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DIONEX

CD20 CONDUCTIVITY DETECTOR
OPERATOR'S MANUAL



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1 • Introduction

1.1 Overview

The CD20 Conductivity Detector is a sensitive, accurate, and versatile instrument for detecting and quantifying ionic analytes in liquid and ion chromatography. It is especially useful for analytes that lack UV chromophores and cannot be determined with adequate sensitivity by UV absorbance. Conductivity detection, especially when combined with chemical eluent suppression, provides excellent sensitivity and selectivity for numerous ionic species, both organic and inorganic.

The major organic analytes are carboxylic, sulfonic, and phosphonic acids; and primary, secondary, tertiary, and quaternary amines. Inorganic analytes include strong acid anions such as the halides, sulfate, nitrate, and phosphate; alkali metal and alkaline earth cations.

1.2 About This Manual

Chapter 1, **Introduction**, provides a brief overview of the CD20 Conductivity Detector and explains the conventions used in this manual, including safety information.

Chapter 2, **Description**, describes physical aspects of the CD20 (front panel controls, electronics, flow cell, etc.), as well as the detector operating modes.

Chapter 3, **Operation and Maintenance**, discusses operating features and explains how to create, edit, and run methods. Routine preventive maintenance requirements are included at the end of this chapter.

Chapter 4, **Troubleshooting**, lists minor operating problems and step-by-step procedures to isolate and eliminate them.

Chapter 5, **Service**, presents step-by-step instructions for routine service and parts replacement procedures.

Chapter 6, **Conductivity Detection**, discusses conductivity detection and its applications.

Appendix A, **Specifications**, lists the CD20 specifications and installation site requirements.

Appendix B, **Installation**, describes how to install the CD20.

Appendix C, **Display Screens**, illustrates and describes all front panel operating and diagnostic screens.

Appendix D, **Signal Processor Functions**, lists the functions of the Signal Processor (SP) card.

Appendix E, **Connector Pinouts**, describes the pinouts for all CD20 connectors.

1.2.1 Typefaces

Typefaces are used in this manual as follows.

- Capitalized bold type indicates a front panel button:

  Press **Enter** to begin running the method.

- Upper-case bold type indicates the name of a menu, the name of a screen, or an on-screen entry:

  Display the **METHOD** screen.

  Move the cursor to the **EDIT** field.

1.2.2 Safety Messages and Notes

This instrument has been designed to comply with the requirements for safety set forth in IEC 1010 *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use*.

This manual contains warnings and precautionary statements that can prevent personal injury and/or damage to the instrument when properly followed. Safety messages appear in bold type and are accompanied by icons.



Indicates a potential hazard which could result in serious injury or loss of life. Any hazard of this type will be located behind a barrier and will be accessible only by use of a tool. Access may be required during installation, maintenance, or service.



Indicates a potential hazard to the operator, or damage to the instrument or other property.

IMPORTANT

Indicates that the function or process of the instrument may be impaired. Operation does not constitute a hazard.

Informational messages also appear throughout this manual. These are labeled NOTE and are in bold type:

NOTE
NOTES call attention to certain information. They alert you to an unexpected result of an action, suggest how to optimize the performance of the instrument, etc.

1.2.3 Symbols

The symbols below appear on the detector, or on detector labels.

~ Alternating current

 Protective conductor terminal

| Power supply is on

 Power supply is off

1.3 Related Manuals

During installation and operation of the CD20, you may need to refer to one or more of the following manuals (depending on your system) for information about other modules and components in the DX 500 system.

The following manuals are provided with their respective products:

LC10 Chromatography Organizer Operator's Manual (Document No. 034858)

LC20 Chromatography Enclosure Operator's Manual (Document No. 034859)

LC30 Chromatography Oven Operator's Manual (Document No. 034860)

GP40 Gradient Pump Operator's Manual (Document No. 034856)

IP20 Isocratic Pump Operator's Manual (Document No. 034857)

PeakNet Software User's Guide (Document No. 034914)

The following manual is provided in the CD20 Ship Kit:

Installation of Dionex Ferrule Fittings (Document No. 034213)

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2 • Description

The CD20 Conductivity Detector is housed in a single-unit DX 500 enclosure (see Figure 2-1). The detector can be stacked on top of other DX 500 units, up to a maximum height of four units. For an illustration of the recommended stacking configuration for DX 500 systems, see Figure B-1 in Appendix B.

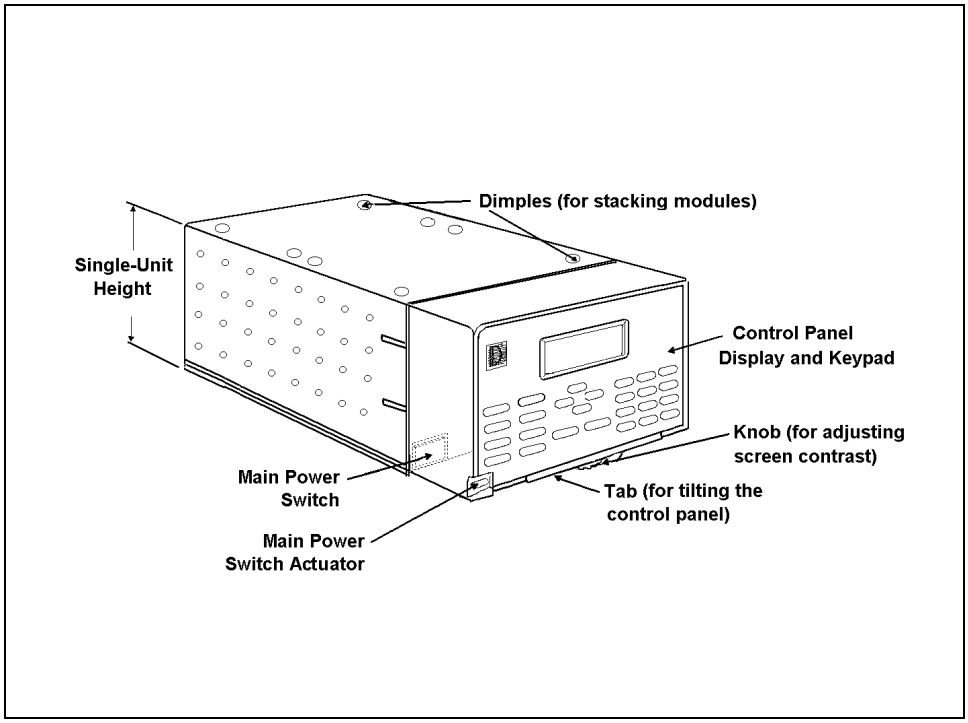


Figure 2-1. CD20 Enclosure

2.1 Front Control Panel

The control panel on the front door of the CD20 contains the liquid crystal display (LCD), the membrane keypad, and the actuator for the main power switch. The electronics chassis is located behind the front door.

Power Switches

The main power switch is on a bulkhead inside the electronics chassis (in the front, left-hand corner). The actuator for the power switch is on the front door, below the control panel (see Figure 2-2). The actuator functions only when the front door is fully closed. When the door is open, press the main power switch to turn the CD20 on and off.

2.1.1 Control Panel Display

The LCD, also called the *screen,* displays CD20 status and operating information. Fields on the screen that are in reverse video (blue letters on a white background) can be edited, while normal video fields are simply informational displays.

There are three ways to improve screen visibility:

- The screen contrast can be adjusted by rotating the knurled knob in the recess below the **Help** and **Menu** buttons.
- The brightness of the screen backlight can be adjusted by resetting this option on the **MODULE SETUP** screen (see Section C.1.5).
- The front control panel can be tilted to four positions. To tilt the panel, lift firmly on the tab in the middle of the recess below the keypad (see Figure 2-2). Push on the tab to return the panel to its vertical position.

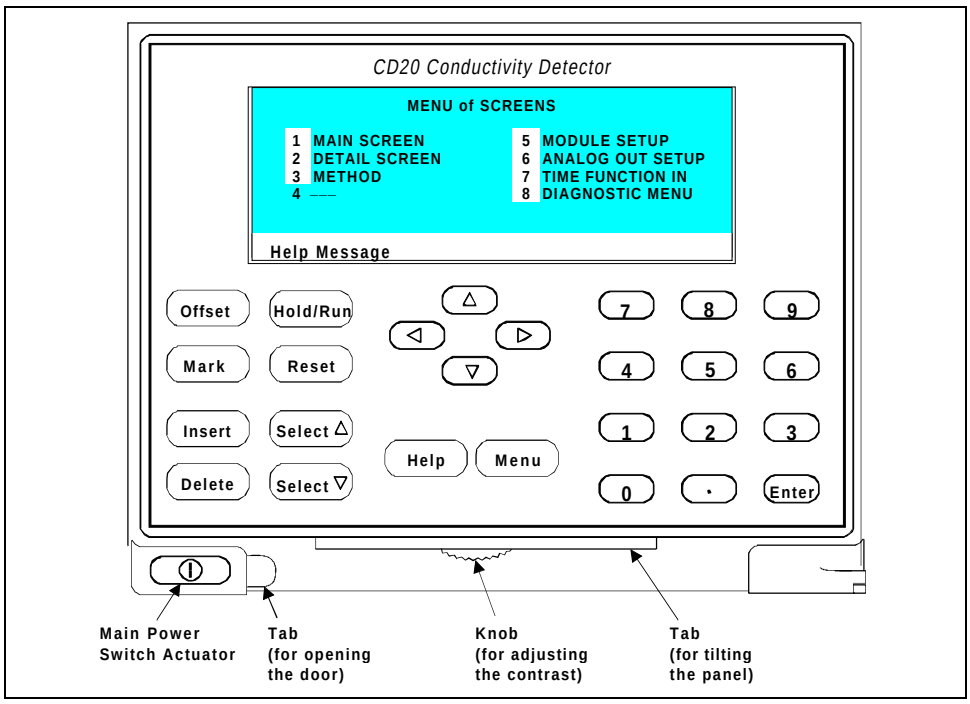


Figure 2-2. CD20 Front Panel

2.1.2 Control Panel Keypad

The buttons on the front panel keypad are used to affect screen functions, to control CD20 operation directly, and to create and modify programmed series of timed events, called methods. For example, pressing **Hold/Run** turns the method clock off **(Hold**) and on **(Run)**, while pressing **Menu** displays a list of available screens. In summary:

- To move from a menu to a screen that is listed as a menu option, press the number button that corresponds to the screen's number, or move the cursor to the desired screen name and press **Enter**.

- To edit a reverse video entry field on a screen, use the four directional arrow buttons to move the cursor to the field. Use the numerical buttons to enter variable values. Use the **Select** ∆ and **Select** ∇ buttons to choose predetermined values.
- To confirm the selected value, you can usually either press a cursor arrow button or press **Enter**. However, in certain fields and/or screens, the only way to confirm the selected value is by pressing **Enter**. These exceptions are the **METHOD** and **SCHEDULE SAVE TO** fields, the **METHOD** and **SCHEDULE RUN** fields, any calibration command, the **DIAGNOSTIC TESTS** screen, and all menu screens.

NOTE
A beep sounds each time you press a keypad button, and a lower frequency beep sounds whenever an error occurs. You can disable the beeps from the MODULE SETUP screen.

Offset

Returns the analog (recorder) output to a predetermined baseline and zeros the display. The resultant value of the offset required is displayed on the **DETAIL** screen. This function can be programmed in a method.

Mark

Sends a 10% positive event mark to the analog (recorder) output. For example, a mark is typically used to indicate a sample injection. This function can be programmed in a method.

Insert

Inserts a new step into a method or waveform.

Move the cursor to the **TIME** field and press **Insert** to add a new step after the cursor position. The parameter fields in the new step will be blank. After entering a time value, press **Enter** or a cursor arrow button. Insert steps in any order and they will be automatically reorganized in the correct chronological order.

Delete

Removes the value from the current entry field so that you can enter a new value. If you press **Delete** and then need to restore the previous value, move the cursor from the field without entering a new value.

Pressing **Delete** when the cursor is in a step entry field on the **METHOD** or **WAVEFORM** screen "blanks" the step parameter value. Moving the cursor to another field does not restore the previous value; instead, the step remains blank, indicating no change from the previous step.

To delete an entire method step:

1. Position the cursor in the method's time field and press **Delete**. The time is removed and the help line displays this message:

   ```
   TO DELETE THIS STEP, PRESS DELETE AGAIN
   ```

2. Press **Delete** again to delete the step. Or, to restore the original time and step parameters, press any button except **Delete**.

Hold/Run

Turns the method clock off (**Hold**) and on **(Run)**. This button functions only when the detector is under Method control (see Section 2.5.2).

When the method clock is in Hold, pressing **Hold/Run** starts the clock at either the initial step of a new method or, if resuming an interrupted method, at the time at which the clock was put in Hold.

When the method clock is in Run, pressing **Hold/Run** stops the method clock, thereby "holding" the method and freezing the current conditions.

Reset

Changes the method clock time to **INIT**, causing the initial conditions specified by the method to occur. This button functions only when the detector is under Method control (see Section 2.5.2).

If the method is running, it continues running. If the method is in Hold, the method clock executes the initial conditions and holds.

Select Δ and Select ∇

When the cursor is positioned at a field with predetermined parameters, these buttons cycle through the options. In fields with predetermined numerical values, pressing **Select** Δ increases the value by one unit; pressing **Select** ∇ decreases the value by one unit. Holding down a **Select** button increases (or decreases) the value continuously. Press **Enter** or a cursor arrow button to confirm the selected value.

←, ↑, →, and ↓

The four cursor buttons move the cursor, in the direction of the arrow, to the next entry field. If there is no changeable field in that direction, the cursor moves diagonally or remains in its current location.

After entering a new value in an entry field, pressing an arrow button to move to another field saves and/or executes the change, except for the following cases: the **METHOD** and **SCHEDULE SAVE TO** fields, the **METHOD** and **SCHEDULE RUN** fields, any calibration command, the **DIAGNOSTIC TESTS** screen, and all menu screens.

Help

Displays a help screen with information pertaining to the current entry field.

Menu

From an operational screen, pressing **Menu** displays the **MENU of SCREENS**. From a diagnostic screen, pressing **Menu** once returns you to the **DIAGNOSTIC MENU**; pressing **Menu** again returns you to the **MENU of SCREENS**.

Numeric Buttons

Enters numeric values into the current entry field. The numeric buttons are 0 through 9 and the decimal.

On a menu screen, pressing a numeric button opens the corresponding screen.

Enter

Saves and/or executes changes made in entry fields. If a menu screen is displayed, pressing **Enter** opens the highlighed screen.

2.2 Rear Panel

The CD20 rear panel (Figure B-2) contains fuses, connectors for line power, and a connection for the optional DX LAN interface.

Power Entry

The power entry, fusing, and EMI filter are mounted on the rear of the 45 W power supply module. The power entry is socketed for a modular power cord (IEC 320 C13). The detector requires a grounded, single-phase power source. The detector may be operated from 85 to 270 Vac, 47 to 63 Hz power. The input power is 50 W maximum. The line voltage is automatically selected and requires no adjustments.



SHOCK HAZARD—If a grounded receptacle is not used, a shock hazard may result. Do not operate or connect to AC power mains without earthed ground connections.

Fuses

The CD20 uses two 3.15 A fast-blow fuses (IEC 127 type 1, P/N 954745). See Section 5.3 for instructions on replacing the fuses.



For continued protection against risk of fire or shock, always replace with fuses of the same type and rating.

DX LAN Connection (Optional)

When you order the DX LAN network, a standard BNC connector is factory-installed in the upper left corner of the CD20 rear panel (see Figure B-2 in Appendix B).

NOTE

To use PeakNet software to control CD20 operation via the DX LAN, you must install a detector interface card (P/N 044196) in the CD20. See Section B.3.2 for installation instructions for the card.

External Connection Access

Connections to the front of the electronics chassis, such as TTL and relay cables, are usually routed to the back of the detector through the cable chase in the bottom of the electronics chassis. They may also be passed through slots at the front of the detector. Cables exit the CD20 through an opening in the rear panel (see Figure B-2).

2.3 Electronics Chassis

The electronics chassis is located immediately behind the front door of the CD20. The chassis contains several electronics cards (printed circuit boards) that are used to control the CD20. Various connectors on the cards allow communication between the CD20 and other DX 500 modules and accessories. Figure 2-3 identifies the cards and their connectors.



Do not remove any of the electronics cards from the detector. There are no user-serviceable components on the cards. If a card requires servicing, it must be performed by qualified personnel following appropriate electrostatic discharge (ESD) handling procedures.

2.3.1 Connectors

Recorder (Slot 2)

This connector is typically used for a recorder/integrator or diagnostic instruments. For a description of the connector pinouts, see Table E-1 in Appendix E.

SRS™ (Slot 2)

All connections to the Self-Regenerating Suppressor, including power, connect here.

DS3 (Slot 2)

All connections to the DS3 Detection Stabilizer, including power, connect here.

Conductivity Cell (Slot 3)

Provides all connections to the conductivity cell, including temperature compensation.

TTL/Relay (Slot 4)

This strip of eight connectors provides an interface with Dionex and non-Dionex modules for TTL and relay control of the detector. See Appendix E for a description of relay and TTL functions and the connections between the CD20 and other modules.

60-pin ribbon connector (Slot 5)

This is the connector plug for the 60-pin ribbon cable to the CD20 front panel (display and keypad).

