Installation and Operating Instructions

Series 501-100 Clarifier Control System CCS2000™ using DE2000C Controller
Series 501-100
Clarifier Control System
CCS2000™
using DE2000C Controller
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This manual includes instructions for the Drexelbrook 501-100 Series CCS2000™ Control System. The CCS2000 Clarifier Control uses ultrasonic technology for measurement of the light rag (fluff) layer and the dense sludge blanket levels, as well as clarity loss of liquor in wastewater and water treatment applications.

The CCS2000 Clarifier system tracks:
- dense sludge blanket
- light rag (fluff) layer.

This dual interface tracking allows pump control on the compacted sludge while still monitoring the rag layer. Both the dense interface and rag layer can be displayed on the front panel and/or assigned to the two analog loops.

The DE2000C is a microcontroller-based receiver that provides power and original control to a remote Transceiver/transducer Probe Subsystem (TPS). It accepts conditioned analog echo signals, performs signal processing, and control process functions according to user-programmed menu selections.

A typical CCS2000™ system is comprised of a DE2000C programmable microcontroller, a 50C-100-1 Transceiver/Transducer Probe Subsystem (TPS), and 280-15-124 rail mounting hardware. A 380-series connecting cable is also provided for the remote connection of the TPS to the DE2000C controller. See Figure 1-1.

The DE2000C controller operates from 120/240 Vac, 50/60 Hz power. It is housed in NEMA 4X fiberglass housing.

- It provides power and signal control for the remote ultrasonic transceiver/transducer probe subsystem (TPS).

- It supplies power for two 4-20 mA current output loops. Using the proprietary DE2000C software, the two channels are dedicated to sludge blanket level and clarity process variables in feet and percent respectively. A two-line front panel display shows real-time processed sludge level and clarity loss values.

- A built-in keypad, also on the front panel, is used for display and menu select/edit functions.
The DE2000C is equipped with:

- four relays assigned to sludge level alarm, clarity alarm, pump control, and rag level alarm. Each relay (operating through the menu-selected values or logic outputs), is used to operate user-provided annunciator and or control devices (e.g., horns, lights, pumps, valves). If the alarm limits are exceeded, the two-line display flashes the display reading to identify the source that is exceeded and the front panel ALARM light (LED) alerts the user.

- a common fault alarm relay. The common fault relay is activated when the system detects poor signal quality (less than 500 mV from the Transceiver/transducer Probe Subsystem) or total signal loss. A fault alarm usually indicates a malfunction in the TPS or failure in cable and/or connections. The fault alarm condition is indicated by the front panel FAULT light (LED).

- a system fault alarm. The DE2000C continuously runs a self-diagnostic program to check for board failure or problems in the microprocessor. The fault alarm condition is indicated by the front panel SYSTEM FAULT light (LED).

- four TTL outputs that directly correspond to the relay outputs.

- an RS-232 serial communication port that can be used to pass tank profile to a PC, or in conjunction with a Digital Recorder printed circuit card to pass recorded level and clarity data to a PC.

The Transceiver/transducer Probe Subsystem (TPS) is a self-contained remote subsystem comprised of:

- a transceiver electronic chassis (40C-100-1) mounted in a five-inch explosionproof housing.

- a transducer (705-610-2) probe assembly that is mounted to the housing to form an integral electronics and probe subsystem.

The TPS needs no adjustments or customer intervention other than connecting the cable assembly at time of installation.
Figure 1-1
CCS2000 Clarifier Control System
System Components
1.3 Model Numbering

The system model number specifies the site mounting/tank application.

5 0 1 - 0 1 X X - X X X - X X 0 CCS2000 Clariier Control

Approvals:
0 = Standard (no approvals)
1 = CE Mark
F = FM

Gain Control
0 = Standard Gain
1 = High Gain

Insertion Length:
03 = 3 feet
05 = 5 feet
07 = 7 feet
08 = 8 feet
09 = 9 feet
10 = 10 feet
12 = 12 feet
14 = 14 feet
16 = 16 feet
18 = 18 feet

Mounting:
0 = Flush mount
1 = 12-inch mount
2 = 24-inch mount
3 = 12-inch mount with Cam unit
4 = 24-inch mount with Cam unit

Software:
8 = Standard
9 = Extended Range

Treatment:
0 = Water
1 = Wastewater
2 = Industrial
### 1.3 Model Numbering

<table>
<thead>
<tr>
<th>Model Numbering</th>
<th>Transceiver/Transducer Probe Subsystem (TPS)</th>
</tr>
</thead>
</table>

#### Housing Type:
- 1 = Chassis only
- C = 5-inch integral Drexelcote<sup>TM</sup>
- F = 5-inch integral standard

#### Approvals:
- 0 = Standard (no approvals)
- 1 = CE Mark
- 2 = FM

#### Gain Control:
- 0 = Standard Gain
- 1 = High Gain
SECTION 2 - INSTALLATION

2.1 Unpacking

Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it immediately to the factory (1-800-527-6297).

2.2 Mounting the DE2000C Controller

Mounting recommendations for the DE2000C Controller are as follows:

- The DE2000C controller is designed for either indoor or outdoor mounting, but should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage.

- It can be mounted up to 500 feet (152.4 meters) from Transducer/transceiver Probe Subsystem.

- For convenience at start-up, place the instrument in a reasonably accessible location.

- Ambient temperatures for the location of the DE2000C should be between -40°F and 185°F (-40°C to 85°C).

Figure 2-1 shows the mounting dimensions of the DE2000C in the 10 x 12 NEMA 4X housing.
All dimensions shown in inches (mm)

Figure 2-1
DE2000C Mounting Dimensions
The Transceiver/transducer Probe Subsystem should be mounted in a location with an ambient temperature between -40°F and 185°F (-40°C to 85°C) and water temperature of 40°F to 100°F (-4°C to 38°C) for the submerged ultrasonic transducer.

Figure 2-2 gives the mounting dimensions for the Clarifier Control transceiver in 5-inch housing.
2.3.1 Railing Types

Normally, the mounting location is 1/3 to 1/2 of the radius of the vessel measured from the outer wall towards the center of the vessel. If the safety railing is not round, a mounting adapter plate is required. See Figure 2-3.

