WARNING

The process medium may be hot or otherwise hazardous. Precautions when removing the sensor from the process line:

Make sure that the process line is not under pressure. Open a vent valve to the atmosphere. For a retractor/isolation valve the line pressure should be within specifications.

For a prism wash system, close a hand valve for the wash medium and disable the wash valve. Loosen the clamp or flange bolts cautiously, be prepared to tighten again. Be out of the way of any possible splash and ensure the possibility of escape.

Use shields and protective clothing adequate for the process medium. Do not rely on avoidance of contact with the process medium. After removal of the sensor, it may be necessary to mount a blind flange for security reasons.

THE PASSWORD FOR PR-01-S IS 784512 IN PROGRAM VERSIONS 4.0 AND HIGHER.

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2. GENERAL INFORMATION

The K-Patents Digital Black Liquor Divert Control System DD-01 provides a divert signal preventing black liquor with dangerously low solids to reach the black liquor burners. The system is built strictly according to the principles of Recommended Good Practice "Safe Firing of Black Liquor in Black Liquor Recovery Boilers" (BLRBAC August, 1982 and revisions April, 1991, and March, 2001).

2.1. DIGITAL DIVERT CONTROL SYSTEM DD-01

![Complete Digital Divert Control System DD-01](image)

The system consists of the following parts (Figure 2.10): Two K-Patents Process Refractometers PR-01-S (A & B) are installed in series in the main black liquor line. Each refractometer is complete with a Sensor, an Indicating transmitter and Interconnecting cables. Each refractometer provides also a 4-20 mA % solids output signal not used by the divert control system.

The Divert Control Unit DD-01 is contained in one enclosure with the same dimensions as the refractometer Indicating transmitter enclosure. The control unit includes:

- an operator panel
- control logics
- contact outputs for prism wash, warnings, alarms and black liquor diversion
- Two isolation valves HIMP-2 (optional) for the refractometers above to allow removal of the refractometers from a pipe with full flow and pressure. The isolation valve includes a prism wash nozzle and two check valves (one for prism wash, one for stuffing box flush).
- A roofed mounting plate to mount the two Indicating transmitters and the Divert Control Unit together.
- Two steam valves with steam traps for prism wash (pneumatic + solenoid valves).
- Two hand valves (one for prism wash, one for stuffing box flush).
- One alarm horn (supplied by the customer).

Note. BLRBAC (The Black Liquor Recovery Boiler Advisory Committee) recommends a spare sensor to be maintained in stock on-site.
2.2. OPERATOR PANEL

The operator panel has a clear layout and the operator can see all information at one glance. The divert decision is controlled from the operator panel which provides doubled security, since all information is simultaneously shown both as LED indication in the Divert Control Unit and as a diagnostic messages in the Indicating Transmitters (Figure 2.20).

Each refractometer has a green OPERATING light (1), so the operator knows when he can rely on the refractometer measurement. A refractometer will influence the divert decision only when the green OPERATING light is on. A malfunctioning refractometer is automatically taken out of operation. One green indicator light SAFE% SOLIDS (2) is based on the two refractometers and the divert decision rules (Section 5.7).

One red DIVERT light (3) that will be switched on when the SAFE% SOLIDS goes off. The DIVERT light indicates divert status of the divert relay. The divert relay has an output switch contact, for use in the Black Liquor Firing Tripping Logic. The relay is OFF in the DIVERT position, because a power failure will give a DIVERT decision.

A lockable OVERRIDE/AUTOMATIC switch (5) and a red OVERRIDE warning light (4) is ON always if switch in OVERRIDE position. If the SAFE% SOLIDS goes OFF and this switch is in the OVERRIDE position, then the OVERRIDE light is lit instead of the DIVERT light. One RESET push-button (6) for the DIVERT action. The DIVERT action always has to be manually reset. If the override switch is in Automatic position and SAFE% SOLIDS is off, the DIVERT action cannot be reset.

One EMERGENCY DIVERT push-button (7) to manually initiate DIVERT in an OVERRIDE or emergency situation. The DIVERT light is lit also after manual divert action. The EMERGENCY DIVERT button has a protective hinged cover, to prevent inadvertent use.

Two indicator lights (8) for the divert valve status TO BY-PASS/TO BURNER from microswitches on the valve. For intermediate valve positions both lights are off.

