

User Guide

Digital Divert Control System
DD-23



PUBLISHED BY

Vaisala Oyj
Vanha Nurmijärventie 21, FI-01670 Vantaa, Finland
P.O. Box 26, FI-00421 Helsinki, Finland
+358 9 8949 1

Visit our Internet pages at www.vaisala.com.

© Vaisala 2021

No part of this document may be reproduced, published or publicly displayed in any form or by any means, electronic or mechanical (including photocopying), nor may its contents be modified, translated, adapted, sold or disclosed to a third party without prior written permission of the copyright holder. Translated documents and translated portions of multilingual documents are based on the original English versions. In ambiguous cases, the English versions are applicable, not the translations.

The contents of this document are subject to change without prior notice.

Local rules and regulations may vary and they shall take precedence over the information contained in this document. Vaisala makes no representations on this document's compliance with the local rules and regulations applicable at any given time, and hereby disclaims any and all responsibilities related thereto.

This document does not create any legally binding obligations for Vaisala towards customers or end users. All legally binding obligations and

agreements are included exclusively in the applicable supply contract or the General Conditions of Sale and General Conditions of Service of Vaisala.

This product contains software developed by Vaisala or third parties. Use of the software is governed by license terms and conditions included in the applicable supply contract or, in the absence of separate license terms and conditions, by the General License Conditions of Vaisala Group.

This product may contain open source software (OSS) components. In the event this product contains OSS components, then such OSS is governed by the terms and conditions of the applicable OSS licenses, and you are bound by the terms and conditions of such licenses in connection with your use and distribution of the OSS in this product. Applicable OSS licenses are included in the product itself or provided to you on any other applicable media, depending on each individual product and the product items delivered to you.

Table of contents

1.	About this document	5
1.1	Version information.....	5
1.2	Related manuals.....	5
1.3	Documentation conventions.....	5
1.4	Trademarks.....	6
1.5	Patent notice.....	6
2.	Product overview	8
2.1	Safety.....	8
2.2	Digital Divert Control System.....	9
3.	Divert Control System DD-23	11
3.1	Divert control unit.....	11
3.2	Operator panel.....	11
3.2.1	Green indicator lights.....	13
3.2.2	Yellow indicator lights.....	13
3.2.3	Red indicator lights.....	13
3.2.4	White pushbuttons.....	13
3.2.5	Header wash key.....	14
3.2.6	Emergency divert button.....	14
3.2.7	External emergency divert button.....	14
3.3	Prism wash.....	14
3.4	Indicating transmitters.....	14
4.	Mounting	15
4.1	Mounting prism wash.....	16
4.2	Wiring.....	16
4.2.1	Relays.....	17
4.2.2	Divert control unit with AC power supply.....	19
4.2.3	Divert control unit with DC power supply.....	22
4.2.4	External power switch for divert control unit.....	24
4.2.5	Switch inputs.....	27
4.2.6	Remote Ethernet connection.....	29
5.	Startup	31
5.1	Divert system pre-startup checklist.....	31
5.2	Divert control unit DD-23 startup.....	31
6.	Configuration	33
6.1	Calibration lock.....	33
6.2	Divert decision rules.....	34
6.3	Refractometer concentration measurement.....	36
6.4	Refractometer activation for divert control.....	36
6.5	Signal difference alarm.....	37
6.6	Low alarms.....	37
6.7	Refractometer malfunction alarm.....	38
6.8	Prism wash.....	38
7.	Regular maintenance and troubleshooting	39
7.1	Information flow.....	39
7.2	Malfunctions.....	39
7.3	Diagnostic tools.....	40
7.4	Troubleshooting.....	41
7.5	Ethernet strain relief for transmitters.....	42

8. Divert control logics	44
8.1 Safety decision logic.....	44
8.2 Divert decision logic.....	45
8.3 In operation logic.....	46
8.4 Malfunction logic.....	49
8.5 Resettable alarm logic.....	50
8.6 Refractometer difference logic.....	52
8.7 Wash arbitration logic.....	52
8.8 Wash check logic.....	54
9. Remote control interface	55
9.1 Divert control unit IP address.....	55
9.2 Remote interface.....	55
9.2.1 Main page.....	55
9.2.2 Instrument pages.....	56
9.2.3 Diagnostics page.....	56
9.2.4 Log page.....	56
9.2.5 Parameters page.....	57
10. DD-23 specifications	58
10.1 Divert control unit specifications.....	58
10.2 Divert control unit spare parts.....	60
Warranty	63
Technical support	63
Recycling	63

List of figures

Figure 1	Complete Digital Black Liquor Divert Control System DD-23.....	10
Figure 2	DD-23 operator panel.....	12
Figure 3	Mounting divert control system.....	15
Figure 4	Transmitter wiring cables and connections.....	16
Figure 5	Divert control unit internal wiring for AC power supply.....	19
Figure 6	Power terminals for AC power supply.....	21
Figure 7	Divert control unit internal wiring for DD-23-M-GP-DC and DD-23-U-GP-DC.....	23
Figure 8	Recommended external power switch.....	25
Figure 9	Header wash key functionality.....	28
Figure 10	Header wash key connections.....	29
Figure 11	Ethernet connection.....	30
Figure 12	Location of calibration lock.....	34
Figure 13	Indicating transmitters (STR) activated to divert control.....	37
Figure 14	Transmitter log page for instrument A.....	41
Figure 15	Transmitter main display, instrument in divert use.....	42
Figure 16	Mounting strain relief.....	43
Figure 17	Safe solids decision logic.....	44
Figure 18	Divert decision logics.....	46
Figure 19	Operation logic.....	48
Figure 20	Malfunction logic repeated for each sensor.....	49
Figure 21	Resettable alarm logic.....	51
Figure 22	Refractometer difference logic.....	52
Figure 23	Wash arbitration logic.....	53
Figure 24	Wash check logic.....	54
Figure 25	DD-23 remote control Main page.....	55
Figure 26	Remote diagnostics page.....	56
Figure 27	Remote log page.....	57
Figure 28	Parameters page.....	57
Figure 29	Divert control unit mounting plate.....	59
Figure 30	Divert control unit and indicating transmitter enclosures.....	59
Figure 31	Divert control unit spare parts.....	60

List of tables

Table 1	Document versions (English).....	5
Table 2	Related manuals.....	5
Table 3	Patents.....	6
Table 4	Mounting divert control system.....	15
Table 5	Connectors for AC power supply.....	20
Table 6	Connectors for DC power supply.....	24
Table 7	Divert decision rule selection.....	35
Table 8	Two instruments in operation, rule 1-of-2.....	35
Table 9	Two instruments in operation, rule 2-of-2.....	35
Table 10	Operation logic when only one instrument operating.....	35
Table 11	Wash parameters for Safe-Drive isolation valve nozzle SDI.....	38
Table 12	Diagnostic messages and their effect on divert operation.....	40
Table 13	Divert control unit specifications.....	58
Table 14	Divert control unit spare parts.....	60

1. About this document

1.1 Version information

This document provides instructions for installing, using and maintaining Vaisala K-PATENTS® Digital Divert Control System DD-23.

Table 1 Document versions (English)

Document code	Date	Description
IM-EN-DD23-D	February 2021	Minor editorial updates
IM-EN-DD23-C	January 2021	New motherboard Minor editorial updates
IM-EN-DD23-B	November 2020	Editorial updates

1.2 Related manuals

Table 2 Related manuals

Document code	Name
IM-EN-PR23	<i>Process Refractometer PR-23 User Guide</i>
IM-EN-SDGEN21-BP	<i>Safe-Drive Process Refractometer Generation 2.1 PR-23-SD Best Practices</i>

1.3 Documentation conventions



WARNING! Warning alerts you to a serious hazard. If you do not read and follow instructions carefully at this point, there is a risk of injury or even death.



CAUTION! Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.



Note highlights important information on using the product.



Tip gives information for using the product more efficiently.



Lists tools needed to perform the task.



Indicates that you need to take some notes during the task.

1.4 Trademarks

Vaisala® and K-PATENTS® are registered trademarks of Vaisala Oyj.

Linux® is a registered trademark of Linus Torvalds.

Windows® is either a registered trademark or trademark of Microsoft Corporation in the United States and other countries.

All other product or company names that may be mentioned in this publication are trade names, trademarks, or registered trademarks of their respective owners.

1.5 Patent notice

This product is protected by the following patents and patent applications and their corresponding national rights:

Table 3 Patents

Product	Applicable patent
Process Refractometer PR-03/23/33	US 9063020 23.2.2032
Process Refractometer PR-03M/23M/MS/W	US 6760098 1.8.2021
	US 9028140 19.1.2032
SAFE-DRIVE Refractometer PR-23-SD	FI 118442 17.6.2026
	US 7631569 9.12.2027

Process Refractometer PR-23/33 also has the following additional patent applications pending:

- FI 20106065
- DE 102011084387.6
- US 13/273,907
- FI 20106066
- DE 102011094386.8
- US 13/274,000

2. Product overview

2.1 Safety

This product has been tested for safety. Note the following precautions:



WARNING! Only licensed experts may install electrical components. They must adhere to local and state legislation and regulations.

Precautions when removing the sensor from the process line:

- Make positively sure that the process line is not under pressure. Open a vent valve to the atmosphere.
- For a prism wash system, close a hand valve for the wash medium and disable the wash valve.
- Loosen the flange or clamp 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 cover for security reasons.



Wear protective eyewear.



Wear protective gloves.

It is the user's responsibility to follow manufacturer's safety and operating instructions. The client's organization has the responsibility to develop and maintain occupational safety and create a safety culture where individuals are expected to follow safety instructions at all times. Any negligence towards safety instructions or failure to comply with safe practices should not be tolerated. It is the manufacturer's responsibility to produce goods that are safe to use when instructions are followed.

The process medium may be hot or otherwise hazardous. Use shields and protective clothing adequate for the process medium. Do not rely on avoidance of contact with the process medium.

2.2 Digital Divert Control System

The Vaisala K-PATENTS® Digital Black Liquor Divert Control System DD-23 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 April 2015). The document is available at <http://blrbac.org/sites/default/files/Safe%20Firing%20of%20Black%20Liquor%20-%20April%202015.pdf>.

The system consists of the following parts: Two Vaisala K-PATENTS® process refractometers PR-23-SD (A & B) are installed in series in the main black liquor line. Each refractometer is complete with a sensor, indicating transmitter and interconnecting cables. Each refractometer provides also two 4 ... 20 mA output signals not used by the divert control system. These can be used to give % solids output or temperature output signals. The sensors are also equipped with a steam wash nozzle although the self-cleaning sensor design may eliminate the need for prism wash.

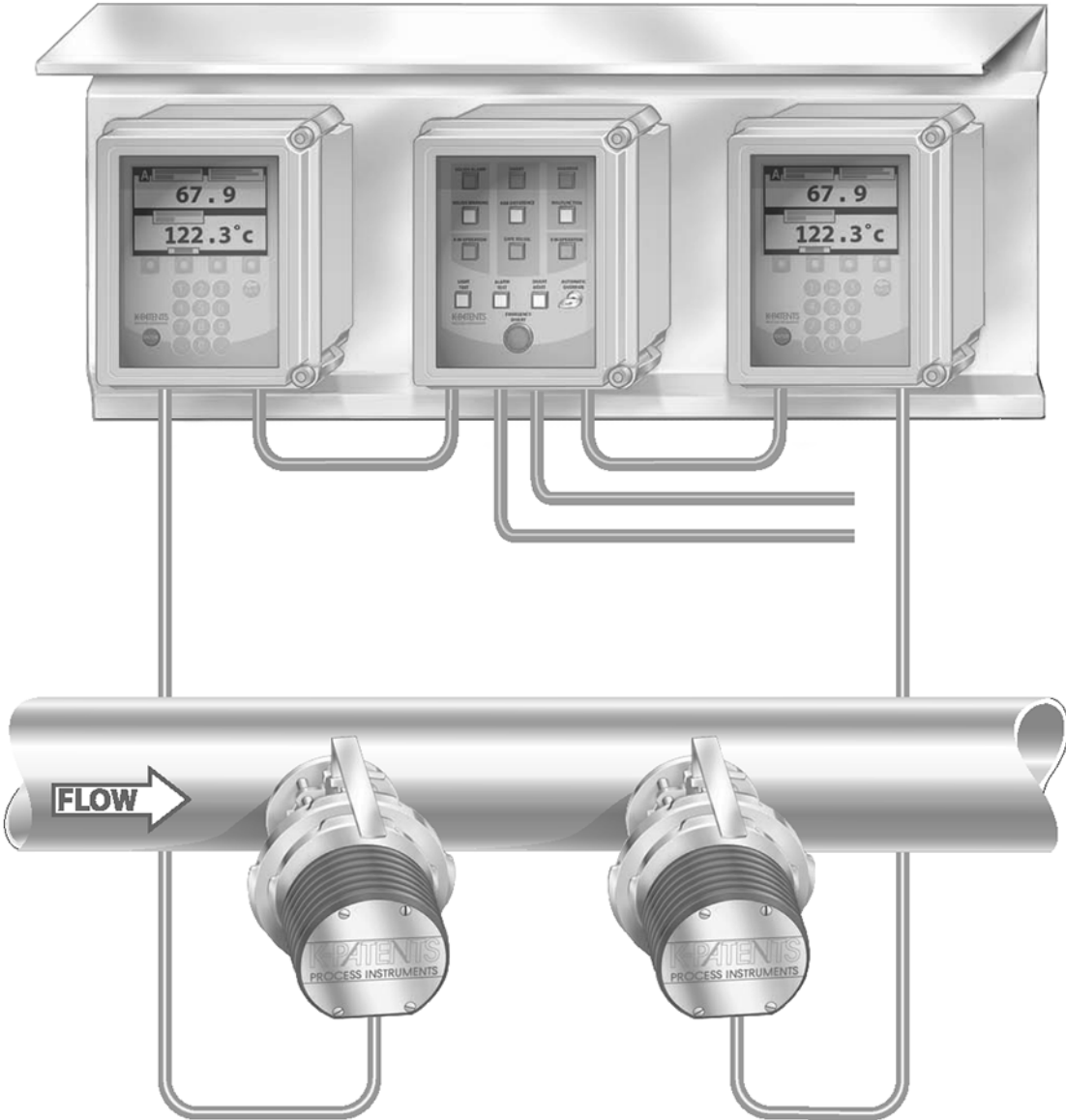


Figure 1 Complete Digital Black Liquor Divert Control System DD-23

3. Divert Control System DD-23

The Divert Control System DD-23 includes the following:

- Divert control unit.
- Two PR-23-SD refractometer sensors.
- Two isolation valves SDI for the sensors 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.
- Wiring to connect the indicating transmitters with the divert control unit.
- Two steam valves with steam traps for prism wash (pneumatic + solenoid valves).
- Two hand valves (one for prism wash, one for stuffing box flush).
- A remote operator panel facility, accessible with a web browser over Ethernet.

BLRBAC (The Black Liquor Recovery Boiler Advisory Committee) recommends maintaining a spare refractometer sensor in stock on-site.

The system can also be used with two PR-21-S process refractometers if installation of or upgrade to PR-23-SD sensors is unfeasible. Both sensors require their own indicating transmitters and the required interconnecting cables between the sensor and transmitter, but otherwise the installation is similar to the PR-23-SD based one.

3.1 Divert control unit

The divert control unit is contained in an enclosure with the same dimensions as the refractometer transmitter enclosure. The control unit includes:

- An operator with system state indicators and pushbuttons
- Relay outputs for connecting to the control system
- Contact inputs for external control
- Ethernet interface for remote operator panel

3.2 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 information is shown both as LED indication in the divert control unit and as a diagnostic messages in the indicating transmitters. The same information is also available through the remote operator panel.

