties then click on the "Configure..." button.
5) To capture data into a file, from the menu select Transfers | Capture text
   Specify the file name and location (Example: C:\Documents and Settings\All Users\Documents\Data Logs\log01.TXT) or use the Browse button to select an existing file to append to. The hyperterminal program will now store any CSV data sent out by the analyzer into the specified file. (You can also use .csv as a file format).



6) To pause or resume data collecting to the specified file, select Transfers | Capture text, then Stop or Resume.
7) To finish the collecting of data, select Transfers | Capture text | Stop from the menu.
8) When exiting the program, a dialog box will ask: Do you want to save session 210-C Conductivity analyzer? If you respond Yes, the next time you select Hyperterminal from the Start menu, you will be able to select the "210-C Conductivity analyzer" settings.

Getting your data into a spreadsheet program.

Example: Load Log File in Excel

The following example illustrates how to load a log file into Microsoft Excel.

1) Open Excel, then from the menu select File | Open.
2) Navigate to the log file. If you used the .TXT, .PRN, or .CSV extension for the log file, you may want to change "List Files of Type" to "**Text Files**", otherwise use **All Files (*.*)**. Select the log file, then click on OK.
3) The "Text Import Wizard" dialog box should open. In "Original Data Type" select **Delimited**, then click the "Next >" button.
4) Under **Delimiters** select "Comma".
5) Click the "Finish" button to load the log file into Excel.
6) The line number or date/time stamp will be loaded in column A, and the input values will be loaded in columns B, C, etc. The date/time stamp will be treated as text, while the input values will be treated as numeric values that can be graphed, manipulated, etc.

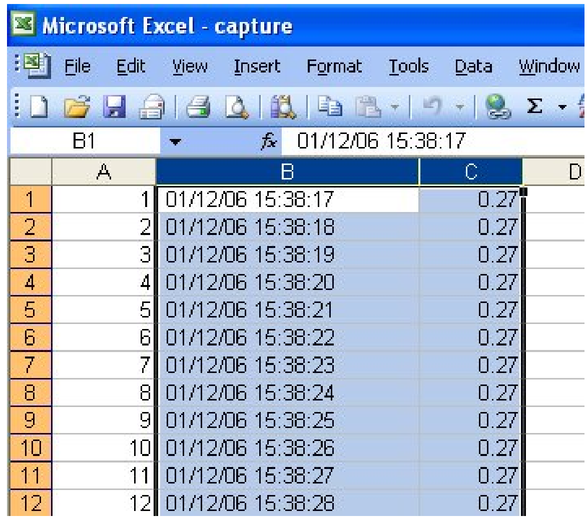
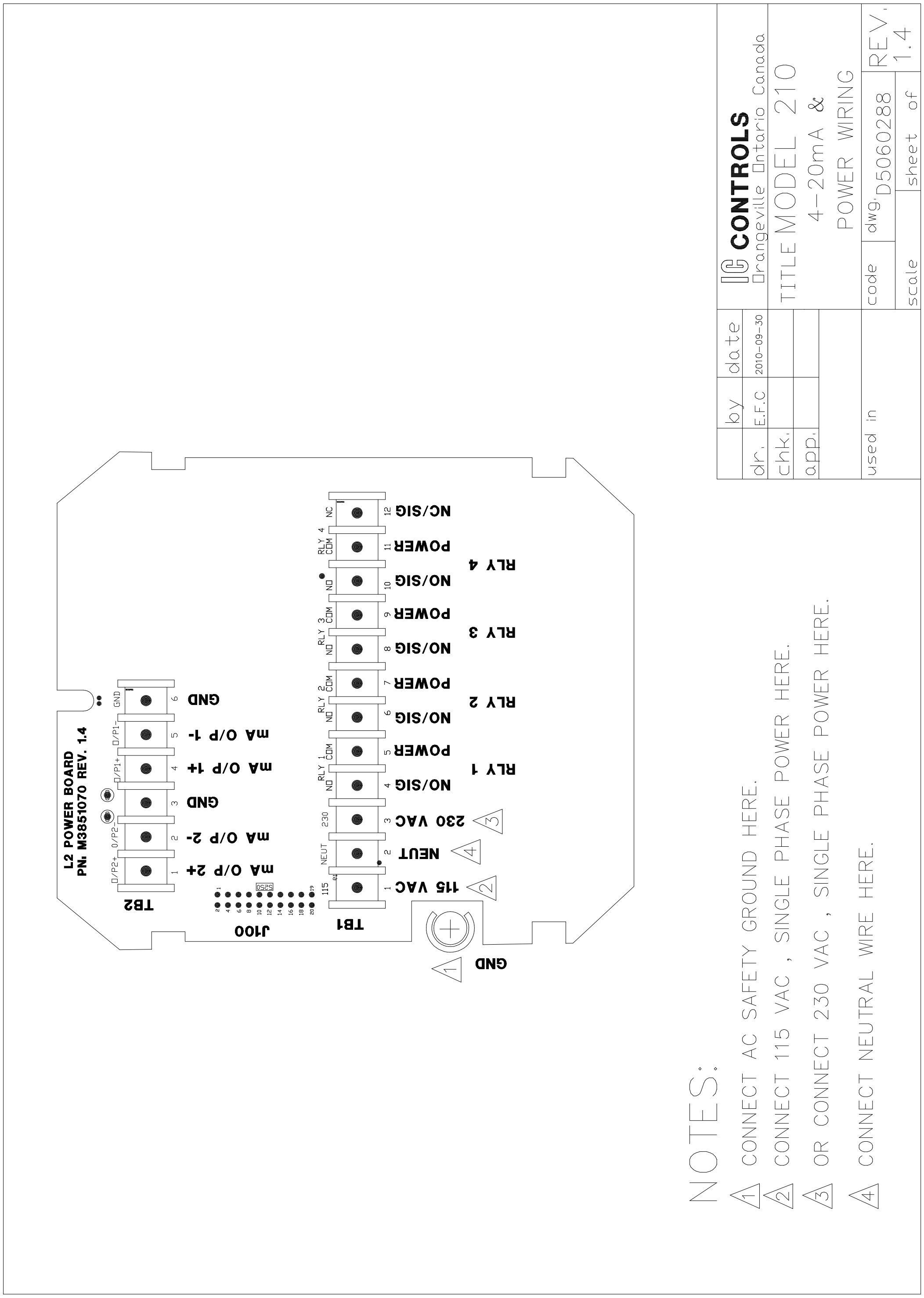