A row of four alarm lights (9) that indicate black liquor SOLIDS WARNING (at 60%), black liquor SOLIDS ALARM (below 58%), refractometer reading more than 2% absolute difference and refractometer malfunction.
A light test button (10) switches all 11 lights on. An alarm reset button (11) resets the alarm lights. For normal operation the operator panel has four green lights on (A OPERATING/B OPERATING/ VALVE TO BURNER/SAFE% SOLIDS).

2.3. ALARMS

The divert control system has four alarms, audible and indicating:

1. Black liquor SOLIDS WARNING, yellow light (60% or below)
2. Black liquor SOLIDS ALARM, red light (58% or below)
3. Refractometers reading more than 2% absolute DIFFERENCE, yellow light
4. Refractometer MALFUNCTION, yellow light

The alarms 1, 2 and 4 are initiated by either refractometer. System contains also optional alarms, see wiring drawing 3.11.

The operator panel contains four indicator lights and an ALARM RESET button. The reset button will silence the audible alarm, but the visual indication will remain until the condition has returned to normal.

To avoid unnecessary alarms the following interlocks are implemented:

- A refractometer can initiate an alarm only when it is operating.
- Alarm 4 can be initiated only if both refractometers are operating.

The parameters (2%, 58% and 60%) are default settings, which can be changed from the Indicating transmitter keyboard (Sections 5.3 and 5.4). The parameter for 2% can be decreased and the parameter for 58% and 60% can be increased.

2.4. PRISM WASH

For K-Patents Process Refractometer, the need of prism wash is reduced and even in some cases eliminated. The prism keeps clean due to the probe design features:

- The prism is flush mounted in a surface deflecting the black liquor main flow, which causes a strong mechanical cleaning action.
- The prism has the same temperature as the black liquor.

In any case, however, an automatic regular prism wash provides an efficient check that the refractometer reacts. A steam wash of 3 seconds every half hour should be sufficient. Automatic single (one-of-two) diversion will occur if either of the refractometers is in wash cycle.

The Divert Control Unit contains two relays for prism wash, WASH A and WASH B. To follow the BLRBAC recommendation not to wash both prisms at the same time, there is an interlock. If both refractometers try to wash simultaneously, one will display "WAIT" and perform the wash when the other has finished.

K-Patents recommends to use a steam trap instead of preconditioning valve to remove condensate from the steam line. The wash times can be seen pressing soft keys "Display"/"System configuration"/"Wash times". To change the wash times, see Section 5.6.
2.5. MASTER DIVERT CONTROL UNIT

Figure 2.50 Operator’s panel and functions of the master divert control unit in the field with LED indications.

1. Black liquor SOLIDS WARNING (at 60%), Black liquor SOLIDS ALARM (below 58%), Refractometer reading more than 2% absolute difference, and Refractometer malfunction.

2. Each refractometer A and B has an OPERATING green light, A refractometer will influence the divert decision only when the green OPERATING light is on. A malfunctioning refractometer is automatically taken out of operation.

3. One green indicator light SAFE% SOLIDS, based on the two refractometers and the divert decision rules.

4. A red OVERRIDE warning light is on always if the override switch is switched on.

5. One red DIVERT light that will be switched on when the SAFE% SOLIDS goes off. The DIVERT light indicates divert status of the divert relay.

6. Two indicator lights for the divert valve status. TO BY-PASS/TO BURNER from microswitches on the valve. For intermediate valve positions both lights are off.

7. A lockable Override/Automatic divert switch

8. A DIVERT RESET push-button.

9. An EMERGENCY DIVERT push-button.

10. A light test button switches all 11 lights on.

11. An alarm reset button resets the alarm lights.
2.6. INDICATING TRANSMITTERS

An Indicating transmitter in a Divert Control System is identical (both hardware and software) to a standard transmitter described in the PR-01-S Instruction manual.

The display, Figure 2.60, will give the following additional information pertinent to the Divert system:

1. A or B in the upper right corner indicates that the transmitter is OPERATING in the divert system as refractometer A or B, Figure 2.10. If a or b is displayed instead, the refractometer is removed from divert control operation. (If the upper right corner is empty, see Section 5.2). For A or B the corresponding green OPERATING light, Figure 2.20, is on, for a or b it is off.

   If you see a ? in this corner, see Section 5.2.

2. A softkey (B) defined by "Remove from divert control" or alternatively "Restore to divert control". The visible effects of pressing "Remove" for refractometer A is that the soft key changes to "Restore", A switches to a, and the green OPERATING light goes off. Further the "Remove" soft key disappears from refractometer B, because B must not be removed if it is the only refractometer in operation.