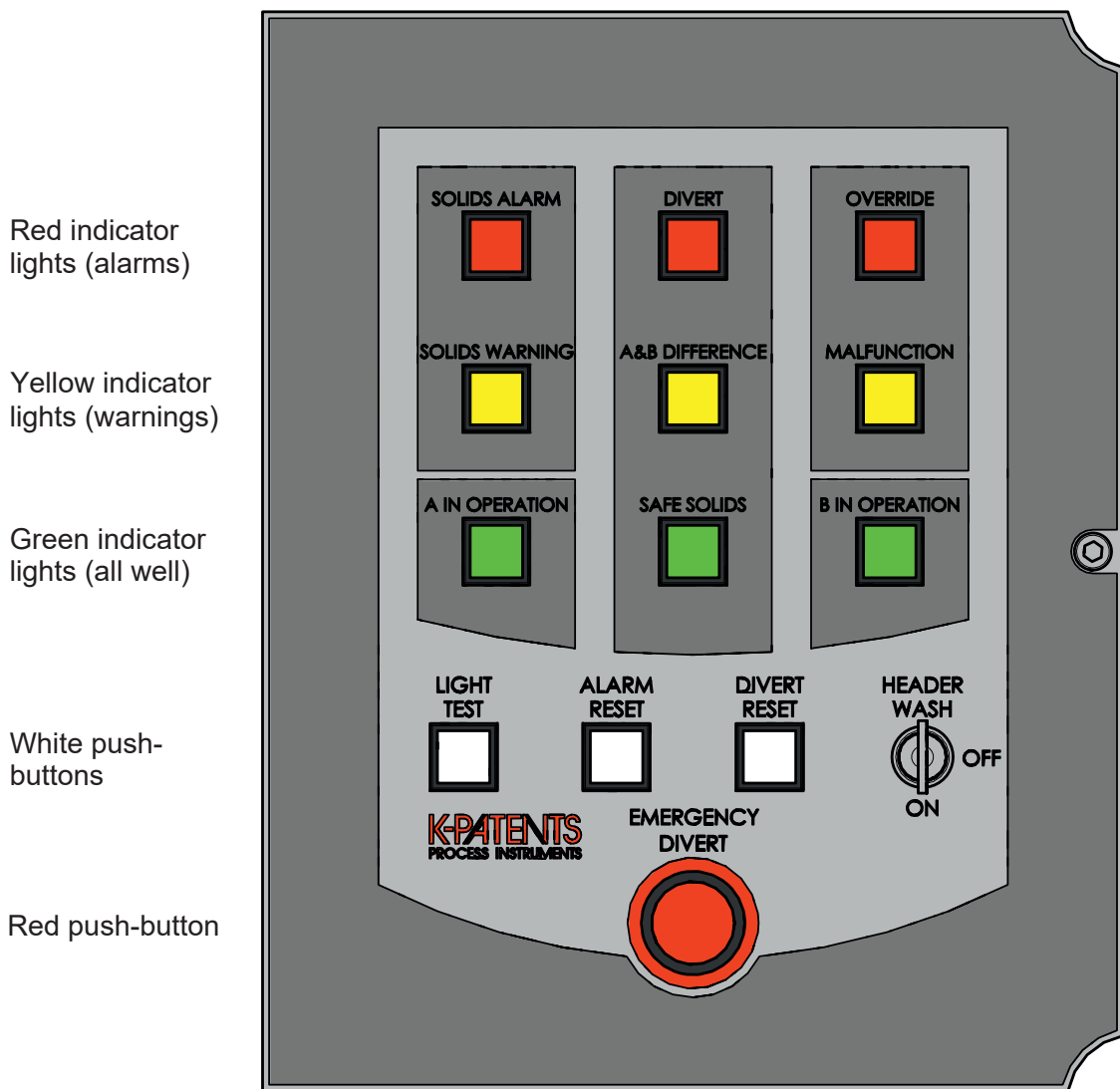


Figure 2 DD-23 operator panel

The three top rows on the operator panel consist of indicator lights. The green A IN OPERATION and B IN OPERATION lights are also push buttons used to include the refractometers in the Divert system. Below the lights there are push buttons and the HEADER WASH key used to operate the system.

The indicator lights on the operator panel are arranged like traffic lights: top row is red for alarm, middle row is yellow for warning and bottom row is green for "system ok". When the system is running normally, only the row of green lights is lighted.

The white LIGHT TEST button is used to check that all the LEDs behind the indicator lights are working. It also verifies the data processing system in the control unit. The other two white push buttons, ALARM RESET and DIVERT RESET can be used to reset the system back to normal after all problems have been fixed. The HEADER WASH key enables the use of ring header washing with water, when set to ON.

The big red EMERGENCY DIVERT push button is used to manually initiate divert in an emergency situation. An external push button can also be connected to a switch input in the control unit as External Emergency Divert Button.

3.2.1 Green indicator lights

Green indicator lights indicate **System OK**.

Each refractometer has a green operating light – **A IN OPERATION** and **B IN OPERATION** – to let the operator know when he can rely on the refractometer measurement. A refractometer can only influence the divert decision and activate warnings and alarms when it is in divert operation, i.e. when its green operating light is lighted.

When **DIVERT** is effective, the system can be reset to normal operation only when **SAFE SOLIDS** is lighted.

3.2.2 Yellow indicator lights

Yellow indicator lights indicate **Warnings**.

The **SOLIDS WARNING** light indicates a black liquor concentration of below warning limit (by default at 60 %). This warning can be activated by either refractometer.

The **A&B DIFFERENCE** light is lighted when the refractometer readings differ by at least 2 %. This warning is only be initiated if both refractometers are operating.

If the yellow **MALFUNCTION** light is switched on, some part of the system – a refractometer, a transmitter or the control unit – is malfunctioning. A list of malfunctions and critical malfunctions is given in [Malfunctions \(page 39\)](#). If a critical malfunction occurs in a sensor or a transmitter, the malfunctioning refractometer is automatically removed from divert operation (its operating light is also switched off). Check the reason for the malfunction and correct the problem, see [Troubleshooting \(page 41\)](#), before returning the refractometer to divert operation.

3.2.3 Red indicator lights

Red indicator lights indicate **Alarms**.

The black liquor **SOLIDS ALARM** is lighted when the concentration reading goes below alarm limit (by default below 58 %). This alarm can be activated by either refractometer depending on the operation rule setting.

The **DIVERT** light is switched on when the **SOLIDS ALARM** is activated. The **DIVERT** light indicates divert status of the divert relay. The relay is inactive in the divert position, because then a power failure will give a divert decision signal to the system.

The **OVERRIDE** light is lighted to indicate that no automatic divert will happen as long as the system is in the header wash state, see [Header wash key \(page 14\)](#).

3.2.4 White pushbuttons

White pushbuttons are for **testing and resetting**.

The **LIGHT TEST** button switches all 12 lights on. The **ALARM RESET** button resets the alarm lights.

3.2.5 Header wash key

The header wash key enables the **ring header wash**.

The header wash key function is a 3-level procedure which can be used when ring header washing with water is needed. When the **HEADER WASH** key is switched to **ON** position and information from black liquor guns switch inputs connected in series tells that guns are out from recovery boiler, then a ring header wash can be done without activating divert.

Pushing the **EMERGENCY DIVERT** button always initiates divert regardless of the header wash functionality.

3.2.6 Emergency divert button

The **EMERGENCY DIVERT** pushbutton is used to manually initiate divert in an emergency situation.

3.2.7 External emergency divert button

An external (remote) push button can also be connected to an input inside the control unit, see [Figure 5 \(page 19\)](#).



CAUTION! External emergency divert button must be normally closed (NC). Opening the circuit initiates divert.

3.3 Prism wash

The wash parameters for the sensors are set through each transmitter.

The transmitters contain a relay for prism wash. To follow the BLRBAC recommendation not to wash both prisms at the same time, the divert control unit implements an interlock which prevents the instrument from washing both sensors simultaneously.

3.4 Indicating transmitters

Mechanically the indicating transmitters shipped with a DD-23 are the same than PR-23 indicating transmitter DTR. The transmitter only allows single sensor connection and a special DD-23 transmitter software is used for the divert system. When divert software is 2.01 or newer, indicating transmitter software version must be 4.12 or newer.

For more information on the basic functions of indicating transmitter, see *Process Refractometer PR-23 User Guide*.

4. Mounting

For mounting of the process refractometers and the isolation valves, consult the separate *Process Refractometer PR-23 User Guide*.

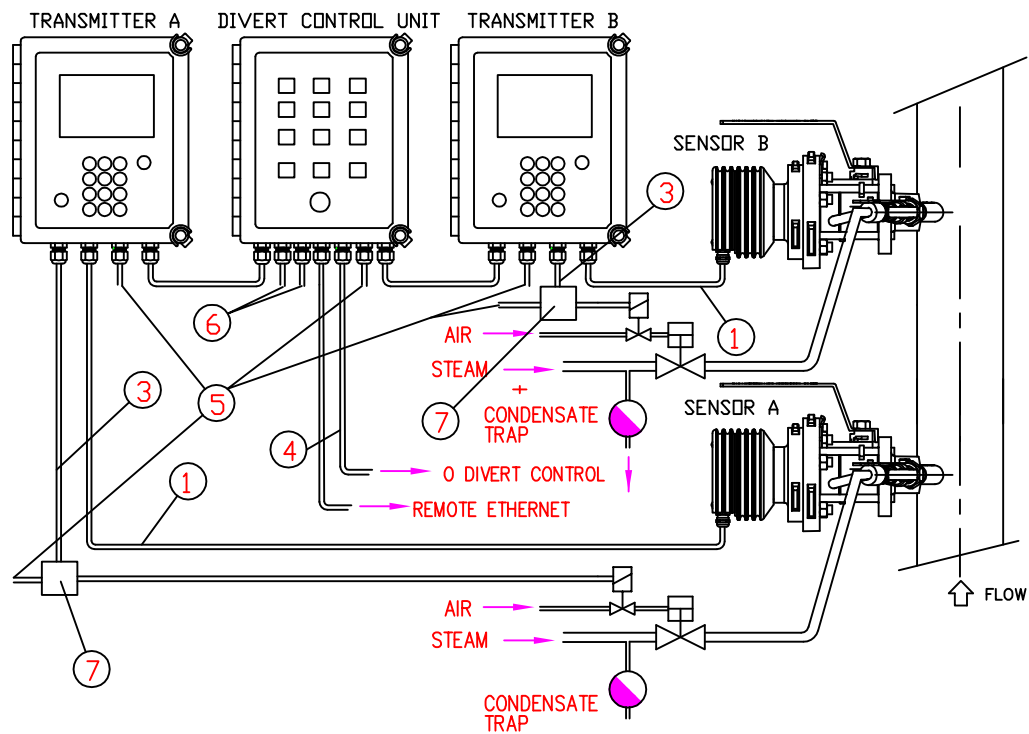


Figure 3 Mounting divert control system

Table 4 Mounting divert control system

Part	Specifications	Supplied by	Qty
1	PR-8230 interconnecting cable between sensor and transmitter	Vaisala	2
2	Ethernet cable divert 0.7 m (2.3 ft)	Vaisala	2
3	Solenoid valve cable multicore 2x1 1.5 mm ² (AWG 16), max. 100 m (330 ft)	Customer	2
4	Divert control cable	Customer	1
5	Power supply multicore 3x1 1.5 mm ² (AWG 16)	Customer	5
6	Relay information to DCS	Customer	3
7	Junction box	Customer	2

4.1 Mounting prism wash

Vaisala recommends to use a steam trap instead of a preconditioning valve to remove condensate from the steam line.

4.2 Wiring

For wiring for complete system, see the following figure which shows the connections to the indicating transmitters and to steam washing. [Figure 5 \(page 19\)](#) has information of all connections to the divert control unit.

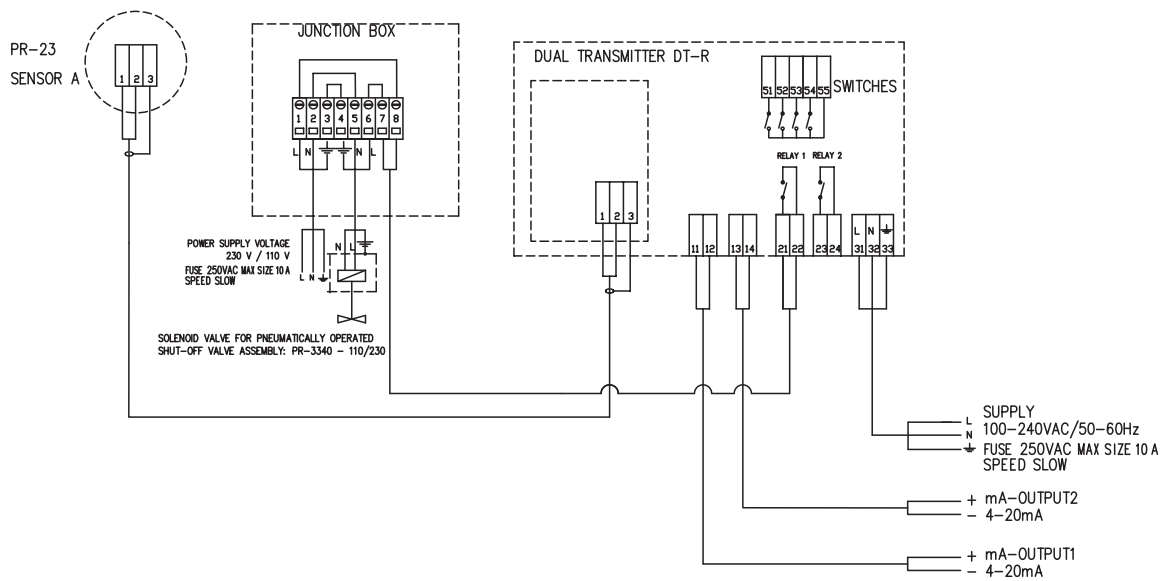


Figure 4 Transmitter wiring cables and connections

4.2.1 Relays



Warning

Warning! Connect only AC or DC power to relays. You can connect AC power to both relays or DC power to both relays, but never connect AC in one and DC in the other relay.

Varoitus! Kytke releisiin vain vaihtovirta **tai** tasavirta. Voit kytkeä vaihtovirran molempiin releisiin tai tasavirran molempiin releisiin, mutta älä koskaan kytke yhteen releeseen vaihtovirtaa ja toiseen releeseen tasavirtaa.

Warning! Anslut endast en AC- eller DC-strömkälla till reläer. Du kan ansluta en AC-strömkälla till båda reläerna eller en DC-strömkälla till båda reläerna, men aldrig ansluta en AC-strömkälla till det ena reläet och en DC-strömkälla till det andra.

Advarsel! Tilslut kun vekselstrøm eller jævnstrøm til relæerne. Du kan slutte vekselstrøm til begge relæer eller jævnstrøm til begge relæer, men tilslut aldrig vekselstrøm til det ene og jævnstrøm til det andet relæ.

Hoiatus! Ühendage releed ainult vahelduvvoolu- või alalisvooluvõrku. Võite mõlemad releed ühendada kas vahelduvvooluvõrku või alalisvooluvõrku, ent mitte kunagi ühte releed vahelduvvooluvõrku ja teist alalisvooluvõrku.

Внимание! Подключайте к реле только питание переменным **или** постоянным током. К обоим реле можно подключить питание переменным или постоянным током, но никогда не подключайте к одному реле питание переменным током, а к другому ----- питание постоянным током.

Ispėjimas! Prijunkite tik AC arba nuolatinę srovę relėms. Galite prijungti kintamąją srovę prie abiejų relijų arba nuolatinę srovę prie abiejų relijų, bet niekada nejunkite kintamosios srovės vienoje ir nuolatinės srovės kitoje.

Ostrzeżenie! Do przekaźników podłączać tylko AC lub DC. Do obu przekaźników może być podłączone zasilanie AC lub zasilanie DC, ale nie wolno podłączać zasilania AC do jednego, a zasilania DC do drugiego przekaźnika.

Varování! K relé připojte pouze střídavé nebo stejnosměrné napájení. Můžete připojit střídavé napájení k oběma relé nebo stejnosměrné napájení k oběma relé, ale nikdy nepřipojujte k jednomu relé střídavé a k druhému stejnosměrné napájení.