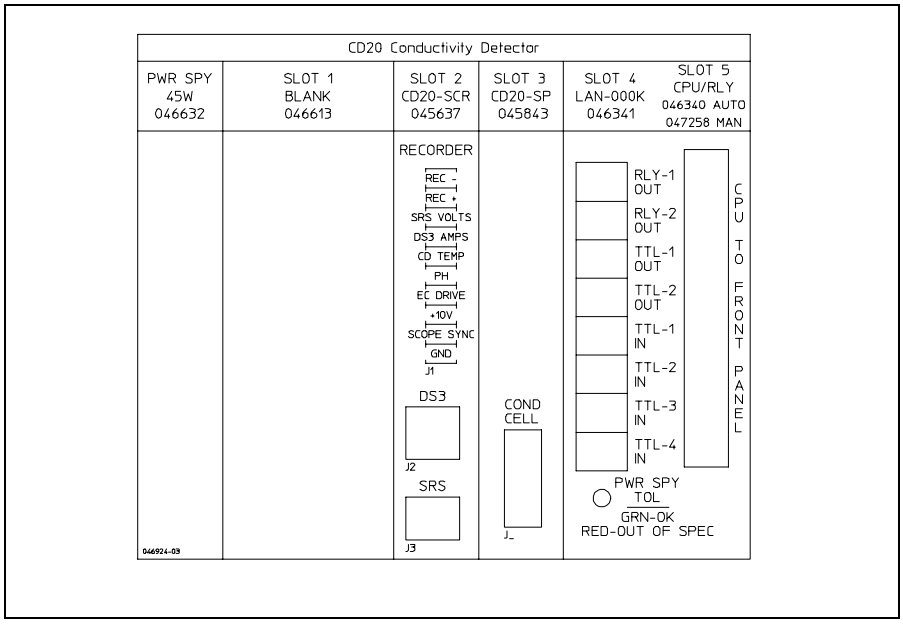


Figure 2-3. CD20 Electronics Chassis Components

2.3.2 Cards

Power Supply Card

Provides 45 watts of power for the detector electronics.

Blank Card

Slot 1 contains a blank card that must be present to complete the electromagnetic interference (EMI) shielding.

SCR (Supply Control/Relay) Card

Interfaces to the CPU; the card contains three functions:

- *16-bit Recorder Output Digital-to-Analog Converter*—Includes an electronic switch for selection of full-scale outputs of 0.01, 0.1, and 1.0 V.

- *SRS Power Supply*—Supplies a regulated current (set by the user) of 50, 100, 300, or 500 mA to the suppressor. An over-voltage detector shuts off the power if the voltage exceeds 8.5 V. An over-temperature detector shuts off the power if the SRS temperature exceeds 40 °C. If either of these events occurs, the SCR card sends an "SRS Alarm" error message to the CPU.
- *DS3 Power Supply*—Supplies heating power to the DS3 Detection Stabilizer. While warming or cooling to a lower set point, a "BELOW TEMP" or "ABOVE TEMP" message is displayed. Once a set point in the range of 25 to 45 °C is reached, proportional heat control maintains a constant temperature.

SP (Signal Processor) Card

Contains all the analog circuitry needed by the CD20, as well as the digital circuitry required to interface to the CPU. See Appendix D for a list of SP card functions.

Relay/DX LAN and CPU Cards

- The CD20 control Moduleware and BIOS reside on the CPU card. The CPU card provides control and monitoring of other modules. A 60-pin ribbon cable assembly links the logic to the CD20 front panel display and keypad.
- The Relay I/O card provides two isolated low voltage relay outputs, two TTL outputs, and four TTL inputs.

The cards are installed in slot 5 of the card cage. The Relay card is a half-card which rides piggyback on the CPU card and sits behind slot 4.

The Relay I/O card is short enough to allow the optional detector interface card (P/N 044196) to be mounted behind it in slot 4. The interface card is required for communication between the CD20 and PeakNet software via the DX LAN.

Power Supply LED

The multicolor LED below the TTL/Relay connections indicates the power supply status:

- A green LED indicates normal operation.
- A red LED indicates a fault condition. When a fault occurs, the CD20 enters its diagnostic state and no other control is permitted until the probelm is corrected. Turning off the power for a few seconds may clear the fault; however, if the red LED is lighted when you turn on the power again, notify Dionex.

2.4 Conductivity Cell

The flow-through conductivity cell has an active volume of about 1.0 µL. Two 316 stainless steel electrodes are permanently sealed into the PEEK cell body. The cell constant has a nominal value of 160 cm^{-1} and is calibrated electronically. A sensor located slightly downstream from the electrodes senses the temperature of liquid passing through the cell. The measured value is used to provide temperature compensation.

The advanced geometry of the cell provides several benefits:

- Excellent accuracy and linearity over the working range
- Efficient sweepout and low volume for low dispersion
- Reduced sensitivity to electrode surface conditions
- Low electrode mass
- Effective temperature compensation

You can order the conductivity cell installed in a DS3 Detection Stabilizer (P/N 044130) for temperature control, or installed in an electrical shield (P/N 044132) which provides no temperature control. Because the DS3 maintains a constant temperature, thus reducing the effects of variations in laboratory temperature, the DS3 is recommended for conductivity detection.

Temperature Control and Compensation

Temperature directly affects the conductivity of a solution. As conductivity increases, the effect of temperature changes becomes more pronounced. For example, building temperature control systems can cause a regular oscillation in the baseline. This, in turn, can affect the reproducibility of an analysis.

In ion chromatography, suppressing eluent conductivity minimizes the effect of temperature variation. Temperature compensation further improves temperature stability. When the conductivity cell is housed in a DS3 Detection Stabilizer, the DS3 enhances the ability of these techniques to reduce temperature effects below the detection limit.

Temperature compensation also ensures that there will be no major change in the baseline or peak heights, should it be necessary to change the DS3 operating set point. Readings will be normalized to 25 °C.

2.4.1 DS3 Detection Stabilizer

The DS3 is a temperature-controlled chamber consisting of a cast aluminum base and cover enclosed in insulating foam. The chamber houses both the conductivity cell and the eluent heat exchanger. Figure 2-4 identifies the major components of the DS3.

The DS3 provides the following benefits:

- Conductivity measurements that are nearly impervious to laboratory temperature variation
- Very low dispersion in the eluent heat exchanger
- Excellent peak height reproducibility
- Remote mounting after either the column or suppressor
- User-settable temperature

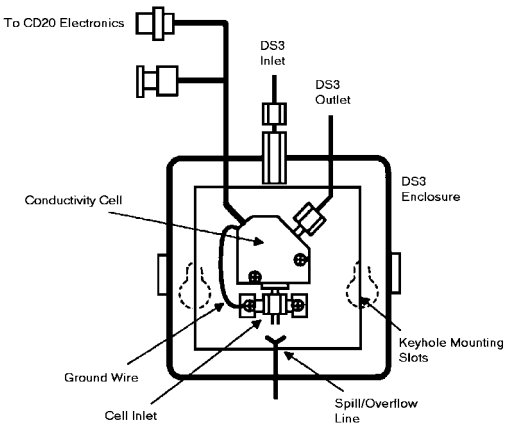


Figure 2-4. DS3 Detection Stabilizer

Power input to a pair of transistors on opposite sides of the DS3 heats it to a set temperature from 25 °C to 45 °C. A sensor near the heat exchanger outlet senses the eluent temperature. The CD20 circuitry compares this temperature with the user-selected temperature and adjusts the heat input in real time to hold the temperature within a few millidegrees.

The DS3 is sealed with an O-ring to trap eluent that may leak from the cell. If 5 mL of liquid accumulates, a thermistor sensor becomes immersed and signals a leak to the CPU. Any additional leakage will be discharged via the spill/overflow line. A second thermistor, above the discharge level, acts as a temperature refererence for the leak sensor.

2.4.2 Shielded Cell

A conductivity cell installed in an electrical shield (P/N 044132) is available. The shield is a stainless steel housing that protects the cell from electromagnetic interference (EMI), but does not provide temperature control.

2.5 Functional Description

2.5.1 Modes of Operation

The CD20 has two operating modes: ***Local*** and ***Remote***. When the detector is powered up, it is always in Local.

To change the operating mode:

1. Open the **MAIN** or **DETAIL** screen.
2. Move the cursor to the **LOCAL** field and use the **Select** Δ or **Select** ∇ button to toggle the mode.
3. Press **Enter** or a cursor arrow button when the mode is correctly selected. If you select **REMOTE**, you must confirm the selection before it is implemented.

Local Mode

Local mode allows two types of commands:

- Direct entry onto a screen, using the CD20 front panel buttons
- TTL and Relay inputs

TTL logic levels can control any four of the CD20 functions listed below; define the functions from the **TIME FUNCTION IN** screen.

- OFFSET
- HOLD/RUN
- SRS OFF/ON

- METHOD NUMBER INCRement
- METHOD NUMBER DECRement
- MARK Recorder
- Increase RANGEX10

This allows control of the CD20 via a remote controller or the timed event function of an integrator. The remaining functions are controlled from the CD20 front panel buttons.

No special setup or switch is required for TTL control, which is always available in Local mode. Front panel control remains active.

Remote Mode

NOTE
For more information about Remote control, refer to the *PeakNet Software User's Guide***.**

Remote mode lets you monitor the CD20 status and control all CD20 functions from PeakNet software, via the DX LAN interface. Select the Remote mode from the **MAIN** or **DETAIL** screen, or from PeakNet.

There are two forms of Remote control: normal Remote and Locked Remote.

During operation in the normal Remote mode, all buttons on the CD20 front panel function except **Hold/Run**. **Enter** can be used to select display functions that do not interfere with DX LAN remote control of a method while it is running.

The Locked Remote mode locks out all parameter changes from the CD20 front panel. Locked Remote can be selected only from PeakNet. It can be deselected from PeakNet, or by turning off the CD20 power. When you turn on the power again, the CD20 will be in Local mode.

If you select Remote mode while the CD20 is running a method, the computer will continue running the method unless you select the Abort command from the PeakNet Run program.

After PeakNet downloads a method to the CD20, the computer activates the method number with a DX LAN command and the **INIT**ial conditions step is activated. If a method is already running, it is interrupted and the CD20 method clock is reset to **INIT**ial conditions. A subsequent Run command will cause the method clock to run, activating the timed event starting with the time 0.00 step of the method.

2.5.2 Control

There are two types of control in either Local or Remote mode: ***Direct*** control and ***Method*** control.

Direct Control

In Direct control, commands are executed as soon as you enter them. Since there is no time-based program, the method clock is not used. The **Hold/Run** and **Reset** buttons are not operable in Direct control.

If a method is running when you select Direct control, that method is aborted and the method clock is reset.

Select Direct control as follows:

1. Open either the **MAIN** or **DETAIL** screen. If **DIRECT CNTRL** is displayed, the mode is already selected and no further action is necessary.
2. If **METHOD** is displayed, move the cursor to **METHOD** and press the **Select** Δ or **Select** ∇ button to toggle between **DIRECT CNTRL** and **METHOD** in the display.
3. Press **Enter** or a cursor arrow button to activate the selection.

Method Control

In Method control, commands are executed as programmed in a method containing time-based program steps. The parameters below are method-controlled and cannot be changed from the CD20 front panel:

- Analog range
- Offset
- Mark
- Relays and TTLs
- SRS current
- DS3 temperature
- Temperature Compensation factor

There are three ways to change a method-controlled parameter:

- Edit the currently running method and save the changes. The changes will be implemented when the method is saved.
- Switch to a different method.
- Abort the method, go to Direct control, and enter the new parameters directly.

Methods are programmed and controlled from the **METHOD** screen. To select Method control while in Direct control, go to either the **MAIN** or **DETAIL** screen. Move the cursor to the **DIRECT CNTRL** field and press the **Select** Δ or **Select** ∇ button, then press **Enter** or a cursor arrow button. **METHOD** will replace **DIRECT CNTRL** in the display.

Each method can contain up to 32 separate time-based steps, starting at time zero (**TIME = 0**). A method is created by first selecting a method number from 0 through 99. The steps are then created, one-by-one, by entering first the time and then the operating parameters you want to be in effect at that time.

Methods are retained in memory even after the detector power is turned off. Up to 100 methods (00 through 99) can be stored in CD20 memory. The actual total depends on the size of each method and the amount of available memory and is usually less than 100.

Besides storing and running methods, the CD20 allows you to run the detector under Method control while you are entering or editing any method, even one that is currently running. When saving changes to the currently running method or switching to a different method, the method clock continues running unaffected. Only those parameter changes which affect the method *after* the current time will be implemented in the current run. Of course, you may intentionally press **Reset** to implement the initial conditions.

You may enter non-method programmed parameters from the front panel, as well as display screens that allow you to monitor detector operation.

Another instrument, such as the GP40 Gradient Pump, can control the CD20 by a method in the pump through the CD20 TTL input ports.

The chromatography system is typically set up so that one module (such as the pump) contains the Method control and drives other modules (such as the detectors).

3 • Operation and Maintenance

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3 • Operation and Maintenance

3.1 Getting Ready to Run

After installing the CD20 Conductivity Detector, or after the power has been off for some time, use the following check list to ready the detector for operation.

- Verify that all cables are correctly connected to the CD20.
- Verify that the CD20 power cord is plugged into the main power.
- Press the power switch actuator on the CD20 front panel (see Figure 2-2) to turn on the power.
- Verify that the CD20 passes all power-up tests (see Section 3.1.1).
- If the conductivity cell is in a DS3 Detection Stabilizer, set the DS3 temperature from the **DETAIL** screen (see Section C.1.3), according to these guidelines:

  If the DS3 is installed in an LC10 Chromatography Organizer or LC20 Chromatography Enclosure, select a temperature at least 5 °C above the highest expected ambient temperature surrounding the DS3.

  If the DS3 is installed in an LC30 Chromatography Oven, select a temperature at least 5 °C above the oven temperature. Do not set the oven temperature above 40 °C (104 °F).

- Turn on the DS3 power. The DS3 will begin warming up at about 1 °C/minute. Baseline conductivity should stabilize once the DS3 reaches the selected temperature.
- As soon as the proper current is determined and eluent is flowing through the Self-Regenerating Suppressor (SRS) at the correct rate, turn on the SRS. (The SRS power is always off when the CD20 is powered up.) After start-up, the usual direction of drift is downward as SRS efficiency improves.

- While waiting for acceptable drift, you may want to select a lower sensitivity. Set the offset to 50%.
- When you are ready to start a run, select the desired sensitivity and offset (if you have not already done so). Press **Offset** before injection and during a run, also, if necessary.

3.1.1 Powering Up

Each time you turn on the CD20 power, the **POWER-UP** screen is displayed. The revision codes on the screen identify the CD20 Moduleware and BIOS, in the event that service is ever needed. If the CD20 is connected to a Dionex PeakNet Workstation, the DX LAN identification number is displayed, also.

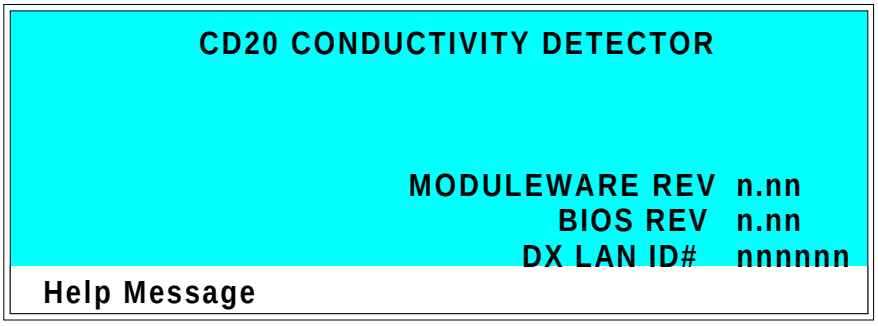


Figure 3-1. Power-Up Screen

At power-up, the detector automatically begins running a series of internal diagnostic and calibration routines. If a test failure occurs, an error message informs you. Press any key to display the **DIAGNOSTIC TESTS** screen (see Section C.2.7) and learn which test failed.

If the CD20 passes all the tests, the display automatically changes from the **POWER-UP** screen to the **MAIN** screen. The **MAIN** screen shows active data in large characters for easier viewing from a distance.

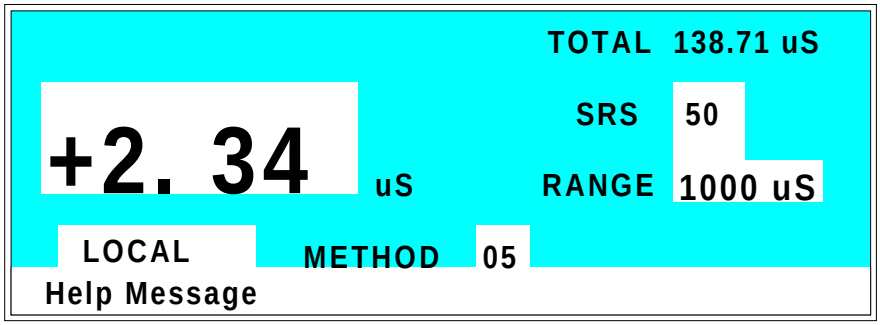


Figure 3-2. Main Screen

Press the **Menu** button to display the **MENU of SCREENS**. There, begin selecting parameters for the Direct control or Method control mode of operation.

3.2 Running Under Direct Control

In the Direct control operating mode, real-time commands are carried out instantly. All detector parameters remain in effect until you change them, and your changes are executed when entered. Since there are no time-based steps, the method clock is not used. The **Hold/Run** and **Reset** buttons are not operable in Direct control.

Select Direct control from the **MAIN** or **DETAIL** screen, as follows:

- If **DIRECT CNTRL** is displayed, this mode is already selected and no action is necessary.
- If **METHOD** is displayed, move the cursor to **METHOD** and press the **Select** Δ or **Select** ∇ button to toggle between **METHOD** and **DIRECT CNTRL** in the display. Press **Enter** or a cursor arrow button to activate the selection.

3.3 Running Under Method Control

In the Method control operating mode, the CD20 is controlled by a series of programmed timed events, known as a *method*. Methods are retained in memory even after the detector power is turned off.

There are two ways to select Method control:

- Go to the **MAIN** or **DETAIL** screen. If **METHOD** is displayed, this mode is already selected and no further action is necessary. If **DIRECT CNTRL** is displayed, move the cursor to **DIRECT CNTRL** and press the **Select** Δ or **Select** ∇ button to toggle between **DIRECT CNTRL** and **METHOD** in the display. Type in a method number and press **Enter** or a cursor arrow button to activate the selection.
- Go to the **METHOD** screen. Move the cursor to the **RUN** field, enter the number of the method to run, and press **Enter**.