Figure 2-3
Types of Railing

Mounting instructions for the TPS are specific according to clarifier application. Refer to the following sections for your mounting application:

2.3.2 Swing Arm Mounting Hardware.
2.3.3 Mounting on a Circular Clarifier with a Swing Mount.
2.3.4 Mounting on a Rectangular Clarifier with a Swing Mount.
2.3.5 Flush Mounting Hardware.
2.3.6 Mounting on a Circular Clarifier with a Flush Mount.
2.3.7 Mounting on a Rectangular Clarifier with a Flush Mount.
Refer to Figures 2-4 through 2-6.

- Using small u-bolts, washers and nuts, attach Transceiver/Transducer Probe Subsystem (TPS) to the support plate (at the indicated mark) so that the transducer face is approximately 3 inches (76.4 mm) below surface of water and the cable fitting on the electronic housing faces the walkway. See Detail A-A on Figure 2-4.

- Using small u-bolts, washers and nuts, attach rake shield so that it extends 3 inches (76.4 mm) past transducer face.

—Standard Railing Instructions
- Place mounting bracket support on top of horizontal railing and slide lower bracket support onto lower horizontal railing. Attach lower bracket support with u-bolt, washers, and nuts.

- Tighten bracket set screw to upper railing to secure mounting bracket.

- If necessary, reposition vertical set bolt so that the TPS hangs perpendicular to water surface. See Detail A-A on Figure 2-4.

—Non-standard Railing Instructions
- Locate position along railing for adapter assembly and drill 9/32 -7/16-inch diameter holes in railing using adapter hole template, shown in Figure 2-6.

- Attach mounting bracket support with adapter assembly to railing with 3/8-inch diameter bolts, nuts and washers.

- If necessary, reposition vertical set bolt so that the TPS hangs perpendicular to water surface. See Detail A-A on Figure 2-4.

2.3.2 Swing Arm Mounting Hardware
Figure 2-4

Swing Arm Mounting, Bracket Installation
Figure 2-5
Swing Arm Mounting, Clearance Dimensions
Figure 2-6
Non-standard Railing Template
2.3.3 Mounting on a Circular Clarifier with a Swing Arm Mount

For best performance, mount the Transceiver/transducer Probe Subsystem on a circular clarifier with a surface skimmer, approximately one third the tank radius from the outside wall. See Figure 2-7a and 2-7b.

**NOTE**

In some cases, it is acceptable to mount the circular clarifier closer to the center (but it is not recommended for best operation). Mounting close to the influent baffle may produce inconsistent sludge and clarity reading due to mixing and presence of unsettled solids (fluff and rag layers) from the influent baffle.

**CAUTION**

Be sure that the transducer is equipped with a splash/skimmer guard.

The mounting for surface skimmer applications has a swing sensor capability. It should be mounted on the rail that allows the probe to swing when engaged by the skimmer arm. The splash/skimmer guard should be adjusted for best angle of engagement to the skimmer arm.

**NOTE**

Be sure to clear all obstructions outside the walkway that could interfere with proper ultrasonic probe operation. Extension arms (12-inch or 24-inch) should be specified when ordering. If there is not proper clearance, the unit will not function properly.
Figure 2-7a
Mounting Configuration, Circular Clarifier with Surface Skimmer
Figure 2-7b
Mounting Configuration, Circular Clarifier with Surface Skimmer
2.3.4 Mounting on a Rectangular Clarifier with a Swing Mount

Swing Arm mounting should be used when the Transceiver/transducer Probe Subsystem is being mounted on a rectangular clarifier with surface flights (rake). See Figure 2-8.

The standard mounting hardware is used to mount on a 1½ to 2-inch round railing. An adapter is required to mount on rail types with dimensions greater than 2 inches.

**CAUTION**

Do not place unit so splash/skimmer guard and flight engagement could get caught on flight surface irregularity. See Figure 2-5. Damage to equipment could occur.

---

**Figure 2-8**

Mounting Configuration, Rectangular Clarifier with Surface Rake
2.3.5 Flush Mounting Hardware

Refer to Figures 2-9 and 2-10.

- Using small u-bolts, washers and nuts, attach Transceiver/transducer Probe Subsystem (TPS) to the mounting bracket (at the indicated mark) so that the transducer face is approximately 3 inches below surface of water and the cable fitting on the electronic housing faces the walkway. See Detail A-A on Figure 2-9.

—Standard Railing Instructions
- Place mounting bracket support on top of horizontal railing and slide lower bracket support onto lower horizontal railing. Attach lower bracket support with u-bolt, washers, and nuts.

- Tighten bracket set screw to upper railing to secure mounting bracket.

—Non-standard Railing Instructions
- Locate position along railing for adapter assembly and drill 9/32-7/16-inch diameter holes in railing using adapter hole template, shown in Figure 2-6.

- Attach mounting bracket support with adapter assembly to railing with 3/8-inch diameter bolts, nuts and washers.

- Tighten bracket set screw to upper railing to secure mounting bracket.
Figure 2-9
Flush Mounting, Bracket Installation
Figure 2-10
Flush Mounting, Clearance Dimensions

All dimensions shown in inches (mm)
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2.3.6   | Mounting on a Circular Clarifier with a Flush Mount: When mounting a Transceiver/transducer Probe Subsystem on a circular clarifier without a surface skimmer and there is no interference (obstructions) in the rail to water path, the flush mount may be used.  
  
  **NOTE**  
  In clarifier applications where surface skimmers are not used, bubbles may settle on the bottom of transducer and may impair signal quality. Drexelbrook can provide optional equipment that minimizes this potential problem. Consult factory at 1-800-527-6297 for additional details. |
| 2.3.7   | Mounting on a Rectangular Clarifier with a Flush Mount: Flush or swing arm mounting can be used when the Transceiver/transducer Probe Subsystem is being mounted on a rectangular clarifier without surface flights. Mounting can be more flexible in terms of desired location. However, try not to place the TPS in tank locations close to influent and/or polymer output ports. |
2.4 Wiring

Ensure that all wiring, electrical fittings and conduit connections conform to your local electrical codes for the location and environment of use.