Figyelmeztetés! Csak AC vagy csak DC tápellátást csatlakoztasson a relékhez. Csatlakoztathat AC tápellátást mindkét reléhez, vagy DC tápellátást mindkét reléhez, de soha ne csatlakoztasson az egyikhez AC, a másikkhoz pedig DC tápellátást.

Warnung! Nur Wechselstrom oder Gleichstrom an die Relais anschließen. Sie können Wechselstrom an beide Relais oder Gleichstrom an beide Relais anschließen, dürfen aber keinesfalls Wechselstrom an ein und Gleichstrom an das andere Relais anschließen.

Waarschuwing! Sluit alleen AC- of DC-voeding aan op relais. U kunt AC-voeding aansluiten op beide relais of DC-voeding op beide relais, maar sluit nooit AC-voeding aan op het ene en DC-voeding aan op het andere relais.

Avertissement! Connectez uniquement une alimentation CA ou CC aux relais. Vous pouvez connecter une alimentation CA aux deux relais ou une alimentation CC aux deux relais, mais ne connectez jamais une alimentation CA à un relais et une alimentation CC à l'autre relais.

¡Advertencia! Conecte solo la alimentación de CA o de CC a los relés. Puede conectar la alimentación de CA a ambos relés o la alimentación de CC a ambos relés, pero nunca podrá conectar una alimentación de CA en un relé y una alimentación de CC en el otro relé.

Avvertimento! Collegare ai relè solamente l'alimentazione CA o CC. È possibile collegare l'alimentazione CA o CC a entrambi i relè, ma non collegare mai l'alimentazione CA in un relè e l'alimentazione CC nell'altro relè.

Relay functions

Relay 1: NORMAL/DIVERT information.

Relay 2: NORMAL/DIVERT information.

Relay 3: SOLIDS WARNING. When one of the refractometers goes lower than the solids warning limit, typically 60 % or higher. See [Low alarms \(page 37\)](#).

Relay 4: SOLIDS ALARM:. When one of the refractometers goes lower than the solids alarm limit, typically 58 % or higher. See [Low alarms \(page 37\)](#).

Relay 5: Refractometer signal difference warning. When the refractometer readings have more than 2 % difference in concentration. See [Signal difference alarm \(page 37\)](#).

Relay 6: Horn relay. Connection to the audible alarm. See [Resettable alarm logic \(page 50\)](#).

Relay 7: Header wash key information. See [Header wash key \(page 14\)](#).

Relay 8: Refractometer A malfunction information. See [Malfunctions \(page 39\)](#) and [Malfunction logic \(page 49\)](#).

Relay 9: Refractometer B malfunction information. See [Malfunctions \(page 39\)](#) and [Malfunction logic \(page 49\)](#).

Relay 10: Information on if refractometer A is active in the divert control system or dropped off.

Relay 11: Information on if refractometer B is active in the divert control system or dropped off.

4.2.2 Divert control unit with AC power supply

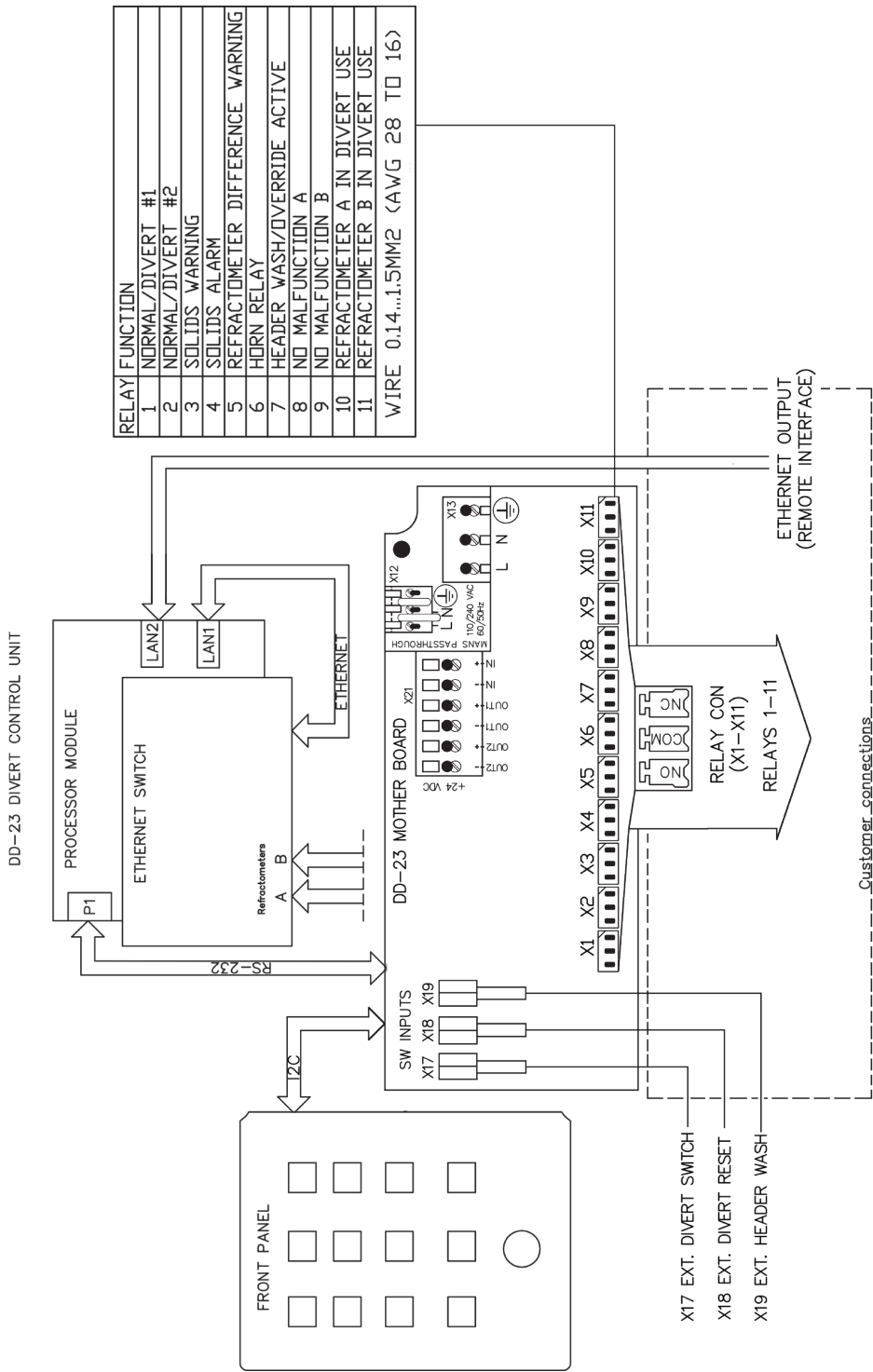
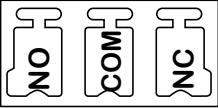
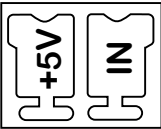


Figure 5 Divert control unit internal wiring for AC power supply

Table 5 Connectors for AC power supply

Connector	Function	Electrical specification
X1	Relay 1: Normal/Divert #1	AC: Max. 3 A, max. 250 V AC, max. 1250 VA DC: Max. 3 A at DC voltage of 30 V DC, max. 0.2 A at DC voltage of 125 V DC Fuse voltage 250 V AC/DC, max size 3 A, fuse speed slow.  RELAY CON (X1 - X11)
X2	Relay 2: Normal/Divert #2	
X3	Solids warning	
X4	Solids alarm	
X5	Refractometer difference warning	
X6	Horn relay	
X7	Header wash/Override active	
X8	No malfunction A	
X9	No malfunction B	
X10	Refractometer A in divert use	
X11	Refractometer B in divert use	
X12	For DD-23 internal use only	
X13	Power L (100-240 VAC), 50-60 Hz, N, protective earth	
X17	Switch input 1: External divert switch	5 V DC (out) and switch inputs are galvanically isolated Power max. 1 W  SWITCH IN (X17 - X19)
X18	Switch input 2: External divert reset	
X19	Switch input 3: Header wash	
X21	For DD-23 internal use only	

Connector plugs for X1 through X11 and X17 through X19: Stripping length for wires 7 mm, torque 0.22 Nm to 0.25 Nm.

The primary AC power is connected to a separate terminal strip X13. The three terminals are marked as follows:

- L
- N
- ⊕

The protective earth is directly connected to the exposed metal parts of DD-23. Wiring to terminals should be min. 1.5 mm². The fuse voltage should be 250 V, max. size 10 A and fuse speed slow. Torque used is 0.5 Nm ... 0.6 Nm. Stripping length is 8 mm for wires. The protective fuse in the building system shall comply with the local requirements.

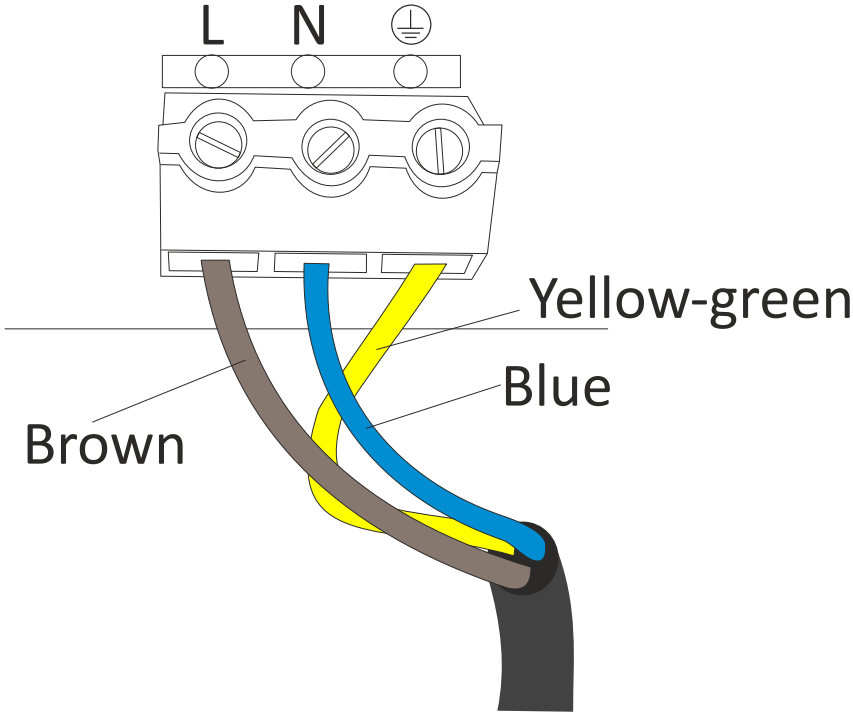


Figure 6 Power terminals for AC power supply

4.2.3 Divert control unit with DC power supply



Warning

Warning! Items DD-23-M-GP-DC and DD-23-U-GP-DC are PELV devices. See type label for supply voltage specifications. Connect the protective grounding to the same grounding potential that is used by the external power supply.

Varoitus! Tuotteet DD-23-M-GP-DC ja DD-23-U-GP-DC ovat PELV-laitteita. Katso syöttöjännitteen tekniset tiedot tyyppikilvestä. Kytke suojaadoitus samaan maadoituspotentiaaliin kuin mitä ulkoinen virtälähde käyttää.

Warning! Objekten DD-23-M-GP-DC och DD-23-U-GP-DC är PELV-enheter. Se typskylt för specifikationer för matningsspänning. Anslut skyddsjordning till samma jordningspotential som används för den externa strömförsörjningen.

Advarsel! Komponent DD-23-M-GP-DC og DD-23-U-GP-DC er PELV-enheder. På typemærkatet kan du se specifikationerne for forsyningsspænding. Forbind den beskyttende jordforbindelse til den samme jording, som den eksterne strømforsyning bruger.

Hoiautus! Seadmed DD-23-M-GP-DC ja DD-23-U-GP-DC on PELV-kaitseväikepingega töötavad seadmed. Toitepinge spetsifikatsioon on tüüpikilbil. Ühendage kaitsemaandus sama maanduspotentsiaaliga, mida kasutab väline toiteallikas.

Внимание! Элементы DD-23-M-GP-DC и DD-23-U-GP-DC ----- это устройства защитного сверхнизкого напряжения. Технические характеристики напряжения питания см. в табличке с паспортными данными. Подключите защитное заземление к тому же потенциалу заземления, который используется внешним источником питания.

Ispejimas! Prekės DD - 23 - M - GP - DC ir DD - 23 - U - GP - DC yra PELV prietaisai. Maitinimo įtampos specifikacijos žr. tipo etiketėje. Prijunkite apsauginį įžeminimą prie to paties įžeminimo potencialo, kurį naudoja išorinis maitinimo šaltinis.

Ostrzeżenie! Pozycje DD-23-M-GP-DC i DD-23-U-GP-DC są urządzeniami PELV. Wartości znamionowe napięcia zasilania podane są na tabliczce znamionowej. Uziemienie ochronne musi być podłączone do tego samego potencjału uziomowego, które jest wykorzystywane przez zewnętrzne zasilanie.

Varování! Položky DD-23-M-GP-DC a DD-23-U-GP-DC jsou zařízení PELV. Specifikace napájecího napětí najdete na typovém štítku. Připojte ochranné uzemnění ke stejnému zemnímu potenciálu, jaký využívá externí napájecí zdroj.

Figyelmeztetés! A DD-23-M-GP-DC és a DD-23-U-GP-DC elemek PELV készülékek. A tápfeszültség specifikációt lásd a típuscímkén. Csatlakoztassa a védőföldelést ugyanahhoz a földelési potenciálhoz, mint amelyet a külső tápegység használ.

Warnung! DD-23-M-GP-DC und DD-23-U-GP-DC sind PELV-Komponenten. Die Spannungsangaben sind dem Typenschild zu entnehmen. Schließen Sie die Schutzerde an das von der externen Stromversorgung verwendete Erdpotential an.

Waarschuwing! Items DD-23-M-GP-DC en DD-23-U-GP-DC zijn PELV-apparaten. Zie typeplaatje voor specificaties van de voedingsspanning. Sluit de beschermende aarding aan op hetzelfde aardingspotential dat wordt gebruikt door de externe voeding.

Avertissement! Items DD-23-M-GP-DC et DD-23-U-GP-DC sont des appareils TBTP. Voir l'étiquette de type pour les spécifications de tension d'alimentation. Connectez la mise à la terre de protection au même potentiel de mise à la terre utilisé par l'alimentation externe.

¡Advertencia! Los elementos DD-23-M-GP-CC y DD-23-U-GP-CC son dispositivos PELV. Consulte la etiqueta de tipo para conocer las especificaciones del voltaje de suministro. Conecte la puesta a tierra de protección al mismo potencial de puesta a tierra que usa la fuente de alimentación externa.

Avvertimento! Gli articoli DD-23-M-GP-CC e DD-23-U-GP-CC sono dispositivi PELV. Vedere la targhetta del modello per le specifiche della tensione di alimentazione. Collegare la messa a terra di protezione allo stesso potenziale di messa a terra utilizzato dall'alimentazione esterna.