If the clock on the **MAIN** or **DETAIL** screen is **INIT**ial when you press **Enter**, the CD20 uses the method **INIT**ial condition parameters to control the module. If the method clock is greater than zero when you press **Enter**, the CD20 uses the method parameters in effect at that time.

Pressing **Run** starts the method clock. From the **INIT**ial conditions, the time 0.00 step is executed as soon as you press **Run**. Remaining steps will be executed according to their programmed times.

3.3.1 Creating a New Method

1. Go to the **METHOD** screen. Enter an unused method number from 0 through 99 in the **EDIT** field and press **Enter** or a cursor arrow button. This displays a blank method on the screen.

   The first step of every method is an initial conditions step with **INIT** in the **TIME** field. The second step is always a time step with 0.00 in the **TIME** field. You cannot delete these steps, although you can change their parameters.

2. Enter the parameters for the initial conditions and time 0.00 steps.

NOTE

The TIME field is the only field in each method step that *must* have an entered value. Leaving any other field blank indicates that the value selected for that parameter in the preceding step is still in effect.

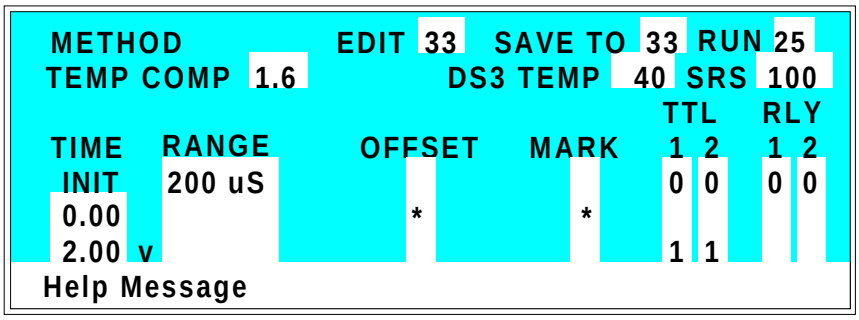


Figure 3-3. Method Screen

3. To create a new method step, move the cursor to a blank **TIME** field, enter the time (in minutes) for the action to be performed, and press **Enter** or a cursor arrow button. Enter a value for each step parameter, or leave a field blank if you want the value selected in the preceding step to remain in effect.

4. Repeat Step 3 for each additional step. Up to 30 steps (32 steps, if PeakNet software is used) can be added after the time 0.00 step.

   Sometimes a method contains more steps than can be seen on the screen at one time. If there is a small **v** next to the time entry at the bottom of the screen, move the cursor *down* to view additional steps. If there is a caret (^) next to the top time entry, move the cursor *up* to view additional steps.

5. To save the new method, move the cursor to the **SAVE TO** field, enter the number that appears in the **EDIT** field, and press **Enter**.

3.3.2 Editing an Existing Method

NOTE

Once you save changes to a method, there is no way to recall the original method. To make experimental changes while retaining the original method, be sure to save the new method, or a copy of the original method, under a *different* method number.

You can modify an existing method by changing, adding, or deleting steps and/or parameters. If the method you are editing is currently running, the changes are stored in memory and implemented when you save the method.

To edit an existing method, go to the **METHOD** screen, enter the method number in the **EDIT** field, and press **Enter** or a cursor arrow button.

Follow the editing instructions in the appropriate section below. When you finish, save the changes to the current method number or select a new number.

Changing Method Parameters

Move the cursor to the desired field and enter a new value, using the CD20 front panel buttons. Press **Enter** or a cursor arrow button after each editing change.

Adding a Method Step

There are two ways to add a step to an existing method:

- Move the cursor on the **METHOD** screen to any **TIME** field. Enter the time and parameters for the new step, and press **Enter** or a cursor arrow button. If necessary, the step will automatically be moved to the correct chronological point in the method.

- Move the cursor on the **METHOD** screen to the line immediately preceding the intended location of the new step. Press **Insert** to insert a blank line below the cursor location. Enter the time and parameters for the new step, and then press **Enter** or a cursor arrow button.

Deleting a Method Step

Move the cursor on the **METHOD** screen to the time of the step to be deleted and press **Delete** twice.

Deleting an Entire Method

Move the cursor on the **METHOD** screen to the **EDIT** field and press **Delete** twice.

Saving a Modified Method

To ***replace*** the original method with a modified version, enter the number of the original method in the **SAVE TO** field and press **Enter**.

To ***retain*** the original method and save the modified version elsewhere in memory, enter an unused method number in the **SAVE TO** field and press **Enter**.

3.3.3 Running a Method

1. Go to the **MAIN** or **DETAIL** screen. If necessary, toggle from **DIRECT CNTRL** to **METHOD** and from **REMOTE** to **LOCAL**.
2. In the **METHOD** field, enter the desired method number and press **Enter** or a cursor arrow button. (Or, to select the method number from the **METHOD** screen, move the cursor to the **RUN** field, enter a method number, and press **Enter**.)
3. If the method clock is already running, the method will start as soon as you enter the method number. If the clock is in Hold, press **Hold/Run** to start the method.

4. The elapsed time on the method clock when the method begins determines at which step the method begins running:

   If the method clock is at **INIT** or time zero, the method begins running using the **INIT** condition parameters.

   If the method clock is greater than zero, the method begins running using the parameters specified in the step for the elapsed time. To start the method at the **INIT** conditions instead, press **Reset**.

3.3.4 Changing the Running Method

To switch from the method currently running to a different method, enter the new method number in the **RUN** field on the **METHOD** screen and press **Enter**. The new method will begin running, using the parameters specified in the step for the current elapsed time. If you prefer to start the method at the **INIT** conditions, press **Reset.**

3.4 Optimizing Temperature Compensation

The CD20 built-in temperature compensation stabilizes conductivity readings by correcting for changes in ambient temperature that occur during a run. For more information about temperature control and compensation, see Section 2.4.

3.4.1 With a DS3 and Conductivity Cell



If the ambient temperature exceeds 45 °C, the DS3 may be permanently damaged. If the DS3 is installed in an LC30 Chromatography Oven, do not set the oven temperature above 40 °C (104 °F).

Housing the cell in a DS3 Detection Stabilizer ensures that there is no more than a minor temperature variation in liquid reaching the cell, so the **TEMP COMP** setting on the **DETAIL** screen can remain at 1.7% per ºC.

Many users are able to stay at a single operating temperature. For optimal accuracy, calibrate the cell at this temperature, using the proper temperature coefficient setting. If you later reset the temperature, the CD20 temperature compensation will normalize conductivity measurements to 25 °C (77 °F) to prevent a major upset in system calibration. If you change the DS3 set point, recalibrate the cell.

If temperature-induced baseline cycling occurs, it is probably caused by another component of the chromatography system. If the variation increases as the eluent reservoir empties, move the reservoir to a more temperature-stable environment and/or wrap the reservoir in thermal insulation.

3.4.2 With a Shielded Conductivity Cell

When the conductivity cell is not inside a DS3 Detection Stabilizer, actual conductivity drifts up and down with fluctuations in laboratory temperature. This is especially noticeable when the thermostat cycles on and off in laboratories with very high air turnover rates and controlled temperature. Selecting the proper temperature compensation factor will minimize the effect of temperature fluctuations.

Start by setting **TEMP COMP** on the **DETAIL** screen to 1.7%. If a sinusoidal baseline variation of the same period as the laboratory cooling or heating occurs, increase or decrease the temperature compensation setting. Continue adjusting it until you find the optimal setting. This is typically between 1.5% to 2% per ºC, suppressed or non-suppressed.

If you notice a slowly increasing or decreasing baseline drift in a laboratory without a temperature control system, look for a corresponding temperature drift. If there is a correlation, adjust the temperature compensation setting until you find the optimal setting.

3.5 Routine Maintenance

- The CD20 electronics are not user-serviceable. Do not remove any of the electronics cards (printed circuit boards) from the detector. Servicing must be performed by qualified personnel.
- Periodically check liquid line connections to the cell (inside the chromatography module) for leaks and clean up any spills.

4 • Troubleshooting

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4 • Troubleshooting

This chapter is a guide to troubleshooting minor problems that may occur while operating the CD20 Conductivity Detector. Turn to the section of this chapter that best describes the problem. There, the possible causes of the problem are listed in order of probability, along with the recommended courses of action.

For additional help, refer to the description of the CD20 diagnostic screens in Appendix C. If unable to eliminate a problem on your own, notify Dionex.

4.1 No Detector Response

- **Cell is off**

  Turn on the cell (from the **MAIN** or **DETAIL** screen).

- **Analog output range set too high; although the display indicates a response, no recorder response observed**

  Select a more sensitive analog output range.

- **Wrong full-scale output (or no full-scale output) selected**

  Select 0.01, 0.10, or 1 volt full-scale.

- **No flow from pump**

  Check the pressure reading on the pump to verify that the pump is on.

- **Detector offset out of range**

  Press **Offset** on the CD20 front panel.

4.2 Low Detector Output

- **Analog output range set too high; although the display indicates a response, no recorder response observed**

  Select a more sensitive analog output range.

- **Insufficient sample injected**

  Increase the injection size or concentration.

- **Cell out of calibration**

  Recalibrate the cell (see Section 5.4).

4.3 High Detector Output

- **Auto offset not activated recently**

  Press **Offset** on the CD20 front panel before making an injection.

- **Background not suppressed by SRS**

  Check the SRS regenerant out line for bubbles; if there are no bubbles, the suppressor may be contaminated. Refer to the SRS manual for troubleshooting guidance.

4.4 Noisy or Drifting Baseline

- **Flow system leak ahead of cell; erratic baseline**

  Check all fittings and liquid lines for leaks. Tighten or, if necessary, replace all liquid line connections. If the connections are made with ferrule fittings, first refer to *Installation of Dionex Ferrule Fittings* for tightening requirements.

- **Pump not properly primed**

  Prime the pump as instructed in the pump manual.

- **Rapid changes in ambient temperature**

  Redirect heating and air conditioning vents away from the cell.

  Purchase a cell in a DS3 Detection Stabilizer (P/N 044130).

  When using a shielded cell, install the cell in the LC30 Chromatography Oven.

- **Insufficient system equilibration following any changes to operating parameters; especially apparent when operating at high sensitivities**

  Allow longer system equilibration before beginning operation.

- **Air trapped in cell; excessive regular pulses in baseline**

  Remove the trapped air (Section 5.2). To prevent air from becoming trapped in the cell in the future, increase backpressure on the cell by reducing the inner diameter of the tubing installed after the cell and before the SRS.

- **Inappropriate SRS operating conditions**

  Refer to the SRS manual for the correct operating conditions.

- **Temperature compensation setting not optimized**

  Optimize the selected setting (see Section 3.5).

- **DS3 above or below set point**

  See Section 4.6.

4.5 Liquid Leaks from the DS3

When a leak is detected, the DS3 leak sensor signals the CPU. If more than 5 mL of liquid accumulates in the DS3, the excess will be drained via the spill overflow line (see Figure 2-4).

- **Loose or defective fittings, or overpressurization caused by a restriction**

  Check the waste line for blockage; a trapped particle can plug the line, causing a restriction and/or leak. If necessary, clear the waste line by reversing the direction of flow.

  Make sure the plumbing downstream from the DS3 is clear; a blockage in the plumbing may overpressurize the DS3, causing it to leak.

  Make sure the downstream backpressure coils are appropriate for the operating flow rate (see Section B.3.3).

  Follow the steps below to disassemble the DS3 and inspect it for the source of the leak. Test and dry the DS3 before reassembly.

  1. Turn off the CD20 power.
  2. Disconnect the cables from the detector.
  3. Disconnect the two 10-32 fitting bolts. Do not misplace the ferrule fittings at the end of the tubing.
  4. Remove the DS3 from the chromatography module by lifting it upward and then pulling it away from its mounting location. Place the DS3 on the workbench.
  5. Open both latches on the DS3 enclosure and carefully lift the DS3 cover, along with its foam insert, exposing the cover of the housing.
  6. Remove the four Phillips screws securing the housing to the housing cover and separate the two parts. Unplug the interconnecting cable, to prevent damage to the small wires.

7. Disconnect the grounding strap. Remove the two cell mounting screws.
8. Rotate the cell inlet tube fitting counterclockwise. Let the cell body back away from the fitting until the fitting threads are fully disengaged. **Do not lose the ferrule.**
9. Check that the end of the inner Tefzel tubing is flush with the end of the plastic sleeve. If necessary, trim the sleeve slightly to prevent dispersion. Push the tubing into the cell until it bottoms out in the hole; then, hold the tubing in place while tightening the nut.
10. After testing for liquid leaks, dry the DS3 and reassemble it by reversing the procedure described in Steps 1 through 9.

- **Liquid seeping from around cell cables**

  The cell is inoperable; return it to Dionex for repair or exchange.

4.6 DS3 Temperature Inaccurate

- **"DS3 SET POINT XX C READY" message displays continuously**

  The control sensor may be faulty. Remove the DS3 cover and measure the temperature of the housing, using any surface thermometer. The cell sensor can be read on the detector and should be within 1 or 2 degrees of the DS3 set point temperature.

- **"DS3 SET POINT XX C UNDER TMP" or "DS3 SET POINT XX C OVER TMP" message displays continuously**

  Verify that the set temperature is at least 5 °C above the external DS3 temperature. Allow 30 to 60 minutes for the DS3 to heat or cool.

  At high flow rates and temperature settings far above ambient, the DS3 requires more time to heat. In extreme cases, such as a very cold room and a high DS3 set point, the DS3 may not be able to reach the set point temperature.

- **DS3 does not heat**

  Remove the cover and inspect the DS3 for broken or shorted wires or for moisture bridging the control thermistor. If a wire is broken or shorted, replace the wire or call Dionex for assistance. If a leak has caused a short, fix the leak and dry the control sensor.

- **"DS3 SET POINT XX C READY" message displays intermittently**

  Make sure that the heater transistors are snug and the control sensor has not been pulled out of the heat exchanger plate.

4.7 Conductivity Inaccurate

- **Cell constant reported on CONDUCTIVITY CALIBRATION screen after cell calibration is not 130 to 190 µS**

  The DS3 has not reached its set point temperature. Set the intended operating temperature and wait until 5 minutes after the "NOT READY" message is displayed, or until the reading is stable.

  Make sure the selected temperature compensation setting is 1.7%/°C. Except at 25 °C, an incorrect temperature compensation setting can cause an incorrect reading.

  The 1 mM KCl calibration solution is spoiled, or there was a mixing error. Remake the solution.

  The electrodes are fouled by grease, precipitate, etc. Flush with a suitable solvent, such as acid, and then flush with 1 mM KCl until the reading is stable.

  The cause is internal leaks, broken or shorted cell or sensor wires. Check the sensor by comparing the cell temperature readout with the actual DS3 temperature. If necessary, return the cell to Dionex for repair. **Do not disassemble the cell; this will break the seal and void your** warranty.

- **Cell temperature readout deviates by more than 2 °C from DS3 set temperature**

  This indicates a serious cell or DS3 sensor problem. Call Dionex for assistance.

4.8 Faulty DX LAN Communication

- **DX LAN interface incorrectly installed**

  1. Make sure a BNC tee connector (P/N 921914) is attached to the DX LAN connector on the CD20 rear panel (see Figure B-2).
  2. Connect the DX LAN cable (P/N 960404) to one side of the BNC tee. **The DX LAN cable must be RG58U or RG58AU.** Do not substitute recorder cables; they have the wrong impedance and will interfere with signals on the DX LAN.
  3. Make sure that the tee connectors at both ends of the network are capped with the terminator plugs (P/N 921034) that are shipped with PeakNet software (see Section B.3.2).

4.9 Diagnostics

NOTE

The CD20 electronic components are not customer-serviceable. Before running a diagnostic test, use the troubleshooting information in earlier sections of Chapter 4 to isolate problems that are unrelated to the CD20 electronics.

The CD20 Moduleware includes several diagnostic tests of the electronics. To access these, select the **DIAGNOSTIC MENU** from the **MENU of SCREENS**. The diagnostic screens are illustrated and described in Appendix C.

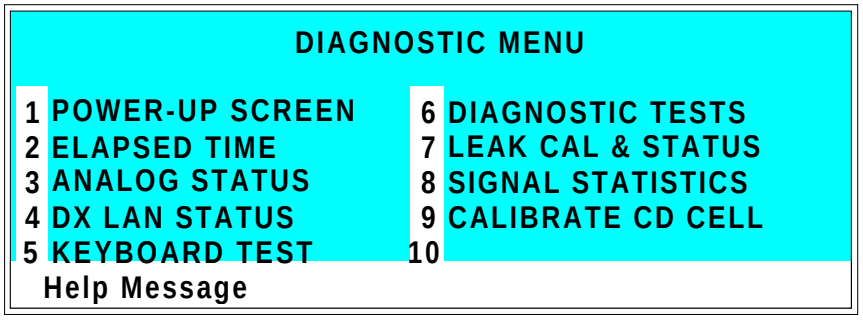


Figure 4-1. Diagnostic Menu Screen

5 • Service

5.1 Eliminating Liquid Leaks 5-3
5.2 Removing Trapped Air from the Cell 5-3
5.3 Replacing the Main Power Fuses 5-4
5.4 Calibrating the Cell 5-5

5 • Service

This chapter describes routine service procedures for the CD20 Conductivity Detector. Before replacing any parts, refer to the troubleshooting information in Chapter 4 to isolate the cause of the problem. When ordering replacement parts, be sure to include the model number and serial number of the detector.

Substituting non-Dionex parts may impair detector performance, thereby voiding the product warranty. For details, refer to the warranty statement in the Dionex Terms and Conditions.

NOTE

The CD20 electronic components are not customer-serviceable. Any repair involving the electronics must be performed by Dionex.