   Note. Always press "Remove" for a refractometer before making service or switching the power off.

3. The "Normal operation" message is substituted by "In divert control operation" or "Removed from divert control". Those messages may change to "Solids warning" or "Solids alarm" at low solids. An additional error message may occur: ** Divert control fault ** combined with a ? in the upper right corner, see Section 6.3.

4. The softkey "Display" (D) leads via "System configuration" (C) to "Divert control system" (D) which gives the following information:

   Refractometer difference alarm limit in % solids
   Solids warning limit in % solids (default value 60%)
   Solids alarm limit in % solids (default value 58%)
   Divert rule and SW1/SW2 positions (Section 5.7)

5. The softkey "Calibrate" (C) gives possibilities to set up for divert control and calibration, see Chapter 5.
2.7. K-PATENTS DIGITAL DIVERT CONTROL UNIT SPECIFICATIONS

Model: DD-01
Enclosure: IP66 Nema 4X, dimensions 226 x 267 mm (8.91 x 10.5 in)
Supply: 24 V DC, provided by the Indicating transmitters
Ambient temperature: max 45 °C (113 °F)
Accessory: Roofed mounting plate for the Divert Control Unit and 2 Indicating transmitters, Figure 2.60.
Material: AISI 316, dimensions 916 x 488 mm (36 x 19.2 in)

Figure 2.70 Divert Control Unit Mounting Plate: Dimensions (mm/in)

Figure 2.71 Divert Control Unit and Indicating Transmitter Enclosures: Dimensions (mm/in)
3. MOUNTING

For mounting of the process refractometer and the isolation valve, consult the separate Refractometer PR-01-S(-EX/FM) Manual.

3.1. WIRING

Wiring for the complete system, see Figure 3.10 and Figure 3.11 which describe also all cables and how each cable is connected.

The cables 1 and 2 are included in the delivery. The terminal strip positions of the Divert Control Unit are specified in Figure 3.11 and Figure 3.12.

Figure 3.10 Divert Control System Wiring Cables and Connections
Figure 3.11  Divert Control System Wiring and Connections
Figure 3.12  Cable connections
Figure 3.13  Divert control circuit board, layout.
4. START-UP

For refractometer start-up consult the separate Refractometer PR-01-S(-EX/FM) Manual and the Mounting
and start-up check list.

4.1. DIVERT CONTROL UNIT START-UP

1. Check the wiring and supply voltage.
   Note: Before the power is switched on, the DIVERT output relay is in DIVERT position.
2. Switch the power on for both Indicating transmitters.
   The control system is now in the DIVERT mode, and the red DIVERT light is on.
3. Press the LIGHT TEST button. All eleven lights should switch on.
4. The upper right corner of the Indicating transmitter displays should now state \texttt{a} or \texttt{b} respectively. If
   not, see Section 5.2.
      
      If the message is "Removed from divert control" the refractometer is ready to "Restore to
      divert control", softkey B.
      
      If the message is "Solids warning" or "Solids alarm" then "Restore" provokes an alarm.
      Press the ALARM RESET button.
      
      For any other message, see Section 6.3.
5. Observe that the VALVE STATUS lights follow the position of the valve.
   Now the Divert Control System is set for normal monitoring operation.
6. Check that the prism wash is working. Press the "Start prism wash", softkey A.
7. When the SAFE % SOLIDS has turned on and also the other conditions for safe boiler operation are
   satisfied, the DIVERT can be turned off using the RESET button.

4.2. DIVERT CONTROL SYSTEM TRIMMING

During the trimming of a new system, it is recommended to keep the key in the OVERRIDE position.

When the key is in the OVERRIDE position, the DIVERT action has to be initiated manually using the
EMERGENCY DIVERT button. This should be done when the green SAFE %SOLIDS light turns off.

The trim procedures are described in Chapter 5, the measurement calibration in Section 5.1 and the prism
wash in Section 5.6.

The key should be turned to the AUTOMATIC position only after it has been decided that sufficient experience has been gained.
5. CALIBRATION

The K-Patents Divert Control System is calibrated by the manufacturer. This chapter contains instructions how to make the fine adjustment of the system.

5.1. REFRACTOMETER CONCENTRATION MEASUREMENT

For refractometer calibration consult also the separate Refractometer PR-01-S(-EX/FM) Manual.