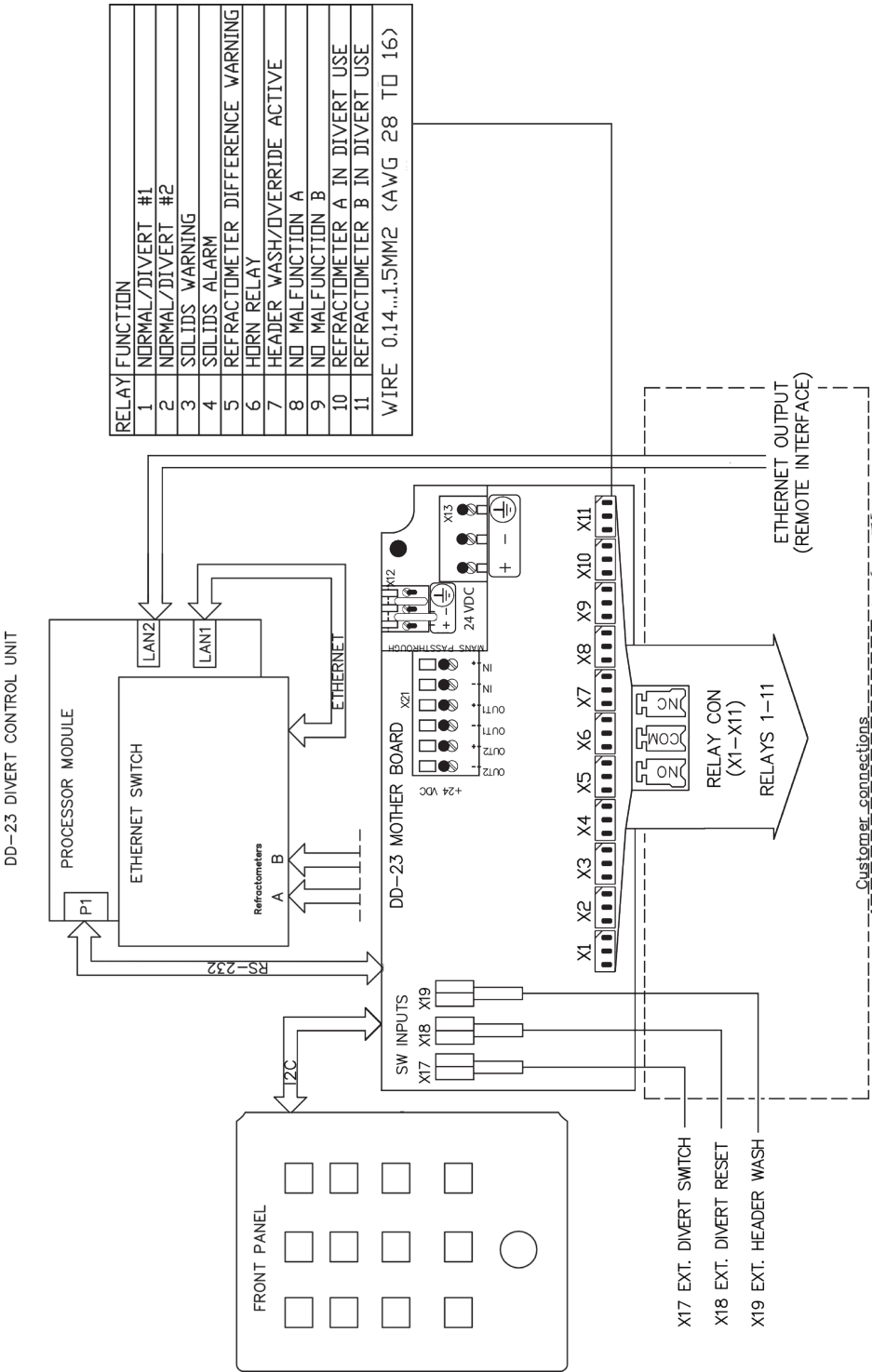
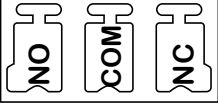
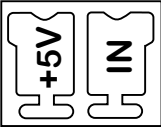


Figure 7 Divert control unit internal wiring for DD-23-M-GP-DC and DD-23-U-GP-DC

Table 6 Connectors for DC power supply

Connector	Function	Electrical specification
X1	Relay 1: Normal/Divert #1	AC: Max. 3 A, max. 250 V AC, max. 1250 VA DC: Max. 3 A at DC voltage of 30 V DC, max. 0.2 A at DC voltage of 125 V DC  RELAY CON (X1 - X11)
X2	Relay 2: Normal/Divert #2	
X3	Solids warning	
X4	Solids alarm	
X5	Refractometer difference warning	
X6	Horn relay	
X7	Header wash/Override active	
X8	No malfunction A	
X9	No malfunction B	
X10	Refractometer A in divert use	
X11	Refractometer B in divert use	
X12	For DD-23 internal use only	
X13	Power 24 V DC	
X17	Switch input 1: External divert switch	5 V DC (out) and switch inputs are galvanically isolated Power max. 1 W  SWITCH IN (X17 - X19)
X18	Switch input 2: External divert reset	
X19	Switch input 3: Header wash	
X21	For DD-23 internal use only	

4.2.4 External power switch for divert control unit

Make sure that you mount an external power switch for the divert control unit. The ratings of the switch are 10 A/250 V. Make sure that the switch is close to the unit and easily reachable. Make sure that you mark the switch as a disconnecting device.

The following figure shows the recommended external power switch, spare part PR-10900. The ratings of the switch are 10 A/250 V.

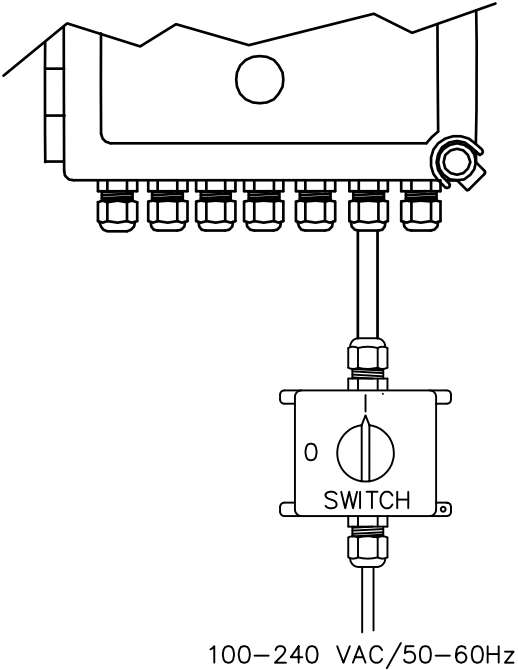


Figure 8 Recommended external power switch



Warning

Warning! Check that the power is off before opening the front panel. To completely turn the power off, use the external power switch.

Varoltus! Tarkista, että virta on katkaistu, ennen kuin avaat etupaneelin. Katkaise virta kokonaan ulkoisella virtakytkimellä.

Varning! Kontrollera att strömmen är avstängd innan du öppnar frontpanelen. Använd den externa strömbrytaren för att stänga av strömmen helt.

Advarsel! Kontroller, at strømmen er slukket, før frontpanelet åbnes. Brug den eksterne afbryder for at slukke helt for strømmen.

Hoiautus! Enne esipaneeli avamist kontrollige, et süsteem poleks pinges all. Toite täielikuks väljalülitamiseks kasutage välist toitelülitiit.

Внимание! Перед открытием передней панели убедитесь, что питание отключено. Чтобы полностью отключить питание, используйте внешний переключатель питания.

Ispėjimas! Prieš atidarydami priekinį skydelį, patikrinkite, ar maitinimas išjungtas. Norėdami visiškai išjungti maitinimą, naudokite išorinį maitinimo jungiklį.

Ostrzeżenie! Przed otwarciem panelu przedniego sprawdzić, czy zasilanie jest wyłączone. W celu całkowitego wyłączenia zasilania należy użyć zewnętrznego wyłącznika zasilania.

Varování! Před otevřením předního panelu zkontrolujte, zda je napájení vypnuto. Chcete-li napájení zcela vypnout, použijte externí vypínač.

Figyelmeztetés! Az előlap kinyitása előtt ellenőrizze, hogy a készülék ki van-e kapcsolva. A készülék teljes kikapcsolásához használja a külső tápkapcsolót.

Warnung! Prüfen Sie, ob das Gerät ausgeschaltet ist, bevor Sie die Frontblende öffnen. Verwenden Sie den externen Netzschalter, um das Gerät vollständig auszuschalten.

Waarschuwing! Controleer of de stroom is uitgeschakeld voordat u het voorpaneel opent. Gebruik de externe voedingsschakelaar om de stroom volledig uit te schakelen.

Avertissement! Vérifiez que l'alimentation est coupée avant d'ouvrir le panneau avant. Pour mettre l'appareil complètement hors tension, utilisez l'interrupteur d'alimentation externe.

¡Advertencia! Verifique que la alimentación está desconectada antes de abrir el panel frontal. Para apagar completamente la alimentación, use el interruptor de encendido externo.

Avvertimento! Verificare che l'alimentazione sia spenta prima di aprire il pannello anteriore. Per spegnere completamente l'alimentazione, utilizzare l'interruttore di alimentazione esterno.

4.2.5 Switch inputs

External divert switch/push button: input X17

An external divert switch can be connected to the DD-23 divert control unit, input X17. If the external divert switch is not used, a jumper has to be connected across X17. The unit is delivered with this jumper connected.

External divert reset button: input X18

If you want to use external divert reset button, it can be connected max. 200 m (600 ft) from DD-23 divert control unit. Use normal instrument cable 2x0.5 (AWG 20) and connect cable to DD-23 motherboard input X18.

You must make sure both refractometers A and B are working before starting to use the remote divert button. The remote interface can be used to check on the refractometers, see [Remote control interface \(page 55\)](#).

The external reset button connection is normally open (NO).

Header wash key: input X19

Black liquor is injected to the recovery boiler through liquor guns. Occasionally the header ring needs washing and during that procedure the divert system has to be bypassed and the liquor guns have to be removed from the furnace. The digital divert control System DD-23 allows for a safe override of divert logic during header ring wash.

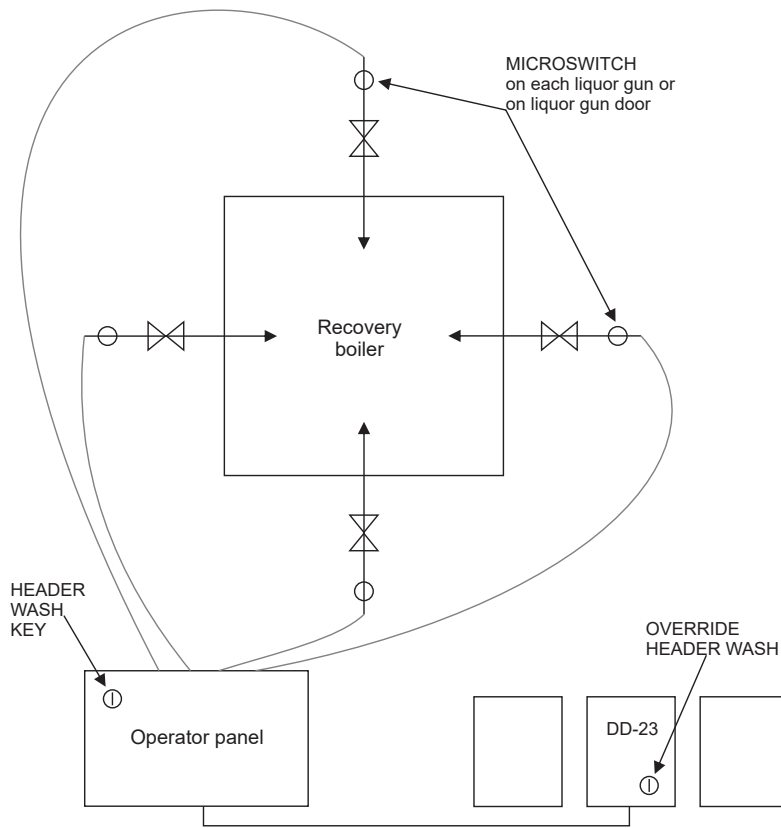


Figure 9 Header wash key functionality

The override is mounted by connecting the gun micro switches in series to the Header Wash/override key switch input X19, see the following figure.

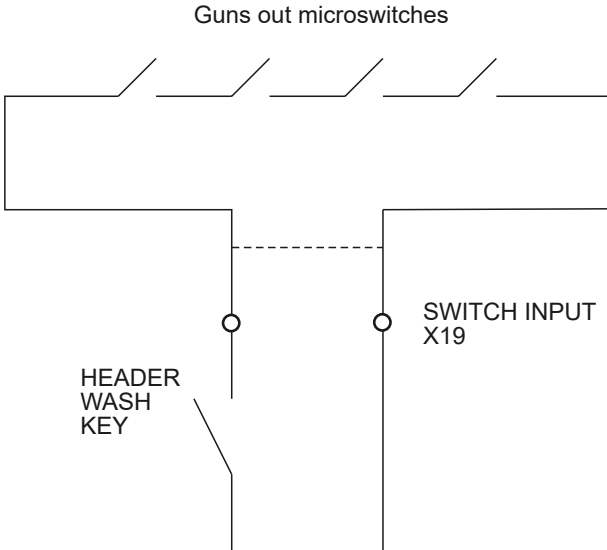


Figure 10 Header wash key connections

The Header Wash Key may be used without the external switch information if a jumper (dotted line in the previous figure) is placed to switch input X19. If the input is left open, the key does not have any effect.

4.2.6 Remote Ethernet connection

The Ethernet connection for the divert user interface DI and data logging purposes is an 8-pin M12 connector at the bottom of the divert unit. The Ethernet cable PR-8430 to DI can be connected while the unit is powered, without opening the case. DD-23 service cable PR-8667 is used when a computer or other device with a RJ45 connector is connected to the DD-23.

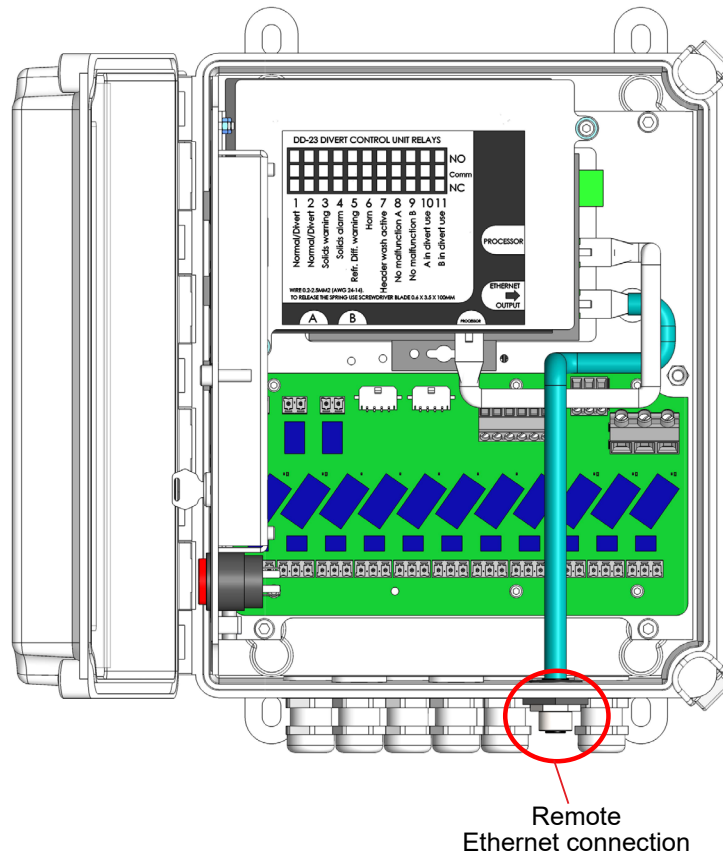


Figure 11 Ethernet connection

5. Startup

5.1 Divert system pre-startup checklist

1. SDI isolation valves mounted correctly.
 - Vertical pipe; MTG453
 - Horizontal pipe; MTG471
2. DD-23 control unit installed; DIM243, see [Figure 29 \(page 59\)](#).
3. Pressure reducing valve, solenoid valve, steam trap installed and connected to the prism wash nozzle on each sensor.
 - Steam pipes for black liquor; MTG470
 - Nozzle; MTG482
4. 9 ... 15 bar (130 ... 220 psi) steam connected to the solenoid valve on each sensor.
5. Instrumentation air 4 ... 6 bar (60 ... 90 psi) connect to the solenoid valve on each sensor.
6. Power supply (230/110 V AC / 24 V DC) connected; SYS358 / [Figure 3 \(page 15\)](#), and WRG366, [Figure 3 \(page 15\)](#).
 - Transmitter A
 - Transmitter B
 - Divert control unit
 - Solenoid valve A
 - Solenoid valve B
7. Cables connected; SYS358 / [Figure 3 \(page 15\)](#), WRG366, [Figure 3 \(page 15\)](#).
 - Transmitter A to sensor A
 - Transmitter B to sensor B
 - Transmitter A to solenoid valve A
 - Transmitter B to solenoid valve B
 - Relay information from the divert control unit to your control system or the divert valve
 - Transmitter A mA output to your control system
 - Transmitter B mA output to your control system
 - Ethernet to your control system (optional)

5.2 Divert control unit DD-23 startup

For the refractometer startup, see *Process Refractometer PR-23 User Guide*.