5.1 Eliminating Liquid Leaks

The PEEK version of the CD20 is plumbed with 1.60-mm (1/16-in) OD PEEK tubing, Dionex ferrule fittings (P/N 043276), and 10-32 fitting bolts (P/N 043275). For tightening requirements, refer to *Installation of Dionex Ferrule Fittings.*

5.2 Removing Trapped Air from the Cell

Air bubbles in the cell can cause regular pulsations of the baseline, random noise, and low readings. Air may have been introduced in the columns during installation, or may result from outgassing of the mobile phase. Connecting a backpressure line to the cell applies enough backpressure to shrink bubbles, thereby allowing them to pass more easily through the cell.

1. Connect a piece of 0.25-mm (0.010-in) ID tubing (P/N 042690), with fittings on both ends, to the cell outlet. Make the line 1 m long for a flow rate of 1.0 mL/min, 2 m for 0.5 mL/min, etc.

2. Use tubing with an inner diameter of at least 1 mm (0.04 in) the rest of the way to the waste container. Use a union (P/N 042627) to connect the backpressure line to the waste line.

IMPORTANT

Make sure the added backpressure does not exceed 0.20 MPa (30 psi). Avoid large increases in flow rate that would result in more than 1.4 MPa (200 psi) being applied to the cell.

5.3 Replacing the Main Power Fuses



WARNING—HIGH VOLTAGE. Disconnect the main power cord from the CD20 rear panel, as well as from its source.

1. Turn off the CD20 main power switch.
2. The fuse holder is in the main power receptacle on the CD20 rear panel (see Figure 5-1). Using a small screwdriver (or your fingernails), push the recessed lock on each side of the fuse holder toward the center; now release the locks and the fuse holder will pop out about 0.16 cm (1/16 in). Pull the fuse holder straight out of the compartment.
3. The fuse holder contains two fuses. Replace these with new 3.15 amp fast-blow IEC127 fuses (P/N 954745). Always replace both fuses, even though only one is open. The other fuse has been stressed and may fail, even under normal operation.
4. The fuse holder is keyed to fit in its compartment only in its proper orientation. After noting this orientation, reinsert the fuse holder into the compartment, applying just enough pressure evenly against the fuse holder to engage the two recessed locks. When both locks are engaged, the fuse holder is flush against the panel.
5. Reconnect the main power cord and turn on the power.

5.4 Calibrating the Cell

Every conductivity cell is calibrated before it is shipped from the factory. The cell calibration constant is recorded on a tag attached to the cell cable, and is also stored in permanent detector memory for use when calculating the measured conductivity.

The calibration constant normally remains unchanged, unless the cell is damaged. To check the value entered in memory, select **CALIBRATE CD CELL** from the **DIAGNOSTIC MENU** to display the **CALIBRATE CONDUCTIVITY CELL** screen. If the cell calibration constant shown on the screen does not match the value recorded on the tag, do **one** of the following:

- Enter a new value, regardless of the composition of the solution in the cell.
- Calibrate the cell at 147.00 µS/cm. This automatically enters a new value for the cell calibration constant into CD20 memory.

To calibrate the cell, follow the steps below.

1. Disconnect the pump output line from the LC10 Chromatography Organizer, LC20 Chromatography Enclosure, or LC30 Chromatography Oven.
2. Connect the pump output directly to the inlet of the DS3 or the shielded cell.
3. Pump 0.001 M KCl calibration solution through the cell. Conductivity is slightly flow-rate sensitive, so select the flow rate used in the majority of your applications.
4. Set **TEMP COMP** on the **DETAIL** screen to 1.7%.
5. If using a DS3, set **DS3 SETPOINT** on the **DETAIL** screen to the intended operating point. Wait until the “DS3 READY” message appears.
6. Wait until the conductivity reading stabilizes (within 0.1 µS), and then calibrate the cell.

7. After calibration, the conductivity reading should be exactly 147.00 µS/cm. A new value for the cell constant will be shown on the **CALIBRATE CONDUCTIVITY CELL** screen; this value will also be entered in memory.
8. Flush the KCl solution from the system by pumping deionized water through the DS3 or cell lines. When the conductivity reading drops to near zero, stop the pump.
9. Disconnect the pump from the DS3 or shielded cell.
10. Reconnect the pump to the chromatography module.
11. Reconnect the liquid line from the suppressor outlet to the cell inlet.
12. Reset **TEMP COMP** to the optimal value for the eluent.
13. Set the pump to a flow rate that is safe for the system in use.

6 • Conductivity Detection

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6 • Conductivity Detection

Ions in solution conduct electrical current when voltage is applied between electrodes contacting the solution. Since the magnitude of this current is nearly proportional to the concentration of dissolved ions, conductivity detection is useful for quantifying ionic analytes. The CD20 Conductivity Detector is designed to measure solution conductivity with exceptional sensitivity and reproducibility.

6.1 How Conductivity Is Measured

Conductivity measurement is best understood by beginning with the *solution resistance, R*. The CD20 measures conductivity by applying an 8 kHz square wave between the conductivity cell electrodes. An alternating potential waveform is used to prevent electron transfer (oxidation/reduction) reactions at the electrodes. Since the detector applies a known voltage to the cell electrodes and the current is measured, *R* is calculated from Ohm's law:

$$R = \frac{E}{i}$$

The inverse of the solution resistance is the *conductance*, *G*. The measured conductance is corrected by the conductivity cell constant, *K*, to produce the conductance which would be measured in a cell containing electrodes of 1 cm^2 surface area which are held 1 cm apart. This quantity is the *conductivity*, κ, and the units are siemens per cm (S/cm). Stated as equations:

$$G = \frac{1}{R} = \frac{i}{E}$$

$$\kappa = K \bullet G$$

6.2 Conductivity of Solutions

According to Kohlraush's law of independent migration, the conductivity of a dilute solution is the sum of the individual contributions to conductivity of all the ions in the solution multiplied by their concentrations (that is, conductivity is directly proportional to concentration). Kohlraush's law further states that each ion carries its portion of the total conductivity without being affected by any of the other ions in solution.

Stated as an equation:

$$\kappa = \frac{\sum_i \lambda_i^o c_i}{1000}$$

Where:

κ is the measured conductivity in S/cm

c_i is the concentration of the ions in equivalents/L. (Equivalents/L equals moles/L times the charge on the ion.)

The *ionic limiting equivalent conductivity*, λ_i^o, is specific for each ion. It is the conductivity of the ion divided by the concentration and extrapolated to infinite dilution. Table 6-2 lists the limiting equivalent conductivities for several organic and inorganic ions. The unit for λ_i^o is $S \cdot cm^2$/equivalent.

Anions	λ_i^o	Cations	λ_i^o
OH^-	198	H^+	350
F^-	54	Li^+	39
Cl^-	76	Na^+	50
Br^-	78	K^+	74
I^-	77	NH_{4+}	73
NO_{3-}	71	Mg_{2+}	53
HCO_{3-}	45	Ca_{2+}	60
SO_{42-}	80	Sr_{2+}	59
$Acetate^-$	41	CH_3NH_{3+}	58
$Benzoate^-$	32	$N(CH_3CH_2)_{4+}$	33

Table 6-2. Limiting Equivalent Conductivities at 25 °C

Values of λ_i^o from this table can be used to calculate conductivities of solutions containing ions. For example, the limiting equivalent conductivity for NaCl at 25 °C is 126.5. This is the sum of the ionic limiting equivalent conductivity for Na^+, which is 50.1, plus that of Cl^-, which is 76.4. A 0.1 mM solution of NaCl at 25 °C has a conductivity of 0.1 × 126.5, or 12.65 µS/cm. The conductivity of a solution of 0.1 mM NaCl plus 0.1 mM Na_2SO_4 would be calculated as follows:

Ions		Charge		Conc.		λ_i^o		µS/cm	
3	×	1	ö	0.1	×	50.1	=	15.0	(Na^+)
1	×	1	ö	0.1	×	76.0	=	7.6	(Cl^-)
1	×	2	ö	0.1	×	80.0	=	16.0	(SO_{42-})
						Total		38.6	

So far, only dilute solutions have been discussed. As concentration increases, the direct proportionality between conductivity and concentration is lost. However, at the analyte concentrations normally encountered in ion chromatography (below 1 mM), conductivity is generally proportional to concentration. For example, the equivalent conductivity at 25 °C of KCl at infinite dilution is 149.9 and at 1 mM it is 146.9, a decrease of only 2%.

However, the conductivity of an eluting analyte is not necessarily directly proportional to concentration, because ionic components of the eluent may be contained in the eluting volume.

If the electrolyte is a weak electrolyte, such as an acid or base with only partial dissociation, then c_i must be replaced by the concentration of the dissociated ions only, since only they contribute to conductivity. For acids and bases, the pK values and the solution pH can be used to calculate the extent of dissociation.

6.2.1 Effect of Hydration Sphere and Solvent on Conductivity

The limiting equivalent conductivity of an ion, λ_i^o , is a measure of ionic mobility. Ionic mobility is greatly affected by the properties of the ion in the solvent; ions with large hydration spheres are less mobile, and therefore less conductive, than ions with small hydration spheres. This explains why λ_i^o for extensively hydrated fluoride (55.4) is lower than λ_i^o for chloride (76.4), which is less hydrated. Solvent viscosity also affects ionic mobility, as ions are more mobile in solvents of lower viscosity.

It is not necessary to know values such as hydration sphere and viscosity, since quantitative analysis is performed by comparing the conductivity of the analyte in the sample to the conductivity of the same analyte in a standard(s). Even when a solvent gradient is used, the composition of the solvent during the elution of the analyte is the same in both the sample and the standard.

6.2.2 Effect of Temperature on Conductivity

Ionic mobility, and therefore conductivity, are greatly affected by temperature. The conductivity of an aqueous solution has been found experimentally to rise about 2% per °C. Thus, it is necessary to hold the eluent temperature as constant as possible to maintain a stable baseline.

When the CD20 cell is housed in a DS3 Detection Stabilizer, the DS3 maintains the cell at a set temperature. In addition, the detector corrects the measured conductivity to that which would be measured at 25 °C. It does this by measuring the cell temperature with a thermistor and multiplying the conductivity by a temperature-dependent constant. This constant, the *temperature compensation factor*, is expressed in units of %/°C.

When operating with the shielded cell, setting an accurate temperature compensation factor helps minimize the baseline drift caused by fluctuations in ambient temperature.

6.2.3 Species Detected by Conductivity

Conductivity detection is typically selected for species that are ionic when they enter the detector cell, especially those with weak UV absorbance. This includes both organic and inorganic ions. Conductivity detection is best suited to anions and cations of strong acids and bases, such as chloride, sulfate, trifluoroacetate, sodium, and potassium. Ions of weaker acids and bases are detected, provided that the eluent pH is chosen to maximize analyte dissociation. (When a suppressor is used, the eluent pH which determines whether an ion is detected is the pH after suppression.)

Anions

Sensitivity is best for anions with pKa values below 6. As analyte ionization (dissociation) decreases, so does sensitivity. Anions with pKa values above 7 can be detected under certain conditions, but signal-to-noise ratios are generally poorer. All organic acids with either carboxylate, sulfonate, or phosphonate functional groups have pKa's below 4.75, so conductivity is the preferred detection method for these species. Common inorganic strong acid anions include chloride, nitrate, phosphate, and sulfate.

Cations

Inorganic cations detected include the alkali metals and alkaline earths. Most transition metal cations are not detected, since they either hydrolyze water to form anions or precipitate in the suppressor. These metals are usually detected by visible wavelength absorbance, following post-column reaction with a chelating indicator.

Nearly all organic cations are amines. Aliphatic amines have pKa's around 10 and are easily detected. Aromatic and heterocyclic amines have pKa's between 2 and 7, too low to be detected by suppressed conductivity following cation exchange separation. Although nonsuppressed detection can be used for these species, sensitivity is generally poor. These amines can be detected by UV absorbance, DC amperometry, or integrated amperometry.

Zwitterions

Amphoteric, or zwitterionic, molecules contain both cationic and anionic functional groups and are difficult or impossible to detect by conductivity. Amino acids, for example, contain both ammonium cationic functional groups and carboxylic acid anionic functional groups. With suppressed conductivity detection, they are generally removed by the suppressor and do not reach the detector. They can be detected by

nonsuppressed conductivity detection if the eluent pH is at a value which results in a net charge on the molecule. Since most zwitterions contain primary, secondary, or tertiary amine functional groups, pulsed or integrated amperometry is often the best detection method. UV absorbance can be used for aromatic zwitterions.

6.2.4 Chemical Suppression

Species detected by conductivity are by their nature ionic, so ion-exchange and ion-pair chromatography are by far the most commonly used separation methods. These methods require eluents containing strong electrolytes, which causes a problem: how to detect the ionic analytes without the detector being overwhelmed by the ions in the eluent. The best solution is to neutralize the eluent in a suppressor.

Figure 6-3 illustrates the suppression mechanism that occurs inside a Dionex Anion Self- Regenerating Suppressor (ASRS) when NaOH is the eluent for anion exchange separation.

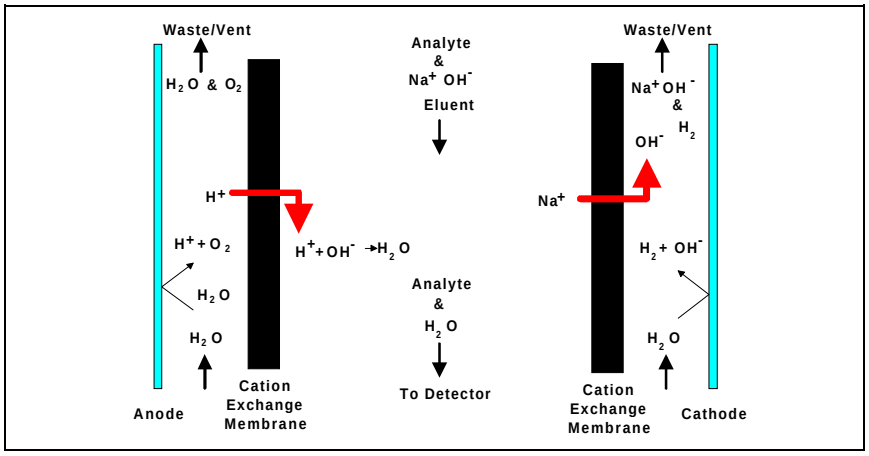


Figure 6-1. ASRS Suppression Mechanism

Analyte anions elute from the column with sodium counterions. Two electrodes, one beside each membrane (on the side opposite the eluent), hydrolyze water to hydrogen and hydroxide ions. Hydrogen ions diffuse across the membrane next to the anode, neutralizing the eluent hydroxide to water, while sodium ions from the eluent diffuse across the other membrane, providing counterions to the hydroxide being generated at the cathode.

In effect, sodium hydroxide from the eluent is transferred across the membrane and does not reach the detector. The resulting eluent background conductivity is near zero, considerably lower than before suppression. Also, the counterion to the anion analytes is now a hydrogen ion, which has a conductivity seven times higher than the original sodium counterion. Since both the anion analyte and the cation counterion produce the detector response, response is increased. The suppressor lowers the background conductivity (and thus the baseline noise and drift) and increases the signal. Suppression can also be accomplished without water electrolysis by pumping a dilute sulfuric acid solution (the regenerant) through the suppressor on the side of the membranes opposite the eluent.

For ion chromatography of cations, the suppressor membranes are anion exchange polymers that allow anions to pass freely, but exclude cations. The eluent uses dilute acids such as methanesulfonic acid (MSA). In the Dionex Cation Self-Regenerating Suppressor (CSRS), methanesulfonate counterions are replaced by hydroxide generated by the electrolysis of water. This neutralizes the acidic eluent and provides the highly conductive hydroxide counterion to the analyte cations.

Use of a suppressor typically increases signal-to-noise ratios about one order of magnitude for strong acid or base ions. The improvement is somewhat less for ions of weak acids or bases, due to decreased ionization at the neutral pH of the eluent after suppression. Nonetheless, the benefits from reducing the background, and therefore the noise, almost always yield a net improvement in signal-to-noise ratio as compared to nonsuppressed conductivity detection.

Suppressors provide several important advantages, listed below. The first three advantages are a direct result of the increased signal-to-noise ratio.

- Lower detection limits
- A possible increase in the dilution of dirty samples, thus extending column life
- Wider dynamic range
- Use of more highly concentrated eluents, thus providing a greater range of elution control and permitting larger sample concentrations or volumes
- Gradient elution capability
- Faster equilibration time
- Elimination of interference from counterions
- Elimination of system peaks

6.2.5 Eluents for Conductivity Detection

When selecting an eluent, the constraints imposed by the separation and detection methods must be considered. The most important criteria for obtaining optimal separation are the elution strength of the eluent, the separation efficiency, and the resolution of the analytes of interest. For conductivity detection, the criteria for a good eluent are the relative conductivity response of the analytes and the magnitude of the background.

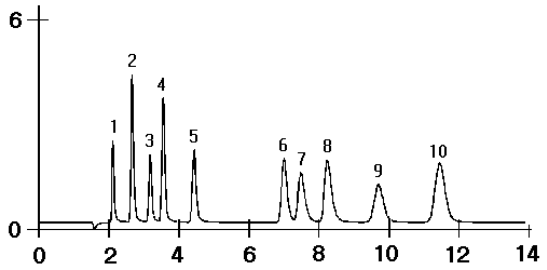
Eluents can be wholly aqueous, containing only water and a strong electrolyte. Or, if an organic solvent-compatible column such as a Dionex OmniPac™ or MPIC™ column is used, typical reversed-phase solvents such as methanol or acetonitrile can be used. Organic solvents are essential components of ion-pair eluents and provide important selectivity control during ion-exchange separations. Since these solvents are nonconducting, they do not interfere with conductivity detection.

Anion Exchange

When a suppressor is used, the ionic components of the eluent must be such that they are removed, or else converted to weakly conducting compounds by the suppressor. Sodium salts of weak acids are used because they are converted to the neutral free acid form in the suppressor. The higher the pKa of the acid, the lower the background conductivity following suppression. Weak acids with pKa's above 6 can be used for isocratic separations. For gradient elution, pKa's should be above 8 to minimize baseline shift during the gradient.

