

# DRS-COMPACT2A, DRS-LIGHT

## Operation and Maintenance Manual

### Protection



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**This document is applicable to the following product(s):**

DRS-COMPACT2A, DRS-LIGHT

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# 1. General introduction

This manual does not cover all aspects and functions of the DRS system. However it covers all essential procedures and aspects for a safe operation and maintenance of DRS-COMPACT2A and DRS-LIGHT numerical protection relays. For explanations operation software DRS-WIN is used preferably.

## 1.1. Application

The digital protection system DRS is a multifunctional protective relay to supervise and protect synchronous as well as non-synchronous machinery, transformers and the combination of generator/transformer units, motors and power supply feeders. All for a complete protection scheme required components, e.g. input CT/VT circuits, measuring circuits, trip logic and alarm output matrix, auxiliary supply, keypad operation and local display, are available in one device.

## 1.2. Operation

The incoming signals from the protected plant, e.g. CT current, VT voltage and binary inputs, are transferred via the denominated terminal connections to the protective device. The computation of these signals with the exception of hardware interference suppression is fully digital. The advantages of digital evaluation are the utmost immunity of the system against component aging, temperature, etc. as well as the possibility to even carry out complex protective duties with a relative simple computable algorithm. Thus the characteristic values of the incoming CT and/or VT signals can be made available for several different protective functions.

The implemented protective functions in the relay are evaluated sequentially 12 times per cycle. Depending on the operating mode of the protected plant, i.e. normal service operation or fault conditions, the protective device produces the corresponding alarm and/or trip commands. These signals are distributed via a software matrix according to the configured tripping scheme.

Optical LED displays indicate the instantaneous alarm annunciation and/or the trip of a protective function. Via a PC further detailed data about the fault sequence such as the fault and event records can be saved, displayed and processed. Configuration and parameter settings are stored into a non-volatile EEPROM. Each change of the parameter settings can be displayed in a modification protocol and printed for further use.

## 2. Operating instructions

### 2.1. Operation using software DRS-WIN

#### 2.1.1. Connecting to the relay

In order to set up an online connection between a DRS-COMPACT2A relay and a PC plug in the interface cable GID-030<sup>1</sup> or TID-006<sup>2</sup> into the interface situated at the front of the relay and to the PC. For a DRS-LIGHT use the interface GID-014<sup>3</sup>. Start the software DRS-WIN.

DRS-WIN searches for connected devices automatically right after the start. If the search fails or does not start, choose the item *Communication Ports* in menu *Communication*. Every detected serial interface port is displayed. Choose the one which is used for the connection to the DRS and click OK. An automatically started search on the enabled ports for the devices takes place. Such a search can be started manually at any time also by clicking on menu item *Search for connected devices* in menu *Communication*.

The parameter file stored in the protection relay is downloaded to the PC. A window appears showing the implemented functions as shown in the figure below.

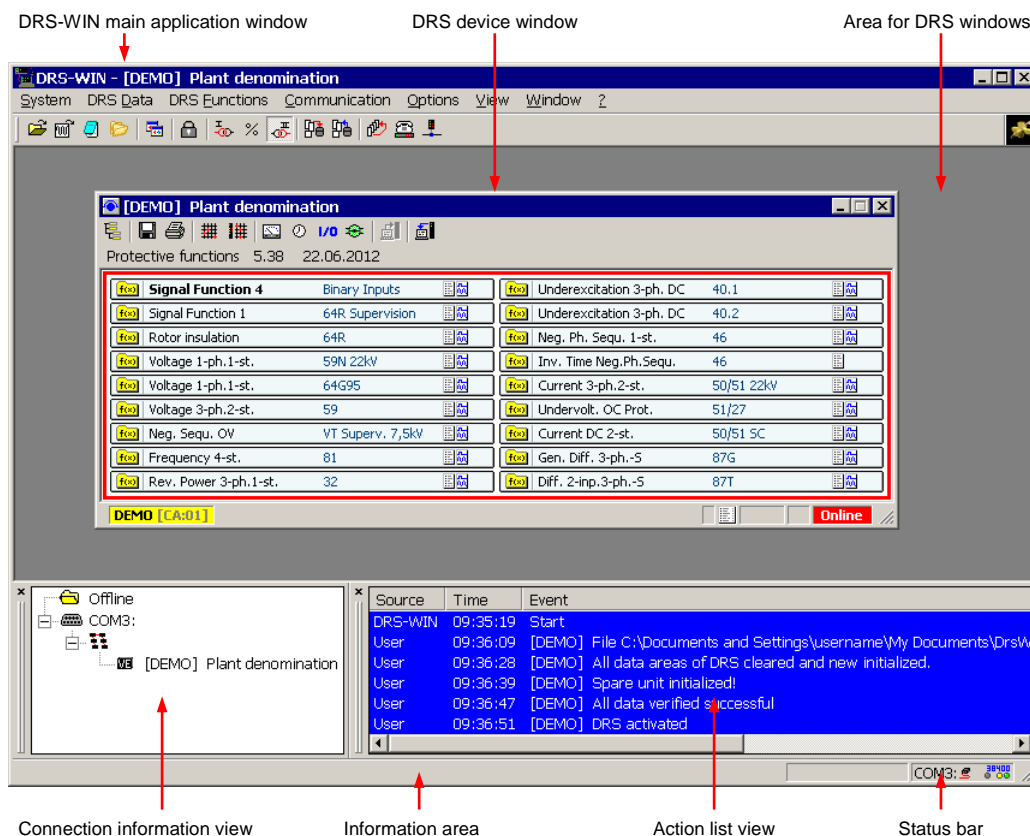


Fig. 1 Main window of DRS-WIN

<sup>1</sup> DRS operation cable RS232 ↔ USB  
<sup>2</sup> DRS operation cable RS232 with opto module  
<sup>3</sup> DRS operation cable RS485 ↔ RS232

## Operating instructions

The main toolbar is in the DRS-WIN main window below the menu bar.

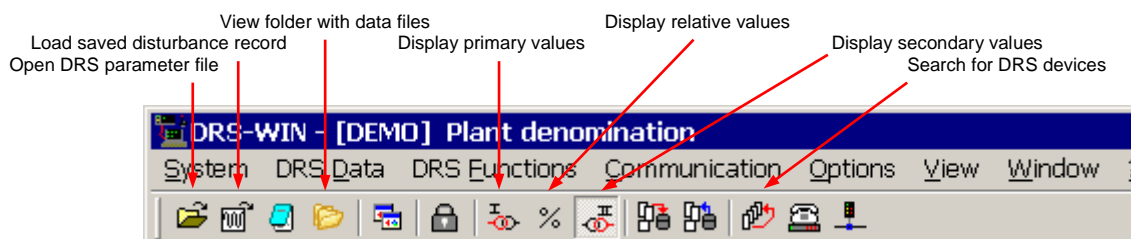


Fig. 2 Main toolbar of DRS-WIN

### 2.1.2. Device window

All the activated protective functions and the indication of the connection status can be seen in the device window. The most important measured values and the settings of the device are accessible via the icons in the toolbar of the device window.

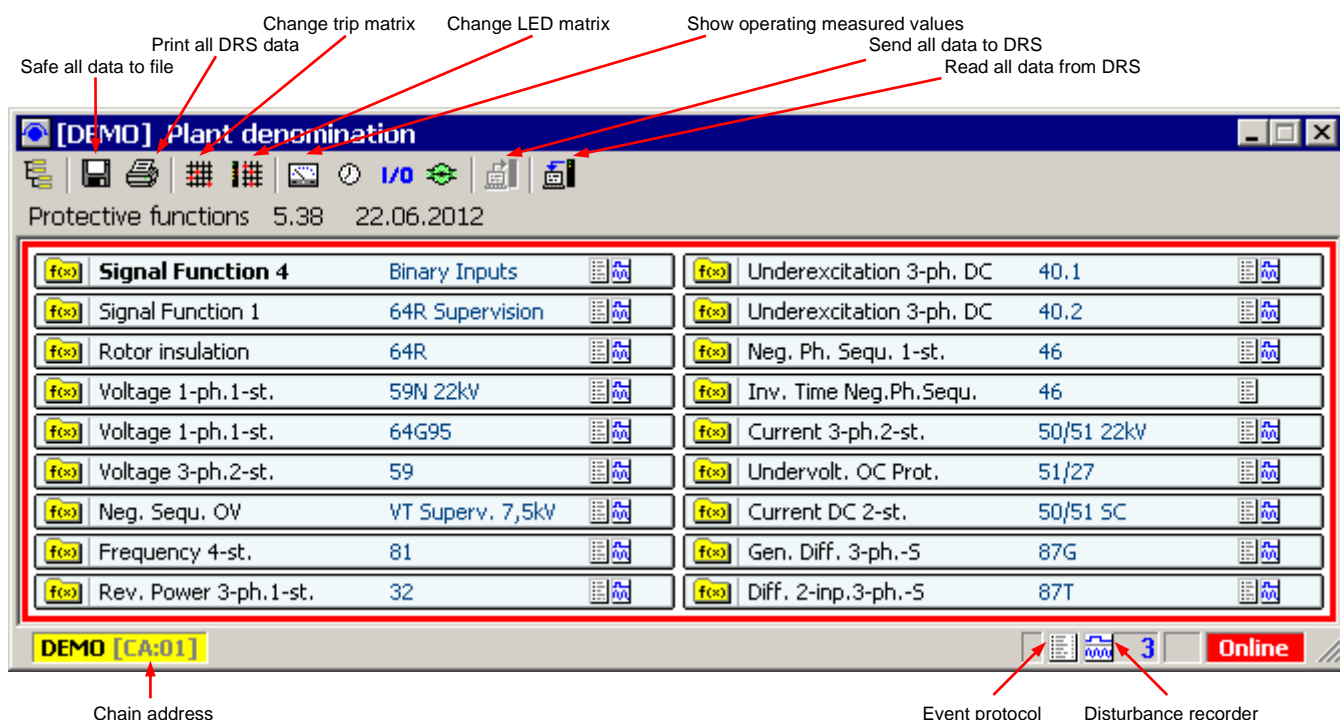


Fig. 3 Device window in DRS-WIN

To display the settings of a protective function click on the function name. A new window appears where the setting values of the chosen function are displayed and can be changed.