**CAUTION**

If the Clarifier Control is located in a hazardous environment, do not open the enclosure cover or make/break any electrical connections without first disconnecting electrical power at the source.

2.4.1 Input Power Wiring to the DE2000C Controller

Input power wiring to the DE2000C is made to the jumper block below the printed circuit cards. Figure 2-11 shows the wiring connections for 120/240 Vac power input connections. Power input is nominal 120 or 240 Vac, 50/60 Hz. Either voltage may be applied without any changes.

**For 120 Vac power input,** connect the hot (black) wire to terminal 1, the neutral (white) wire to terminal 2 and the ground (green) wire to terminal 3.

**For 240 Vac power input,** connect one hot (L1) wire to terminal 1, the second hot (L2) wire to terminal 2 and the ground wire to terminal 3.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 Vac</td>
<td>B</td>
<td>W</td>
<td>G</td>
</tr>
<tr>
<td>240 Vac</td>
<td>L1</td>
<td>L2</td>
<td>Gnd</td>
</tr>
</tbody>
</table>
2.4.2 Analog/Digital Input Wiring (DE2000C to Transceiver)

The Analog to Digital Converter board must be located in the last card slot (location J10).

A specified length of 8-conductor shielded cable is supplied to connect the remote TPS to the DE2000C. The DE2000C should be located so the cable length should not exceed 500 feet.

—from DE2000C

• Refer to Figure 2-11. Locate the connector on the A/D card, location J10. Terminals 1 through 4 are for signal I/O from the transceiver assembly.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Signal</th>
<th>Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Brown</td>
</tr>
<tr>
<td>2</td>
<td>E+</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>Neg. Trigger</td>
<td>Green</td>
</tr>
<tr>
<td>4</td>
<td>Pos. Trigger</td>
<td>Blue</td>
</tr>
</tbody>
</table>

• Locate the power connector to TPS below the printed circuit cards. These connectors pull off for ease of wiring. Power connector terminals supply DC voltage to the transceiver.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Signal</th>
<th>Wire*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-12 Vdc</td>
<td>Orange</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Black</td>
</tr>
<tr>
<td>3</td>
<td>+12 Vdc</td>
<td>Red</td>
</tr>
</tbody>
</table>

*With the connector installed, the wires are Red, Black, and Orange from left to right.

• Drain wire is connected to ground bar.

• Connect the wires using a small screwdriver, and replace the connectors into the sockets.

—to Transceiver

• Refer to Figure 2-12.

• Plug in connector
Figure 2-11
DE2000C Power Input Wiring
Controller Connector

<table>
<thead>
<tr>
<th>Signal</th>
<th>Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>E+</td>
<td>White</td>
</tr>
<tr>
<td>GND</td>
<td>Brown</td>
</tr>
<tr>
<td>+12V</td>
<td>Red</td>
</tr>
<tr>
<td>-12V</td>
<td>Orange</td>
</tr>
<tr>
<td>GND</td>
<td>Black</td>
</tr>
<tr>
<td>-TR</td>
<td>Green</td>
</tr>
<tr>
<td>+TR</td>
<td>Blue</td>
</tr>
</tbody>
</table>

Figure 2-12
DE2000C to Transceiver Wiring
Figure 2-13 shows the circuit card board positions in the DE2000C.

- Turn off power to the unit.

To remove a circuit board from a slot in the card cage:
- remove wiring terminals with wires attached by grasping terminal strip and pulling out.
- grasp each card-securing pin with thumb and forefinger and pull card out of cage.

To re-insert the boards:
- use Figure 2-13 to locate correct board assignment,
- insert board into card guides,
- slide into place,
- press card-securing pins to lock,
- replace all connectors.

- Turn on power to the unit.
Board Identification Chart (NOTE 3)

<table>
<thead>
<tr>
<th>CARD SLOT</th>
<th>IDENTIFICATION</th>
<th>FUNCTION</th>
<th>STD/OPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>MCU</td>
<td>MICROPROCESSOR</td>
<td>S</td>
</tr>
<tr>
<td>J2</td>
<td>S/F</td>
<td>STANDARD FUNCTIONS</td>
<td>S</td>
</tr>
<tr>
<td>J4</td>
<td>RLY</td>
<td>RELAYS</td>
<td>S</td>
</tr>
<tr>
<td>J6</td>
<td>A/O</td>
<td>ANALOG OUTPUT, NON-IS</td>
<td>O</td>
</tr>
<tr>
<td>J6</td>
<td>DRR</td>
<td>DIGITAL RECORDER MODULE</td>
<td>O</td>
</tr>
<tr>
<td>J7</td>
<td>-</td>
<td>I.S. WIRING SHIELD</td>
<td>S</td>
</tr>
<tr>
<td>J8</td>
<td>-</td>
<td>(FUTURE)</td>
<td></td>
</tr>
<tr>
<td>J9</td>
<td>A/O</td>
<td>ANALOG OUTPUT, I.S. (NOTE 1)</td>
<td>S</td>
</tr>
<tr>
<td>J10</td>
<td>A/D</td>
<td>ANALOG/DIGITAL CONVERTOR</td>
<td>S</td>
</tr>
<tr>
<td>J11</td>
<td>-</td>
<td>FRONT PANEL CONNECTOR</td>
<td>S</td>
</tr>
<tr>
<td>J12</td>
<td>-</td>
<td>POWER SUPPLY INPUT</td>
<td>S</td>
</tr>
<tr>
<td>J13</td>
<td>-</td>
<td>POWER SUPPLY OUTPUT</td>
<td>S</td>
</tr>
</tbody>
</table>

Refer to Sheet 4 through 6 for Wiring Details.

NOTES:
1. SEE INSTRUCTION MANUAL 501-100-LM AND CONTROL DRAWING FOR RECOMMENDED PRACTICES WHEN INSTALLING INTRINSICALLY SAFE SYSTEMS.