The CONC% displays of the two Indicating transmitters have to show the same value. If there is a difference, this can be eliminated by changing the Bias for one of the refractometers. Key in the sequence Calibrate / Parameters / CONC(RI) / Parameters / Bias. Comparison with sample determination can decide which one should be corrected.

Example: If the Indicating transmitter of A displays CONC% = 63.2% and B displays CONC% = 63.8%, the difference can be eliminated e.g. by lowering B by 0.6%. Read bias from the display of refractometer B. If bias = 52.923 then enter a new bias = 52.323.

Due to its digital measurement principle, the readings of the K-Patents Process Refractometer do not drift by time. Frequent recalibrations based on off-line moisture analysis must be avoided, as they will introduce random fluctuations to the refractometer readings.

If the concentration reading is noisy, the damping can be increased. Enter Calibrate / Parameters / CONC(RI) / Damping time. The Damping time is the time in seconds for the signal to reach half of its final value after a step change. Increase the damping time in small steps, and wait for the result.

5.2. REFRACTOMETER ACTIVATION FOR DIVERT CONTROL

When a refractometer is activated for Divert control, the upper right corner of the display shows alternatively A, a, B, b or ?. If the corner is blank the divert function must be activated by pressing the sequence Calibrate/Parameters/Divert control/Divert control and select "1 Activated".

The program has to be version 4.0 or higher, otherwise "8 Divert control" is missing from the CALIBRATE menu. The program EPROM has then to be changed to an up-dated version.

The decision to display A (a) or alternatively B (b) is not programmed, it depends on to which SERIAL BUS port in the Divert unit (Figure 3.13) the Indicating transmitter is connected.

If a Divert activated refractometer is used in another type of application, the divert function has to be deactivated by selecting "0 Not activated". After de-activation all references to Divert functions disappear except "8 Divert control" in the CALIBRATE menu.

Note. If a message DIVERT CONTROL FAULT and a ? appear on the IT-R display, the reason is one of the following:

1. Cables between the IT-R and the terminals 8-14 on the DD-01 are not properly connected. Re-connect to fix.

2. Communication 485 component IC 17 (A) or IC 19 C (B) is broken on the PR-7310 board inside the DD-01. Replace board.

3. Communication 485 component IC 1r is broken on the PR-7010 board in side the IT-R. Replace board.

4. Dip switch 3. is in the “up” position which means that the PR-7310 card is configured to work in the remote mode. Change the dip switch back to low (=off) position.
5.3. SIGNAL DIFFERENCE ALARM

According to BLRBAC, if a difference of 2% solids (absolute value) or greater exists between refractometer readings, an alarm shall be activated.

The alarm limit 2% can be changed from the keyboard using the sequence Calibrate/Parameters/Divert control/Ref. difference limit. If the deviation alarm trips seem too frequent, it may help to increase the signal damping, Section 5.1.

Note. If the two refractometers have different limit values, the lower value is used by alarm system.

5.4. LOW ALARMS

The low alarm limits are set from the keyboard of the Indicating transmitter. Enter sequence Calibrate/Parameters/Divert control. The menu will show “3 Low conc warning limit” and “4 Low conc divert limit”. The latter has a double function: Both LOW SOLIDS ALARM and DIVERT limit.

The Indicating transmitter display will carry the messages “Solids warning” and “Solids alarm” when the corresponding alarms occur.

Note. The alarm limits are set separately for the two refractometers. Each refractometer gives an alarm according to its own settings.

5.5. REFRACTOMETER MALFUNCTION ALARM

The built-in intelligent diagnostics of K-Patents Process Refractometer provides a tight control of the operation. A full test cycle is completed with an interval less than one second. A description of the microprocessor implemented diagnostics is given below. For details consult the Instruction Manual of the refractometer PR-01-S. Only errors classified as Equipment malfunctions will cause alarm and removal from the Divert control system. Process related faults will only cause a message in the Indicating transmitter display. See also Section 6.3 for additional diagnostics.

The most important test is to check the signal coming from the digital image sensor during measurement. Improper function of light source, optical components, image sensor and sensor driver are recognized by this test.

The compensation for temperature measurement is checked, both the temperature element and the A/D converter.

The cable between Sensor and Indicating transmitter is checked using a check sum method, thus recognizing short circuits, open circuits and excessive disturbances.

The microprocessor system has also a self-checking test program to ensure the proper operation of the CPU and the memories. The constants in the EEPROM memory are tested to be within strict limits of acceptance.