To display the settings for the trip matrix click on the matrix icon. A new window appears where the trip matrix is displayed and can be modified.

The file name is created automatically on saving the data to a file on a storage media. Each relay has a unique identification and the file extension VE. In this file all the settings are stored. The default folder for storing VE files can be opened by pressing key F11 or clicking on *View Plant Files* in menu *View*. A VE file is required for the initialization of a DRS spare unit.

A password must be entered before a modification of the parameters is possible. Please refer to section 2.1.7.

### 2.1.3. Modified data and the reference file

With the very first downloading of the parameters from a protection relay the DRS-WIN creates automatically a reference file. This file contains all settings of the protective functions of a DRS. In case of changes of settings of protective functions the DRS-WIN compares the new settings with the data in the reference file. A warning triangle on the bottom of the device window indicates that there is a difference between the setting file and the reference file.

To accept the differences in comparison to the reference file, click on the warning triangle and a dialog window opens like in figure below. Which kind of parameter was changed is displayed in this window in a tree view. It is possible to accept the changes with the button *Save reference file* and the warning triangle disappears in the device window.

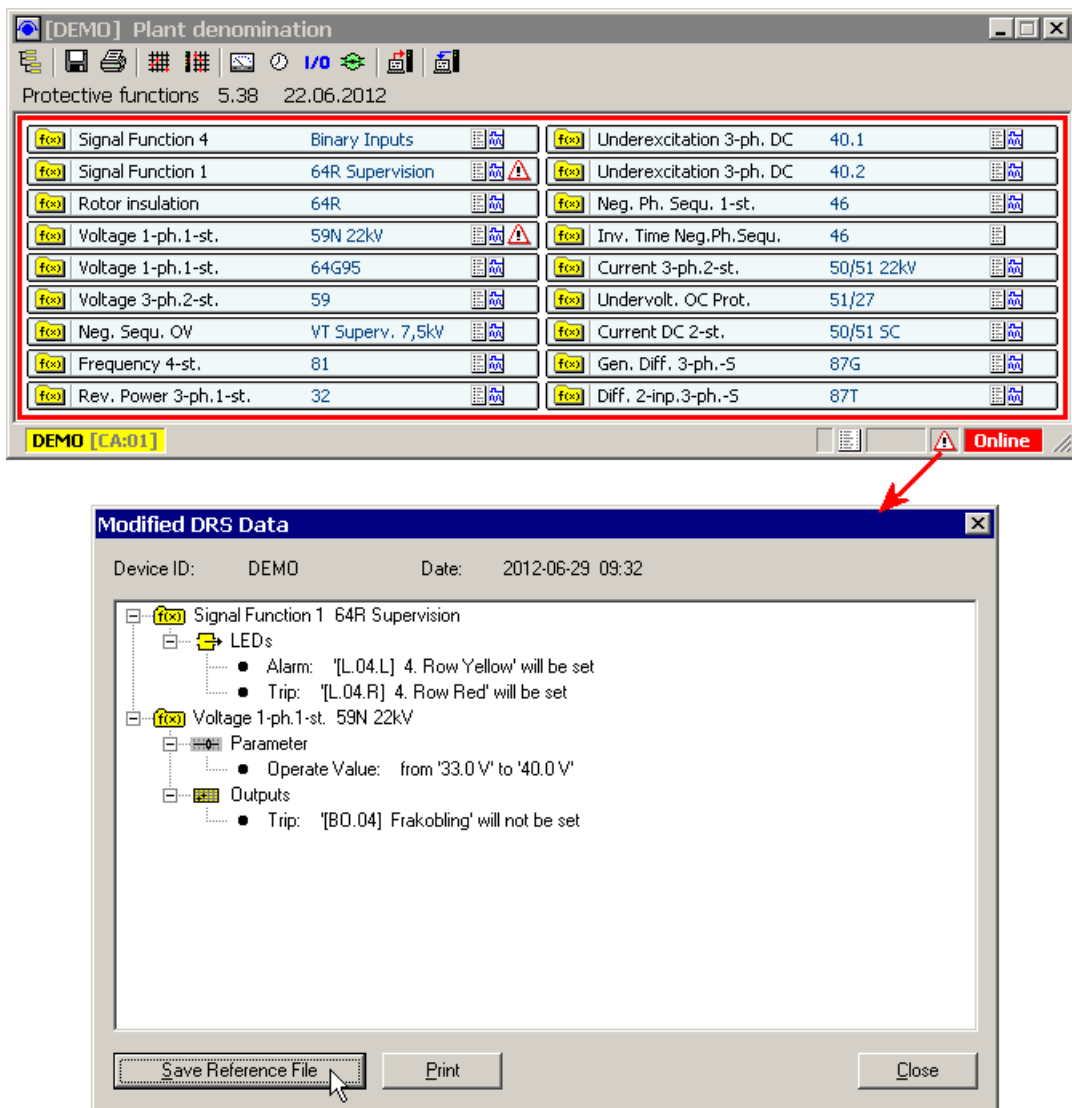


Fig. 4 Modified data in comparison to reference file



## 2.1.4. Binary input/output preset

The binary input/output preset can be used to activate the binary inputs and outputs of the protection relay for testing. The state of the binary inputs or outputs can be set in this window. It is also possible to monitor the actual state of the inputs and outputs.

Activating in menu *System* the menu item *Binary I/O Preset* opens the window for binary value preset.

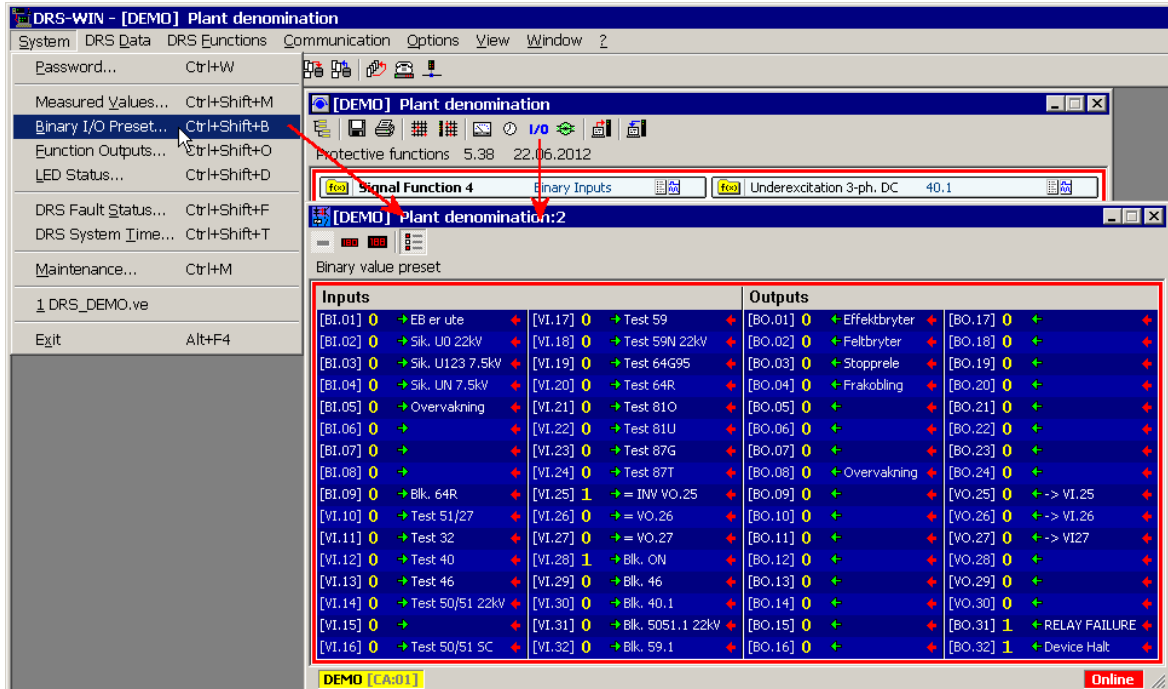


Fig. 5 Binary I/O preset in DRS-WIN

By clicking on current state of an input or output a window opens where the required state of the input or output can be set with button *Apply* or *OK* until *Regular function* is selected and *Apply* or *OK* is pressed again. The difference between these two buttons is that with *OK* the window is closed whereby with *Apply* the window remains open.