Sodium hydroxide solutions make excellent eluents for anion exchange chromatography because hydroxide is neutralized in the suppressor to water (the free acid form of hydroxide). This occurs case regardless of the concentration, making it most useful for gradient elution. Another common eluent is a carbonate/ bicarbonate buffer. It is suppressed to carbonic acid (pKa = 6.2), which has conductivity low enough for isocratic elution, but not for gradient. Carbonate/bicarbonate buffers are easily prepared and are routinely used for isocratic separations of inorganic anions (see Figure 6-2).

Other eluents for suppressed anion chromatography include the sodium salts of boric acid (borax, tetraborate, pKa = 9.2) and p-yanophenol (pKa = 8.0). Borate forms weak bonds with hydroxy-organic acids, producing changes in selectivity compared to hydroxide. Because of its high pKa, background conductivity following suppression is very low, making it



Column: IonPac AS12A and AG12A
Eluent: 2.7 mM Sodium carbonate
0.3 mM Sodium bicarbonate
Flow Rate: 1.5 mL/min
Detection: Suppressed conductivity
Peaks:

1 Fluoride 3 mg/L	6 Bromide 20 mg/L
2 Chlorite 20 mg/L	7 Chlorate 20 mg/L
3 Bromate 20 mg/L	8 Nitrate 20 mg/L
4 Chloride 6 mg/L	9 Orthophosphate 30 mg/L
5 Nitrite 10 mg/L	10 Sulfate 20 mg/L

Figure 6-2. Anion Standard

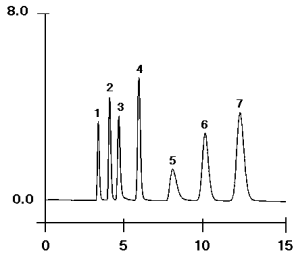
useful for gradient elution. p-Cyanophenol is a powerful monovalent displacer, useful for eluting strongly retained hydrophobic monovalent anions such as iodide and thiocyanate.

In nonsuppressed (sometimes called single-column) ion chromatography, the ionic components in the eluent are chosen so that their conductivity is as different as possible from the analyte's. For anion IC, large ions with low equivalent conductivity may be used, such as benzoate and phthalate. These produce backgrounds of moderately high conductivity. A buffer composed of a gluconate/borate solution produces somewhat lower backgrounds. Sensitivity and baseline noise are acceptable for analyzing samples

containing high concentrations of analytes. However, the advantages provided by a suppressor are not realized.

Cation Exchange

Millimolar concentrations of dilute strong acids, often mixed with organic solvents, are good choices for cation exchange chromatography of both monovalent and divalent cations. Methanesulfonic acid (MSA) is commonly used, since it is compatible with the Cation Self-Regenerating Suppressor (CSRS). A large number of amines and inorganic cations can be eluted in a single run with a gradient of MSA and acetonitrile (see Figure 6-3).



Column:	IonPac CS12A (no guard)
Eluent:	20 mN Sulfuric acid
Flow Rate:	1.0 mL/min
Inj. Volume:	25 mL
Detection:	Suppressed conductivity, CSRS AutoSuppression

Peaks:

1	Lithium	0.5 mg/L (ppm)
2	Sodium	2.0
3	Ammonium	2.5
4	Potassium	5.0
5	Morpholine	25.0
6	Magnesium	2.5
7	Calcium	5.0

Figure 6-3. Amines and Inorganic Cations

Some columns require a stronger displacing ion than hydrogen to elute more strongly retained divalent cations. The zwitterion 2,3-diaminopropionic acid (DAP), when mixed with a strong acid to protonate the DAP, works well.

The best eluents for nonsuppressed cation IC are dilute strong acids like 1 mM nitric acid. However, backgrounds are very high (around 1 μS), so signal-to-noise ratios are not good enough for low-level work. Since the conductivity of the hydrogen ion exceeds that of all other cations, elution of analytes causes decreases in conductivity and eluting analytes produce dips instead of peaks.

Ion-Pair

Eluents for ion-pair chromatography contain mixes of aqueous and organic solvent solutions with hydrophobic ion-pair reagents as additives. Commonly used reagents include quaternary ammonium salts for anion separations and long-chain sulfonates for cation separations. For suppressed conductivity detection, these reagents are easily used provided that the counterions are either hydroxide (anion-ion pair) or hydrogen ion (cation-ion pair). These are marketed by Dionex as IonSep® reagents. The reagents are purified solutions of quaternary ammonium hydroxide solutions and sulfonic acid solutions.

A • Specifications

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A • Specifications

A.1 Electrical

Main Power 85 to 270 Vac, 47/63 Hz; 40 W Max, 25 W typical. The CD20 power supply is auto-sensing and requires no voltage adjustment.

Fuses Two 3.15 amp fast-blow IEC127 fuses (P/N 954745)

Analog Output User-selectable full-scale output of 10, 100, or 1000 mV

A.2 Environmental

Operating Temperature 4 ºC to 40 ºC (40 ºF to 104 ºF)

Operating Humidity 5 to 95% relative humidity, non-condensing

A.3 Physical

Dimensions 22.5 cm W x 17.0 cm H x 42.0 cm D (8.8 in W x 6.6 in H x 16.4 in D)

6 cm (2.4 in) clearance required behind the detector

Weight 8.2 kg (18 lb)

A.4 Display and Keypad

Display Liquid crystal display with adjustable backlighting

Keypad 26-button keypad for entering commands and numerical values for screen parameters

A.5 Detector

Range	0.01 µS to 3000 µS, full-scale
Temperature Compensation	0.0 to 3.0% per ºC
Cell Drive	Variable 8 kHz square wave
Local Operation	Front panel controls and display status of all functions
Remote Operation	Control of four functions via TTL or Relay contacts
DX LAN Operation (Optional)	All functions can be controlled by PeakNet Software on a PC connected to the CD20 via the DX LAN interface

A.6 Conductivity Cell

Cell Body	PEEK
Active Volume	1.0 µL
Maximum Pressure	2.0 MPa (300 psi)
Electrodes	316 stainless steel

A.7 SRS Power Supply

Supply Current	50, 100, 300, 500 mA @ 1.5 to 7.5 V
Over-Voltage Alarm	8.5 V
Over-Temperature Alarm	40 ºC (104 ºF)

A.8 DS3 Detection Stabilizer (Optional)

Operating Temperature	25 ºC to 40 ºC (50 ºF to 104 ºF)
Warm-up Time	10 minutes (typical)
Temperature Alarms	*Not Ready* message displayed when under or over the set temperature

B • Installation

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B • Installation

B.1 Facility Requirements

- Make sure the CD20 installation site meets the electrical and environmental specifications listed in Appendix A.
- Install the CD20 on a sturdy table or workbench, at a height that ensures convenient viewing of the front panel display.
- Allow at least 6 cm (2.4 in) clearance behind the CD20 for power connections and ventilation.

B.2 System Configuration

Dionex DX 500 modules are designed to be stacked on top of each other up to a maximum height of four units (see Figure B-1). The CD20 is one unit high.

Stacking the interlocking modules creates a compact system that occupies a minimal amount of bench space. It also minimizes the length of tubing and cable connections in the system. All cables are routed through the front slots and rear chases under the modules.

NOTE

Ship Kits for the DX 500 pumps and chromatography modules contain a shoe (P/N 046478) and two ties (P/N 046476). These items help secure the CD20 to other DX 500 modules, preventing the modules from tilting or sliding apart. Installation of the shoe and ties is optional. For installation instructions, refer to the pump or chromatography module manual.

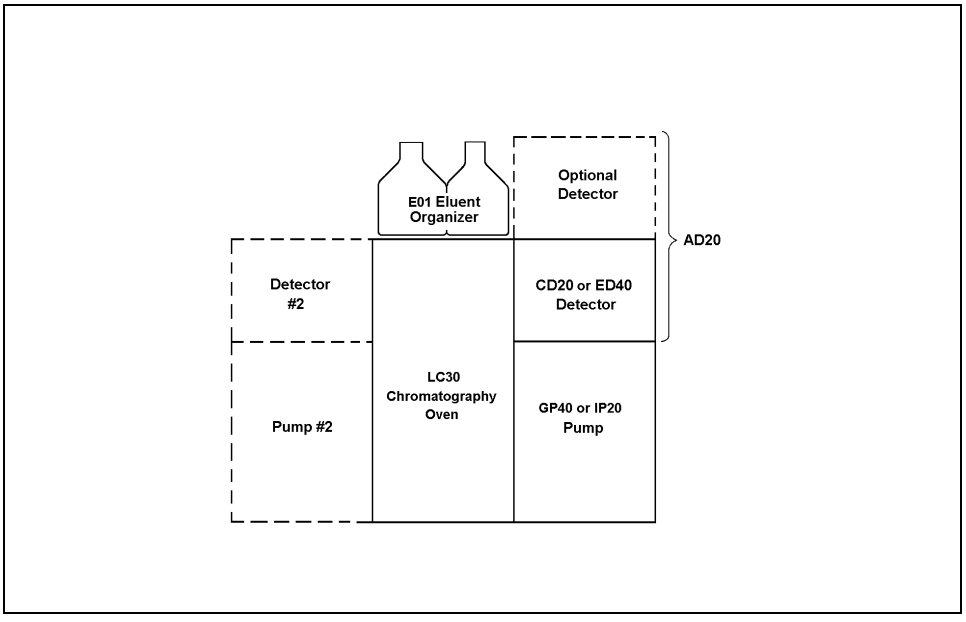


Figure B-1. Recommended DX 500 System Configuration

B.3 Installation

CAUTION

During installation, or whenever it is necessary to move the detector, lift it only from the bottom or side. Lifting the CD20 by the front panel door will damage the door hinges.

B.3.1 Power Connection

You can control power to the CD20 from the main power switch on either the CD20 or the LC30 Chromatography Oven (if present). In either case, no adjustment is required to select the line voltage.

For on/off control from the CD20, connect the modular power cord (IEC 320 C13) provided in the CD20 Ship Kit (P/N 046298) from the main power receptacle on the CD20 rear panel (Figure B-2) to a grounded, single-phase power source.

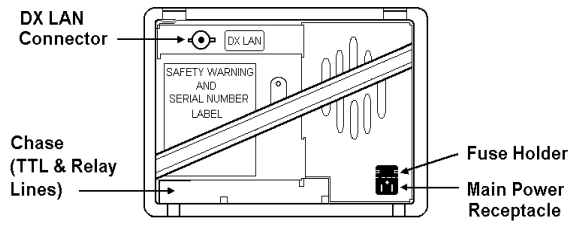


Figure B-2. CD20 Rear Panel

The LC30, when properly connected to other modules in the chromatography system, can function as the main power source for the system. The LC30 Ship Kit provides IEC jumper power cables (P/N 960748) for this purpose. If desired, connect a jumper cable from the CD20 main power receptacle to one of the four IEC auxiliary receptacles on the LC30 rear panel. From now on, you can leave the CD20 power switch on continuously and use the LC30 main power switch to turn the detector on and off.



SHOCK HAZARD—To avoid electrical shock, use a grounded receptacle. Do not operate or connect to AC power mains without an earthed ground connection.

B.3.2 DX LAN Network Connection (Optional)

In order to communicate with PeakNet software, a detector interface card (P/N 044196) must be installed in the CD20 and a DX LAN cable (P/N 960404) must be connected to the DX LAN connector on the CD20 rear panel.

IMPORTANT

STATIC—The CD20 electronics are not user-serviceable. The detector interface card should be installed by qualified personnel only. Observe standard anti-static procedures when installing the interface card or handling the CPU card.



To prevent damage to the detector, turn off the main power before installing the interface card. After confirming that the LED on the CPU card is off (not green or red), unplug the power cord from the mains. Do not rely on the front panel power switch.

1. Remove any TTL/Relay plugs from the connectors at slot 4 in the CD20 electronics chassis. (To identify card locations, see the label on the inside of the CD20 front door or to Figure 2-3 in this manual.)
2. To disconnect the 60-pin ribbon cable from the CD20 front panel, first close the tilt panel, exposing the 60-pin connector and its ejector latches. Remove the cable by opening the ejector latches.
3. Using a screwdriver as a lever, open the white ejector latch at the bottom of the CPU card. Remove the CPU card, cable, and Relay card as a single unit.
4. Insert the detector interface card (P/N 044196) into slot 4. Slide the card to the rear of the detector. Verify that the BNC connector is aligned with the hole at the rear and that the card is aligned with the connector. Press firmly on the card until it mates fully with the connector on the rear panel.
5. Reinstall the CPU/Relay card. Press firmly until the CPU card is inserted into the connector on the rear panel.
6. Reconnect the ribbon cable to the 60-pin connector on the front panel. The header and connector are key-polarized near the center. The ejector latches must be partially open to accept the cable connector.
7. If the detector is the last module in the network to be connected, install a terminator plug (P/N 921034) on the remaining port of the BNC tee connector. (Terminator plugs are shipped with PeakNet.) If this is not the last module, connect the cable from the next module to the BNC tee.

IMPORTANT **Make sure terminator resistor plugs are installed at both ends of the DX LAN.**

8. Connect the DX LAN cable (P/N 960404) to the DX LAN connector on the CD20 rear panel.

NOTE
An optional 15-meter (50-ft) DX LAN extension cable (P/N 046016) is available from Dionex.

B.3.3 DS3 Detection Stabilizer Installation

Install the DS3 with the conductivity cell (P/N 044130) in a DX 500 chromatography module—LC10 Chromatography Organizer, LC20 Chromatography Enclosure, or LC30 Chromatography Oven—or on a laboratory workbench. The instructions for installing the DS3 in an LC20 and LC30 are identical. The LC10 installation procedure is presented separately because it is slightly different.

The DS3 can be plumbed for three operating modes:

- AutoSuppression™ Recycle mode (SRS required), shown in Figure B-3
- AutoSuppression with External Regenerant mode (SRS required), shown in Figure B-4. Also plumb the system in this way for the AutoSuppression Chemical Suppressor and MMS Pressurized Regen System configurations.
- Nonsuppressed mode, shown in Figure B-5. Note that conductivity measurements made when no suppressor is in-line may show noticeable baseline drift.

The CD20 Ship Kit includes certain items required when installing the SRS:

- SRS gas separator waste tube (P/N 045460)
- Backpressure coil for 4 mm SRS (P/N 045877)
- SRS-to-CD20/ED40 control cable (P/N 046346)

NOTE

The instructions here do not replace the instructions in your SRS manual. For detailed SRS installation instructions, and for the initial start-up procedure that must be performed before you begin routine operation, please refer to the SRS manual.

Backpressure Requirements

All HPLC detector cells require enough backpressure to prevent mobile phase in the cell from degassing due to abrupt volume changes between the small inner diameter of the connecting tubing and the larger volume of the cell. Degassing creates bubbles in the cell and disrupts detector responsiveness.

Before plumbing a system for the AutoSuppression mode, check the SRS manual for backpressure requirements.

NOTE

The backpressure generated by the DS3, cell, and backpressure tubing is applied to the SRS. For example, with 1 meter of 0.25-mm (0.01-in) ID tubing at a flow rate of 1.0 mL/min, the backpressure is about 200 kPa (30 psi).

For backpressure requirements for the Nonsuppressed mode, see Table B-1. The minimum backpressure should be 0.21 to 0.34 MPa (30 to 50 psi) per minute.