2. POWER INPUT IS NOMINAL 120 OR 240 VAC 50/60 HZ. EITHER VOLTAGE MAY BE APPLIED WITHOUT ANY CHANGES.

3. ANALOG/DIGITAL CONVERTOR PCB MUST BE LOCATED IN (J10) OTHER PCBS WILL FUNCTION IN ANY OTHER POSITION BUT MAY HAVE TO BE PLACED TO THE RIGHT OR LEFT (I.S. TO THE RIGHT) OF THE INTRINSIC SAFETY WIRING SHIELDS DEPENDING ON THE SYSTEM REQUIREMENTS. THE STANDARD SYSTEM IS AS SHOWN.

4. J# REFERS TO THE DESIGNATION FOUND ON BOTTOM CIRCUIT BOARD (MOTHER BOARD) NEXT TO PLUG IN CONNECTORS.
2.4.4 Analog Output Wiring

Analog output wiring is shown in Figure 2-14.

- #18 Awg wire is the recommended wire size for analog output wiring. Twisted shielded pair is recommended in areas of high electrical noise.

- Locate the connector on the Analog Output board.
  Terminals 1 and 2 are for sludge level.
  Terminals 3 and 4 are for % clarity.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Signal</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+ Sludge Level</td>
<td>4-20 mA</td>
</tr>
<tr>
<td>2</td>
<td>- Sludge Level</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>+ Clarity</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>- Clarity</td>
<td>4-20 mA</td>
</tr>
</tbody>
</table>

- Make the designated analog output connections to the analog output board and plug the connector back into its designated location.

2.4.5 Relay Wiring

Relay board wiring is shown in Figure 2-14. In an intrinsically safe system, the Relay board must be placed on the left side of the wiring barrier in position J6.

- #18 Awg wire is the recommended maximum wire size for relay wiring.

- Locate label A on the Relay board.
  Label A contains the two (2) connector terminals for relays 1 through 4.
  Relays 2 and 4 use terminals labeled 1, 2, 3.
  Relays 1 and 3 use terminals labeled 4, 5, 6.

- Locate label B on the Relay board.
  Label B contains 5 switches for manual relay control.
  Switches 1 through 4 control the position (normal or alarm) of relay 1 through 4.
  Switch 5 selects either the auto or manual control mode. If switch 5 is set in manual control, all of the relays are set manually.
2.4.5 Relay Wiring (cont.)

- Locate label C on the Relay board.  
  Label C contains 4 sets of relay status lights indicating normal (green) or alarm (red) for each relay.

- Locate label D on the Relay board.  
  Label D is a yellow L.E.D. that indicates the relay card is in the manual mode.

The wiring for each relay is identical. Use the following procedure to wire a relay. It assumes Relay 1 is being wired and that the relay-controlling device is 120 Vac-powered.

a. Remove connector for selected relay.

b. Insert 120 Vac power line into:  
   terminal 5 for relays 1 and 3;  
   terminal 2 for relays 2 and 4.

c. Insert a wire from the input terminal of the controlled device into:  
   terminal 4 for relays 1 and 3;  
   terminal 1 for relays 2 and 4.  
This wiring configuration turns the device ON when the relay is in the alarm state.

  OR

Insert a wire from the input terminal of the controlled device into:  
   terminal 6 for relays 1 and 3;  
   terminal 1 for relays 2 and 4.  
This wiring configuration turns the device OFF when the relay is in the alarm state.

d. Connect the Power Return terminal of the controlled device to the 120 Vac neutral line.

e. Replace connector in socket. Wiring is complete.
DE2000C Analog Output and Relay Wiring

**Figure 2-14**

Non-Intrinsically Safe Area

Intrinsically Safe Area

4.20 mA Outputs wired as "Source" (Standard)

4-20 mA

Load Max. 500Ω

#18 AWG recommended wire size. Twisted Shielded pair is recommended in areas of high electrical noise.

Note:

Fault LED will be illuminated when 4-20 mA current loop circuit is open.

**Relay Assignment**

- Relay 1 - Sludge Alarm
- Relay 2 - Clarity Alarm
- Relay 3 - Sludge Pump Control
- Relay 4 - Spare Relay Assignment

Relay Connections

Contacts shown in the power off and/or alarm position

#18 AWG Recommended
## 2.4.6 Common Alarm and Fault Alarm Wiring

Figure 2-15 shows the common alarm and fault wiring. The common alarm and fault relays are located on the standard functions card in slot J2 of the card cage.

On the Standard Functions card:
Label C connector contains the common alarm contacts.
Label D connector contains the common fault contacts.

The wiring for common alarm and common fault are identical. Use the following procedure to wire the common alarm contacts. The procedure assumes that a 120 Vac-powered horn is actuated by the common alarm contacts.

a. Remove connector C for common alarm. (connector D for common fault).

b. Place the 120 Vac hot line into terminal 2 and tighten.

c. Connect one of horn terminals to terminal 1 and tighten.

d. Connect other horn terminal to the 120 Vac neutral line.

e. Replace connector in the socket. The horn will sound when the common alarm is activated or when there is a line power loss to the DE2000C.

### Fault Alarm

Tied to the *signal quality*. When the signal quality is below a preset threshold value, the common fault relay will de-energize and the yellow FAULT LED on the front panel will illuminate.

The yellow FAULT LED will remain illuminated until the condition causing the fault is corrected. The common fault relay will remain de-energized until the **ACK** key is pressed, or the condition causing the fault is corrected. When the **ACK** key is pressed, the common fault relay will energize. However, if the fault condition remains for one damping period the relay will again de-energize.
Figure 2.15
DE2000C Common Alarm and Fault Wiring
Remote Pushbutton Wiring

TTL Output Wiring

Common Fault Relay Contacts
Shown in the power off and/or alarm position

Common Alarm Relay Contacts
Shown in the power off and/or alarm position

TTL1
(4) TTL outputs corresponding to relay or logic outputs 1-4

TTL2
TTL3
Output 5V for non-alarm TTL assignments

TTL4
(1 standard TTL load)
TTL1 - Sludge Level Alarm
TTL2 - Clarity Alarm
TTL3 - Pump On
TTL4 - Spare Relay Assignment

Connection for N.O., remote push button to acknowledge the common alarm or common fault relays. (There is one Ack. button on front panel as standard). Max distance 500' (152.4 M).