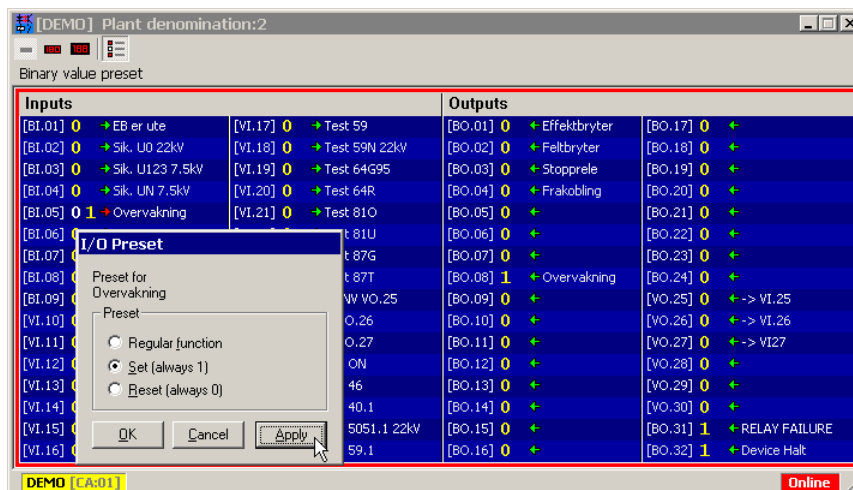


Fig. 6 Forcing binary inputs and outputs with DRS-WIN

In case the window of the *Binary I/O Preset* is closed all the inputs and outputs are set to *Regular function* automatically.

### 2.1.5. Disturbance recorder

In case a fault was recorded or in case disturbance records are stored in the DRS device the symbol of an oscillogram appears on the bottom of the device window. The number in the area beside the symbol of the oscillogram indicates how many records are stored in the DRS device. Click on the oscillogram symbol to open the window for reading the disturbance records. A dialog window opens like in the following figure.

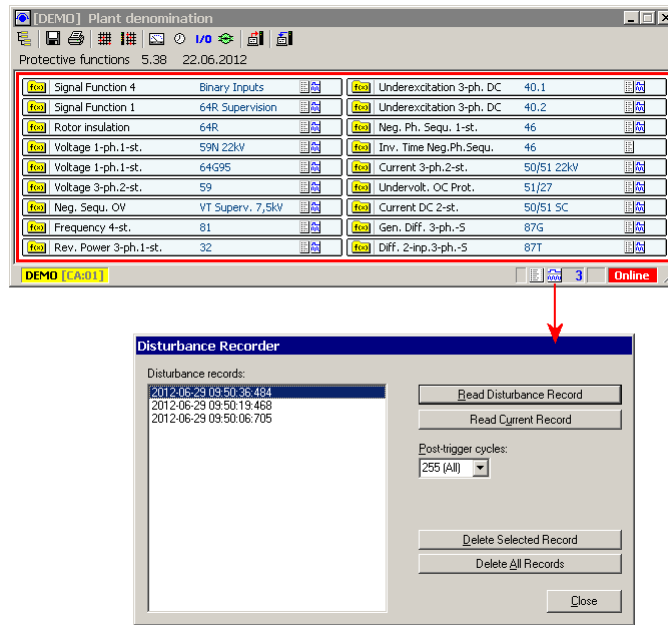


Fig. 7 Reading disturbance records from device with DRS-WIN

Select a fault record and press the button *Read Disturbance Record*. Now the fault recording is downloaded from the DRS device to the PC which can take some time. It is possible to cancel the downloading without losing the downloaded data. Press the disc symbol in the window of the fault recording to save a read disturbance record.

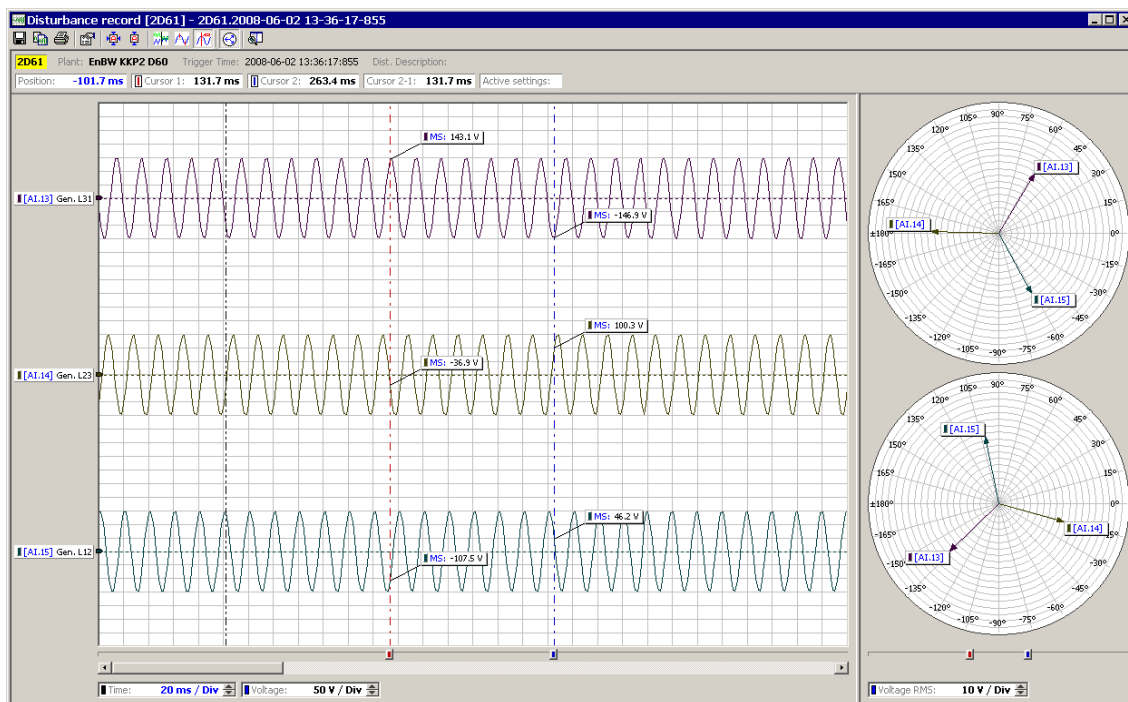


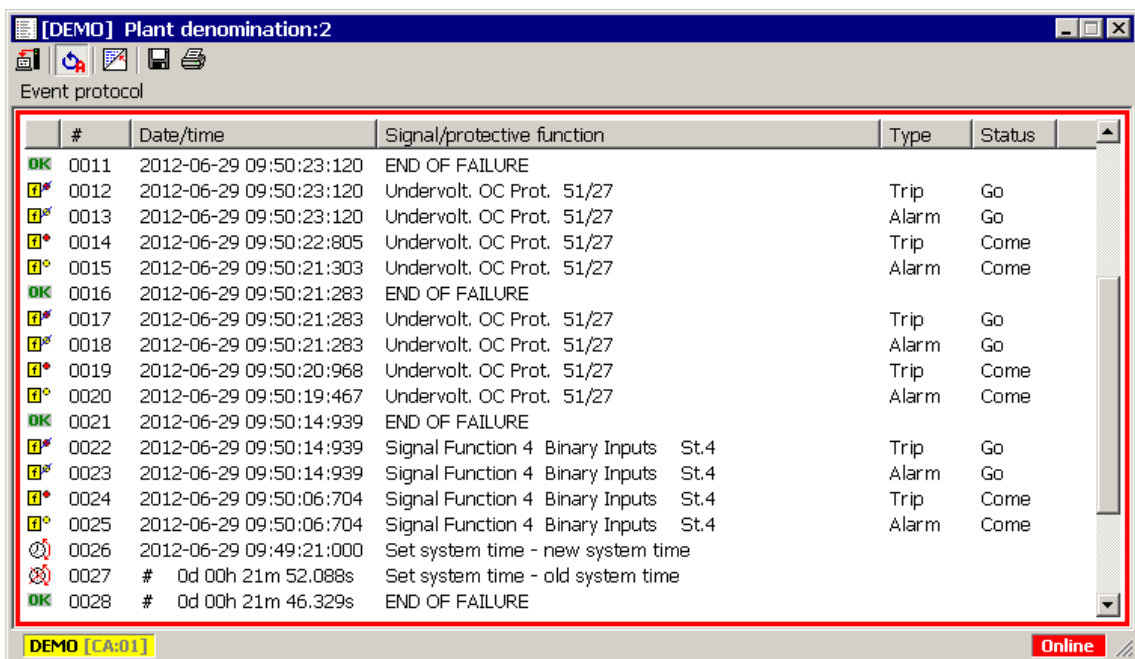
Fig. 8 Disturbance record window in DRS-WIN

## Operating instructions

The file name is created automatically. The default folder for storing disturbance records can be opened by pressing key F8 or clicking on *View Dist. Records* in menu *View*. Three files are stored for each disturbance record. They have the extensions CFG, DAT and HDR. Just the CFG and DAT files are required to open the disturbance record with a COMTRADE viewer. The HDR file contains additional data of the device and the view for DRS-WIN.