- ▶ 1. Check the wiring and supply voltage. Before the power is switched on, set the divert output relay 'normal operation' to divert position.
2. Connect the mains power to start the system. There are no power switches in the instruments. They are always on when the mains power is connected.
3. While the control unit is powering up, the **DIVERT** and **SOLIDS ALARM** lights are both blinking. When the unit is fully functional, it is in the divert mode: the **DIVERT** light is on and the **SOLIDS ALARM** light is blinking.

4. Press the **LIGHT TEST** button on the divert control unit. All 12 lights switch on.
5. Reset the solids alarm by pressing the **ALARM RESET** button. The indicator stops blinking and stays on.
6. Each indicating transmitter shows now refractometer letter, either **a** or **b**, in the upper left corner of the transmitter display. If there's a question mark instead of a letter on either of the transmitters, see [Regular maintenance and troubleshooting \(page 39\)](#). If the process pipe is full, the message for each refractometer is **Normal operation**; if process pipe is empty, message is **NO SAMPLE**.
Now activate refractometer A into the divert by pushing the button **A IN OPERATION** on divert control unit panel. The button lights up and on the transmitter display the refractometer letter changes to capital A. Then activate refractometer B similarly by pushing the button **B IN OPERATION**.
If the green **IN OPERATION** light blinks, the refractometer in question is performing wash. The refractometer automatically comes into operation after it has finished washing.
The divert control system DD-23 is set for normal monitoring operation.
7. When black liquor is in the line, check that the prism wash is working for each refractometer. First press soft key **MENU** on the transmitter keyboard, then choose **3 SYSTEM STATUS** to get to the system status display. Now press soft key **WASH** to initiate manual wash; follow the optical image and check that it changes during the steam wash. If wash is successful, wait until message is **Normal operation** and then proceed with startup. If wash doesn't work, see [Regular maintenance and troubleshooting \(page 39\)](#).
8. If the three green lights on the third row are all on and all conditions for safe boiler operation are satisfied, turn off diversion by pressing the **DIVERT RESET** button. All warning lights are now turned off and only the 3 green lights are on.

6. Configuration

The divert control system is shipped fully calibrated by the manufacturer. This chapter contains instructions on how to make fine adjustments of the system.

6.1 Calibration lock

Parameter changes are possible only when the calibration lock is open. The calibration lock can be closed by a switch inside the control unit cover, see the following figure. When the lock is open, a red led is illuminated next to the lock switch. For safety reasons, keep the calibration lock open only during parameter changes, done through the web interface, see [Remote control interface \(page 55\)](#).

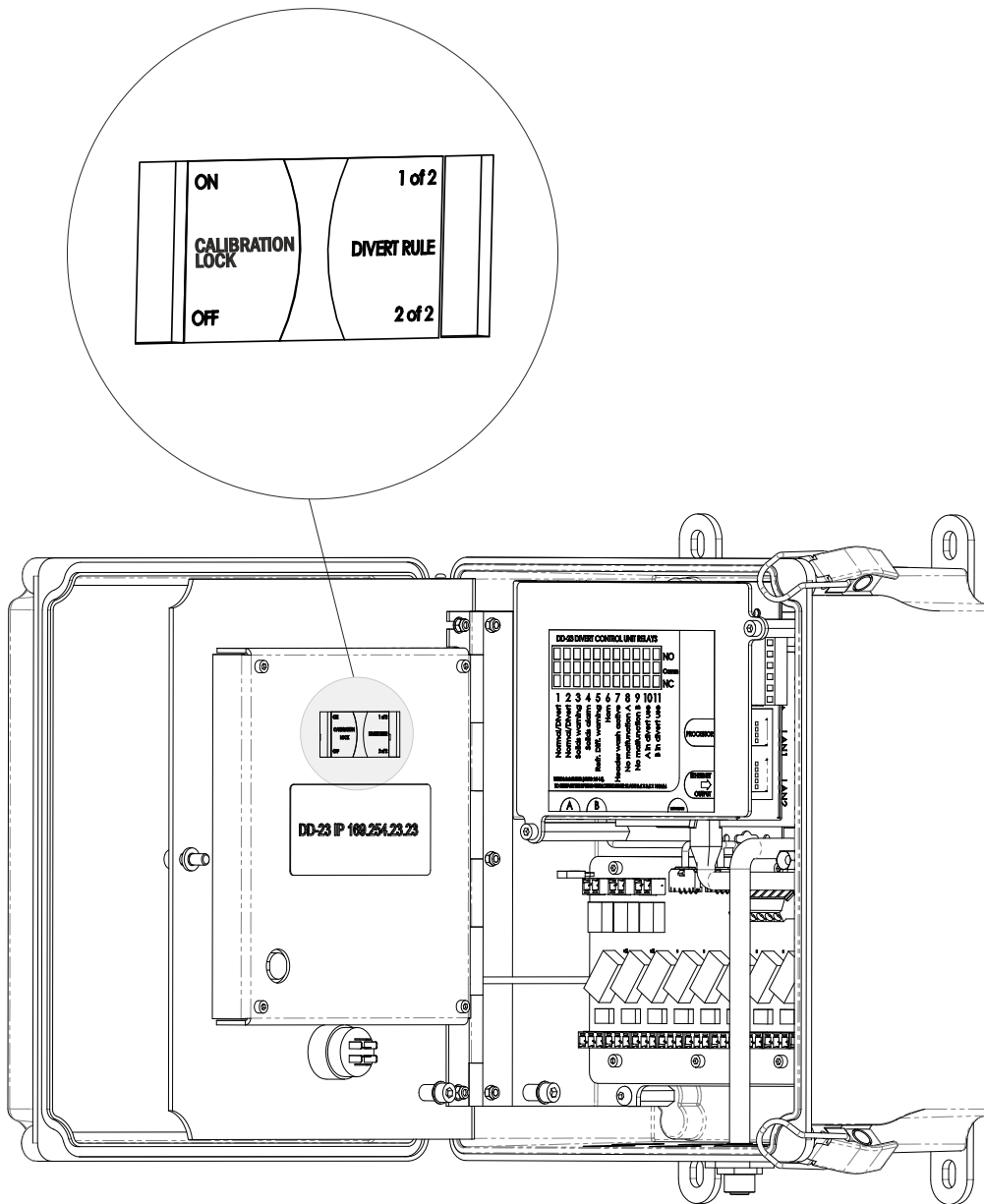


Figure 12 Location of calibration lock

6.2 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, rule #2 may be preferred at the cost of safety. The rule 2 has later been accepted by BLRBAC.

The divert decision rule is selected by the rule switch inside the divert control unit cover, see [Figure 12 \(page 34\)](#). The state of the switch is indicated by a yellow indicator LED for rule #2 and a green one for rule #1.

Table 7 Divert decision rule selection

Rule switch	Rule
1-of-2	Rule #1
2-of-2	Rule #2

The following tables provide logical descriptions of the safety decision logics.

Table 8 Two instruments in operation, rule 1-of-2

		A	
		Under 58 %	Over 58 %
B	Under 58 %	Divert	Divert
	Over 58 %	Divert	Safe

Table 9 Two instruments in operation, rule 2-of-2

		A	
		Under 58 %	Over 58 %
B	Under 58 %	Divert	Unsafe
	Over 58 %	Unsafe	Safe

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 rule selection has no influence on the divert decision in this case.

Table 10 Operation logic when only one instrument operating

A or B	
Under 58 %	Unsafe

Over 58 %	Safe
-----------	------

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.

Emergency divert

In all cases the system can be set to **DIVERT** by pressing the **EMERGENCY DIVERT** button or an external emergency divert button, see [External emergency divert button \(page 14\)](#).

6.3 Refractometer concentration measurement

For refractometer calibration, see *Process Refractometer PR-23 User Guide*.

The CONC% displays of two indicating transmitters have to show the same value within 0.5 %. If there is a difference, this can be eliminated by adjusting the bias for one of the refractometers; comparison with sample determination can decide which one should be corrected.

In the PR-23 refractometer system, bias is the parameter F00, the third parameter in the field adjustment parameter list. To change it, first press the **MENU** soft key, then **5 CALIBRATION**, then **1 CHEMICAL & FIELD PARAMETERS** and then **2 FIELD CALIBRATION PARAMETERS**. Choose **3 F00 (BIAS)** to change the bias (see *Process Refractometer PR-23 User Guide*).

If indicating transmitter A displays 68.2 % and B displays 68.8 %, the difference can be eliminated by lowering B by 0.6 %. This is done by setting the field calibration parameter F00 to -0.6 in indicating transmitter B.

Due to its digital measurement principle, the readings of Vaisala K-PATENTS® Process Refractometer do not drift by time. Avoid frequent recalibrations based on offline moisture analysis, as they introduce random fluctuations to the refractometer readings.

6.4 Refractometer activation for divert control

When a refractometer is activated for divert control, the upper left corner of the transmitter display shows alternatively **A**, **a**, **B**, **b** or **?**. If the corner is blank, the instrument is not suitable for divert operation.

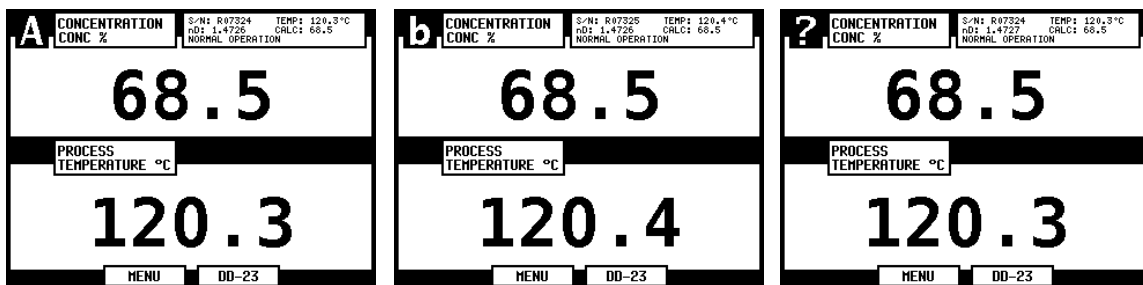


Figure 13 Indicating transmitters (STR) activated to divert control

The decision to display A (a) or alternatively B (b) depends on the IP address settings in the transmitter. The IP address of instrument A is 172.16.23.2 and that of instrument B is 172.16.23.3. These addresses have been set in the factory and should not be changed. (See Chapter 8 for information on system IP address and connecting to the DD-23 system.)

If a question mark appears on the transmitter display, the reason is usually that the Ethernet cable between the transmitter and the control unit is not properly connected or divert control unit is not powered on. Reconnect (or replace cable, if necessary) to fix.

The refractometer program version has to be 3.00 or higher to have divert system functionality. Divert version 2.01 or higher requires STR software version 4.12 or higher. Also, the refractometer has to have the correct software parameters to be used in a divert control system. In order to convert a stand-alone refractometer into one used on the divert control system, contact Vaisala. The easiest way to check if a refractometer is configured for DD-23 use is to look at the main display. If the ?/a/A/b/B letter is present (see the figure above), the instrument can be used in the divert control system.

If a DD-23 activated transmitter is used in another type of application, the divert function has to be deactivated by Vaisala.

6.5 Signal difference alarm

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

The alarm limit of 2 % is the maximum difference. The limit can be changed into a smaller number through the remote interface, see [Remote control interface \(page 55\)](#).

6.6 Low alarms

Solids warning

If the concentration reading of either refractometer falls below this limit (60 % by default), the warning is activated. The limit can be changed through the remote interface, see [Parameters page \(page 57\)](#).

Minimum low warning level is 60 % according to BLRBAC.

Solids alarm

If the concentration reading of either refractometer falls below this limit (58 % by default), the alarm is activated. The limit can be changed through the remote interface, see [Remote control interface \(page 55\)](#).

Minimum low alarm level is 58 % according to BLRBAC.

6.7 Refractometer malfunction alarm

The built-in intelligent diagnostics of Vaisala K-PATENTS® process refractometer provide a tight control of the operation. A full test cycle is completed with an interval of less than one second. For more information, see *Process Refractometer PR-23 User Guide*.

Not all malfunctions cause the instrument to be removed from the divert control system. However, all malfunction alarms need to be checked, see [Malfunctions \(page 39\)](#) for more information.

6.8 Prism wash

Even though the sensors are equipped with a steam wash facility, it is not necessarily needed. For Vaisala K-PATENTS® Process Refractometer, the need of prism wash is reduced and even in some cases eliminated due to self-cleaning design.

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. Only one instrument is washing at a time, and during the wash the system acts in the single-instrument mode.

To change wash times or relay configurations, see *Process Refractometer PR 23 User Guide*.

The following table gives the recommended wash pressures and times.

Table 11 Wash parameters for Safe-Drive isolation valve nozzle SDI

	Minimum above process pressure	Maximum above process pressure	Wash time	Recovery	Interval
Steam (SN)	5 bar (70 psi)	8 bar (115 psi)	3 ... 5 s	20 ... 30 s	20 ... 30 min

Do not exceed the recommended wash times, because some process media may burn to the prism surface if steamed for longer time. In case of coating, shorten the wash interval.



CAUTION! If wash check is enabled on the instrument it can cause the instrument to be taken out of divert use if during the set wash tolerance time no wash cycles have been noted as successful. This can cause a divert if both instruments fail wash checks in sequence.

7. Regular maintenance and troubleshooting

As divert control system is a digital system, no special maintenance is needed. The **LIGHT TEST** button on the operator panel, see [Figure 2 \(page 12\)](#), sends a signal to the microprocessor, and the microprocessor switches all 12 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, see the information flow in [Information flow \(page 39\)](#) and the logic diagrams in [Divert control logics \(page 44\)](#).

7.1 Information flow

Divert control unit is connected to the refractometers through an Ethernet connection. The control system asks for the measurement data from the instruments several times each second. Based on the data received it makes the divert operation decisions.

Each refractometer performs its measurement functions independently. The instruments also have their own internal diagnostics, which are used in the divert decision logic, as well, see [Malfunctions \(page 39\)](#).

As the divert control system requests information several times a second, all communication problems are found immediately. In case one of the refractometers does not respond to control unit, the non-responding instrument is dropped from operation and the malfunction alarm is set.

An important information when troubleshooting communication problems is the letter on the upper left corner of each refractometer, see [Figure 13 \(page 37\)](#). If the instrument has not received any data requests from the divert control unit during the last second, the letter turns into a question mark (?). If the letter is a/A/b/B, then the communication link between the divert control unit and the instrument is fully functional.

7.2 Malfunctions

If the divert control unit cannot communicate with a refractometer, or if the internal diagnostics of a refractometer indicate a measurement problem, the malfunction indicator, see [Figure 2 \(page 12\)](#), is illuminated and the corresponding relay 8 or 9, see [Figure 5 \(page 19\)](#), is activated. The diagnostic message of the refractometer can be seen on the transmitter screen, see [Figure 12 \(page 34\)](#). Some of these messages, e.g. **PRISM WASH**, are only informative and do not indicate a measurement problem. The following table summarizes all diagnostic messages and their effect on the divert control system operation.

If the malfunction is severe enough to make the measurement result unreliable, the refractometer cannot be used in making the divert decision. In that case the instrument is dropped from the Divert Control System, and cannot be taken on-line manually until the problem is fixed.

For more information on possible causes of each error, see *Process Refractometer PR-23 User Guide*.