RS-232 Data Communications Output:
RD - Receive Data
SD - Send Data

18 AWG twisted shielded pair (recommended)

NOTES:
1. See instruction manual 501-100-4LM for more detailed wiring information if required.
Following is an example of the fault alarm relay wiring.

—Example of Pump Control using the Fault Alarm Relay and Relay #3

Refer to Figure 2-16.

- Wire the pump to Relay #3’s common terminal contact and then through the NC contact to the common terminal of the fault alarm relay.

- The fault alarm relay will de-energize when power is lost to the unit or if the unit is in a fault condition, and will prevent the pump from running.

During normal operation:

- The normally open contact of the fault alarm relay will be in the closed position, allowing the pump to operate.

- When the sludge level reaches the pump-on setpoint, the normally closed contacts of relay #3 will be in their closed position, allowing the pump to run.

- When the sludge reaches the pump-off setpoint, the normally closed contacts of relay #3 will open, locking out the pump.
2.4.7 TTL Output Wiring

TTL output wiring is shown in Figure 2-15. The TTL outputs are located on the connector labeled B on the Standard Functions card. The Standard Functions card is located in slot J2 of the card cage.

- A TTL high output (5V) indicates a normal condition.
- A TTL low (0V) indicates an alarm condition.

Use the following procedure to wire the TTL outputs.

a. Remove connector B.

b. Connect a ground wire from terminal 6 to the ground of the device receiving the TTL output from the DE2000C.

c. Wire from the TTL output terminals 1 through 4 to the TTL inputs of the receiving device.

d. Replace the connector in the socket. TTL output wiring is complete.
2.4.8 Remote Acknowledge Switch Wiring

A Remote Acknowledge pushbutton switch can be mounted up to 500 feet away from the DE2000C. It allows common alarms and common fault alarms to be acknowledged from a separate location.

Figure 2-15 shows the Remote Acknowledge switch contacts. The contacts are located on connector A on the Standard Functions card in slot J2 of the card cage.

Use the following procedure to wire the Remote Acknowledge switch.

a. Remove connector A.

b. Insert a wire into terminal 1 and tighten.

c. Insert another wire into terminal 2 and tighten.

d. Connect the two wires to the normally open and common terminals of the push-button switch.

e. Replace the connector in the sockets. Wiring is complete.
3.1 Sensor Fouling

In certain cases, the sensor may be fouled at frequent intervals in tanks that do not have a surface skimmer. A fouled sensor can be caused by gas bubbles that become trapped on the underside of the sensor. The condition is aggravated if other solids become attached to the sensor bottom and create a surface that the bubbles can adhere to.

If the tank has a surface skimmer, the CCS2000 sensor should always be mounted in the skimmer path. The lifting and movement clears the sensor periodically of bubbles and solids. By observing the SIGNAL QUALITY on the Clarifier menu (Table 4-1), the drop to low values (< 1.0) may indicate poor signal quality and possibly a fouled sensor. This can be confirmed by physically shaking the sensor mount and observing a sudden improvement in signal quality (re-enter the menu and scroll to SIGNAL QUALITY e.g. 1.0 → 6.0).

3.2 Installing a Cone

Tanks that exhibit continuously high levels of gas and do not have a surface skimmer will show sensor fouling symptoms. To alleviate (not eliminate) this problem, install a cone shroud as shown in Figure 3-1. The cone protects the sensor from collecting excessive solids and gas bubbles.

**NOTE**

There are applications where the tank may exceed specified control limits (toxic shock, human error, etc.) and foul the cone. To restore proper operation:

- lift the unit out,
- remove the cone,
- clean cone along with sensor.

3.3 Signal Quality Alarm

Sometimes, due to tank liquor composition and temperature, installing a cone does not reduce the frequency of a fouled sensor. Plant personnel have to provide periodic and sometimes frequent cleaning.

To alert the user to a potential sensor fouling condition:

- wire the fault alarm into the control room or other convenient location.

- fault alarm will activate on loss of signal quality and alert plant personnel to the problem.
INSTALLATION INSTRUCTIONS

WARNING: SST CONE FACE HAS SHARP EDGES. USE CARE DURING INSTALLATION.

1. UNSCREW CENTERING BOLTS TO ALLOW TRANSDUCER TO SLIDE INTO PVC CONE.

2. ALIGN CENTERING BOLTS WITH WHITE MARK ON PROBE ASSEMBLY THEN SECURE CONE TO PROBE ASSEMBLY WITH CENTERING BOLTS.

3. POSITION PROBE ASSEMBLY SO WHITE MARK IS AT WATER LEVEL THEN SECURE TO MOUNTING BRACKET OR BRACKET ARM ASSEMBLY.

All dimensions shown in inches (mm)
SECTION 4 - CONFIGURATION

This section outlines the procedure for programming the DE2000C. It describes how to use the keypad and access the menu items needed to specify the Clarifier application.

4.1 Start-up

Check all wiring and power connections to the CCS2000 before applying power to the unit.

Apply power to start the CCS2000. It displays:

![DREXELBROOK ENG. CO.]

![CCS2000 Ver.#.#X]

where #.#X reflects the software version.

After a few seconds, system goes into operation mode, and the two-line display reads:

![SLUDGE LEVEL #.# ft]

![CLARITY LOSS ## %]

The flashing dot at the bottom right of the display indicates that the system is operating.

4.1.1 Changing the Two-Line Display

There are three options for viewing the realtime display:

- Level and Clarity
- Level
- Depth

Choose one of the display options by toggling between them using the DISPLAY button.
4.1.1 Changing the Two-Line Display

- Level and Clarity
  - Level
  - Depth

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarity Loss</td>
<td>Relative change in suspended solids in the defined zone of the tank.</td>
</tr>
<tr>
<td>Sludge Level</td>
<td>Distance from sludge interface to tank bottom.</td>
</tr>
<tr>
<td>Sludge Depth</td>
<td>Distance from water surface to sludge interface.</td>
</tr>
<tr>
<td>Rag Level</td>
<td>Distance from top of rag (fluff) layer to the tank bottom.</td>
</tr>
<tr>
<td>Rag Depth</td>
<td>Distance from the water surface to the top of the rag (fluff) layer.</td>
</tr>
</tbody>
</table>

To configure the menu items for the CCS2000 instrument, exit the operation (or realtime) mode and enter the configuration (or setup) mode. The DE2000C configuration menus can be accessed by pressing EDIT, 3-key password, and EDIT.