### 2.1.6. Event recording

All alarms and trips are stored in the event protocol. The records can be stored in a file by pressing the disc icon. The default folder for storing event recordings can be opened by pressing key F9 or choosing *View Event Protocols* in menu *View*. The file names for the event recordings are created automatically by the DRS-WIN and contain the relay denomination and the time when the event record was stored.



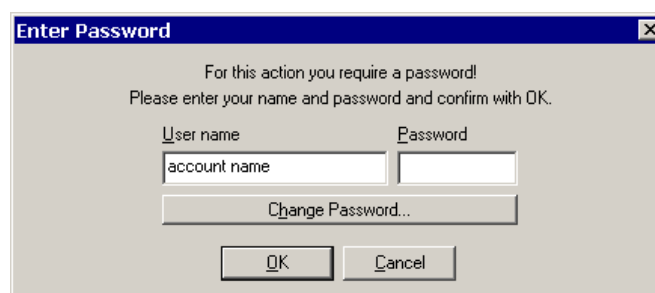
The screenshot shows the 'Event protocol' window in DRS-WIN. The window title is '[DEMO] Plant denomination:2'. The table below lists the event records:

#	Date/time	Signal/protective function	Type	Status
OK 0011	2012-06-29 09:50:23:120	END OF FAILURE		
0012	2012-06-29 09:50:23:120	Undervolt. OC Prot. 51/27	Trip	Go
0013	2012-06-29 09:50:23:120	Undervolt. OC Prot. 51/27	Alarm	Go
0014	2012-06-29 09:50:22:805	Undervolt. OC Prot. 51/27	Trip	Come
0015	2012-06-29 09:50:21:303	Undervolt. OC Prot. 51/27	Alarm	Come
OK 0016	2012-06-29 09:50:21:283	END OF FAILURE		
0017	2012-06-29 09:50:21:283	Undervolt. OC Prot. 51/27	Trip	Go
0018	2012-06-29 09:50:21:283	Undervolt. OC Prot. 51/27	Alarm	Go
0019	2012-06-29 09:50:20:968	Undervolt. OC Prot. 51/27	Trip	Come
0020	2012-06-29 09:50:19:467	Undervolt. OC Prot. 51/27	Alarm	Come
OK 0021	2012-06-29 09:50:14:939	END OF FAILURE		
0022	2012-06-29 09:50:14:939	Signal Function 4 Binary Inputs St.4	Trip	Go
0023	2012-06-29 09:50:14:939	Signal Function 4 Binary Inputs St.4	Alarm	Go
0024	2012-06-29 09:50:06:704	Signal Function 4 Binary Inputs St.4	Trip	Come
0025	2012-06-29 09:50:06:704	Signal Function 4 Binary Inputs St.4	Alarm	Come
0026	2012-06-29 09:49:21:000	Set system time - new system time		
0027	# 0d 00h 21m 52.088s	Set system time - old system time		
OK 0028	# 0d 00h 21m 46.329s	END OF FAILURE		

Fig. 9 Event protocol view in DRS-WIN

### 2.1.7. Password input

For each modification of the parameters the DRS-WIN requires a password. This is to avoid that the parameters are changed unintentionally. The password is individually selectable for each DRS and is stored in the DRS file and in the device. The password can be changed via the menu *System* on menu bar. The default password is 'A'.



The screenshot shows the 'Enter Password' dialog box. It contains the following text and fields:

For this action you require a password!  
Please enter your name and password and confirm with OK.

User name:

Password:

Change Password...

OK Cancel

Fig. 10 Entering password in DRS-WIN

### 2.1.8. Fault status

In case of an internal relay failure details can be found in the menu *System, DRS Fault Status*.

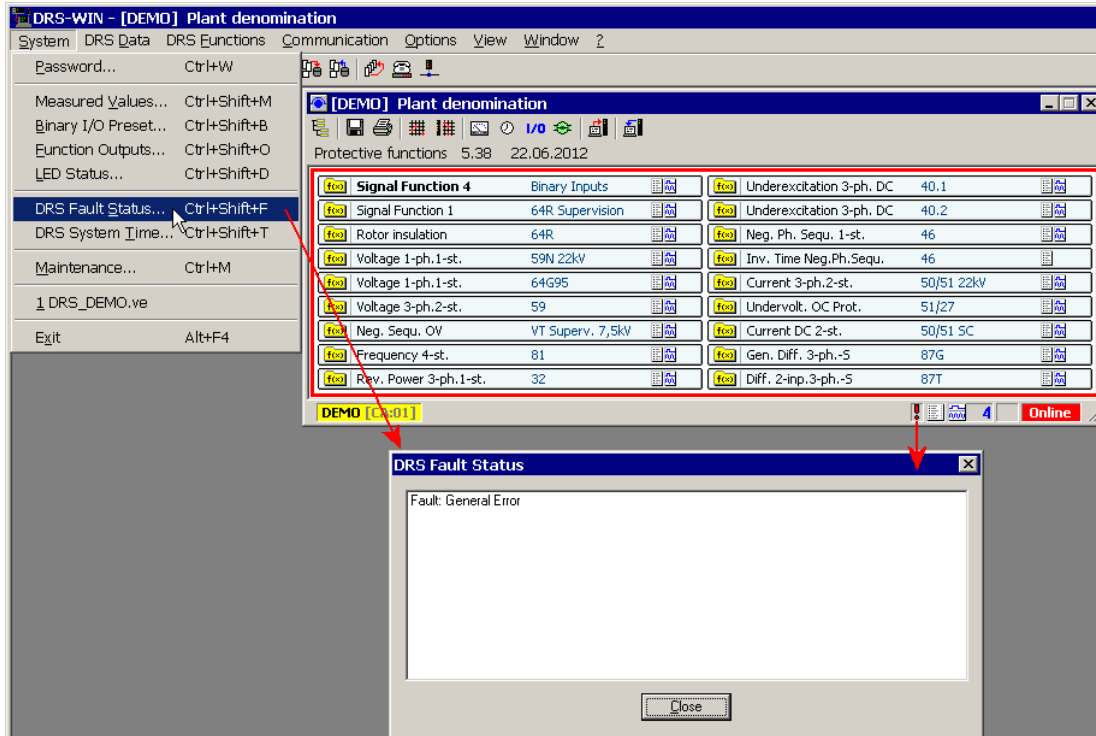


Fig. 11 Fault status display in DRS-WIN

### 2.2. Operation using local display and keypad

The user interface of a DRS relay consists of a two-line LCD with 16 characters each line and a keypad with 6 keys.

During normal operation, e.g. after start up or expiring of the corresponding timeouts, the device is in the main menu, i.e. the display light is off and the first line of the display indicates the version of the device and the hardware version. The second line displays the currently measured operating values of the various CT and VT inputs as well as additional function measured values which are selected by the user.

When a monitoring routine detects a fault, the display light is switched on and the display shows **!!DRS FAULT!!** in the first line. The display light stays on until the fault condition is reset manually. Then the kind of relay fault can be viewed in the submenu *Display Fault Status* (section 2.2.4).

If the relay operates, the last alarm or trip (plant specific denomination or protective function name) is indicated on the display. The function with the last alarm or trip is only shown on the display when at least one of the alarm or trip LED is on. All alarms and trips with additional information as time and stage of alarm or trip can be viewed in the submenu *Output Event Protocol* (section 2.2.2).

The local operation is designed in a way that all relay parameters can be displayed without password input. But modification of any setting parameters can only be carried out by entering the correct password.

Following buttons and keys are available:

### Reset button blue

Serves to reset the optical indication (status LED, alarm and trip LED) as well as for LED test.

### Membrane keypad

6 keys for local operation of the relay. Entries are menu controlled corresponding to the indication shown on the relay display.

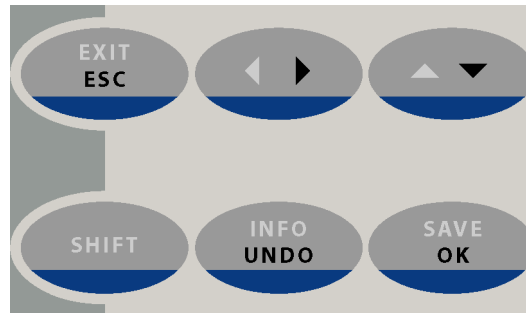


Fig. 12 Membrane keypad

With the exception of the **SHIFT** key all other keys have different functions depending in which menu or submenu they are operated.