Table 12 Diagnostic messages and their effect on divert operation

Message	Instrument dropped from the divert control system
EXTERNAL HOLD	
EXTERNAL WASH STOP	
HIGH SENSOR HUMIDITY	
HIGH SENSOR TEMP	
HIGH TRANSMITTER TEMP	
LOW IMAGE QUALITY	X
LOW TEMP WASH STOP	
LOW TRANSMITTER VOLT	
NO OPTICAL IMAGE	X
NO SAMPLE	X
NO SAMPLE/WASH STOP	
NO SENSOR	X
NO SIGNAL	X
NORMAL OPERATION	
OUTSIDE LIGHT ERROR	X
OUTSIDE LIGHT TO PRISM	X
PRECONDITIONING	
PRISM COATED	X
PRISM WASH	
PRISM WASH FAILURE	X
PRISM WASH WARNING	
RECOVERING	
SHORT-CIRCUIT	X
STARTING UP...	X
TEMP MEASUREMENT FAULT	

7.3 Diagnostic tools

In order to make troubleshooting easier, there are several built-in diagnostic tools.

An event log is built in the system. A short log showing last 6 events can be accessed from the transmitter main display by pressing the soft key **DD23**. A more complete event log can be found in the web-based remote interface, see [Log page \(page 56\)](#).

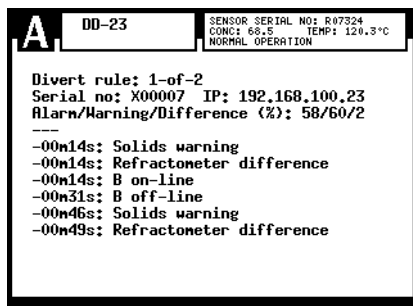


Figure 14 Transmitter log page for instrument A

The remote interface also provides a diagnostic page which gives full information on the system state (concentrations, relay state, switch state, indicator state), see [Diagnostics page \(page 56\)](#).

7.4 Troubleshooting

A question mark (?) on the refractometer display

Cause: The refractometer does not receive information request packets from divert control unit. This may be caused by a faulty cable, faulty parameters, or equipment malfunction either in the refractometer or in divert control unit.

Action: If the instrument has never been functional, or if it is possible someone has changed the instrument parameters, there may be a configuration problem with the IP addresses. The IP address in the refractometer should be set as given in [Refractometer activation for divert control \(page 36\)](#). If possible, cross-check the addresses from the diagnostic web page.

A physical problem can be ruled out by looking at a small LED close to the transmitter's Ethernet connector. If the LED is green, the cable is ok. One way to isolate the problem is to swap the cables between the refractometers. A standard Ethernet cable can be used as a troubleshooting aid (either straight-through or cross-over).

A refractometer refuses to come online

Cause: Either there is no communication to the refractometer or there is a malfunction in the refractometer. It is also possible the transmitter is not configured for divert use.

Action: Check that there is a/A/b/B on the refractometer display. If there is a question mark (?) instead, see above.

Check that there is a soft key DD23 on the refractometer main display (see the following figure). If the soft key is not present in the main display, the instrument is not configured for divert use. If this is the case, please contact Vaisala.

In other cases, check the diagnostic message on the refractometer screen, see [Malfunctions \(page 39\)](#).

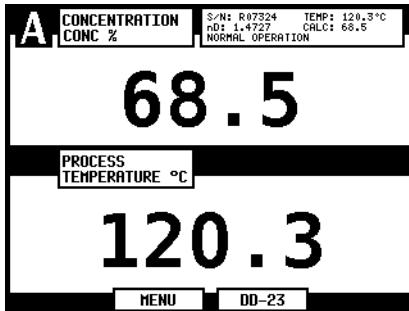


Figure 15 Transmitter main display, instrument in divert use

No lights come up in the divert control unit

Cause: There is no power on the instrument or there is a hardware fault.

Action: Check that the instrument receives power. In normal operation several relays have their associated LEDs lit. If there are any LEDs lit in the Divert Control Unit, the unit receives power.

All lights are blinking

Cause: There is an unrecoverable hardware fault in the divert control unit.

Action: Contact Vaisala.

7.5 Ethernet strain relief for transmitters

When the transmitter door is opened, the Ethernet cable connecting the transmitter to the divert unit may come off. This can be fixed by mounting a strain relief plate in the transmitter.

- ▶ 1. Screw on the strain relief plate.
- 2. Fasten the ethernet cable to the relief plate with cable ties.

3. Cut the ends of the cable ties.

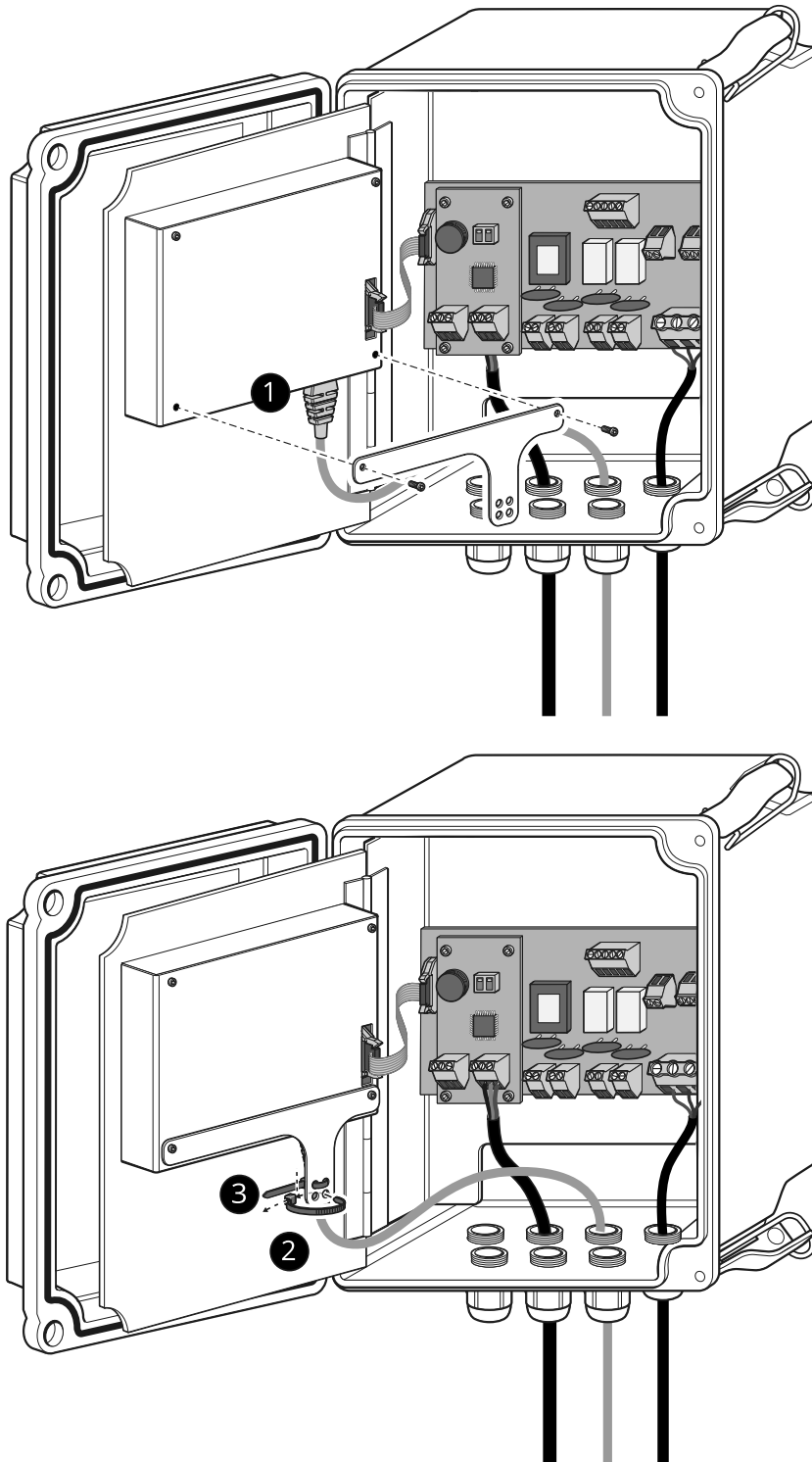


Figure 16 Mounting strain relief

8.2 Divert decision logic

After the system has evaluated the solid contents to be either safe or unsafe, see [Safety decision logic \(page 44\)](#), it decides whether the system should be in the **DIVERT** state. This decision is made according to the flow diagram in the following figure.

The default state of the system is the **DIVERT** state. It can be changed to the **NO DIVERT** state only by manually pressing the **DIVERT RESET** push-button when the solid content is sufficient (**SAFE SOLIDS**). If the solid content drops to **UNSAFE**, the system drops into the **DIVERT** state.

The only exception to this is when the **HEADER WASH** is active. In that case the solid content checking is skipped. The system may then be switched between the **DIVERT** and **NO DIVERT** states by using the **EMERGENCY DIVERT** and **DIVERT RESET** push buttons in the operator panel (or the equivalent external emergency divert and divert reset buttons).

The system will drop to the **DIVERT** state in all cases when the **EMERGENCY DIVERT** button (or its external counterpart) is pressed.

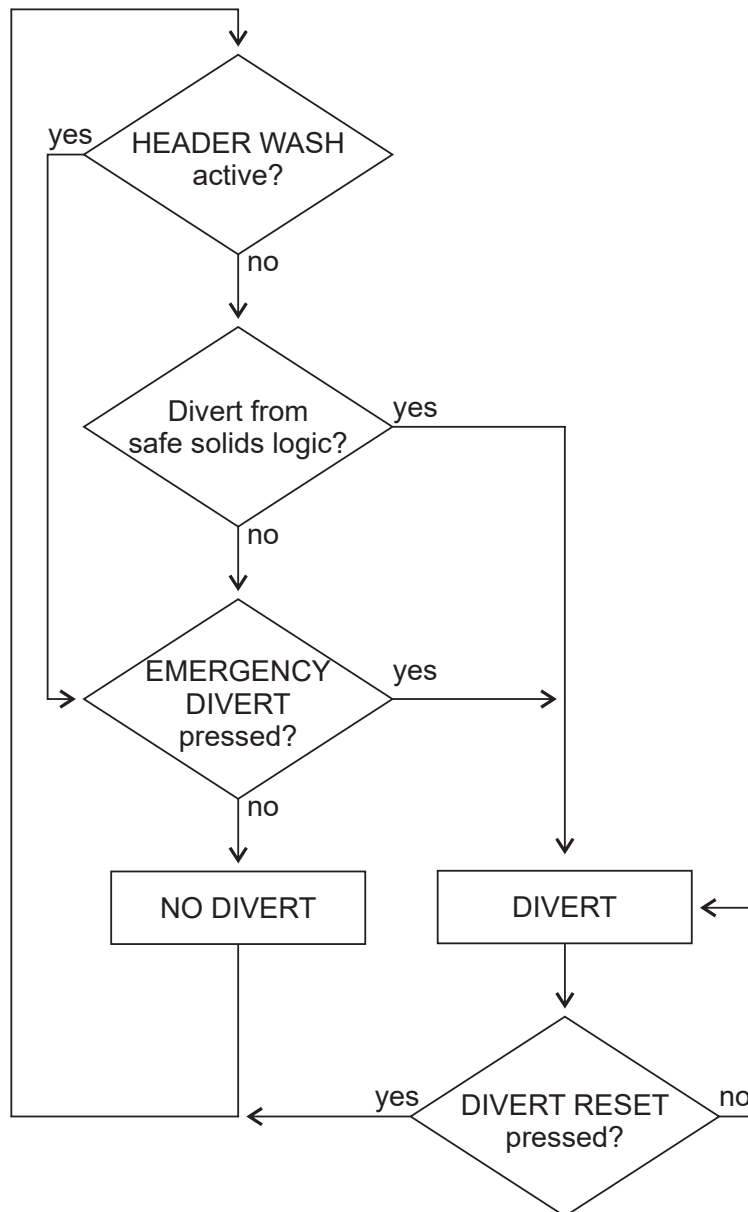


Figure 18 Divert decision logics

8.3 In operation logic

Whether an instrument is in operation depends on the operator's commands and the instrument's diagnostics. The decision is carried out as outlined in the following figure.

An instrument can be in one of three different states: **IN OPERATION**, **NOT IN OPERATION**, and **WAIT**. When the instrument is **IN OPERATION**, it is used in deciding whether the solid content is in the safe level, see [Safety decision logic \(page 44\)](#). When the instrument is **NOT IN OPERATION** or **WAIT** states, it is not used.

The **WAIT** state occurs when the operator has requested the instrument to come into operation by pressing the button, but the instrument is in the wash cycle and comes into operation after the wash cycle is completed.

The actual state can be seen from the **IN OPERATION** light. If the light is on, the instrument is **IN OPERATION**. If the light is off, the instrument is **NOT IN OPERATION**, and if the light is blinking it is in the **WAIT** state.

The default state of an instrument is to be **NOT IN OPERATION**. It can be taken into operation by pressing the **IN OPERATION** button unless there is a critical malfunction see [Malfunctions \(page 39\)](#).

An instrument automatically drops into **NOT IN OPERATION** if there is a critical malfunction. It may also be dropped by the **IN OPERATION** button unless it is the only instrument used.

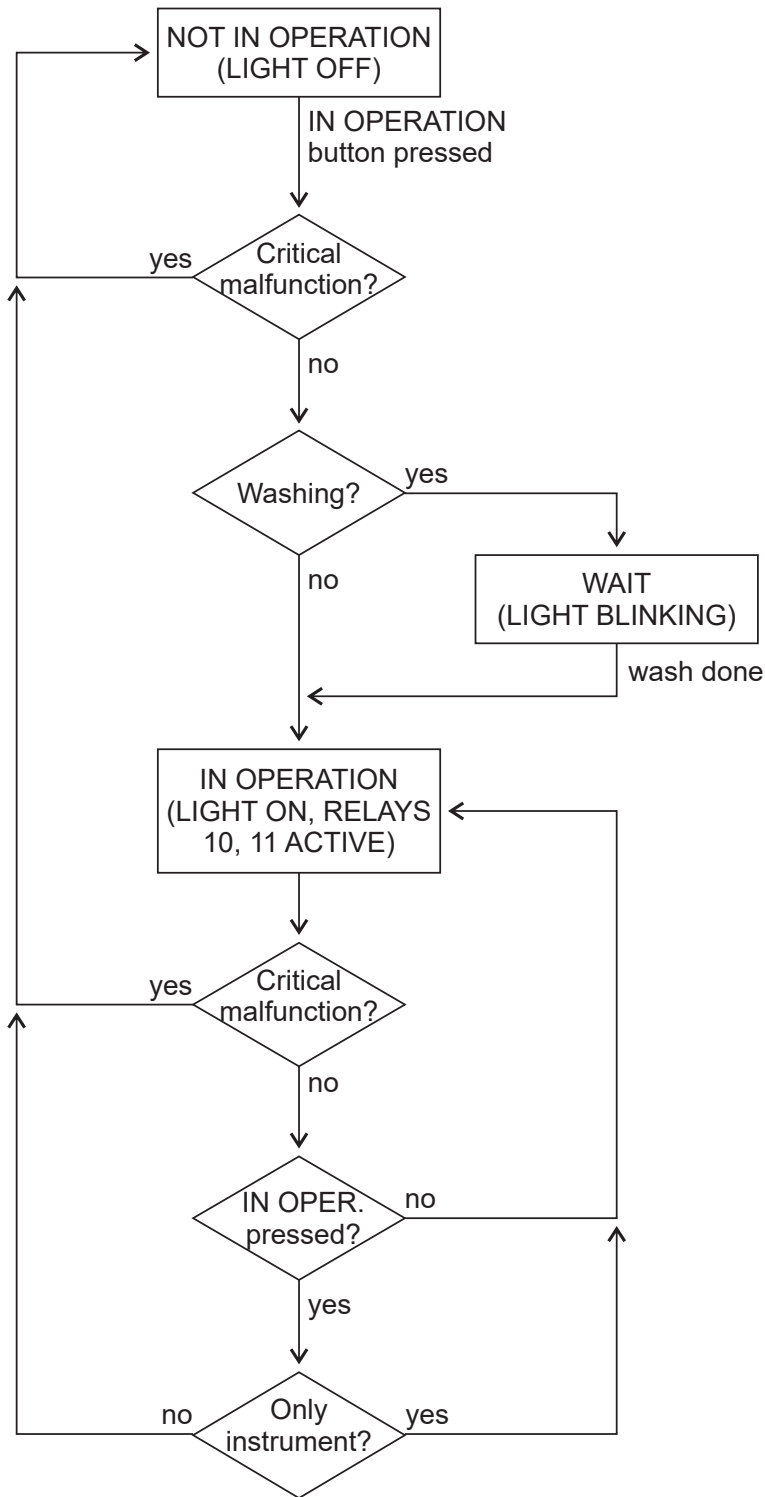


Figure 19 Operation logic

8.4 Malfunction logic

The **MALFUNCTION** light is illuminated when the internal diagnostics of either of the two instruments indicates a malfunction or there is a communication timeout to either of the instruments, see the following figure.