Flow Rate (mL/min)	Tubing ID	Coil Length	Number of Coils
0.5 to 1.5	0.25-cm (0.010-in)	0.76 M (2.5 feet)	2
1.5 to 3.0	0.25-cm (0.010-in)	0.76 M (2.5 feet)	1
0.12 to 0.37	0.12-cm (0.005-in)	0.30 M (1.0 feet)	2
0.37 to 0.75	0.12-cm (0.005-in)	0.30 M (1.0 feet)	1

Table B-1. Coils for Backpressure Requirements (Nonsuppressed Mode)

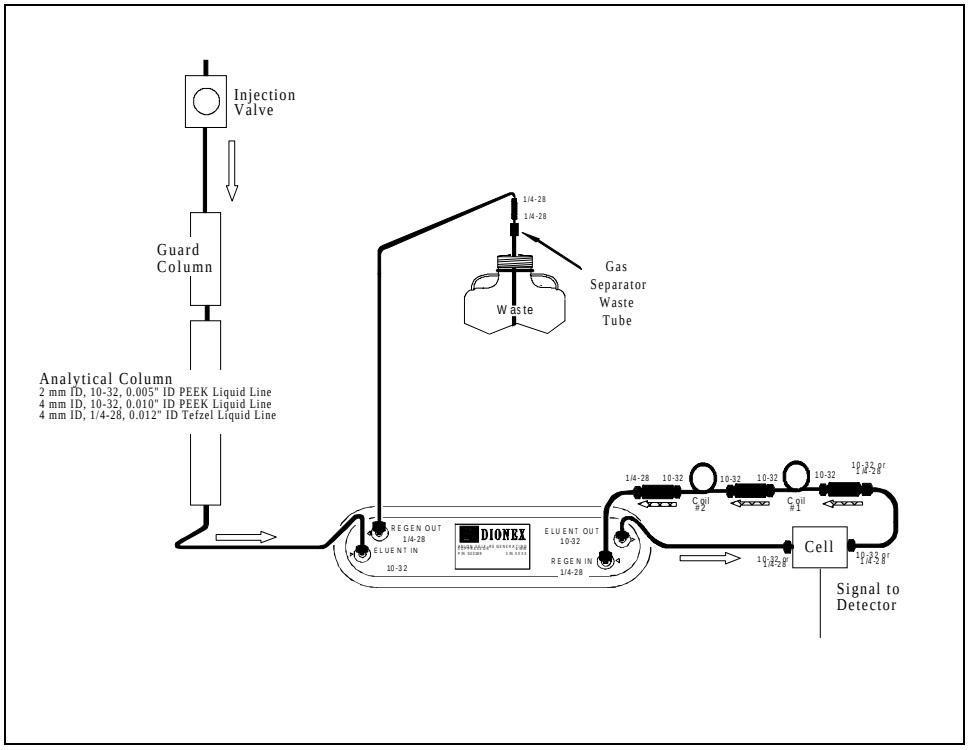


Figure B-3. AutoSuppression Recycle Mode

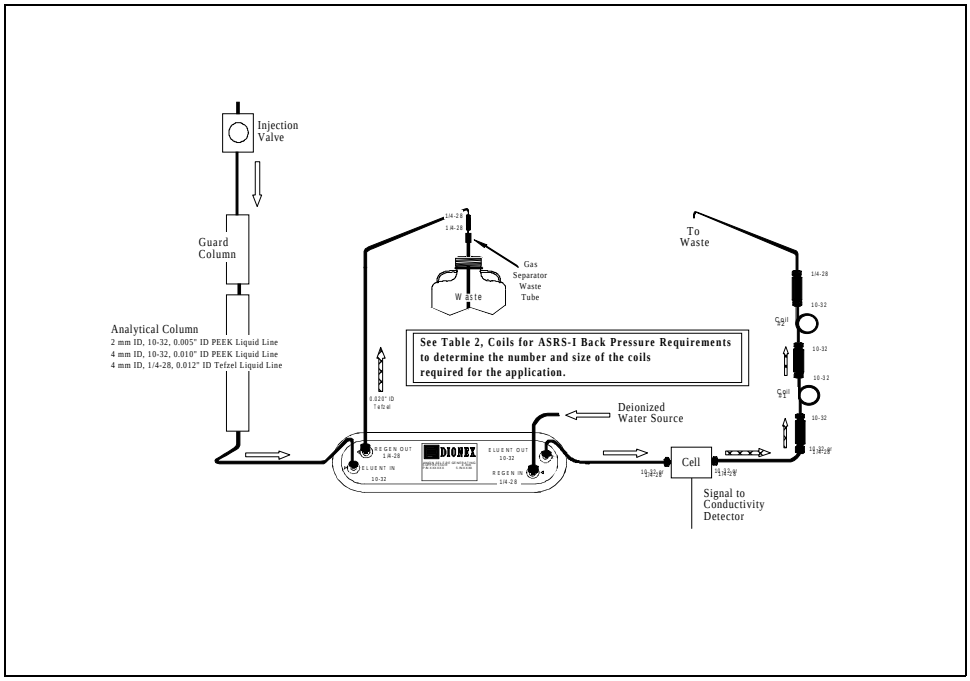


Figure B-4. AutoSuppression Mode, External Regenerant

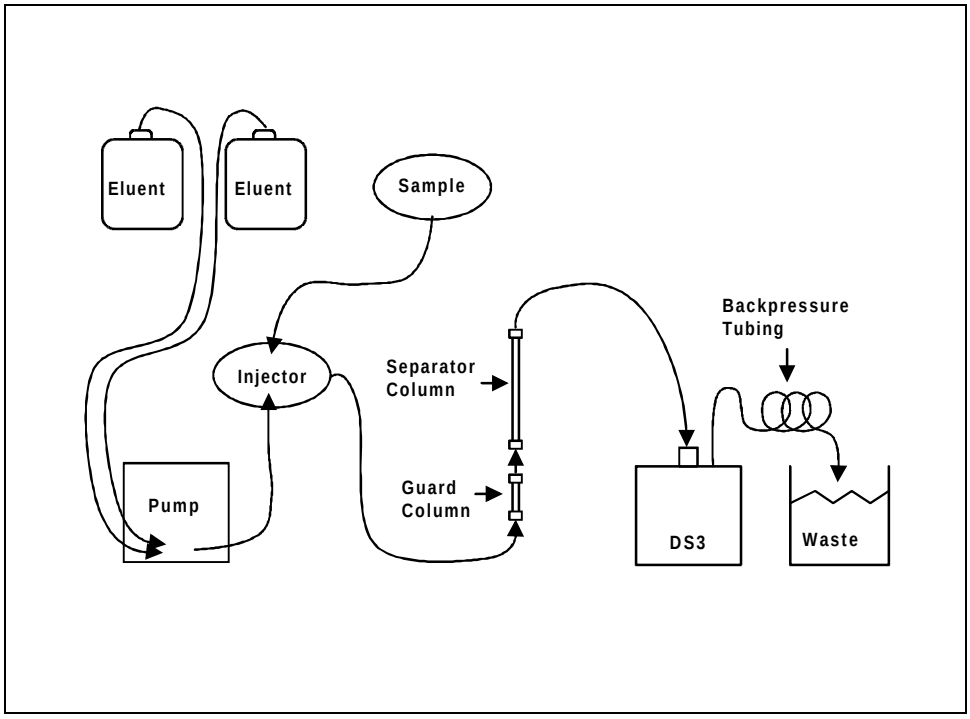


Figure B-5. Nonsuppressed Mode

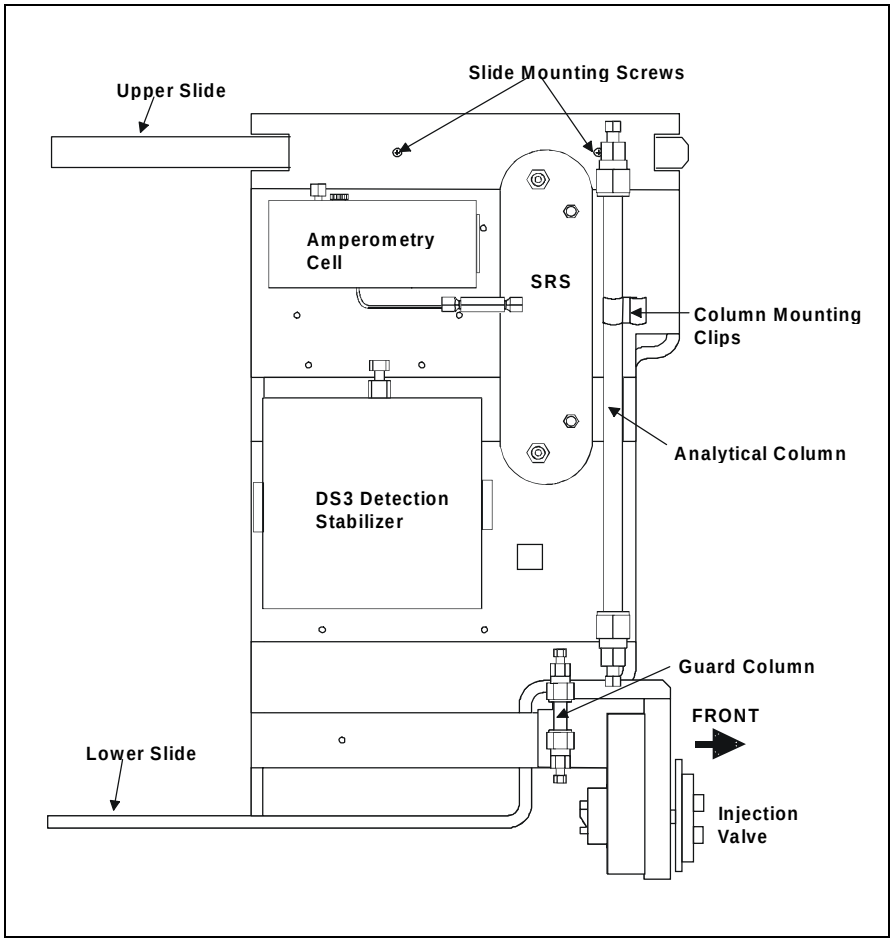


Figure B-6. Typical DS3 Installation in LC20 or LC30

Installing a DS3 in an LC20 or LC30

1. Position the keyhole slots on the rear of the DS3 over the shoulder washers on the LC20 or LC30 component mounting panel(s), then pull the DS3 down into position.

2. Route both DS3 cables out the hole located at the back of the LC20 or LC30 and into the cable chase at the base of the detector. Next, route the cables through the cable chase to the front of the detector. (You can also route the cables into the detector through the slots on the sides of the detector.)
3. Plug the connectors on the cables into the appropriate jacks on the SCR card. (To identify the card location and connector positions, see the label on the inside of the CD20 front door or to Figure 2-3 in this manual.)
4. Connect the eluent outlet of the column or suppressor to the DS3 inlet, using 0.25-mm (0.010-in) ID tubing (P/N 042690), 10-32 fittings (P/N 043275), and ferrules (P/N 043276).
5. Connect the outlet of the DS3 (the 10-32 coupler) to either the SRS REGEN IN port (for AutoSuppression Recycle mode) or to the backpressure line leading to waste (for AutoSuppression with External Regenerant mode or Nonsuppressed mode).
6. Direct the spill/overflow tubing to the spill tray at the bottom front of the LC20 or LC30.

Installing a DS3 in an LC10

1. Cut the spill/overflow tubing within 2.0 cm (3/4 in) of the DS3 enclosure.
2. Position the keyhole slots on the rear of the DS3 enclosure over the shoulder washers located on the LC10. Push the DS3 down to secure it in place.
3. Route both DS3 cables through the hole located at the base of the detector cable chase. Next, route the cables through the cable chase to the front of the detector. (You can also route the cables into the detector using the slots on the sides of the detector.)
4. Plug the connectors into the appropriate jacks on the SCR card. (To identify the card location and connector positions, see the label on the inside of the CD20 front door or to Figure 2-3 in this manual.)

5. Connect the eluent outlet of the column or suppressor to the DS3 inlet, using 0.25-mm (0.010-in) ID PEEK tubing (P/N 042690), 10-32 fittings (P/N 043275), and ferrules (P/N 043276). See Table B-1 for backpressure requirements.
6. Connect the outlet of the DS3 (the 10-32 coupler) to the SRS REGEN IN port (for AutoSuppression Recycle mode) or to the backpressure line leading to waste (for AutoSuppression with External Regenerant mode or Nonsuppressed mode).

B.3.4 Shielded Conductivity Cell Installation

The installation instructions for the shielded conductivity cell (P/N 044132) are the same as for the DS3, except that the shielded cell does not have a heater power cord. The shielded cell installs in the same location as the DS3, and the keyhole slots on its base plate fit on the LC10, LC20, and LC30 in the same way as the keyhole slots on the DS3.

B.3.5 Recorder/Diagnostic Connection

Connecting a strip chart recorder or integrator to the CD20 lets you record or monitor several parameters besides the cell analog output. For the recorder/diagnostic signal cable pinouts, see Table E-1 in Appendix E.

Use the twisted black and red wires (P/N 043598) provided in the CD20 Ship Kit to connect a recorder or integrator to the SCR card. Strip the ends of the wires and insert into the plugs; the signal wire (red) goes on the top of each plug and the ground wire (black) goes on the bottom. Tighten the locking screws with the screwdriver (P/N 046985) provided in the CD20 Ship Kit.

B.3.6 Relay/TTL Control Connections

TTL inputs 1, 2, 3, and 4 can be used to control four of the functions listed below. Select the functions from the **TIME FUNCTION IN** screen.

- OFFSET Recorder
- HOLD/RUN Program
- SRS OFF/ON
- METHOD NUMBER INCRement
- METHOD NUMBER DECRement
- MARK Recorder
- Increase Recorder RANGE x10

The CD20 Ship Kit includes eight 2-pin connector plugs (P/N 921019): four inputs and four outputs. Attach individual wires, twisted pairs, or coaxial cables to the plugs. See Table E-3 in Appendix E for the Relay/TTL connector pinouts.

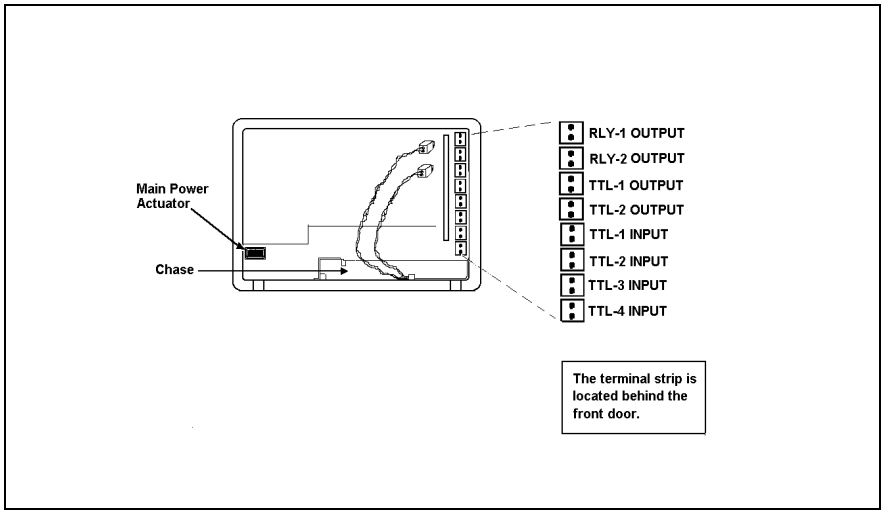


Figure B-7. TTL Connections

Strip the end of the wire(s) and insert into the plugs; the signal wire (red) goes on top of each plug and the ground wire (black) goes on the bottom. Tighten the locking screws with the screwdriver (P/N 046985) provided in the Ship Kit.

Connections 1 and 2 can be programmed to switch any low-voltage control. Switched current must be less than 200 mA and 42 V peak.



CAUTION

The relay outputs, TTL inputs, and TTL outputs all use a connector of the same style. Do not inadvertently connect relay loads that include power supplies to the TTL inputs or TTL outputs. Relay loads in excess of 200 mA or with included power supplies over 42 V may damage the relay drivers on the CPU module.

B.4 Automatic SRS Power Control (Optional)

TTL connections can be used to automatically switch off the power to a Self-Regenerating Suppressor (SRS) when the flow from the pump stops.

1. On the **PUMP OPTIONS** screen, set **TTL2 OUTPUT USAGE** to **0 Flow**. (For more details, see the operator's manual for the GP40 Gradient Pump or IP20 Isocratic Pump.)
2. On the CD20 **TTL FUNCTION IN** screen, assign **TTL3** to **SRS OFF/ON**.
3. Locate the twisted black and red wires (P/N 043598) and two green TTL connector plugs (P/N 921019) provided in the CD20 Ship Kit.
4. Strip the ends of the wires and insert them into the plugs, with the signal wire (red) on top of each plug and the ground wire (black) on the bottom. Tighten the locking screws with the screwdriver (P/N 046985) provided in the CD20 Ship Kit.
5. Plug one end of the cable into TTL2 OUT on the pump.

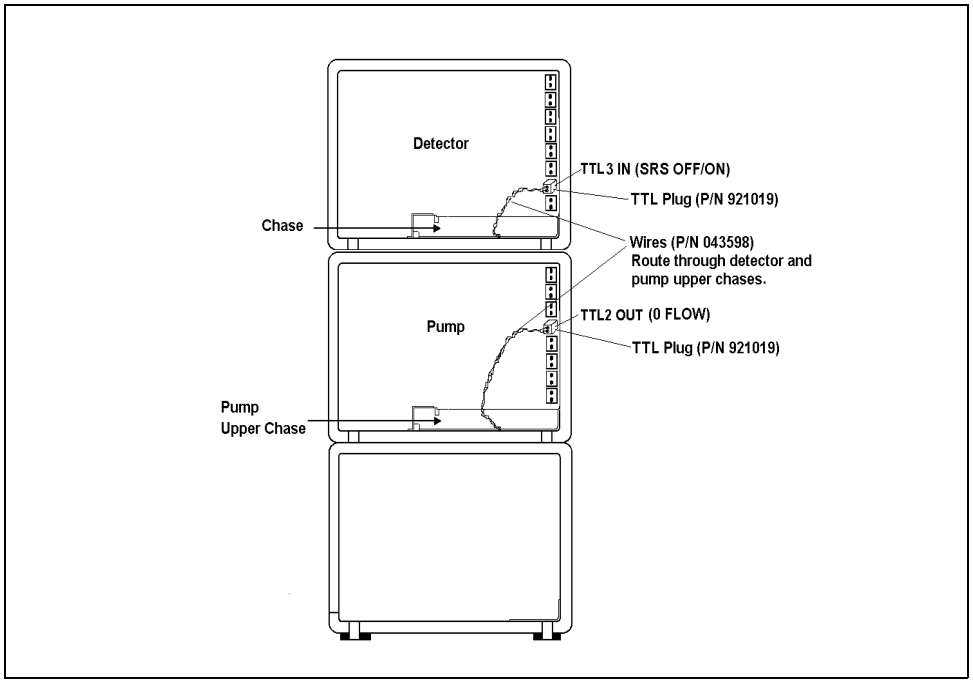


Figure B-8. TTL Connections for SRS Power Control

6. Route the cable through the upper chase of the pump and the CD20, and then plug the free end of the cable into TTL3 IN on the CD20 (see Figure B-6).

7. Turn off the flow (from the pump) and confirm that the detector automatically turns off the SRS. First, however, expect a 5-minute delay from the time the CD20 receives the signal until the power to the SRS is turned off; this delay allows momentary flow interruptions without disturbing the SRS.

C • User Interface

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C • User Interface

This appendix illustrates and describes all of the screens available for display on the front panel of the CD20 Conductivity Detector. There are two categories of screens: operational and diagnostic.

- ***Operational*** screens enable you to create, edit, and run methods that control CD20 operation, and to select default parameters for the detector.
- ***Diagnostic*** screens provide access to diagnostic information and tests, including some screens that enable you to calibrate various CD20 functions.