The 3-key password ensures that the changes to the application cannot be made without the knowledge of the proper personnel.

The user password is:

EDIT, ↑↑↑, EDIT.

After the password is entered, the display reads:

DREXELBROOK ENG. CO.
CCS2000 Ver.#.#X

where #.#X reflects the software version.

Diagram:

LEVEL Mode
- Sludge Level = 3 ft
- Rag Level = 5 ft
- Tank Depth = 12 ft

DEPTH Mode
- Sludge Depth = 9 ft
- Rag Depth = 7 ft
- Tank Depth = 12 ft

All measurements from bottom of tank
4.3 Keypad Functions

The label on the inside panel defines the terminology used in the configuration menu, as shown in Figure 4-1, and indicates connector definitions for each board in the controller.

After a few seconds, the first configuration menu item is shown. See Figure 4-2.

When configuring the CCS2000, use the following keypad functions:

- Use the \( \downarrow \) \( \uparrow \) keys to scroll through the menus.

- Use the EDIT key to make a change to the menu item. The first character of the second line flashes to indicate that you can edit the menu item.

- Use the \( \downarrow \) \( \uparrow \) keys to move the cursor.

- Use the \( \downarrow \) \( \uparrow \) keys to edit the menu items.

- Press the ENTER key to update the system after each change that is made to the configuration or press CLEAR to discard the change. The edited configuration item continues to be displayed until the one of the \( \downarrow \) \( \uparrow \) keys is pressed.

- Press the DISPLAY key to exit configuration and return to operation mode.

Table 4-1 provides a definition of the menu items used in configuration of the CCS2000 system. Figure 4-2 shows the configuration programming sequence.

4.4 Configuration Error Message

If an unacceptable value is entered for an operating parameter (tank depth, upper clarity zone, etc.), the unit will display:

```
Configuration Error
Default in Use
```

when the DISPLAY button is pressed to return the unit to operation mode.

The questionable parameter is set to the default value. For example, if a 10-foot tank depth is mistakenly entered as 00 foot, the default 12-foot value is entered and the message shown above is displayed.
Figure 4-1
CCS2000 Definition of Terms

- Tank Depth
- Water Level Mark
- Transducer mounted 3" below water surface
- Clarity Zone Top (1 ft / .5 m Min) (From Water Surface)
- Clarity Zone
- Clarity Zone Bottom (From Water Surface)
- Sludge Span (20 mA level mode, 4 mA depth mode) (From Bottom)
- Sludge Depth
- Sludge Range
- Sludge Level
- Sludge Zero (4 mA level mode, 20 mA depth mode) (From Bottom)
- Rag Zero (4 mA level mode, 20 mA depth mode) (From Bottom)
- Rag Span (20 mA level mode, 4 mA depth mode) (From Bottom)
- Sludge Alarm
- Pump On (From Bottom)
- Pump Range
- Pump Off (From Bottom)

0% 100%
CLARITY LOSS
Figure 4-2
Configuration Programming Sequence
## 501-100 Series CCS2000™ Clarifier Control

### Table 4-1

**Configuration Menu Items**

<table>
<thead>
<tr>
<th>Configuration Item</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit Selection</strong></td>
<td>The system can be configured in feet or meters.</td>
</tr>
<tr>
<td><strong>Tank Depth</strong></td>
<td>The length measured from the bottom of the vessel to the water surface at the transducer mounting location. The distance between the transducer surface and the water surface should be three inches.</td>
</tr>
<tr>
<td><strong>Sludge Zero (4 mA)</strong></td>
<td>The sludge level equivalent to 4 mA analog output. Measured from the bottom of the vessel. 1st analog loop</td>
</tr>
<tr>
<td><strong>Sludge Span (20 mA)</strong></td>
<td>The sludge level equivalent to 20 mA analog output. Measured from the bottom of the vessel. 1st analog loop</td>
</tr>
<tr>
<td><strong>Sludge Alarm</strong></td>
<td>The level of sludge that the alarm relay will operate and cause the sludge level reading on the display to flash. Measured from the bottom of the vessel.</td>
</tr>
<tr>
<td><strong>Sludge Range</strong></td>
<td>Signal monitoring occurs within the limits designated for the sludge range (T_{sludge}-1). See 4.5 Sludge Range.</td>
</tr>
<tr>
<td><strong>2nd Loop Assignment</strong></td>
<td>The 2nd analog output loop can be assigned to Clarity Loss or Rag.</td>
</tr>
<tr>
<td><strong>Clarity Zero</strong></td>
<td>The clarity loss percentage that equals 4 mA analog output.</td>
</tr>
<tr>
<td><strong>Clarity Span</strong></td>
<td>The clarity loss percentage that equals 20 mA analog output.</td>
</tr>
<tr>
<td><strong>Rag Zero</strong></td>
<td>The rag level that equals 4 mA, measured from the tank bottom. See 4.6 Sludge and Rag Depth Mode.</td>
</tr>
<tr>
<td><strong>Rag Span</strong></td>
<td>The rag level that equals 20 mA, measured from the tank bottom. See 4.6 Sludge and Rag Depth Mode.</td>
</tr>
<tr>
<td><strong>Clarity Zone Top</strong></td>
<td>The upper range limit of the vessel that the system will monitor tank clarity. Measured from the water surface.</td>
</tr>
<tr>
<td><strong>Clarity Zone Bottom</strong></td>
<td>The lower range limit of the vessel that the system will monitor tank clarity. Measured from the water surface.</td>
</tr>
<tr>
<td><strong>Clarity Alarm</strong></td>
<td>The percentage of clarity at which the alarm relay will operate and the clarity loss reading on the display will flash.</td>
</tr>
<tr>
<td><strong>Pump On</strong></td>
<td>Sludge level that de-energizes the pump relay (Relay #3).</td>
</tr>
<tr>
<td><strong>Pump Off</strong></td>
<td>Sludge level that energizes the pump relay (Relay #3).</td>
</tr>
</tbody>
</table>
### Configuration Menu Items