The performance of the microprocessor is of critical importance for the measurement control. A separate hardware watch-dog circuit ensures the proper microprocessor operation by checking that the microprocessor regularly sends out a predetermined pulse sequence. Another hardware circuit checks that the supply voltage to the microprocessor is within safe limits, to prevent any brownout stray output pulses.

5.6. PRISM WASH

A prerequisite for a proper function of the divert system, is that the prism wash works. The TEST value in the display should increase at least 20 steps during WASH, provided TEST is not close to its maximum value 248. See Sections 8.1, 8.5 and 9.2 in PR-01-S Instruction Manual.
WASH TIMES

The wash times can be seen by pressing Display/System configuration/Wash times. The values set at delivery are the following:

- Preconditioning = 0 seconds
- Wash time = 3 seconds
- Recovery time = 30 seconds
- Interval = 20 min

The wash times are changed by pressing the sequence Calibrate/Parameters/Prism wash.

Note: maximum wash time is 30 seconds and maximum recovery time 30 seconds.

WASH CHECK

This function can be defined from the prism wash menu: Calibrate/Parameters/Prism wash/Wash test. A prism wash is accepted if:

a. TEST exceeds “TEST limit”
b. TEST increases more than “TEST difference”

The default values of “TEST limit” and “TEST difference” are zero (0), which makes the wash check inactive. If the wash is not accepted, the diagnostic message will be “Prism wash failure”.

A “Wash retries” parameter can also be set to repeat the wash if the wash check fails. The default value is zero (0).

WASH STOP

Wash stop function can be defined from the prism wash menu. Wash can be prevented when the process temperature is below the set limit, thus indicating that the pipe is not in use. To activate the “wash stop” key sequence: Calibrate/Parameters/1. Prism wash/Wash stop/1. Active and set the temperature limit.

The default value for wash stop is inactivate. When the wash is not accepted the diagnostics message is “Wash stop/temp. limit”.

EXTERNAL WASH STOP

An input switch can be configurated to an external wash stop to prevent the prism wash when the corresponding input switch is connected. “External wash stop”-message will show when automatic wash is activated from the soft keys. The input switch can be set to protect the refractometer e.g. if the process is stopped.

AUTOMATIC SINGLE DIVERSION CONTROL DURING PRISM WASH CYCLE

Automatic single (one-of-two) diversion control will take place if either of sensors are in prism WASH cycle.

5.7. DIVERT DECISION RULES

TWO REFRACTOMETERS IN OPERATION:

BLRBAC states the following: For the solids measurements, two refractometers in series must be used. When both refractometers are in service, the requirement for an automatic black liquor diversion can be satisfied by either of the following options:

1. If either refractometer reads dissolved solids content 58% (default) or below, an automatic black liquor diversion must take place.
2. When both refractometers read dissolved solids content 58% (default) or below, an automatic black liquor diversion must take place.

Either option is satisfactory.

The rules are listed in decreasing order of security. Only rule 1 satisfies the high safety requirements set by BLRBAC, August, 1982. On the other hand, the probability of false trips decreases with decreasing safety. It means that if false trips are too frequent, the rule 2 may be preferred at the cost of safety. The rule 2 has later been accepted by BLRBAC.

A third conceivable alternative is to base the decision on only one refractometer (the master) and use the other refractometer (the slave) for comparison only (and difference alarm). Concerning security and false trips, this rule is a compromise between rules 1 and 2.

The divert decision rule is selected by the switch SW on the divert control board (Figure 3.13). ON position is upwards.

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<td>OFF</td>
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<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
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Table 5.70 Divert decision rule selection.

ONLY ONE REFRACTOMETER IN OPERATION:

When only one instrument is IN OPERATION the divert action takes place if this instrument reads 58 % or below. The status of SW (Table 5.70) has no influence on the divert decision in this case.

NO REFRACTOMETER IN OPERATION:

If both instruments are out of operation (due to malfunction or maintenance), then according to BLRBAC divert action must take place. See also Section 8.7 about external DC supply.

REMOTE DIVERT SWITCH CONFIGURATION

<table>
<thead>
<tr>
<th>Switch SW</th>
<th>Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW 3</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>DD-01 normal operation</td>
</tr>
<tr>
<td>ON</td>
<td>Remote divert card activated See Section 8.8.</td>
</tr>
</tbody>
</table>

See Section 5.2 if you have on the screen the message DIVERT CONTROL FAULT.
6. MAINTENANCE

As the Divert Control System is a pure digital system, no special maintenance is needed. The LIGHT TEST button on the operator panel (Figure 2.50) sends a signal to the microprocessor, and the microprocessor switches all 11 LED lights on as long as the button is pressed. This way not only the lights but also the processing system is checked.