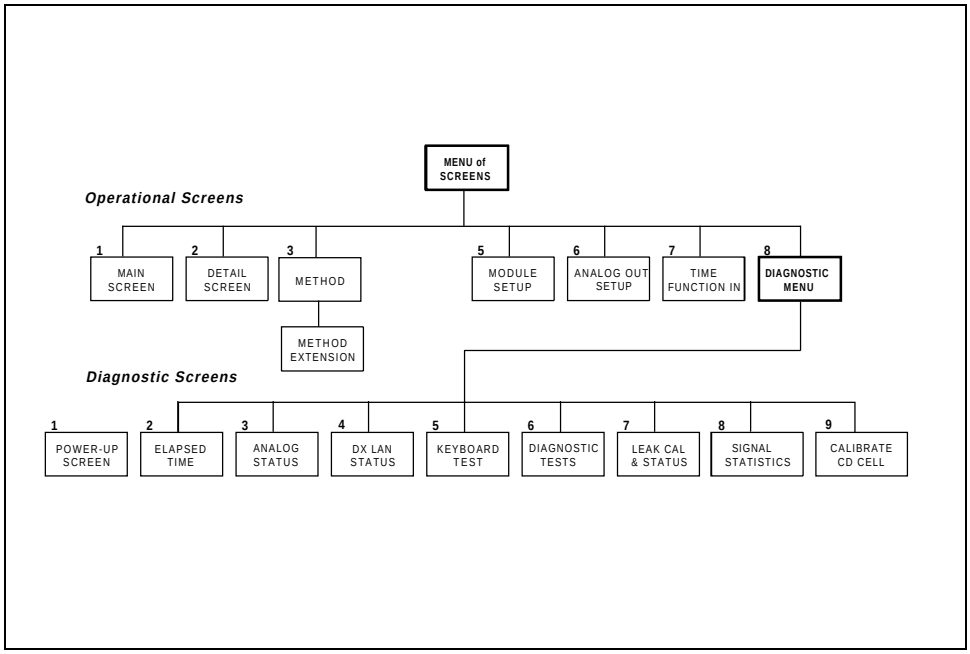


Figure C-1. CD20 Menu Structure

C.1 Operational Screens

C.1.1 Menu of Screens

The **MENU of SCREENS** provides top-level access to the menu structure.

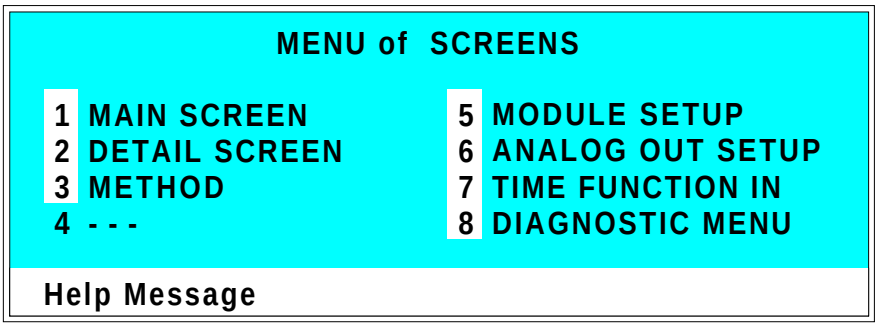


Figure C-2. Menu of Screens

There are two ways to select a screen from this menu:

- Use the cursor arrow buttons to move the cursor to the field containing the screen number and press **Enter**.
- Press the number button on the front panel keypad that corresponds to the screen.

To display a brief description of each menu option, press the **Help** button.

C.1.2 Main Screen

The **MAIN** screen displays the measured conductivity (siemens) and other primary functions in large characters to make viewing easier from a distance.

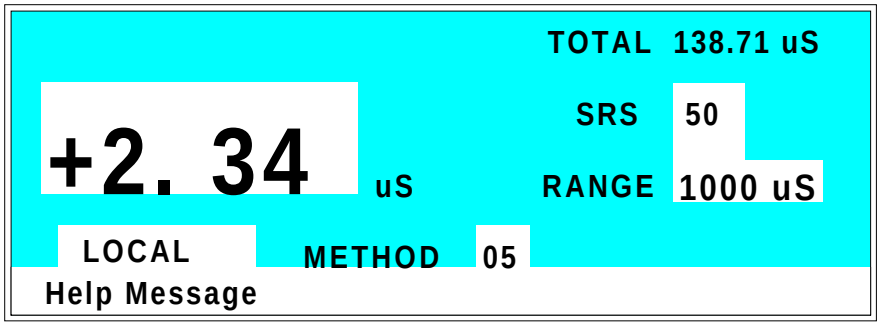


Figure C-3. Main Screen

TOTAL	Displays total conductivity (without an offset).
SRS	Selects the amount of current sent to the suppressor. Current selection depends on the eluent concentration, flow rate, etc. The discrete settings are Off, 50, 100, 300, and 500 mA.
RANGE	Sets the analog output scale factor. Select a range between 0.01 and 3000 µS.
METHOD	Sets the method number. Pressing **Select** and **Enter** sets the detector to Direct control.
CONTROL MODE	Sets the detector to Local, Remote, or Locked Remote control.

C.1.3 Detail Screen

The **DETAIL** screen includes all the fields contained on the **MAIN** screen, as well as the TTL and Relay fields and fields to control detection. Refer to the **MAIN** screen for a description of fields that are common to both screens.

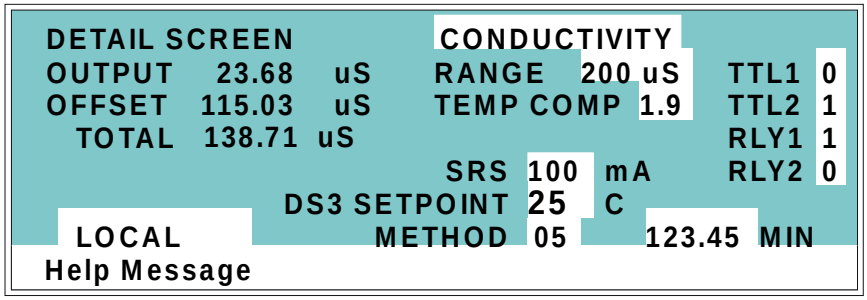


Figure C-4. Detail Screen

TEMP COMP — Sets the temperature compensation factor. The range is 0 to 3%. 1.7% is appropriate for most eluents.

DS3 SETPOINT — Sets the temperature of the DS3 Detection Stabilizer.

TTL1
TTL2 — Provides TTL control of accessories. In a method, these values occur according to the method timing. In Direct control, select off (0) or on (1).

RLY1
RLY2 — Provides relay contact closure control of accessories. In a method, these values occur according to the method timing. In Direct control, select off (0) or on (1).

C.1.4 Method

A method consists of a series of timed steps. Each step has a set of parameters associated with it.

Initial conditions are applied when a method is invoked. A lower case **v** next to the last step on the display indicates that the method contains more steps.

Blank fields denote no change from the previous step. The **Delete** button blanks the field.

NOTE

TEMP COMP, DS3 TEMP, and SRS CURRENT are not time-programmable.

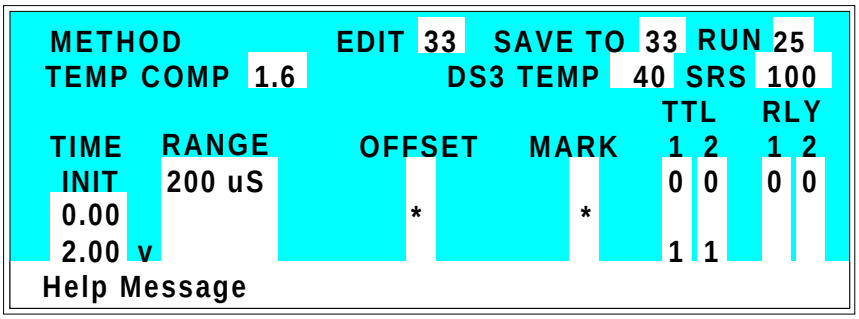


Figure C-5. Method Screen

EDIT	Specifies the method number (0 through 99) to edit.
SAVE TO	Specifies the method number (0 through 99) to save the current method to.
RUN	Specifies the method number (0 through 99) to run. The **Hold/Run** button controls the running of the method.
TEMP COMP	Sets the Temperature Compensation factor.

SET TEMP	Sets the temperature for the DS3 Detection Stabilizer.
SRS	Sets the Self-Regenerating Suppressor current.
TIME	Specifies the start time for each step. Times are displayed chronologically.
RANGE	Sets the analog output range.
OFFSET	Stores the offset value. The baseline is set by subtracting the offset measured when this step is executed from all subsequent measurements. An asterisk (*) indicates that OFFSET will occur at this time.
MARK	Sends a positive pulse to the analog output (recorder) as an event marker. An asterisk (*) indicates that a MARK will occur at this time.
TTL	Sets TTL1 and TTL2 to off (0) or on (1).
RLY	Sets RLY1 and RLY2 to off (0) or on (1).

C.1.5 Module Setup

The backlight intensity, key beep, and error beep are configured from the **MODULE SETUP** screen.

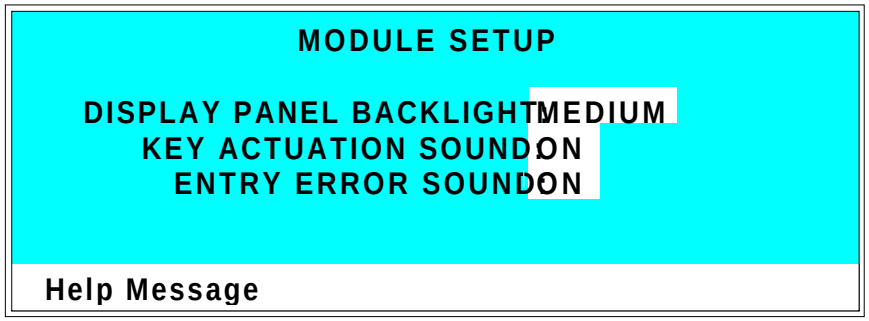


Figure C-6. Module Setup Screen

DISPLAY PANEL BACKLIGHT	Sets the display panel backlight to **LOW**, **MEDIUM**, **HIGH**, or **OFF**.
KEY ACTUATION SOUND	Toggles the keypad touch sound. When this option is selected, the detector sounds a beep when a button is pressed.
ENTRY ERROR SOUND	Toggles the error sound. When this option is selected, the detector sounds a beep when an invalid entry is made.

C.1.6 Analog Out Setup

The **ANALOG OUT SETUP** screen contains parameters for setting the analog output, such as for a recorder or oscilloscope.

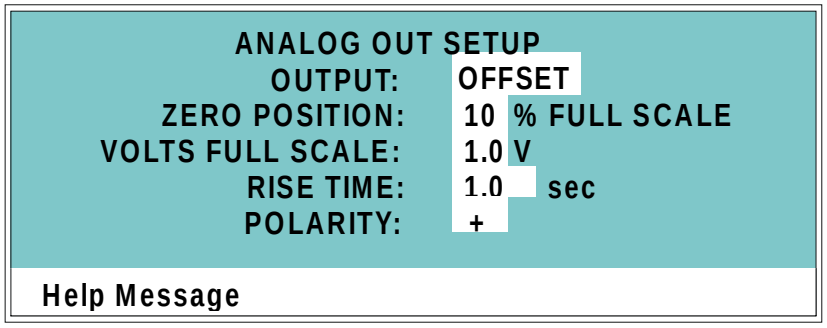


Figure C-7. Analog Out Setup Screen

OUTPUT — Sets the analog output to one of the following:
OFFSET uses the offset level value.
TOTAL sets the detector output to the total cell conductivity, charge or current, disabling the offset function.
ZERO sets the detector output to zero volts.
FULL SCALE sets the output to the full-scale setting.

ZERO POSITION — Sets the analog (recorder) offset level (0 to 100%).

VOLTS FULL SCALE — Sets the full-scale voltage for a signal equal to the range setting. The discrete settings are 1.0, 0.1, and 0.01 volts.

RISE TIME — Sets the output filter rise time to 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, or 10.0 seconds. Rise time is a measure of how quickly the detector goes from 10% to 90% of step input changes. A digital filter is used with zero undershoot or overshoot for minimal peak distortion.

POLARITY	Determines the output voltage polarity. The output is usually set to positive polarity. Negative polarity is used to reverse peaks from indirect detection.

C.1.7 Time Function In

Four input TTL controls may be assigned to the time input functions via the **TIME FUNCTION IN** screen. Control is enabled when Local mode is selected.

Use the **Select** buttons to assign TTL1 through TTL4 to any four of the seven time functions. TTL input ports can also be assigned to the **INCR** and **DECR** fields, to increase or decrease the method number.

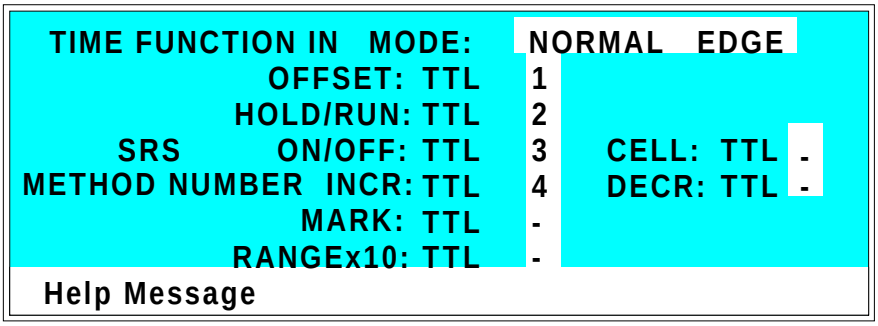


Figure C-8. Time Function In Screen

C.2 Diagnostic Screens

To access the CD20 diagnostics, select the **DIAGNOSTIC MENU** from the **MENU of SCREENS**. While a diagnostic screen is displayed, pressing the **Menu** button returns you to the **DIAGNOSTIC MENU**. From the **DIAGNOSTIC MENU**, pressing **Menu** returns you to the **MENU of SCREENS**.

C.2.1 Diagnostic Menu

Figure C-9 shows the **DIAGNOSTIC MENU**. The nine menu options are explained in detail in the following sections.

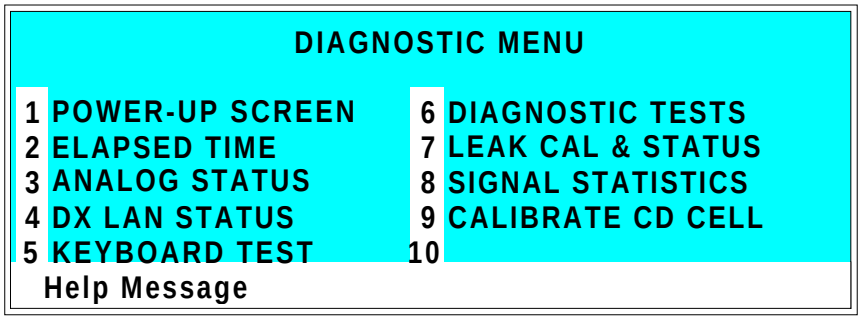


Figure C-9. Diagnostic Menu Screen

There are two ways to select a screen from this menu:

- Use the cursor arrow buttons to move the cursor to the field containing the screen number and press **Enter**.
- Press the number button on the front panel keypad that corresponds to the screen.

To display a brief description of each menu option, press the **Help** button.

C.2.2 Power-Up Screen

The **POWER-UP** screen displays the revision numbers for the Moduleware and BIOS code. It also displays the identification number of the optional DX LAN interface, if connected.

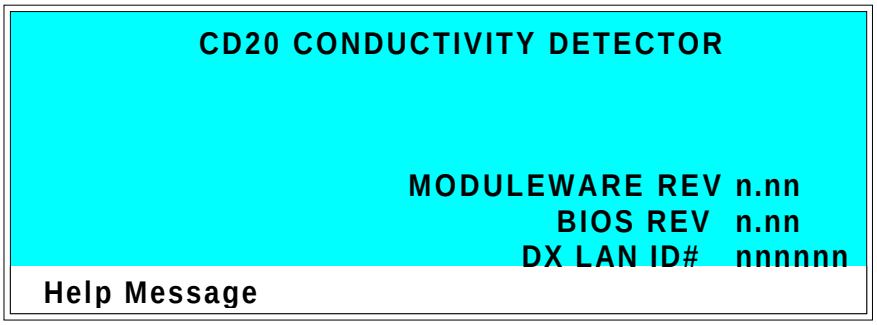


Figure C-10. Power-Up Screen

C.2.3 Elapsed Time

This screen reports for how long various CD20 parameters have been in use. The status of each parameter updates in real time.



Figure C-11. Elapsed Time Screen

MODULE ON	Reports the total time the detector has been powered up in its lifetime.
BACKLIGHT	Reports the total time the LCD backlight has been on in its lifetime.
SRS ON	Reports the total time the SRS has run. Reset this field to zero after changing the SRS.
CD CELL ON	Reports the total time the conductivity cell has run. Reset this field to zero after replacing the cell.
RESET	Allows a timer to be reset to zero to restart the counter. Reset the appropriate timer after installing a new component.

C.2.4 Analog Status

This screen reports the status of several analog test points. If a run is in progress, the status updates are from the last idle state. If no run is in progress, the values are in real time.

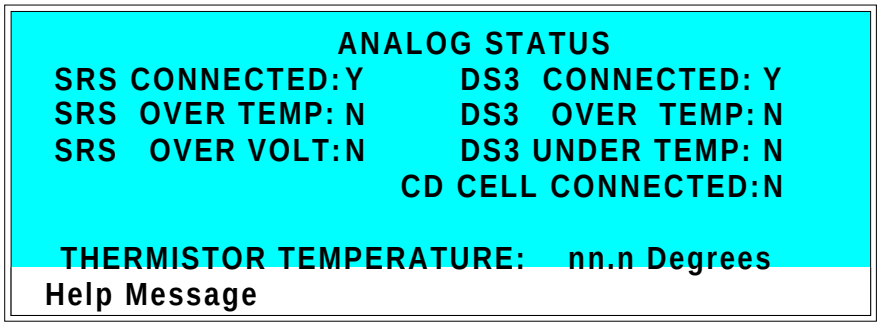


Figure C-12. Analog Status Screen

SRS CONNECTED	Indicates whether a Self-Regenerating Suppressor is connected to the detector.
SRS OVER TEMP	Indicates whether the SRS is over the temperature specified.
SRS OVER VOLT	Indicates whether the SRS is over the voltage range specified.
DS3 CONNECTED	Indicates whether a DS3 Detection Stabilizer is connected to the detector.
DS3 OVER TEMP	Indicates whether the DS3 is over the temperature specified.
DS3 UNDER TEMP	Indicates whether the DS3 is under the temperature specified.
CD CELL CONNECTED	Indicates whether a conductivity cell is connected to the detector.
THERMISTOR TEMPERATURE	Indicates the temperature recorded from the conductivity cell thermistor.