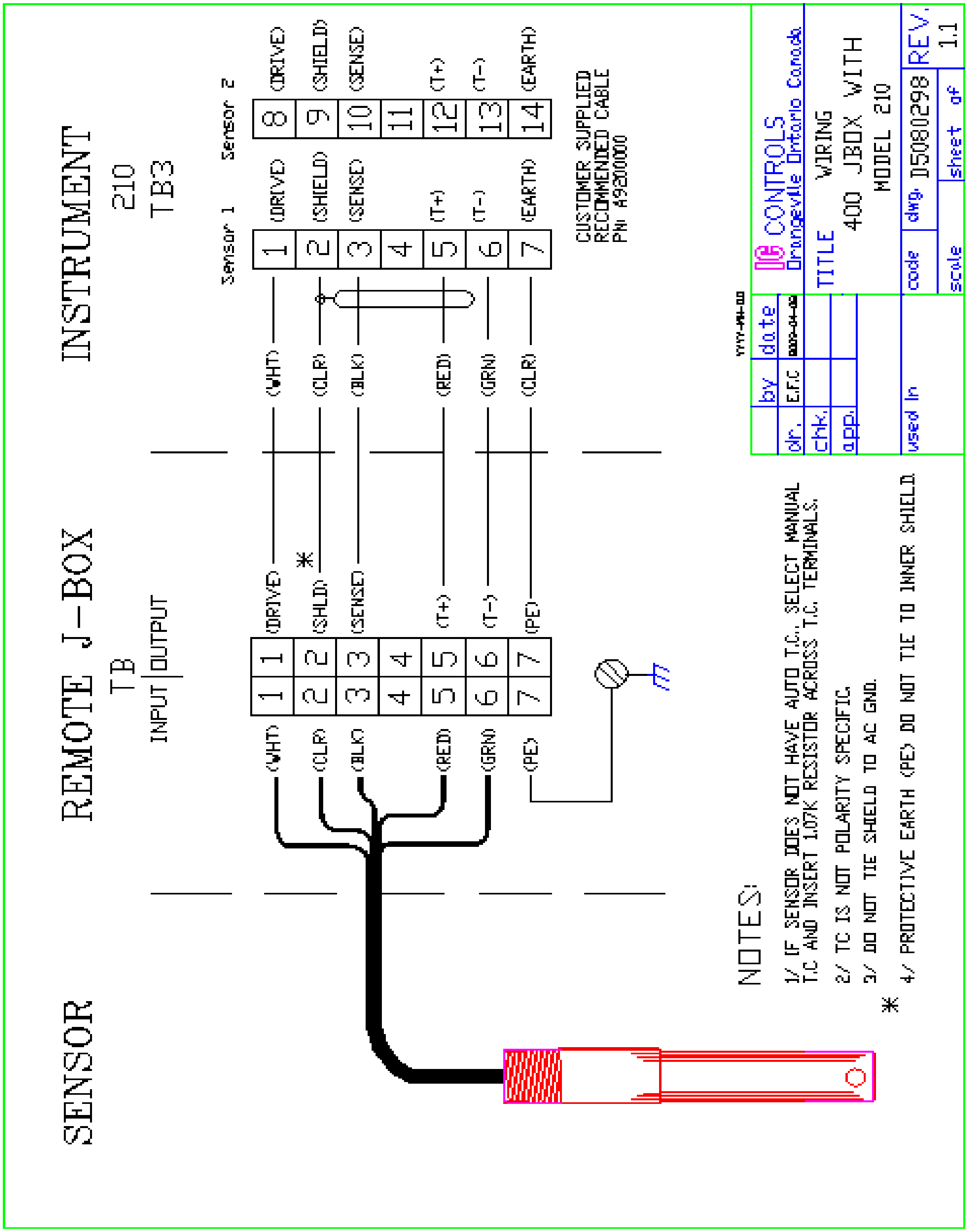
Illustration 58: Excel spreadsheet

DRAWINGS

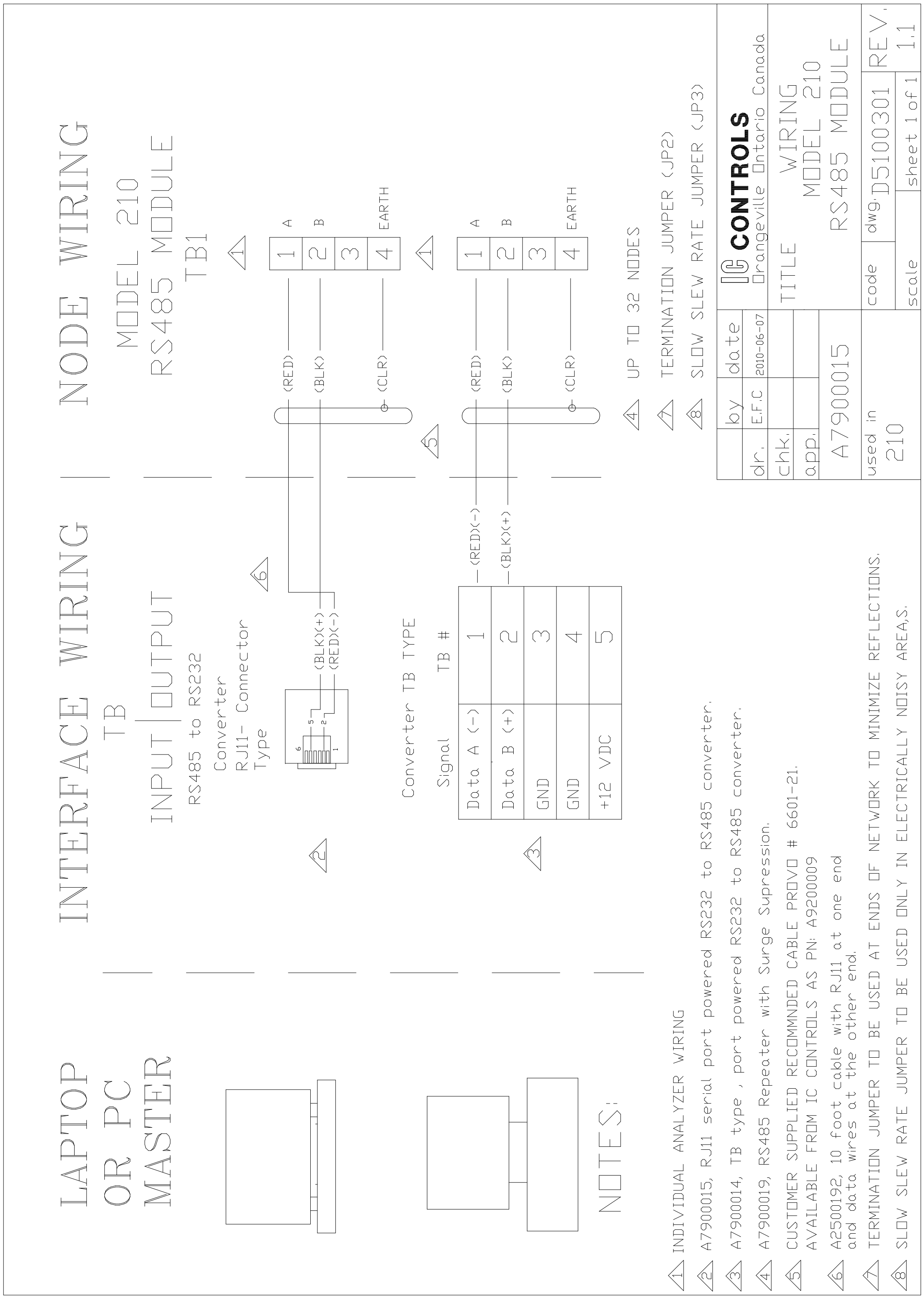