To assist the identification of a faulty component, the information flow and the circuit diagrams are given in Sections 6.1 and 6.2. Also the logic diagrams of Chapter 7 may be of help.

6.1. INFORMATION FLOW

The power and information flow of the total Divert system is shown by Figure 6.10. Additional information about the cable connections is found in Figures 3.10, 3.11 and 3.12.
6.2. DIVERT CONTROL CIRCUIT BOARDS

The component lay-out of the divert control circuit board is shown by Figure 3.12 and the circuit diagram by Figures 6.20 to 6.25.

Figure 6.20 Operator panel board, component layout.

Figure 6.21 Operator panel PR-7311 circuit diagram, page 2 of 2
Figure 6.22 Operator panel PR-7311 circuit diagram, page 1 of 2.
Figure 6.23 Divert control board PR-7310 circuit diagram. Page 1 of 3.
Figure 6.24 Divert control board PR-7310 circuit diagram. Page 2 of 3.
6.3. DIAGNOSTIC MESSAGES

For diagnostic messages in the Indicating transmitter display, see the PR-01-S manual. The following messages appear only in divert systems:

- "In divert control operation" or "Removed from divert control", Section 2.6.
- "Solids warning" and "Solids alarm", Section 5.4.
- ** Divert control fault **

This message indicates that there is no communication to the divert control unit, probably cable error, Figure 3.12, cable 2.

If the instrument is not applied in a divert control system, de-activate the divert function, see end of Section 5.2.

Further the message ** Relay unit fault ** may appear. This indicates that the Relay unit PR-7080 functions are defined, but no Relay unit is connected. Normally a Relay unit is not used in a Divert system because the wash contacts are in the Divert control unit. Clear the relay functions by the key sequence Calibrate/Relay unit and select an "0 Not Defined" for all four relays. For using an optional relay unit, see PR-01-S Manual, section 9.1.

6.4. DIAGNOSTIC LIGHTS

The Divert circuit board, Figure 3.12, contains the following diagnostic LEDS:

D3 Processor cycles: should flash
D4 Processor reads serial bus: should flash
D10 Serial bus A input: should flash
D11 On if 24 V DC supply from A is OK
D12 Serial bus B input: should flash
D13 On if 24 V DC supply from B is OK
D14 On if external 24 V DC is applied
D19 Wash relay A on
D20 Wash relay B on
D21 Solids warning relay on
D22 Solids alarm relay on
D23 Divert relay on = not DIVERT (Section 2.2)
D24 Horn on
D25 Refractometer difference relay on = difference alarm
D26 Override
D27 Valve to bypass
D28 Valve to burner
6.5. PUSH-BUTTON ASSEMBLY

Before removing the push button or the lockable Override/Automatic switch from the front panel turn the screw 1/4 to the left, Figure 6.50. This will release the contact element.

![Securing and removal of the contact element.](image)

Figure 6.50 Securing and removal of the contact element.

6.6. FUSES

The following fuses are printed on circuit board PR-7130:

- **Fuse F1:** Microfuse IEC 127-3/1 DC Power (24 VDC) main fuse. Protects UL 198G 1A, fast divert electronics against wrong voltages especially from external DC supply.

- **Fuse F2:** 5 x 20 mm fuse IEC 60127, 1A, fast AC supply to solenoid valves. Protects cable and coil, if faults appear.

- **Fuses F3, F4:** Microfuse IEC 127-3/1, Fuses protect switch of divert valve position UL 198G 63 mA, fast feedback. Any external voltage connected to these circuits causes fuse blow.
7. DIVERT CONTROL LOGIC

A logical description of the system is provided as a complement to the previous information about the electronics.

7.1. BLOCK DIAGRAM

The block diagram Figure 7.10 shows the connections between the different logical subsystems.

![Block diagram of the divert control system]

Figure 7.10  Block diagram of the divert control system
7.2. LOGICAL DIAGRAMS

Figure 7.20 The operation logics.

Figure 7.21 The divert decision logics.
Figure 7.22 The alarm decision logics.
7.3. SAFETY DECISION LOGICS

The logical description of the Safety Decision Logics in Figure 7.10 is given by the following tables:

- Table 7.30 One - of - two
- Table 7.31 A master, B slave
- Table 7.32 Two - of - two

Note. NOT OPERATING includes the wash cycle.