Not all malfunctions are critical malfunctions which drop the instrument from operation, see [In operation logic \(page 46\)](#). For a complete list of possible malfunctions, see [Malfunctions \(page 39\)](#).

The **MALFUNCTION** light reflects the decision taken by this logic. However, as the **MALFUNCTION** light is one of the resettable alarms, it may be blinking even when the malfunction itself is cleared if the **ALARM RESET** button has not been pressed, see [Resettable alarm logic \(page 50\)](#).

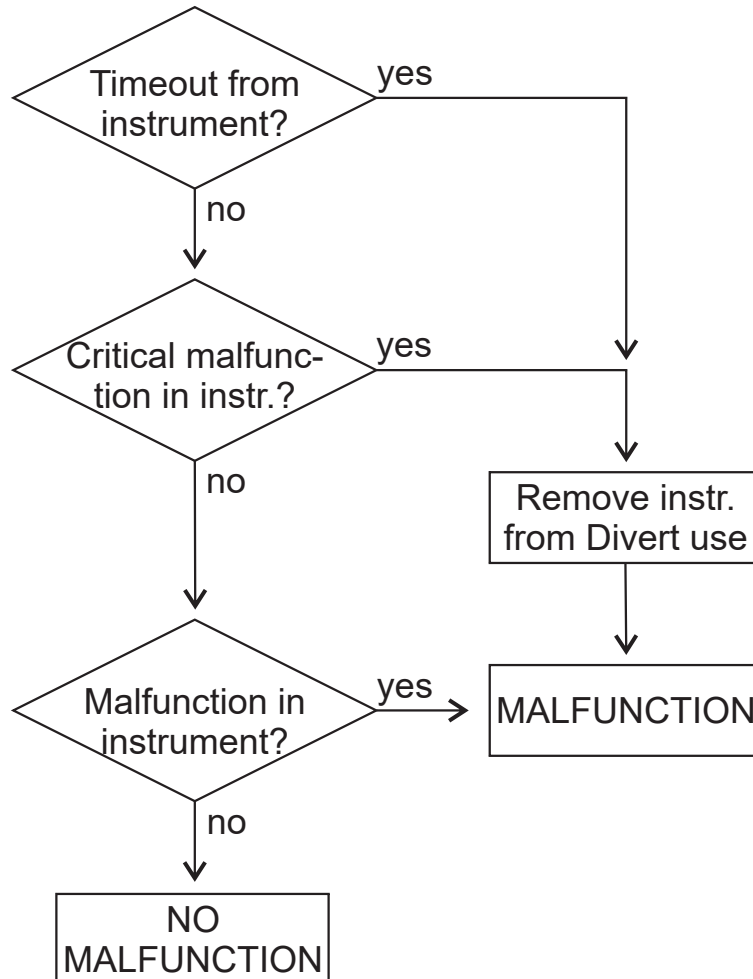


Figure 20 Malfunction logic repeated for each sensor

8.5 Resettable alarm logic

In order to identify new alarms, there is a resettable alarm logic in the divert control unit. There are four possible alarm sources: **SOLIDS ALARM**, **SOLIDS WARNING**, **A&B DIFFERENCE**, and **MALFUNCTION**. All of these follow the same alarm reset rules, see the following figure.

When a new (unacknowledged) alarm activates, the corresponding light starts blinking in the operator panel, and relay 6 is activated. When the **ALARM RESET** button is pressed, relay 6 is inactivated.

The state of the alarm indicator in the operator panel depends on whether the cause for the alarm is still present. If the cause has cleared (for example, solids content has risen above the warning limit), the light goes off when the **ALARM RESET** is pressed. If the cause has not cleared, the light will be steadily illuminated.

A non-illuminated light means there is no alarm. A steadily illuminated alarm light means there is a problem which persists but the problem has been acknowledged by pressing the **ALARM RESET**. A blinking light means the problem has not been acknowledged, but gives no information whether the problem is still there or not.

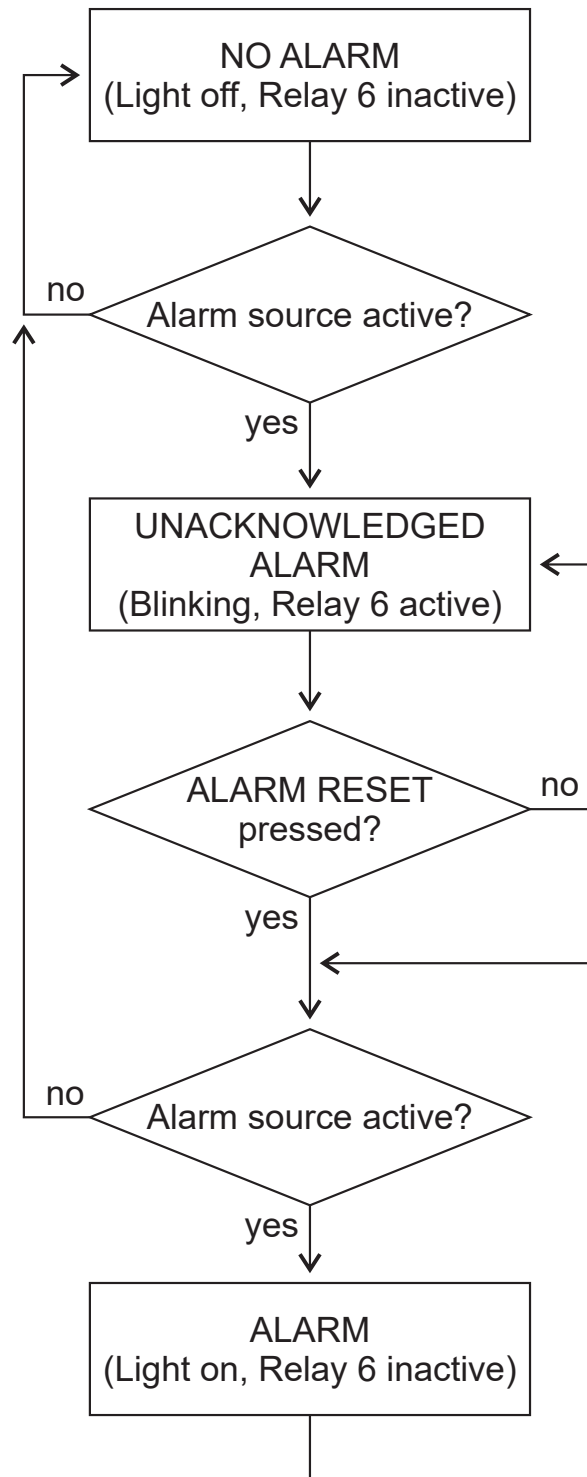


Figure 21 Resettable alarm logic

8.6 Refractometer difference logic

If there are two refractometers in operation (taken into operation, not washing), the control unit monitors the difference in reading between the two instruments, see the following figure. If the difference is more than 2 %, a refractometer difference warning is given with the corresponding front panel indicator and relay.

The divert decision logic, see [Divert decision logic \(page 45\)](#) is not affected by the refractometer difference, but a significant difference between the two instruments indicates one of the instruments is not measuring reliably. In this case the instruments and wash systems have to be checked immediately. Ignoring to do this may result in an erroneous divert decision.

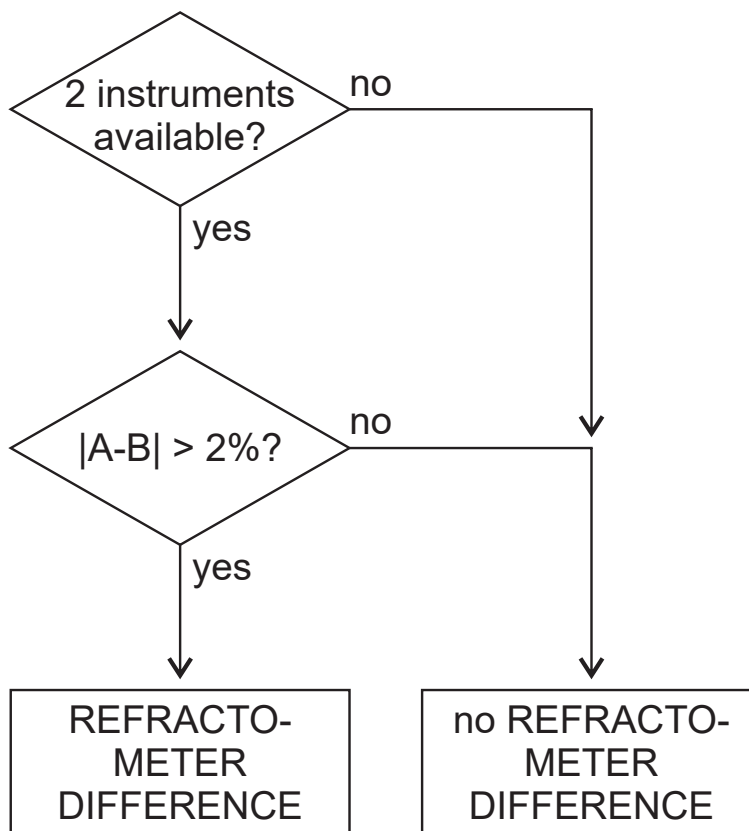


Figure 22 Refractometer difference logic

8.7 Wash arbitration logic

The divert control unit takes care that if there are two instruments in operation, they won't wash at the same time (as that would trip the system). This is done by the simple logic described in the following figure.

Each instrument controls its own wash cycle. Before it starts washing, it requests a wash permission from the Divert Control Unit. If the other instrument is already washing, the unit does not grant this permission until the wash cycle is completed.

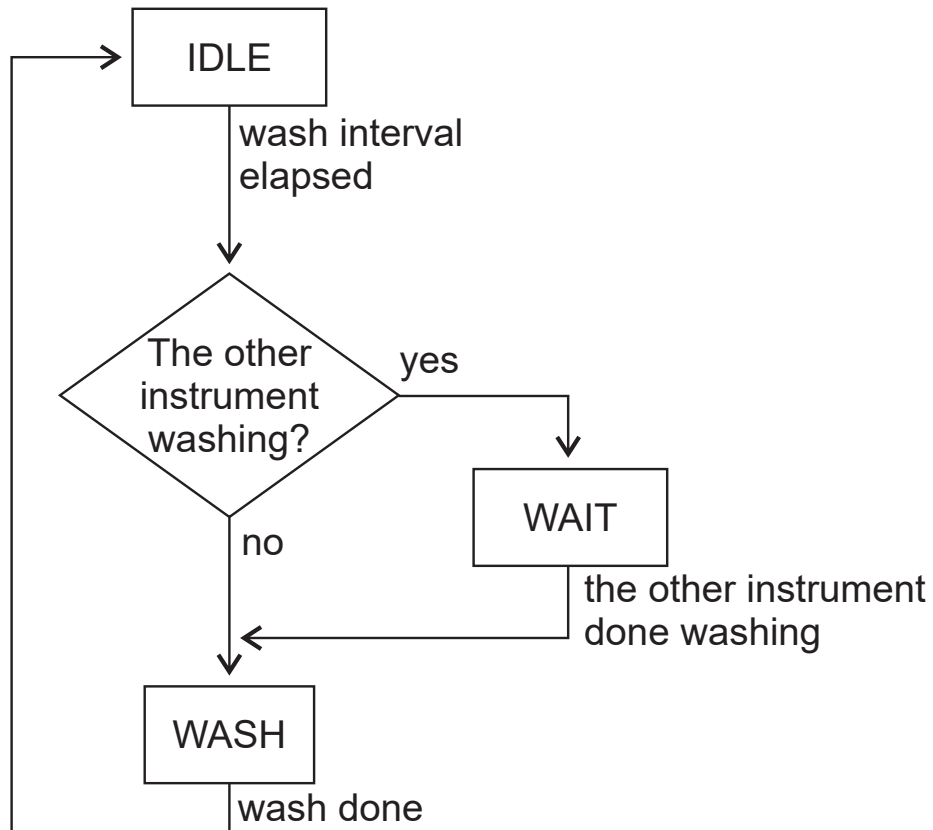


Figure 23 Wash arbitration logic

8.8 Wash check logic

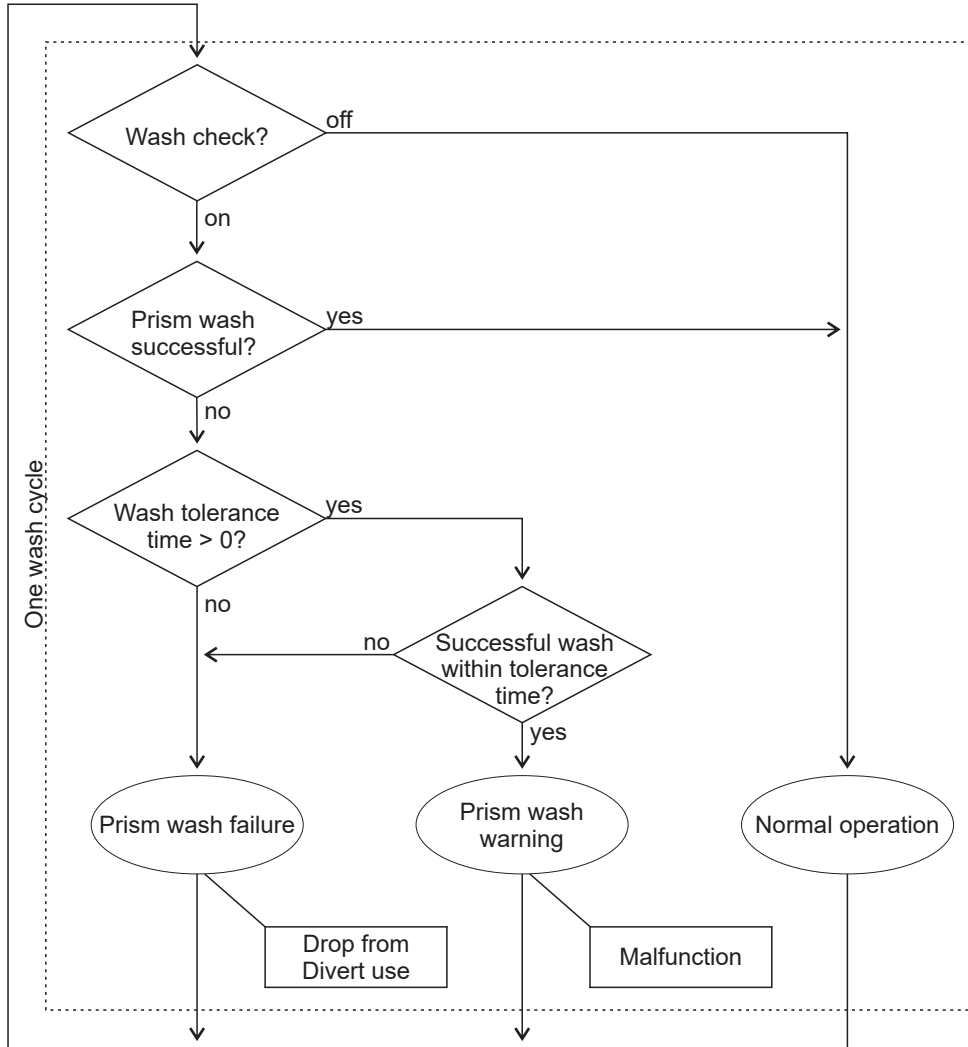


Figure 24 Wash check logic

By default the wash tolerance time is 0.