D5900288: Wiring & Terminal Location



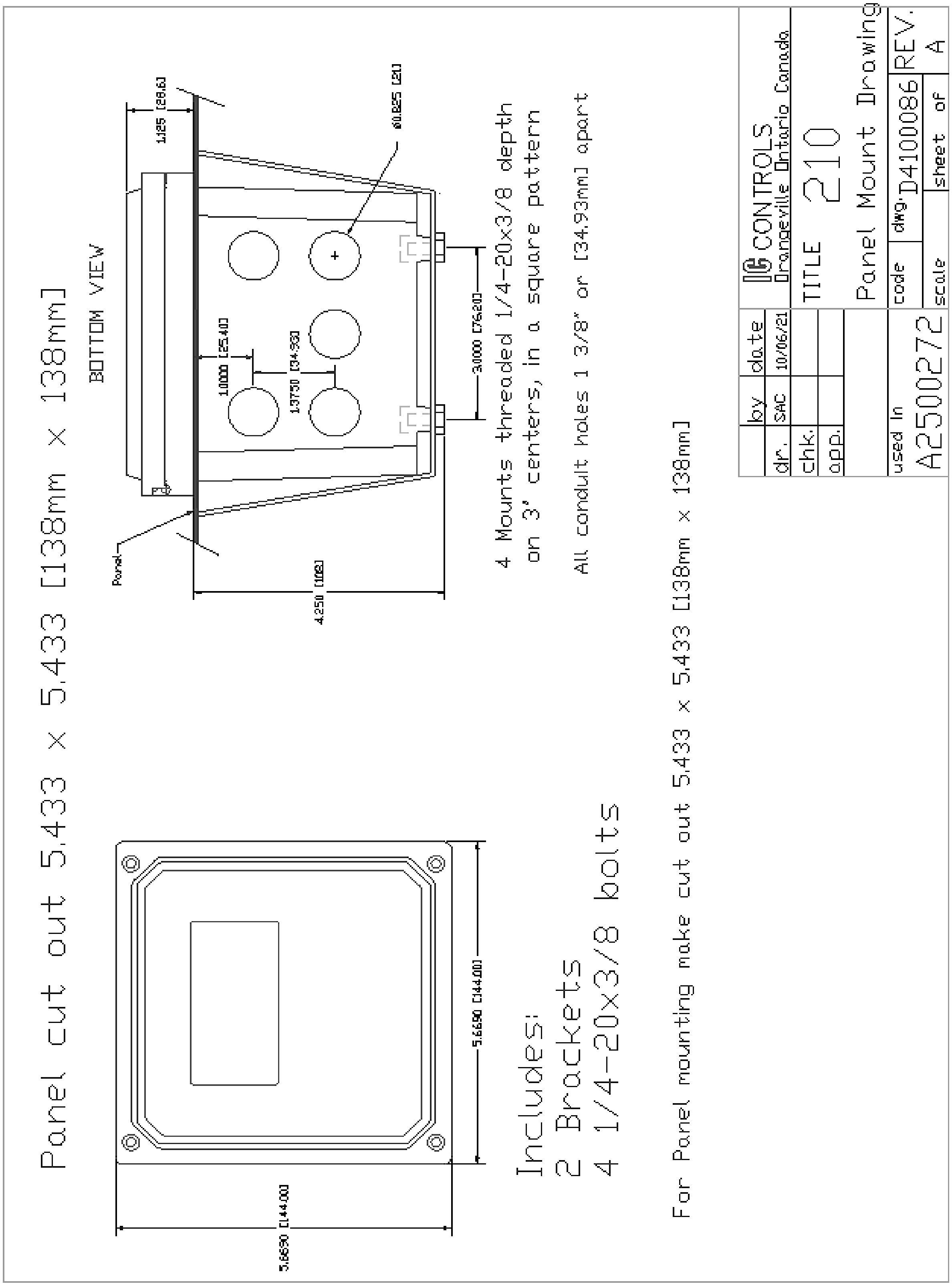