See also Section 5.7.

<table>
<thead>
<tr>
<th>A</th>
<th>&lt;58 OPERATING</th>
<th>NOT OP</th>
<th>&gt;58 OPERATING</th>
<th>NOT OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>&lt;58 OPERATING</td>
<td>Unsafe</td>
<td>Unsafe</td>
<td>Unsafe</td>
</tr>
<tr>
<td></td>
<td>NOT OP</td>
<td>Unsafe</td>
<td>Safe</td>
<td>Unsafe</td>
</tr>
<tr>
<td>&gt;58 OPERATING</td>
<td>Unsafe</td>
<td>Safe</td>
<td>Safe</td>
<td>Safe</td>
</tr>
<tr>
<td>NOT OP</td>
<td>Unsafe</td>
<td>Unsafe</td>
<td>Safe</td>
<td>Unsafe</td>
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</table>

Table 7.30 One-of-two decision rule
<table>
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<th></th>
<th>A</th>
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<td>NOT OP</td>
<td>&gt;58 OPERATING</td>
<td>NOT OP</td>
</tr>
<tr>
<td>B &lt;58 OPERATING NOT OP</td>
<td>Unsafe</td>
<td>Unsafe</td>
<td>Safe</td>
<td>Unsafe</td>
</tr>
<tr>
<td></td>
<td>Unsafe</td>
<td>Unsafe</td>
<td>Safe</td>
<td>Unsafe</td>
</tr>
<tr>
<td>B &gt;58 OPERATING NOT OP</td>
<td>Unsafe</td>
<td>Safe</td>
<td>Safe</td>
<td>Safe</td>
</tr>
<tr>
<td></td>
<td>Unsafe</td>
<td>Unsafe</td>
<td>Safe</td>
<td>Unsafe</td>
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</tbody>
</table>

Table 7.31  A master, B slave

<table>
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<th>A</th>
<th></th>
<th>A</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;58 OPERATING</td>
<td>NOT OP</td>
<td>&gt;58 OPERATING</td>
<td>NOT OP</td>
</tr>
<tr>
<td>B &lt;58 OPERATING NOT OP</td>
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<td>Safe</td>
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<tr>
<td>B &gt;58 OPERATING NOT OP</td>
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<td></td>
<td>Unsafe</td>
<td>Unsafe</td>
<td>Safe</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>

Table 7.32  Two-of-two decision rule
8. OPTIONAL CONFIGURATIONS

8.1. REMOTE DIVERT CONTROL UNIT

The remote divert control unit is an option of the digital divert control system DD-01, see Figure 8.20. The remote divert control unit operates as a main unit, which means that the master divert unit is for indication only. If the remote divert control unit is not in operation, the master divert unit in the field operates as a main unit.

The remote control unit communicates with the master divert unit in the field through a modem. Connection and wiring is made according to Figure 8.40.

For contact terminals see Figure 8.41. Contact terminals 24 and 25 are for communication OK signal.

8.2. EQUIPMENT

Figure 8.20 Complete remote divert control system.
8.3. REMOTE DIVERT CONTROL UNIT IN THE CONTROL ROOM

The remote divert control unit contains all information for the deviation decision. The operation is clearly indicated with LED lights as follows:

1. A row of four alarms (indicating Black liquor SOLIDS WARNING (at 60%), Black liquor SOLIDS ALARM (below 58%), Refractometer reading more than 2% absolute difference, and Refractometer malfunction).

2. Each refractometer A and B has an OPERATING green light, so the operator knows when he can rely on the refractometer measurement.
   A refractometer will influence the divert decision only when the green OPERATING light is on. A malfunctioning refractometer is automatically taken out of operation.

3. One green indicator light SAFE% SOLIDS, based on the two refractometers and the divert decision rules.

4. A red OVERRIDE warning light.

5. One red DIVERT light that will be switched on when the SAFE% SOLIDS goes off, providing OVERRIDE is off. The DIVERT light indicates divert status of the divert relay.

6. Two indicator lights for the divert valve status. TO BY-PASS/TO BURNER from microswitches on the valve. For intermediate valve positions both lights are off.

7. A lockable Override/Automatic switch.

8. One RESET push-button for the DIVERT action. The DIVERT action always has to be manually reset. If the override switch is in automatic position and SAFE% SOLIDS is off, the DIVERT cannot be reset.