C.2.5 DX LAN Status

The DX LAN driver monitors several types of errors that may occur on the network. The detector reads the DX LAN error counts and displays them on this screen, along with the DX LAN addresses. Most errors are caused by a defective cable, missing or incorrectly terminated cable. The DX LAN cable must be RG58U or RG58AU.

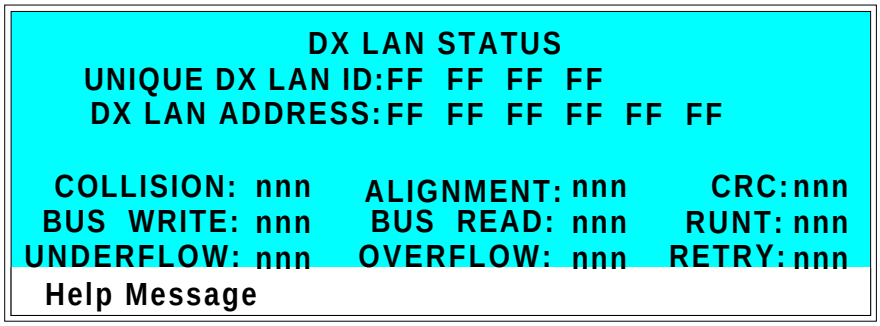


Figure C-13. DX LAN Status Screen

UNIQUE DX LAN ID — Displays the three-byte DX LAN ID programmed into the detector Moduleware (in HEX). The ID is unique to the detector and never changes.

DX LAN ADDRESS — Displays the six-byte DX LAN address assigned by the PC (in HEX). The first three bytes are the system assignment and the last three bytes are the assignment within the system.

COLLISION — Indicates that 16 unsuccessful transmissions of the same packet occurred, due to collisions.

BUS WRITE — Indicates that a ready response could not be issued within 2.4 microseconds after the WR signal was asserted. This occurs when the transmit buffer memory is full.

UNDERFLOW	Indicates that data from the transmit section of the hardware buffer memory is not available for serial transmission. The DX LAN will continue to send out this data frame.
ALIGNMENT	Indicates that a packet was received with an alignment error, meaning that there were one to seven extra bits at the end of the packet. This is usually caused by a collision or a faulty transceiver.
BUS READ	Indicates that a ready response could not be issued within 2.4 microseconds after the ready signal was asserted. This occurs when reading an empty buffer.
OVERFLOW	Indicates that the DX LAN hardware receive buffer became full and had to reject a packet for lack of space.
CRC	Indicates that a packet was received with a CRC error. This usually means that a collision has corrupted the packet.
RUNT	Indicates that a “runt” packet (one less than 15 bytes in length) was received. This usually occurs after a collision has truncated the original length.
RETRY	Indicates the number of retries required to transmit the last packet.

C.2.6 Keyboard Test

You can conduct an interactive test of the CD20 front panel keypad from this screen. Pressing any front panel button changes the corresponding button indicator on the screen to reverse video. This confirms proper operation of that button. When you release the button, the display returns to normal video.

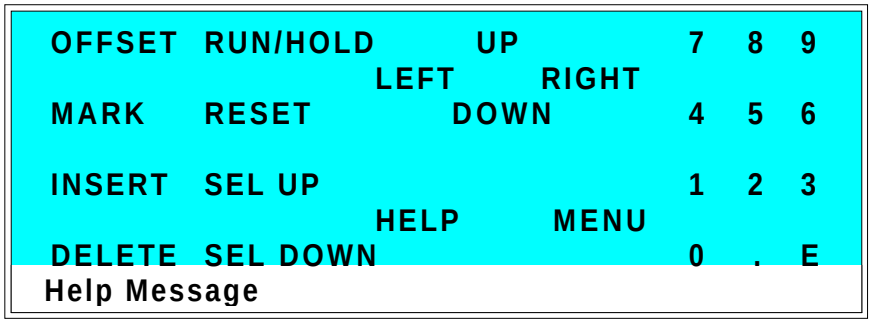


Figure C-14. Keyboard Test Screen

C.2.7 Diagnostic Tests

These tests verify the integrity of the detector electronics and functions.

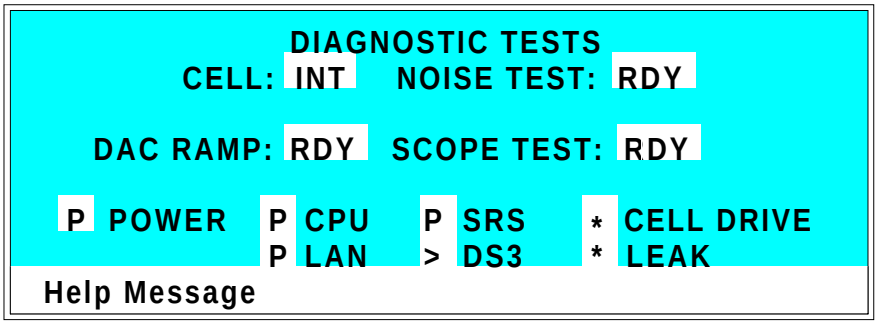


Figure C-15. Diagnostic Tests Screen

CELL — Specifies whether the cell to be tested is internal (INT) or external (EXT).

NOISE TEST — Selects one of the following test modes:

RDY—The system is idle and ready to begin a test.

CD—Selects the conductivity cell for testing.

DAC RAMP — Selects the DAC test mode. The test linear ramps the output of the selected DA on the SP or SCR card from 0 to full-scale and can be plotted from the recorder output or from PeakNet. The ramp test modes are:

RDY—The system is idle and ready to begin a test.

CDO—Tests the CD Offset DAC (eight iterations, one for each gain; the eighth iteration is flat on top). Disconnect the conductivity cell before running this test.

REC—Tests the Recorder Output DAC.

SCOPE TEST

Generates test waveforms that can be monitored on test points on the SCR and SP cards, using an oscilloscope or chart recorder. The test modes are:

RDY—The system is idle and ready to begin a test.

CDF—Tests the CD Offset DAC output (TP9 on the SP card) and the CD fine filter circuit (TP19 on the SP card). TP9 outputs a square wave with a frequency of 200 ms and an amplitude from 0 to -0.1 V. TP19 outputs a sine wave with a frequency of 200 ms. The peak-to-peak amplitude is 4.40 V.

CDT—Tests the CD Temperature Compensation DAC (TP26 on the SP card). The output is a square wave in which the bottom and top amplitudes increase and decrease from 11 V to 12 V. Before running this test, connect the DS3 and set the temperature to 45 °C, or connect a dummy thermistor value of 42 kΩ to pins 2 and 3 of the conductivity cell connector.

SCR—Tests the SCR DAC for the DS3 set point temperature (TP13 on the SCR card) and SRS current set point (TP17 on the SCR card). The output on each test point is a linear ramp that goes from 0 to 10 V in 2.5 seconds. Disconnect the DS3 and SRS before running this test.

The following tests can be run from the **DIAGNOSTIC TESTS** screen. To begin a test, select the asterisk (*) in the field beside the test name and press **Enter**. When the test is complete, the entry field displays either **P** (pass) or **F** (fail).

NOTE

Running the following tests disturbs the equilibration of the detector as services cycle on and off and the system runs through its test modes. After testing, allow the system to equilibrate before resuming operation.

- POWER—Checks the +5, ±15, and +24 volt monitor on the Relay card.
- CPU—Checks the CPU internal configuration and the Moduleware checksum.
- DX LAN—Checks the DX LAN hardware configuration and loop-back.
- SRS—Varies the SRS power supply and checks the flags.
- DS3—Varies the DS3 temperature set point and checks the flags.
- CELL DRIVE—Switches in a resistor in place of the cell to provide a calibrated signal to read.
- LEAK—Checks the detector's leak sensor for a correct, open circuit, or short circuit condition.

C.2.8 Leak Sensor Calibration and Status

This screen reports the status of leak sensor parameters.

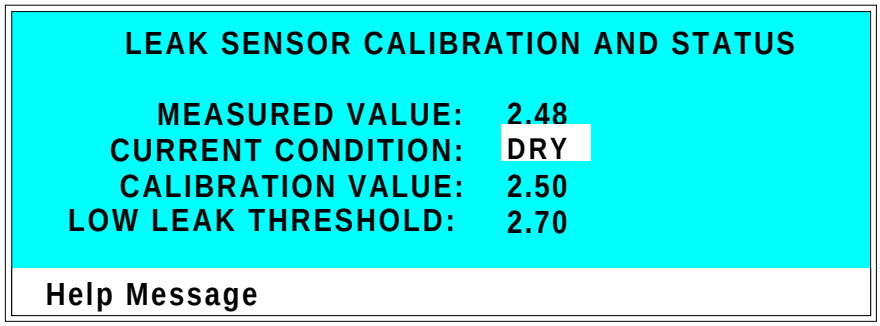


Figure C-16. Leak Sensor Calibration and Status Screen

MEASURED VALUE	Reports the measured voltage from the leak sensor.
CURRENT CONDITION	Reports the current (error) condition of the leak sensor: WET, DRY, or ERR. Error indicates an open or short circuit. To calibrate a leak sensor, select **CAL** and press **Enter**. After calibration, the field will revert to DRY, unless an error condition exists.
CALIBRATION VALUE	Reports the value saved when the leak sensor was last calibrated.
LOW LEAK THRESHOLD	Reports the threshold value below which a leak is indicated. This is based on the calibration value.

C.2.9 Signal Statistics

This screen enables you to monitor the selected input to the A/D circuitry. When the screen is first displayed, the **MAX** and **MIN** status values are equal to the **INPUT** value, and **DURATION** reads 0. Status values are reported in A/D volts and are updated dynamically.

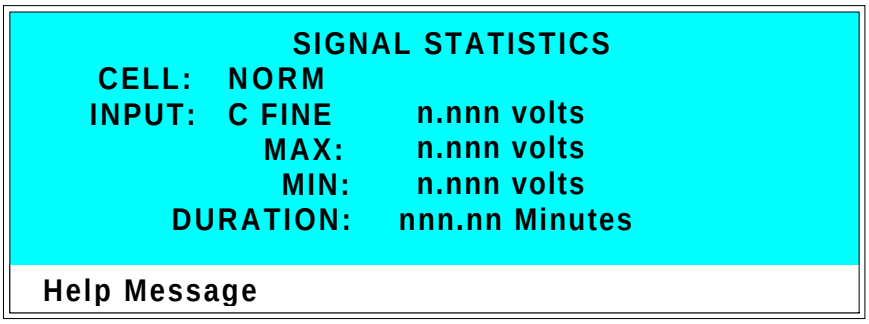


Figure C-17. Signal Statistics Screen

CELL	Selects the cell test mode: NORM—Uses input data from the cell. FIXED—Uses a fixed dummy cell for input.
INPUT	The measured data from the A/D circuit: C FINE—Conductivity cell fine input C COARSE—Conductivity cell coarse input C THER—Conductivity cell thermistor input LEAK—Leak detector input DRIVE—Cell drive circuit input
MAX	The maximum input data value during the duration of the test.
MIN	The minimum input data value during the duration of the test.
DURATION	The duration (in minutes) of the test. The test starts when you enter this screen and terminates when you exit.

C.2.10 Calibrate Conductivity Cell

This screen allows you to calibrate the conductivity cell with 1 mM KCl.

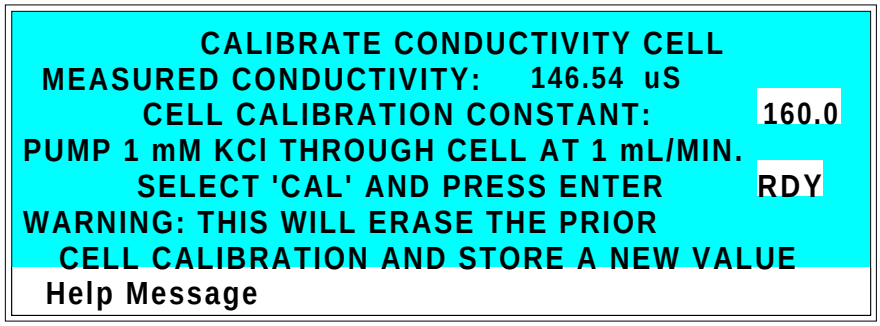


Figure C-18. Calibrate Conductivity Cell Screen

CONDUCTIVITY — Reports the measured conductivity from the conductivity cell.

Calibrate — Select **CAL** and press **Enter** to calibrate the conductivity cell to the value displayed in the conductivity field. The calibration assumes that uncontaminated 1 mM KCl is flowing through the cell at normal backpressure. The new value replaces the previous calibration value.

D • Signal Processor Functions

D • Signal Processor Functions

The functions of the Signal Processor (SP) card are as follows:

- Temperature compensation digital-to-analog converter
- Cell chopper, driver
- Offset digital-to-analog scaling switch
- Conductivity signal receiver
- Second stage amplifier and gain switch
- Synchronous rectifier
- 5 mS Noise filter
- DC amplifier 100 mS filter
- Signal selection (MUX)
- 16-bit Analog-to-digital converter
- Digital interface

E • Connector Pinouts

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E • Connector Pinouts

E.1 Recorder/Diagnostic Signal Pinouts

This section describes the Recorder/Diagnostic Signal pinouts. The connector is supplied plugged into the socket. The pins are numbered consecutively from 1 to 10 (top to bottom).

Pin	Signal
1	Recorder Negative
2	Recorder Positive
3	SRS Supply Voltage
4	DS3 Supply Current
5	Conductivity Cell Flow Stream Temperature
6	This pin is not used by the CD20.
7	This pin is not used by the CD20.
8	+10 V Reference from SCR Card
9	This pin is not used by the CD20.
10	Common Ground for Signals 3 through 9

Table E-1. Recorder/Diagnostic Cable Pinouts

E.1.1 Signal Electrical Parameters

Pin 1 Attach the negative input of the chart recorder to pin 1.

Pin 2 The full-scale output range setting (0 to 0.01 V, 0 to 0.1 V, or 0 to 1.0 V) is selected from the **ANALOG OUTPUT** screen.

The output resistance is 1 to 2 kΩ.

Pin 3 The voltage is equal to that developed across the SRS. The SRS is driven by a regulated current source.

The output resistance is 10 kΩ.

Pin 4 The voltage is proportional to the DS3 heater current. The maximum heater power produces approximately 1.2 V.

The output resistance is 5 kΩ.

Pin 5 The voltage is related to the inverse exponential of the temperature. Table E-2 lists the conductivity flow stream temperatures.

The output resistance is 1 kΩ.

°C	Volts	Slope (-mV/°C)
0	2.00	88
5	1.71	75
10	1.42	63
15	1.18	52
20	0.97	43
25	0.80	35
30	0.65	28
35	0.53	23
40	0.45	20
45	0.35	15
50	0.30	13

Table E-2. Conductivity Flow Stream Temperatures

Pin 6 This pin is not used by the CD20.

Pin 7 This pin is not used by the CD20.

Pin 8 The signal is 10.00 ± 0.01 V.

The output resistance is 0 Ω.

The maximum load current capability is 10 mA. This output may be divided with a resistor network to provide an offset to a monitoring device. Shorting or overloading this output will disrupt operation of the SCR module.

Pin 9 This pin is not used by the CD20.

Pin 10 A signal ground (0 volts) for monitoring only. Avoid connecting this pin to any grounds or sources of AC or DC current. This ground may be used in common for any of the signals on pins 3 through 9.

E.2 TTL/Relay Pinouts

The TTL and Relay connectors are on the DX LAN/Relay card. The TTL and Relay connectors all have the same pinout configuration; be careful to use the correct connector.

Connector Number	Pin Number	Description
Relay 1	1 and 2	Solid State Relay Contacts Out
Relay 2	1 and 2	Solid State Relay Contacts Out
Relay 3	1 2	TTL Out (1 kΩ pull up to +5, 100 mA sink) Ground
Relay 4	1 2	TTL Out (1 kΩ pull up to +5, 100 mA sink) Ground
Relay 5	1 2	Input TTL 1 Ground
Relay 6	1 2	Input TTL 2 Ground
Relay 7	1 2	Input TTL 3 Ground
Relay 8	1 2	Input TTL 4 Ground

Table E-3. TTL/Relay Connector Pinouts

E.3 DS3 Connector Pinouts—SCR

The DS3 Detection Stabilizer connects to the SCR card. The connector is a double-row, 1.6 cm (0.63 in) latching displacement connector.

Pin Number	Description
1	DS3 Ground (body)
2	+24 V
3	Base Drive
4	Emitter
5	Emitter
6	Thermistor Ground
7	Thermistor
8	Leak +5 V
9	Leak
10	Leak Ground
11	Disconnect
12	Disconnect Ground Sense

Table E-4. DS3 Connector Pinouts

E.4 SRS Connector Pinouts—SCR

The SRS (Self-Regenerating Suppressor) connects to the SCR card. The connector is a double-row, 0.84 cm (0.33 in) latching displacement connector.

Pin Number	Description
1	Ground
2	Thermistor
3	SRS Positive
4	SRS Negative
5	Disconnect Sense
6	Disconnect (Ground)

Table E-5. SRS Connector Pinouts

E.5 Conductivity Cell Connector Pinouts—SP

The conductivity cell connects to the SP card. The connector is a single-row, shielded, latching displacement connector.

Pin Number	Description	Color (inside cable)
1	Cell Drive	Red COAX
2	Ground (Thermistor and Shield)	All COAX shields
3	Thermistor	Black COAX
4	Cell Return	Red COAX
5–8	Grounded (Plug Body Shield)	On receptacle only, not on plug

Table E-6. Conductivity Cell Connector Pinouts

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