General meaning and function of the keys:

- SHIFT** is only used in combination with a second key to enable the second key function.
- ESC** returns to the higher level menu whereby all modified parameters in the current menu are lost.
- EXIT** returns to the main menu whereby all modified data in all submenus are lost (abort).
  - ▶ shifts the cursor one position to the right.
  - ◀ shifts the cursor one position to the left.
  - ▼ changes to the next data set, e.g. next protective function, decreases a digit of a value by 1 or the whole value by one step, or selects the previous character or value.
  - △ changes to the previous data set, e.g. previous protective function, increases a digit of a value by 1 or the whole value by one step, or selects the next character or value.
- UNDO** discards modifications and restores the initial parameter value on entering the menu or clears the last entry.
- INFO** is used for displaying further information such as plant or relay specific texts of protective functions or I/O's.
- OK** for entering a submenu, confirming of a modification or entered value and returning to the upper menu, and confirming saving of a new set of parameters into the relay.
- SAVE** starts saving a new set of parameters into the relay which are permanently stored after an additional confirmation with the **OK** key.

### 2.2.1. Menu 'Display Measured Values'

This menu is accessed by pressing the **▶** key in the main menu. Pressing **△ ▼** scrolls through the measured values. **ESC** exits menu and returns to the main menu.

### 2.2.2. Menu 'Output Event Protocol'

This menu is accessed by pressing the **ESC** key in the main menu.

Important keys:

- ▼** scrolls downwards to the next, older entry in the protocol.
- △** scrolls upwards to the previous, younger entry in the protocol.
- ▶** changes the display in the second line on a protective function entry.
- ◀** changes the display in the first line on a protective function entry.
- OK** jumps to the most recent entry which can be a different one as on entering the menu, if new entries have been recorded.
- ESC** exits menu and returns to the main menu.

### 2.2.3. Menu 'System Functions'

This menu is accessed by pressing the **EXIT** key in the main menu.

In this menu special system functions can be called. With these system functions certain system values can be viewed or modified. This menu does not require a password input.

Following keys are available in the menu *System Functions*:

- △ ▼** scrolls through the system functions.
- OK** calls the corresponding system function.
- ESC** exits menu and returns to the main menu.

#### 2.2.3.1. Menu 'Binary Inputs'

In this menu the current status of all available binary inputs can be observed. It is accessed from the menu *System Functions* by pressing the **OK** key when *Binary Inputs* is displayed in the second line. **△ ▼** scrolls through the available binary inputs. **ESC** exits menu and returns to the menu *System Functions*.

#### 2.2.3.2. Menu 'Binary Outputs'

This menu is accessed from the menu *System Functions* by pressing the **OK** key when *Binary Outputs* is displayed in the second line. In this menu the current status of all available binary outputs can be observed. After a password input also an inversion of the status is possible.

Important keys:

- △ ▼** scrolls through the available binary outputs.
- SAVE** inverts the status of the current output. This is only enabled after a password input and with a display of only a single output.
- ESC** exits menu and returns to the menu *System Functions*.

### 2.2.3.3. Menu 'Spare Unit'

This menu is accessed from the menu *System Functions* by pressing the **OK** key when *Spare Unit* is displayed in the second line.

Select the option *Spare Unit*, confirm with **OK** and quickly enter the password within 5 seconds with pressing the key sequence **▶**, **UNDO**, **SHIFT**, **OK**.

The display indicates now:

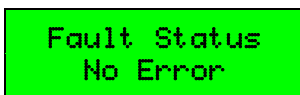


As an indication of this mode the green LED is flashing.  
Connect with DRS-WIN to initialize the relay with a parameter file.

### 2.2.4. Menu 'Display Fault Status'

This menu is accessed by pressing the **◀** key (=SHIFT plus **▶**) in the main menu.

When there is at least one relay fault (refer to red fault LED at the relay front and the fault message **!!DRS FAULT!!** in the first line of the main menu as well as to the fault alarm via the alarm relays), the type of fault is displayed. When there is no device fault, following display makes this clear:



Following keys are available in the menu **Display Fault Status**:

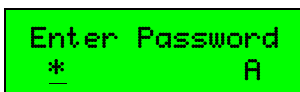
- △ ▼** scrolls through the faults (if present).
- ◀ ▶** scrolls through the inputs or outputs in case of a binary input or output fault.
- ESC** exits menu and returns to the main menu.
- EXIT** returns to the main menu.

### 2.2.5. Password Input

Default password: **A**

All actions when working with the relay which lead to modification of the existing configuration are protected with a password. Without entering the password the parameter settings can only be viewed but not changed.

To enter the password following request is shown on the display:



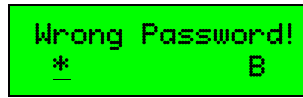
Now the displayed character can be modified via the **△ ▼** keys to the first character of the password. If necessary a new character can be entered by moving the cursor with the **▶** key to the next right positioned digit and can again be modified to the next password character with the **△ ▼** keys, and so on. If a character is entered incorrectly it can be deleted with the **UNDO** key or corrected with the **△ ▼** keys after setting the cursor with the **◀ ▶** keys on the wrong character. After selecting the last password character the procedure is terminated with the **OK** key. When the correct password is entered any further operations are authorized.



## Operating instructions

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Otherwise following display is shown:



In this case the entry has to be repeated or corrected as outlined before.

## 2.3. LED indications

Of the 28 LED (DRS-COMPACT2A) / 10 LED (DRS-LIGHT) at the relay front 2 of them are allocated to the system status indication (green/red in the 1<sup>st</sup> row) whereas the remaining LED serve as instantaneous and time delayed trip displays. The LED denominations respectively their allocations to the protective functions are shown on the designation label beside the LED.

### Status LED (row 1)

LED in service (green) (O)	
Steady light	Normal service operation Voltage supplies are present and within limits.
Flashing light	The relay is in service, but no protective functions are active either being not configured or in an operating mode where no protective functions are carried out, e.g. a spare relay not initialized.
Dark	No supply voltage and not ready for service. This condition will be registered by the relay's fault alarm contact.
LED fault (red) (F)	
Dark	No system fault and normal service conditions
Flashing light	The self monitoring system has detected a <b>category 1</b> failure. For troubleshooting please refer to section 3.2.
Steady light	The self monitoring system has detected a <b>category 2</b> failure. For troubleshooting please refer to section 3.2.

### Alarm and trip LED (row 2 to row 14)

Indication of instantaneous and/or time delayed trips are provided by the freely programmable yellow alarm and red trip LED allocated to the various protective functions in row 2 to row 14 (DRS-COMPACT2A) / row 2 to row 5 (DRS-LIGHT). The LED are configured to be hand reset.

#### 2.3.1. Resetting of LED indications

Prior to resetting the LED indication the cause for this, especially for the status LED display, should be investigated and rectified if necessary.

##### Reset of instantaneous and delayed trip LED

The alarm and/or trip LED can be reset by shortly pressing the blue reset button located above the LED row. During this process all LED will be illuminated for test purposes. Resetting the indication has in no way any influence on fault and event records.

##### Reset of the status LED

The status LED are extinguished by keeping the reset push button pressed for about 5 seconds until the left and right LED columns start flashing alternately. By resetting the status LED all other indications are reset also, but not any analog fault and none of the event records stored in the device.

### 3. Maintenance instructions

#### 3.1. Maintenance and inspection plan

The DRS relays are maintenance free relays with no user serviceable parts. During the life of the relay it should be checked for operation during regular maintenance period of protected primary equipment (e.g. generator, transformer).

ANDRITZ HYDRO GmbH as manufacturer of DRS series of protective relays recommends a maintenance interval of 4 to 6 years.

The work to be done for DRS relay maintenance includes consistency check of parameter file (refer chapter 2.1.3), secondary injection including pick-up values and trip characteristic, alarms to SCADA system, trip outputs, measured values and binary inputs.

It is recommended that the following tests are carried out:

##### 3.1.1. Optional activities during operation

No.	Maintenance and inspection work	Interval								Reference / Note
		Daily	Weekly	Monthly	Quarterly	Bi-annually	Annually	5 years	Revision	
1	Relay									-
	Check the measurements for plausibility					x				2.1.2, 2.2.1

Tab. 1 Activities during operation

##### 3.1.2. Recommended activities during maintenance period / shut down of machine

No.	Maintenance and inspection work	Interval								Reference / Note
		Daily	Weekly	Monthly	Quarterly	Bi-annually	Annually	5 years	Revision	
1	Cubicle surface									-
	Cleaning of dust							x		-
2	Trip circuit									-
	Initiate a trip by forcing the corresponding output of the relay							x		2.1.4, 2.2.3.2
3	Complete functional check									-
	Secondary injection							x		-

Tab. 2 Activities in case of shut-down machine

## 3.2. Malfunction

The DRS protection relays are provided with extensive self monitoring and self checking systems which produce a corresponding optical indication (local display – section 2.2.4; LED – section 2.3) and operate a status relay. A DRS-COMPACT2A is equipped with two normally closed contacts (BO.31/32). A DRS-LIGHT has one changeover contact.