9. EMERGENCY DIVERT push-button.

10. A light test button switches all 11 lights on.

11. An alarm reset button resets the alarm lights.

12. Communication to MASTER DIVERT ok, indication light blinking.

13. Power supply ok, indication light on.

Note when remote divert in use, master divert unit in the field is for indication only!
8.4. WIRING AND MOUNTING

For wiring of the complete system, see Figure 8.40, which also specifies the cables and connections.

Figure 8.40 Digital Divert Control System with Remote Divert Control Unit Wiring.
Figure 8.41 Remote Divert Control Unit terminals.

Figure 8.42 Digital Divert Control System: Remote Divert Control Unit mounting.
8.5. SERIAL OUTPUT

Each Indicating transmitter has a serial output not used by the Divert Control unit. This serial output is selectable RS-232/RS-485 (see PR-01-S Manual) and contains concentration, temperature and error data. It contains also information whether the refractometer is in divert operation or not.

Possible uses of the Serial output: To communicate with a computer substituting the Divert Control unit.

8.6. CURRENT OUTPUT SIGNAL

Each Indicating transmitter provides a 4-20 mA output concentration signal not used by the Divert system. To calibrate this signal for suitable %Solids range, press Calibrate/Output signal/Current output, see PR-01-S Manual.

8.7. EXTERNAL DC POWER SUPPLY

The Divert Control unit may be connected to a DC power supply as a back-up. At AC power failure the refractometers will black-out, but the Divert Control unit will still work. In this case the DIVERT signal can be prevented by turning the key to OVERRIDE. Terminals are 15 (+24VDC) and 16 (ground).

The power requirement is 24 VDC, 500 mA.

8.8. DIVERT CONTROL UNIT CARD IN THE REMOTE UNIT

In the remote unit the divert control card the third dip switch SW3 must be in the ON position (“up”).

See Figure 3.13 and Sections 5.2. and 5.7.
9. DIVERT CONTROL UNIT PARTS LISTS

9.1. DIVERT CONTROL UNIT AND OPTIONAL REMOTE DIVERT CONTROL UNIT

<table>
<thead>
<tr>
<th>Item</th>
<th>Pcs.</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Enclosure</td>
</tr>
<tr>
<td>1.1</td>
<td>7</td>
<td></td>
<td>Conduit hubs 1/2” NPT-Type ST-1 (US)</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>PR-7310</td>
<td>Divert Control Unit Card</td>
</tr>
<tr>
<td>3.1</td>
<td>1</td>
<td></td>
<td>Modem transformer</td>
</tr>
<tr>
<td>3.2</td>
<td>1</td>
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<td>1</td>
<td></td>
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<td>4</td>
<td>1</td>
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<td>1</td>
<td>PR-7311</td>
<td>LED Display card</td>
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<tr>
<td>6.1</td>
<td>2</td>
<td>PR-6551</td>
<td>Switch unit, green</td>
</tr>
<tr>
<td>6.2</td>
<td>1</td>
<td>PR-6551</td>
<td>Switch unit, red for Emergency divert</td>
</tr>
<tr>
<td>6.3</td>
<td>1</td>
<td>PR-6551</td>
<td>Switch unit, green for Emergency divert reset</td>
</tr>
<tr>
<td>6.4</td>
<td>1</td>
<td>PR-6552</td>
<td>Lock unit for Automatic/Override divert operation</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>PR-6501</td>
<td>Divert Fuse set: 9 fuses (3 x Microfuse 1A, fast IEC 127-3/1, UL 198G; 3 x 5x20mm Fuse 1A, fast; 3 x Microfuse 63 mA, fast IEC 127-3/1, UL 198G)</td>
</tr>
</tbody>
</table>

INSTRUCTION MANUAL FOR DD-01
DOCUMENT/REVISION: IMD 1/5
Effective: June 20, 2005
### 9.2. REMOTE DIVERT CONTROL UNIT

<table>
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<td>6.2</td>
<td>1</td>
<td>PR-6551</td>
<td>Switch unit, red for Emergency divert reset</td>
</tr>
<tr>
<td>6.3</td>
<td>1</td>
<td>PR-6551</td>
<td>Switch unit, green for Emergency divert reset</td>
</tr>
<tr>
<td>6.4</td>
<td>1</td>
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<td>1</td>
<td>RACK Power 24V</td>
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