9. Remote control interface

The remote interface is based on a web server inside the divert control unit. It consists of several web pages, easily accessible through the links on the navigation bar in the left, see [Figure 25 \(page 55\)](#). The remote interface is optimized for the Firefox browser, version 2.0 or newer, although it may work with other browsers. Firefox is free and exists for Windows, Mac OS X and Linux, it can be downloaded through <http://www.mozilla.com/>.

9.1 Divert control unit IP address

The divert control unit can be reached through two different IP addresses. In nonnetworked applications (only a DD-23 and a single computer) the IP address is 169.254.23.23. This IP address is factory set and cannot be changed. If the divert control unit is to be connected to a network, the network settings can be changed through the parameter page of the remote interface, see [Parameters page \(page 57\)](#).

9.2 Remote interface

9.2.1 Main page

The remote indicator **Main** page gives a quick overview over system status.

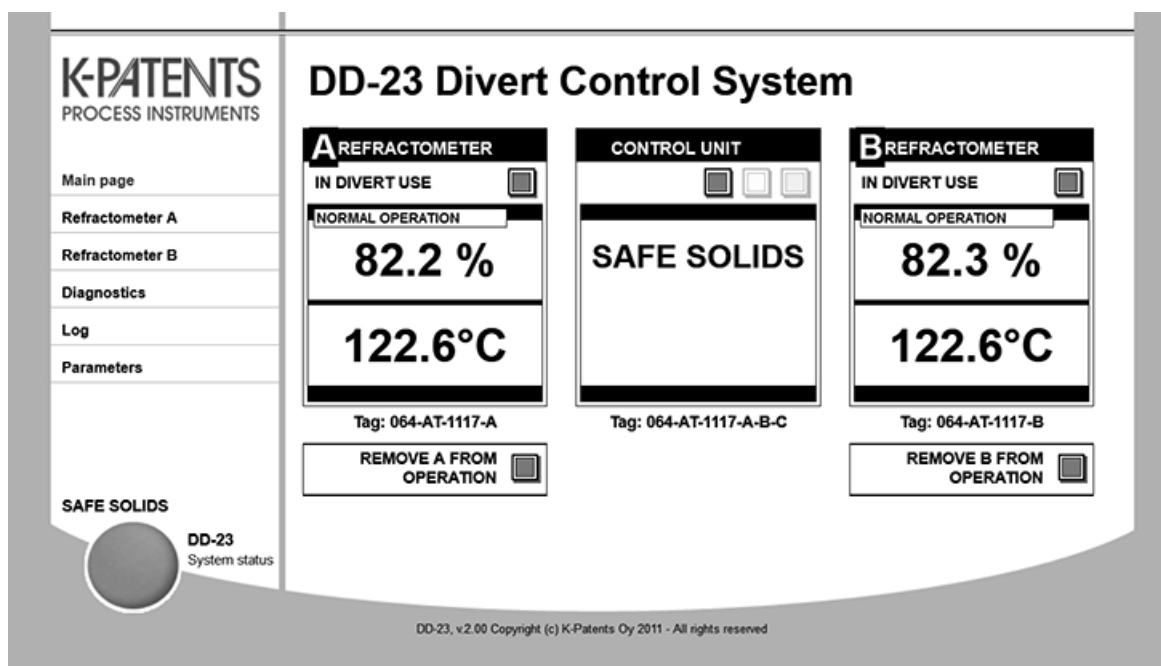


Figure 25 DD-23 remote control Main page

9.2.2 Instrument pages

The pages for instrument A and instrument B are normal transmitter homepages. See the *Process Refractometer PR-23 User Guide* for more information.

By default, the instrument pages open in a new tab in your browser; the DD-23 page you started from stays open in the original tab.

9.2.3 Diagnostics page

The diagnostics page gives a full account on instrument settings and the instrument's status at the moment, including information about, for example, relays, switches and pushbuttons.

K-PATENTS PROCESS INSTRUMENTS	
Main page	
Refractometer A	
Refractometer B	
Diagnostics	
Log	
Parameters	
SAFE SOLIDS	
	DD-23 System status
Diagnostics	
General	
Timestamp	946767180, 861971
DD version	2.02
DD serial	X00049
Relay card version	0.99
Relay card serial	Y00000
UI version	0.99
UI serial	Z00051
Tag	064-AT-1117-A-B-C
Refractometer A	
In divert use	yes
Status	NORMAL OPERATION
Concentration	82.19 %
Temperature	122.62 °C
Tag	064-AT-1117-A
Refractometer B	
In divert use	yes
Status	NORMAL OPERATION
Concentration	82.32 %
Temperature	122.64 °C
Tag	064-AT-1117-B
Operational parameters	
Alarm limit	58.00
Warning limit	60.00
Refr. difference	2.00
Hysteresis	0.05
Rule	2-of-2
Calibration seal	not set

Figure 26 Remote diagnostics page

9.2.4 Log page

The log page gives a more extensive, printable log of events.

K-PATENTS
PROCESS INSTRUMENTS

Log

The DD-23 system log is shown below. The log view is automatically updated every 10 seconds.

Last log update: 23-Sep-2014 13:04:38

```

19-Sep-2014 08:03:37: Divert reset
19-Sep-2014 08:03:35: B: on-line, sensor s/n R10947
19-Sep-2014 08:03:35: Safe solids
19-Sep-2014 08:03:35: A: on-line, sensor s/n R10948
18-Sep-2014 15:02:50: B: Bias: -0.5
18-Sep-2014 15:02:50: Divert
18-Sep-2014 15:02:50: Rule: 2-of-2
18-Sep-2014 15:02:50: SS: 58.0, SW: 60.0, SD: 2.0, HY: 0.05
18-Sep-2014 15:02:50: Calibration lock off
18-Sep-2014 15:02:49: TAG DD/A/B: 064-AT-1117-A-B-C/064-AT-1117-A/064-AT-1117-B
18-Sep-2014 15:02:49: Degrees: C
18-Sep-2014 15:02:49: IP: 172.16.100.23/255.255.0.0, GW: 172.16.0.1
18-Sep-2014 15:02:49: DD-23 v.2.02 starting up (S/N: 49)

```

Main page

Refractometer A

Refractometer B

Diagnostics

Log

Parameters

SAFE SOLIDS

Figure 27 Remote log page

9.2.5 Parameters page

Divert control unit parameters can only be changed through the parameter page. However, note that the calibration lock, see [Calibration lock \(page 33\)](#), has to be open (off) before parameters can be changed. If calibration lock is on, parameter changes are not possible. The calibration lock status is given on top of the parameter page and if the lock is on, changes not permitted, the **Submit** button is missing.

K-PATENTS
PROCESS INSTRUMENTS

Parameters

N.B. The calibration lock is not set, setting the parameters is possible. Please note that errors in changing the parameters may cause the system to enter the divert function.

Instrument tags

Refractometer A tag: 064-AT-1117-A
 Refractometer B tag: 064-AT-1117-B
 Divert control unit tag: 064-AT-1117-A-I

Display parameters

Temperature units: °C

Network settings

DD-23 IP address: 172.16.100.23
 DD-23 subnet mask: 255.255.0.0
 DD-23 gateway address: 172.16.0.1

Operational parameters

Alarm limit: 58.0 %
 Warning limit: 60.0 %
 Difference: 2.0 %
 Hysteresis: 0.05 %

Submit

Main page

Refractometer A

Refractometer B

Diagnostics

Log

Parameters

SAFE SOLIDS

DD-23
System status

Copyright (c) K-Patents Oy 2008 - All rights reserved

Figure 28 Parameters page

10. DD-23 specifications

10.1 Divert control unit specifications

Table 13 Divert control unit specifications

Item	Details
Model	DD-23
Enclosure	IP66 Nema 4X, dimensions 226 × 267 mm (8.91 × 10.5 in)
AC power supply	AC input 100 ... 240 V AC ±10 %, 50/60 Hz, 30 VA, fuse voltage 250 V AC, fuse max. size 10 A, fuse speed slow
DC power supply	DC input 24 V DC ±10 %, fuse voltage min. 48 V DC, fuse max. size 4 A, fuse speed fast
Overvoltage category	Overvoltage category II
Ambient temperature	Max. 45 °C (113 °F)
Altitude	Max. altitude 2000 m (6562 ft)
Relative humidity	0 ... 100 %
Pollution degree	Pollution degree 2
Wet location	Not applicable
Indoor or outdoor use	Indoor use only
Accessory	Roofed stainless steel mounting plate for the divert control unit and 2 indicating transmitters, see the following figure
Material	AISI 316, dimensions 916 × 488 mm × 250 mm (36 × 19.2 × 10 in)
Relays X1-X11	3 A, 240 V NO/NC, fuse voltage 250 V, max. size 10 A and fuse speed slow.

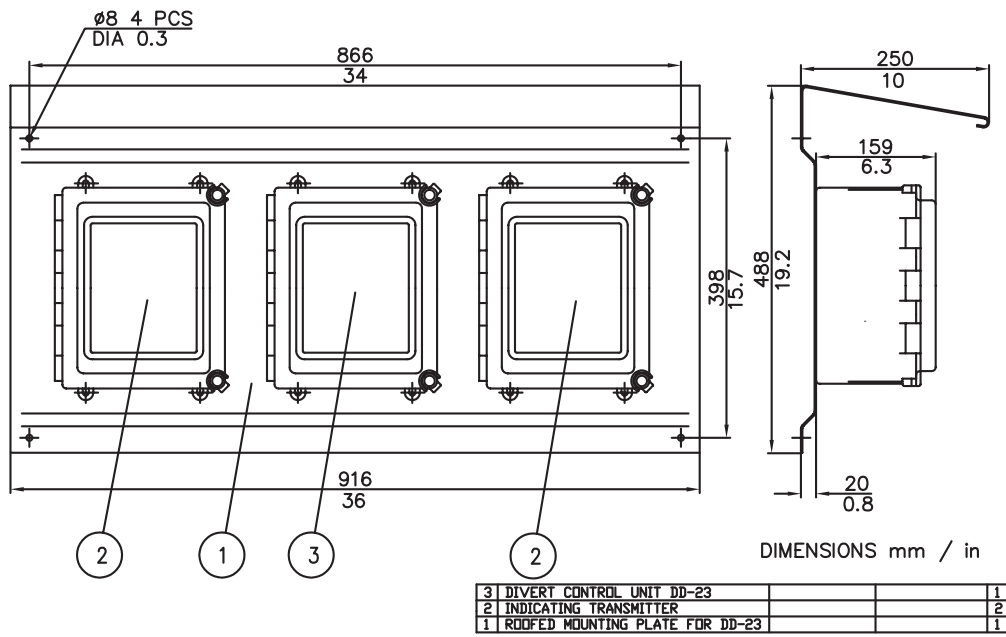


Figure 29 Divert control unit mounting plate

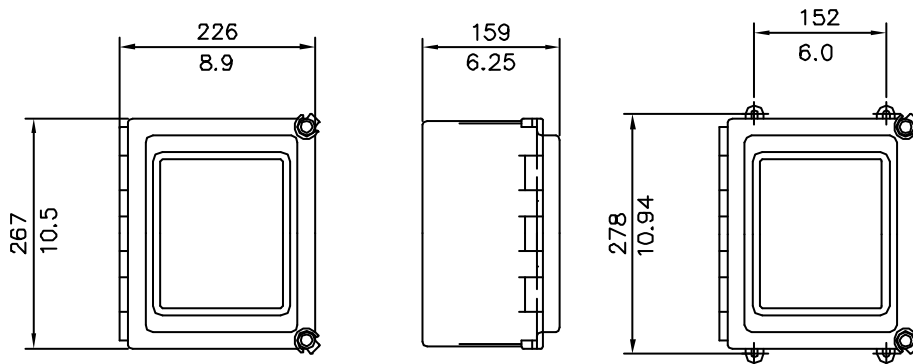


Figure 30 Divert control unit and indicating transmitter enclosures

10.2 Divert control unit spare parts

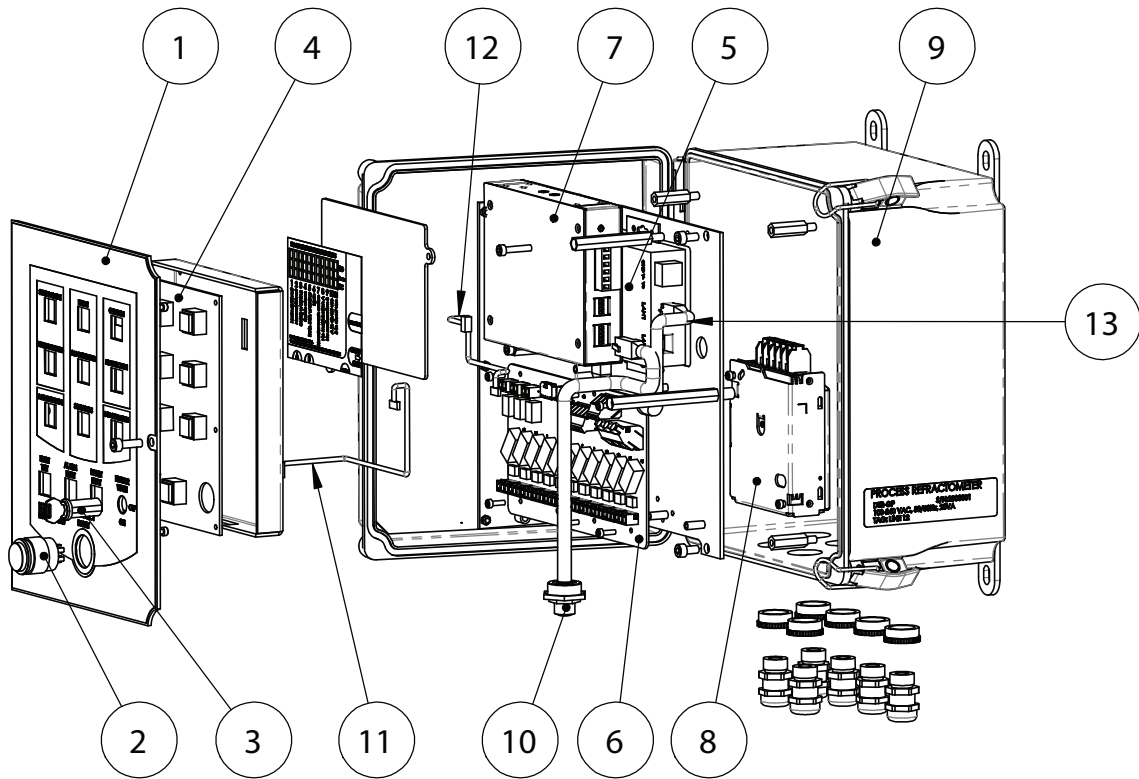


Figure 31 Divert control unit spare parts

Table 14 Divert control unit spare parts

Number	Part name	Spare part number
1	DD-23 front panel	PR-12100
2	Nikkai LB-15WK switch	PR-12101
3	Nikkai SK-12AA key switch	PR-12102
4	User interface card	PR-12020-SP
5	Moxa switch	PR-12103
6	DD-23 motherboard	PR-12010-SP
7	Moxa processor	PR-12104
8	Power supply unit AC / DC	PR-10810-SP / PR-10820-SP
9	Enclosure	PR-7602
10	Ethernet cable	PR-8665
11	DD-23 motherboard-keyboard cable	PR-12105

Number	Part name	Spare part number
12	DD-23 motherboard-Moxa cable	PR-12106
13	DD-23 ethernet cable assembly	PR-12108

Warranty

For standard warranty terms and conditions, see www.vaisala.com/warranty.

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

Technical support



Contact Vaisala technical support at helpdesk@vaisala.com. Provide at least the following supporting information as applicable:

- Product name, model, and serial number
- Software/Firmware version
- Name and location of the installation site
- Name and contact information of a technical person who can provide further information on the problem

For more information, see www.vaisala.com/support.

Recycling



Recycle all applicable material.



Follow the statutory regulations for disposing of the product and packaging.

VAISALA

www.vaisala.com