### NOTICE

Each fault alarm indicates that the system is not fully functioning and the user has to make the decision whether or not the protected apparatus should remain in service.

### 3.2.1. Procedure in case of malfunction

Determine the type of failure on the local device (section 2.2.4) or by usage of the software DRS-WIN (section 2.1.8) and write it down. Use the form given in section 6.

If there are entries in the event protocol and saved disturbance records which occurred in the period around the relay failure please save them too, see sections 2.1.5 and 2.1.6.

Two categories of faults are distinguished by status LED (please refer 2.3):

**Category 1:** Perform a reset of the status LED according to section 2.3.1.

**Category 2:** Perform a hardware reset. A hardware reset can be performed either by disconnecting the power supply or by

**DRS-COMPACT2A:** pressing *Reset* button at the relay.

**DRS-LIGHT:** pressing the keys **SHIFT + ESC + UNDO** for approximately 3 seconds.



### NOTICE

A hardware reset shall be only performed during standstill.

Pressing the keys **SHIFT + ESC + UNDO** for approximately 3 seconds at a DRS-COMPACT2A relay resets the communication processor unit responsible for the communication to the control system. This can be performed if the failure message is related to any SIP or NIP error. The execution of the protective functions is not affected by a reset of the communication processor unit.

**On the next pages instructions are given.**



### NOTICE

Switching off the power supply erases all internal records (disturbance records, event records, and DRS fault status).

3.2.2. Troubleshooting DRS-COMPACT2A

Two categories of faults are distinguished:

**Category 1:** without blocking of the protective functions. Only status contact BO.31 is in origin position.

**Category 2:** with blocking of the protective functions. Status contact BO.31 and BO.32 are in origin position.

Section 3.2.3.1 and 3.2.3.2 list these faults.

Failure	Category		Possible origin of fault				Action to be taken					
	Category 1	Category 2	Hardware	Firmware	VE file	External	Status LED reset	Communication reset	Check fault record, measurements	Check parameters	Hardware reset	Re-initialize relay
Binary Output Error	X		X				1				2	
Binary Input Error	X		X				1				2	
EEPROM Write Error	X		X				1				2	
Fault RAM Error	X		X				1				2	
ME-OK ADC-Overrun Error	X		X				1				2	
CO-OK DSP-Overrun Error	X		X				1				2	
Oversampling Error	X		X				1				2	
XTAL Error	X		X				1				2	
+5V Supply Voltage Error	X		X				1				2	
SIP Hardware Error	X		X				1				2	
SIP Software Error	X			X	X		1	2		3		
Synchronization Error	X			X	X		1a		1b			
CT/VT Error	X			X	X		1a		1b			
General Error	X			X	X		1a			1b		
Program Overflow Error	X			X	X		1				2	
ADC Error (Current / Voltage Inp.)		X	X				1				2	
Sample/Hold Trigger Error		X	X				1				2	
DSP Program Error		X	X				1				2	
Parameter RAM Error		X	X				1				2	
System RAM Error		X	X				1				2	
Program Memory Error		X	X				1				2	
+12V Supply Voltage Error		X	X				1				2	
-12V Supply Voltage Error		X	X				1				2	

Tab. 3 Troubleshooting DRS-COMPACT2A

Above table represents the standard designation of faults to Category 1 and 2. Individual designation is possible on request.



**NOTICE**

Send the relay for repair if the failure is related to the hardware. Otherwise contact ANDRITZ HYDRO personnel for support.

3.2.3. Troubleshooting DRS-LIGHT

Two categories of faults are distinguished:

**Category 1:** without blocking of the protective functions.

**Category 2:** with blocking of the protective functions.

The status contact is set in origin position.

Section 3.2.3.1 and 3.2.3.2 list these faults.

Failure	Category		Possible origin of fault				Action to be taken					
	Category 1	Category 2	Hardware	Firmware	VE file	External	Status LED reset	Communication reset	Check fault record, measurements	Check parameters	Hardware reset	Re-initialize relay
Binary Output Error	X		X				1				2	
Fault RAM Error	X		X				1				2	
+5V Supply Voltage Error	X		X				1				2	
Synchronization Error	X			X	X		1a	1b				
CT/VT Error	X			X	X		1a	1b				
General Error	X			X	X		1a		1b			
LAN Hardware Error	X		X				1				2	
LAN Software Error	X			X	X	X	1			2		
Terminal Error	X			X	X		1			2		3
IEC-Firmware Error	X			X	X		1			2		3
Program Overflow Error	X				X	X	1				2	
ADC Error (Current / Voltage Inp.)		X	X				1				2	
Parameter RAM Error		X	X				1				2	
System RAM Error		X	X				1				2	
Program Memory Error		X	X				1				2	
+12V Supply Voltage Error		X	X				1				2	
-12V Supply Voltage Error		X	X				1				2	
Reference Voltage Error		X	X				1				2	
+5V Supply Voltage Error		X	X				1				2	
Power Supply Error		X	X				1				2	

Tab. 4 Troubleshooting DRS-LIGHT

Above table represents the standard designation of faults to Category 1 and 2. Individual designation is possible on request.



**NOTICE**

Send the relay for repair if the failure is related to the hardware. Otherwise contact ANDRITZ HYDRO personnel for support.

### 3.2.3.1. Category 1 faults

In case the relay indicates category 1 failure by LED indication (refer chapter 2.3), the processing unit is still working.

#### **Binary Output Error**

The self monitoring software has detected a fault in one of the binary outputs.

#### **Binary Input Error**

The self monitoring software has detected a fault in one of the binary outputs.

#### **EEPROM Write Error**

Indicates that writing changed parameters to the relay is not working properly.

#### **Fault RAM Error**

Indicates a problem with the memory storing disturbance records.

#### **SIP Hardware Error**

A hardware problem has been detected on the communication processor unit.

#### **ME-OK ADC-Overrun Error**

The self monitoring software has detected a fault in the ADC conversion i.e. no valid measured value could be noticed within a specific period of time.

#### **CO-OK DSP-Overrun Error**

Indicates that the digital signal processor (DSP) cannot execute all protective function algorithms within the defined time period which can cause from a problem with software or hardware.

#### **Program Overflow Error**

Indicates that the program (all active protective functions) was not executed within the allocated time interval.

#### **Oversampling Error**

Indicates that the digital signal processor (DSP) cannot execute the necessary calculations between the samples in case of active oversampling (I>>>) or if the signal line (hardware) does not provide a valid signal level.

#### **XTAL Error**

Indicates a missing clock pulse at the microcontroller. The microcontroller works with its lower internal default frequency (2 to 5 MHz) whereby internal timings are wrong in this case.

#### **+5V Supply Voltage Error (DRS-COMPACT2A)**

Indicates an exceeding of the range of tolerance of +5V supply voltage.

#### **General Error**

Indicates that BO.31 is activated via the relay's trip matrix.

#### **SIP Software Error**

Indicates an error in configuration or in the settings of parameters of the communication to the control system.

#### **Synchronization Error**

Indicates a deviation of nominal frequency and the sampling frequency of  $> \pm 12.5\%$ . Possible reason: frequency rise after load rejection.

#### **CT/VT Error**

Checks the current and voltage measurements on symmetry.

#### **LAN Hardware Error**

A hardware problem has been detected on the network communication processor unit.

**LAN Software Error**

Indicates an error in configuration or in the settings for IEC 60870-5-104 of the communication to the control system.

**IEC-Firmware Error**

Indicates a mismatch of the parameters for the communication interface after a firmware update. Re-initialize the relay, see section 3.3.2.

**Terminal Error**

Indicates a mismatch of the parameters for the terminal operation after a firmware update. Please contact our ANDRITZ HYDRO protection team.

**3.2.3.2. Category 2 faults**

In case the relay indicates category 2 failure by LED indication (refer chapter 2.3), the main processing unit is not working any longer (relay halt).

**ADC Error (Current / Voltage Inp.)**

Indicates a problem in the reference channel of the analog/digital conversion.

**Sample/Hold Trigger Error**

Indicates a problem in the control of the sample/hold stage, i.e. a missing sample pulse.

**DSP Program Error**

Indicates a problem with the program memory in the digital signal processor.

**Parameter RAM Error**

Indicates a problem in the parameter RAM.

**System RAM Error**

Indicates a problem in the system RAM.

**Program Memory Error**

Indicates a discrepancy between FLASH checksum and the periodically counted checksum.

**+12V Supply Voltage Error**

Indicates a problem in +12V auxiliary supply.

**-12V Supply Voltage Error**

Indicates a problem in -12V auxiliary supply.

**Reference Voltage Error**

Indicates a falling below or exceeding the range of tolerance of the reference voltage for the ADC.

**+5V Supply Voltage Error (DRS-LIGHT)**

Indicates an exceeding of the range of tolerance of +5V supply voltage.

**Power Supply Error**

Summary indication of *+12V Supply Voltage Error*, *-12V Supply Voltage Error*, *Reference Voltage Error* and *+5V Supply Voltage Error*.



### 3.2.4. Universal interface module UAKB used for rotor earth fault protection

The rotor earth fault protection applies a DC voltage between the excitation circuit and earth for measuring the rotor earth resistance.