D5080298: Sensor Wiring and 400 Jbox



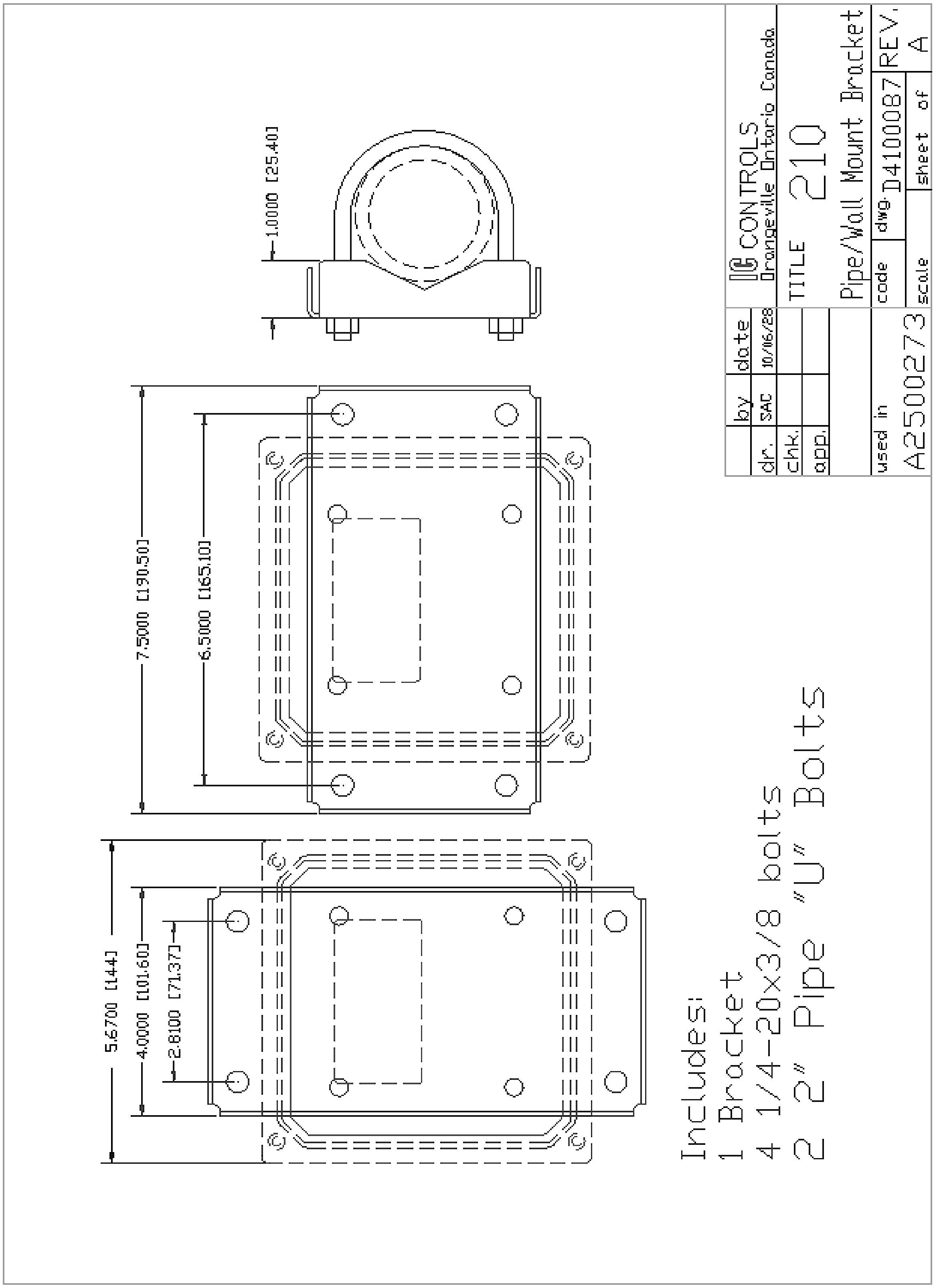
D5100301: Wiring RS485 Module



D4100086: Panel Mounting



D4100087: Pipe/wall Mounting



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