<table>
<thead>
<tr>
<th>Configuration Item</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rag Alarm</strong></td>
<td>The level of rag that the alarm relay will operate and cause the rag level reading on the display to flash. Measured from the bottom of the vessel.</td>
</tr>
<tr>
<td><strong>Common Alarm</strong></td>
<td>The common alarm can be enabled or disabled. It can be assigned to any combination of the sludge alarm setpoint, clarity alarm setpoint, and the pump control. The common alarm relay will de-energize and the red ALARM LED will illuminate on the front display panel when an alarm condition is present. The red ALARM LED will remain illuminated until the condition is corrected. The common alarm relay remains de-energized until the ACK key is pressed, or the condition causing the alarm is corrected. When the ACK key is pressed, the common alarm relay will energize. However, if the alarm condition remains for one damping period the common alarm relay will again de-energize.</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>The common alarm can be triggered by one of the following alarm sources:</td>
</tr>
<tr>
<td><strong>Level</strong></td>
<td>• Level</td>
</tr>
<tr>
<td><strong>Rag</strong></td>
<td>• Rag</td>
</tr>
<tr>
<td><strong>Rag or Clarity</strong></td>
<td>• Rag or Clarity</td>
</tr>
<tr>
<td><strong>Rag or Level</strong></td>
<td>• Rag or Level</td>
</tr>
<tr>
<td><strong>Rag or Clarity or Level</strong></td>
<td>• Clarity</td>
</tr>
<tr>
<td><strong>Clarity</strong></td>
<td>• Clarity</td>
</tr>
<tr>
<td><strong>Level or Clarity</strong></td>
<td>• Level or Clarity</td>
</tr>
<tr>
<td><strong>Damping Time</strong></td>
<td>Time delay imposed on output signal reading and display update to counteract rake effects. The output can be set to update between 0 and 30 minutes. See 4.7 Damping Time.</td>
</tr>
<tr>
<td><strong>Density Factor</strong></td>
<td>Desired density of sludge. See 4.9 Density Factor.</td>
</tr>
<tr>
<td><strong>Signal Quality</strong></td>
<td>Measure of received signal strength. Read-only menu item. See 4.8 Signal Quality.</td>
</tr>
<tr>
<td><strong>Analog Output Check</strong></td>
<td>This function allows you to set a mA value on the screen, and then use a meter to confirm the output on the A/O board. Also useful when calibrating additional instruments in the loop. For example: calibrating a chart recorder to 4-20mA corrected.</td>
</tr>
<tr>
<td><strong>Communications ID</strong></td>
<td>This function assigns identification for multiplexed serial communications capable of communicating with up to 30 additional CCS2000 systems. The default value is set to 1 and should remain 1 when communicating with Scopeview™ software, version 2.0. Consult factory for required software.</td>
</tr>
</tbody>
</table>
4.5 Sludge Range

For optimal clarifier operation, the sludge range should not exceed Tank Depth minus one foot \((T_D - 1)\). If you know the actual range that the sludge will vary, you can set Sludge Range to 2 feet greater than the maximum expected sludge level (but not greater than \(T_D - 1\)).

4.6 Level and Depth Modes

The sludge interface can be displayed as **LEVEL** from the bottom of the vessel or **DEPTH** from the water surface. Refer to 4.1.1 *Changing the Display* and the following pages. Example 4-1 illustrates configuration in the **LEVEL** mode and Example 4-2 illustrates configuration in the **DEPTH** mode.

4.7 Damping Time

The CCS2000 sludge value varies because of crest/trough rake effects and dynamic effluent stratification (material entering tank creating distinct solids strata for brief periods of time). For example, with a nominal 3 foot blanket, the sludge value could vary as much as 1 foot.

At different stages of installation damping time can be useful to optimally view the sludge value without factoring the external conditions.

- The damping time determines the frequency at which the CCS2000 updates the 4-20 mA output and the two-line display.
- The CCS2000 screen and 4-20 mA output are updated after the system is put into operation or after a menu change.

When damping time is set to 0, a true reading requires 3 minutes of continuous operation. Once a true reading is posted, the display updates every 8-10 seconds.

When damping time is set to 1, a true reading occurs after 15 minutes and is then updated every 1 minute.

*When setting damping time, here are some guidelines:*
- Usually during initial startup, damping time is set to 0 to get quicker values posted.
- When all other menu selections have been made, the damping factor should be set for 1 for best results. The CCS2000 sludge value is updated every minute.
- It is not recommended to use a damping time greater than 2 (although available) when tank conditions vary significantly within a 30 minute period.
When setting the zero and span in the **LEVEL** mode, the values are referenced from the tank bottom. In Example 4-1, the display is in **LEVEL** mode and the settings are:

- Zero (4mA) = 0 feet from the bottom
- Span (20mA) = 14 feet from the bottom

The display indicates a sludge depth of 6.0 feet and the output loop is:

\[
\left( \frac{\text{Sludge Level}}{\text{Span}} \right) \times 16 + 4
\]

\[
\left( \frac{6}{14} \right) \times 16 + 4 = 10.85\text{mA}
\]

Configuration is the same for Rag zero and Rag span.

**Example 4-1**

*Setting Zero and Span in Sludge Level and Rag Level Mode*
When setting the zero and span in the DEPTH mode, the values are referenced from the tank bottom even though the depth displayed by the CCS2000 is referenced from the water surface. In Example 4-2, the display is in DEPTH mode and the settings are:

Zero (4mA) = 14 feet from the bottom  
Span (20mA) = 4 feet from the bottom

The display indicates a sludge depth of 11.5 feet and the output loop is:

\[
\left( \frac{11.5 - 4}{10} \right) \times 16 + 4 = 16.00\text{mA}
\]

Configuration is the same for Rag zero and Rag span.

**Example 4-2**  
**Setting Zero and Span in Sludge Depth and Rag Depth Mode**
4.8 Signal Quality

Signal quality is a measure of signal strength. Signal quality ranges from 0 to 10 with 10 being the strongest quality. Signal quality is an indicator of potential equipment problems. For example, signal quality drops significantly when the sensor is fouled.