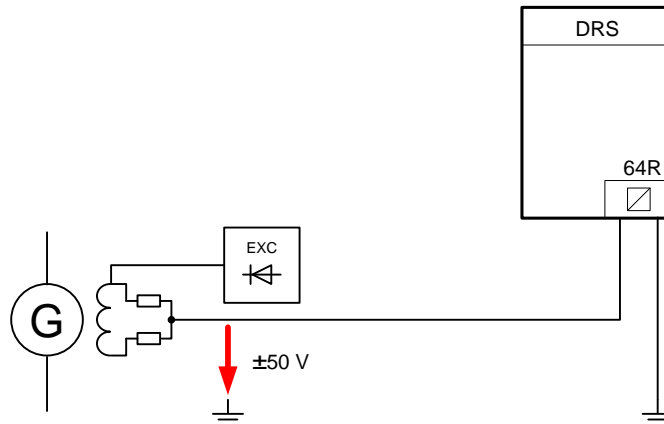


Fig. 13 Rotor earth fault protection: signal injection



#### CAUTION

The relay is injecting  $\pm 50$  V between field and earth!

Depending on the plant configuration the wire can be automatically disconnected by a contact (e.g. field breaker, field flashing). In such case an alarm is suppressed via interlocking with the circuit breaker position or via connecting a capacitance to ground. Please check the circuit diagram.

#### 3.2.4.1. Measurement transducer UAKB supervision

The rotor earth fault protection can detect if measuring circuit is interrupted. In this case the rotor earth fault protection can be blocked (according parameterization of software function) and a corresponding alarm is initiated.

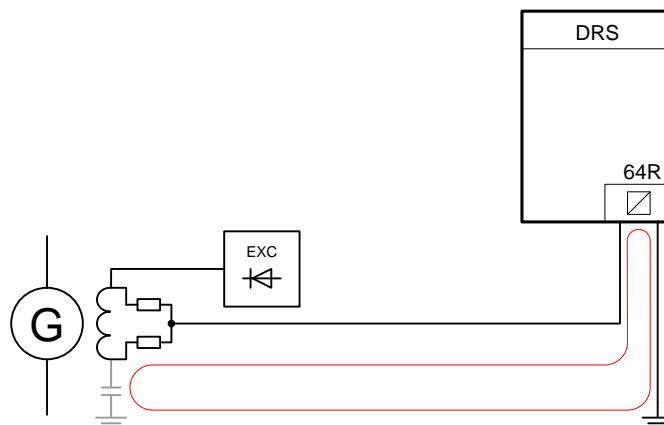


Fig. 14 Rotor earth fault protection: wiring supervision

### 3.3. Repair of malfunctions

#### 3.3.1. Exchange of relays

If a relay is not working properly it has to be exchanged.



#### WARNING

The following steps have to be met as minimum requirement:

- Disconnect completely
- Secure against re-connecting
- Verify that the installation is dead (de-energized).
- Carry out grounding and short-circuiting
- Provide protection against adjacent live parts



#### WARNING

Current transformer circuits need to be short circuited first before the wiring connected to the relay can be removed. A current transformer produces a very high voltage if the current transformer circuit is open-circuited with the primary energized. This can damage the electrical equipment and can harm the operation staff.



#### NOTICE

Working at the protection system shall only be performed when the protected object is out of service.

### 3.3.2. Initialization of a spare unit

In case a DRS is configured as a spare unit, the following display indication appears after switching on the relay power supply:



In addition the green LED in the first row is blinking. Should the device not be in the status of a spare unit, please refer to section 2.2.3.3.

The DRS spare unit has to be programmed with a parameter file. Parameter files have the file extension VE.

The user interface of the respective DRS spare unit has to be connected via the operation cable to the PC (RS232 interface for DRS-COMPACT2A, RS485 interface for DRS-LIGHT). After starting the DRS-WIN software a connection to a spare unit is detected automatically. Refer to section 2.1.1 if no spare unit is automatically detected.

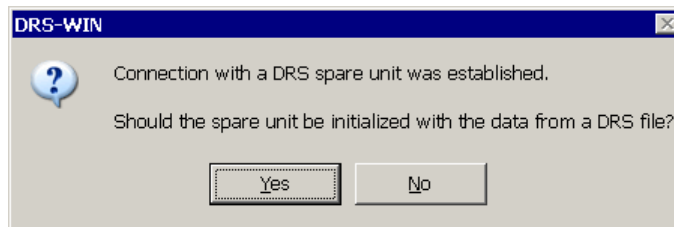


Fig. 15 Initializing a spare unit: initial prompt

By confirmation of starting the initialization with *OK*, the user is asked to select the required parameter file. A correct selection has to be ensured and completed by pressing the button *Open*. The *Browse* feature provides the access to the folder with the files if the VE files should not be stored in the default folder *Plants*,

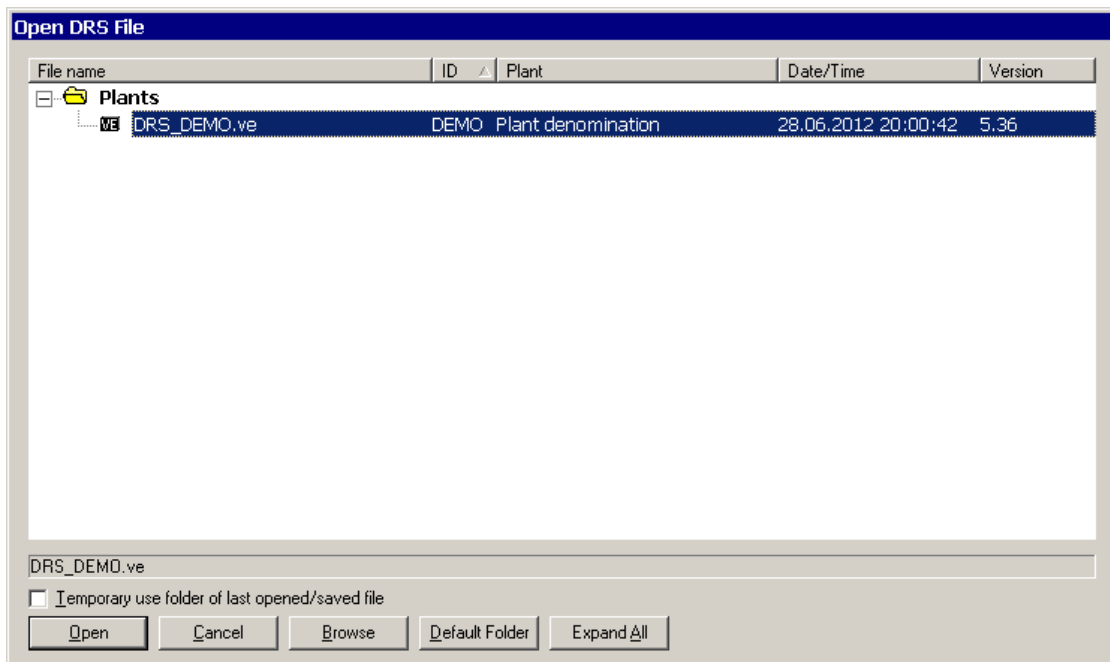


Fig. 16 Initializing a spare unit: selection of the required VE file

For safety reasons a reconfirmation is implemented for the file selection:

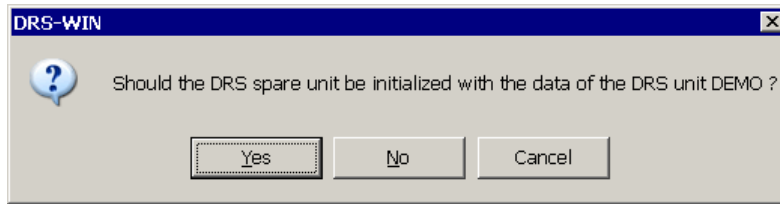


Fig. 17 Initializing a spare unit: confirmation

DRS-Win starts automatically loading the data of the file into the DRS.

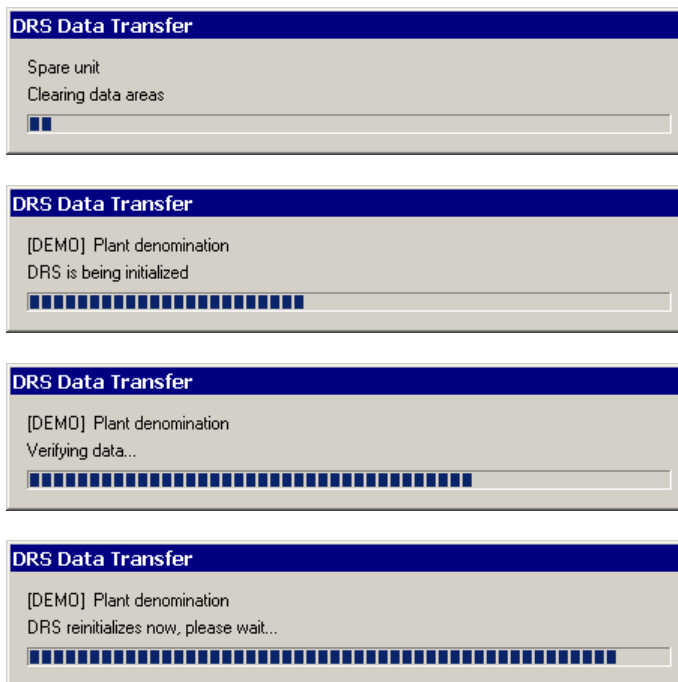


Fig. 18 Initializing a spare unit: loading

The device is ready for operation which is indicated by an *Online* connection status.