- If the signal quality drops to 0, the SYSTEM FAULT indicator lights and the fault relay de-energizes. The fault relay contact can be used for remote signalling of a potential problem.

4.9 Density Factor

Select the density factor according to the desired density of sludge as determined by plant operations. Factory default density factor is set to 9.

- Heavy sludge is detected by selecting the values between 7 to 15; 15 giving the highest density/thickest blanket level and 7 giving mid-range density blankets.

- Based on field-correlated data, sludge density ranges of 1.5 to 5% or greater use density factors of 7 through 15.

- For lighter density blankets (fluff detection), use density factors from 6 to 0. Zero gives the lightest (earliest) possible blanket detection.

- For reliable detection, density levels should be greater than 0.1%. For values less than 0.1%, contact Drexelbrook Engineering for application assistance.

- For tanks that have an extensive fluff layer followed by a blanket where the density change is not significantly different from the fluff, (e.g., fluff = 0.1% and the blanket = 0.5%), the density factory should be set in the 10-15 range so that the CCS2000 will respond to the thickest blanket value.

In some cases the Density Factor needs to be adjusted in order to satisfy a specified sludge level requirement. For example, when the operator measures (with a core sample or equivalent) a particular value and wants the CCS2000 to report that value.

- To increase the CCS2000 reported value, decrease the Density Factor.
- To decrease the CCS2000 reported value increase the Density Factor.
NOTE

When damping time is set to 0, a true reading requires 3 minutes of continuous operation.
Once a true reading is posted, the display updates every 8-10 seconds.
When damping time is set to 1, a true reading occurs after 15 minutes and updated every 1 minute thereafter.

(1) Be careful when comparing measured values. Differences in observation and technique can produce inaccurate results.

(2) The maximum attainable value reported by the CCS2000 is with a Density Factor = 0.
SECTION 5 - SERVICE

5.1 Telephone Assistance

If you are experiencing difficulty with your Drexelbrook equipment and attempts to locate the problem have failed:
• contact your local Drexelbrook representative,
• call the Service department toll-free at 1-800-527-6297 (in US and Canada) or 1-215-674-1234 (International),
• fax the following information to the Service department at 1-215-443-5117.

To expedite assistance, please provide the following information:

Instrument Model Number ___________________________

Sensing Element Model Number and Length ___________

Coax Cable Length (remote systems) _____________

Original Purchase Order Number _________________

Material being measured ___________________________

Temperature ______________________________________

Pressure ________________________________________

Agitation________________________________________

Brief description of the problem ___________________

_________________________________________________

Checkout procedures that have failed________________

_________________________________________________

5.2 Equipment Return

In order to provide the best service, any equipment being returned for repair or credit must be pre-approved by the factory.

In many applications, sensing elements are exposed to hazardous materials.
• OSHA mandates that our employees be informed and protected from hazardous chemicals.
• Material Safety Data Sheets (MSDS) listing the hazardous materials that the sensing element has been exposed to must accompany any repair.
• It is your responsibility to fully disclose all chemicals and decontaminate the sensing element.
| 5.2 Equipment Return (cont.) | To obtain a return authorization (RA#), contact the Service department at 1-800-527-6297 (US and Canada) or 1-215-674-1234 (International). Please provide the following information:

Model Number of Return Equipment __________________

Serial Number __________________

Original Purchase Order Number __________________

Process Materials that equipment has been exposed to __________________

MSDS sheets for any hazardous materials

Billing Address ____________________________________________

Shipping Address ____________________________________________

Purchase Order Number for Repairs __________________

*Please include a purchase order even if the repair is under warranty. If repair is covered under warranty, you will not be charged.*

Ship equipment freight prepaid to:
DREXELBROOK ENGINEERING CO.
205 KEITH VALLEY ROAD
HORSHAM, PA 19044
COD shipments will not be accepted.

| 5.3 Field Service | Trained field service personnel are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Preventative Maintenance and Calibration Certification service contracts are also available to maintain plant efficiency. Contact the Service department for more information.

| 5.4 Customer Training | Instrument Training Seminars for customers are conducted at the factory. These sessions, guided by Drexelbrook engineers and specialists, provide detailed information on all aspects of level measurement, including theory and practice of instrument operation. Contact the Training Department for more information. |
6.1 DE2000C Controller Specifications

—Power Requirements
110-230 Vac, 50-60 Hz
Maximum power, 70 watts

—Operating Temperature
-40°F to 185°F (-40°C to 85°C)

—Analog Outputs
(2) 4-20 mA: sludge level and percent clarity

—Loop Resistance
500 ohms maximum

—Relays
all 5A, SPDT
• common alarm
• fault alarm
• sludge level alarm
• clarity level alarm
• pump control with adjustable deadband
• spare

—TTL Outputs
0.5 Vdc @ 125 mA maximum

—Display
2-line x 20-character (each line)
vacuum fluorescent display

—Keypad
9-key membrane, weatherproof

—Transient Protection
10 amp on transceiver input loop

—Housing
Fiberglass, meets NEMA 1-4X, 5 & 12
6.2 Transceiver/Transducer Probe Subsystem (TSP) Specifications

—**Power**
Supplied by DE2000C

—**Operating Temperature**
Transceiver: -40°F to 185°F (-40°C to 85°C)
Transducer: 40°F to 100°F (4.44°C to 37.78°C)

—**Transient Protection**
10 amp surge protection

—**Housing**
NEMA 4X (IP-65), explosionproof

—**Connecting Cable**
Standard 8-conductor shielded cable
24 AWG
up to 500 feet.

6.3 System Specifications

—**Tank Depth**
20 feet maximum

—**Sludge Span**
19 feet maximum

—**Sludge Range**
20 feet maximum

—**Sludge Density**
0.5-10%

—**Accuracy**
±3% or 6-inch (greater of)

—**Temperature Effect**
.1%/°C

—**Dead Zone**
3 inches (76.4 mm) from bottom of tank

—**Near Zone**
1 foot from face of transducer