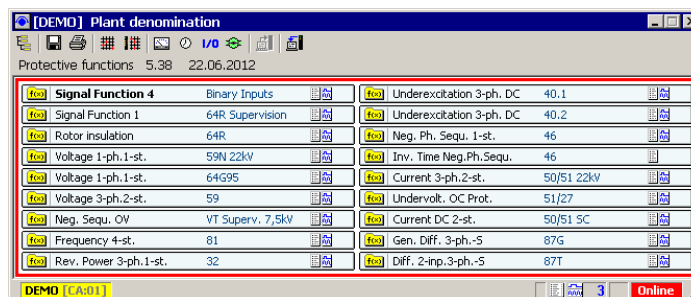


Fig. 19 Initializing a spare unit: relay ready for operation

It is recommended to do a short check of the device status:

- Check actual relay measuring values
- Check status of binary relay inputs and outputs
- Check trips of protection functions with software test inputs (*Binary I/O Preset*, section 2.1.4)

**3.3.3. Universal interface module UAKB**

The UAKB unit is an optional module of the DRS COMPACT2A and provides an extension of the functionality. The type code defines if the relay is equipped with an UAKB module. Certain functionalities of the UAKB module need calibration or parameterization (rotor earth fault protection, stator earth fault protection, shaft current protection, PT100 evaluation). To avoid doing this in case of a relay exchange, it is recommended to install the UAKB of the relay to be replaced in the new relay. If key H is 4, 5 or 6 in product code, the relay is equipped with an UAKB module<sup>4</sup>.

DRS-C2- 3 2 / x / x x / xxxxxxxx / H I J K L / x x / xxx / xx

The figure below shows how to get access to the UAKB module:



Fig. 20 Access to the UAKB module

There are several PCB inside the relay. The arrow indicates the UAKB module.

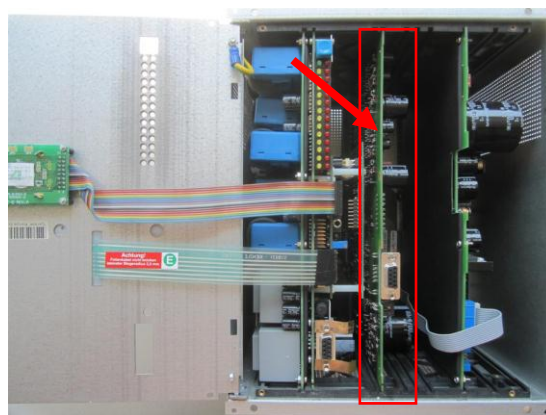



Fig. 21 UAKB module in the device

	NOTICE
	<p>A PCB shall be only removed or placed with the power supply switched off.</p>

<sup>4</sup> Calibration and parameterizing an UAKB module is explained in detail in the document DIC-033-1 listed in section 5.

## 4. Technical data

### 4.1.1. Auxiliary power supply

Nominal auxiliary supply $V_{aux}$ :	250 / 220 / 110 / 60 / 24 VDC
Power consumption:	In normal state approx. 15 W (reference on battery side) Operating state approx. 30 W (all trip outputs energized)
Voltage out time at $V_{aux} > 60$ V:	> 50 ms
Recommended m.c.b.:	2 A, C characteristic

### 4.1.2. Analog input evaluation

#### 4.1.2.1. CT circuits

Nominal frequency $f_N$	50 Hz or 60 Hz, optional 16.7 Hz
Nominal current $I_N$	1 A / 5 A for the CT inputs 1 to 9 1 A / 0.1 A / 0.01 A for CT input 10
CT circuit rating:	continuously $4 \times I_N$ 10 s rating $30 \times I_N$ 1 s rating $100 \times I_N$ dynamic $250 \times I_N$ (1 half period, peak value)
Burden for each phase:	< 0.1 VA at $I_N$
Technology:	linear hall sensors

#### 4.1.2.2. VT circuits

Nominal frequency $f_N$	50 Hz or 60 Hz, optional 16.7 Hz
Nominal voltage $V_N$	100 / 110 / 120 V
Maximum continuous $V_N$	200 V
Burden for each phase:	0.3 VA at $V_N$
Technology:	electromagnetic VT

### 4.1.2.3. Inputs for specific analog signals module UAKB

#### Rotor earth fault protection

The rotor earth fault protection is operating according to the adaptive frequency evaluation.

Measuring range	0...200 kOhm
Measuring frequency	0.3...3 Hz
Permissible rotor capacitance	0...10 $\mu$ F
Alarm and trip setting values	0...100 kOhm
Maximum rotor voltage	1000 VDC with direct field excitation 500 VDC with auxiliary exciter machine

#### Shaft current supervision

The shaft current supervision or bearing protection checks the current in the generator shaft which is detected from the input signals of a special shaft current CT with a ratio of 500...1000 / 1 A.

Measuring range	0...160 mA AC (RMS input value)
Signal evaluation	1 <sup>st</sup> , 3 <sup>rd</sup> , 5 <sup>th</sup> , 7 <sup>th</sup> , and 9 <sup>th</sup> harmonics of the nominal frequency.

#### Measuring transducer

The 2 configurable transducers are for the signal adaption and galvanic isolation from plant elements. Following configurations are possible:

##### PT100 element

Measuring range	-40...110 °C
Signal element	2 or 3 wire platinum element with 100 Ohm at 0 °C

##### Voltage or current input

Input range	0...60 mV, 0...10 V, 0(4)...20 mA DC
-------------	--------------------------------------

##### Current output

Remote indication of the rotor earth resistance on a 4...20 mA metering instrument with a non-linear scale of 0...200 kOhm.

##### Starting earth fault protection (SFC protection)

Measuring range	with a -10...+10 A DC LEM CT LT100-S or a 20 A / 60 mV shunt
-----------------	---

##### Low frequency overcurrent

Measuring range	0...0.5 x $I_N$ , $f_{min} = 3$ Hz
-----------------	------------------------------------

##### 100% stator earth fault protection (20 Hz injection principle)

Measuring range	0...10 kOhm
-----------------	-------------

### 4.1.3. Inputs for binary signals

Binary signals are incorporated into the protection system via potential free optical isolators.

Nominal input voltage: 24, 60, 110 or 220 VDC, other voltages on request  
 Current consumption: approx. 3 mA per input  
 Threshold voltage: 70% of the nominal voltage

### 4.1.4. Binary outputs

The protection system is provided with a defined number of outputs for alarms and trips. These outputs are normally open relay contacts.

The DRS-COMPACT2A has 24 free configurable alarm and trip outputs and in addition two normally closed contacts are assigned for the relay status information, i.e. device faulty annunciation.

Technical data about the output relays (basically according to VDEW recommendations):

Make capacity > 1000 W resp. VA at L/R=40 ms  
 Break capacity 30 W resp. VA at L/R=40 ms  
 Continuous current rating 5 A  
 Short time current rating 30 A / 0.5 s  
 Switching voltage 220 V nominal DC/AC  
 Make contacts freely configurable  
 Operating time 5 ms typical  
 Reset time 2.5 ms typical

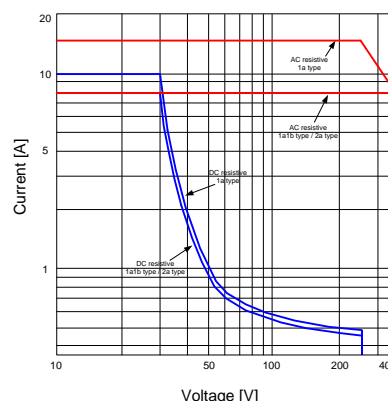


Fig. 22 Load limit curve of output relay

### 4.1.5. Status contacts

DRS-COMPACT2A 2 normally closed contacts  
 DRS-LIGHT 1 changeover contact

### 4.1.6. Control System Connection

To connect to the control equipment (SCADA, station control system) following alternative protocols are supported according to the relay type code:

IEC 60870-5-103 Connection for FO cable with ST plugs or electrical with a 9 pin sub-D plug  
 IEC 60870-5-104 Connection with a RJ45 plug  
 MODBUS Galvanic connection via screw type terminals (on request only)

### 4.1.7. Storage Conditions

Temperature +5 °C ... +30 °C  
 Humidity Annual average <75% relative humidity  
 93% on a maximum of 30 days a year  
 Condensation must be avoided



### 4.1.8. Terminal assignment

#### 4.1.8.1. DRS-COMPACT2A

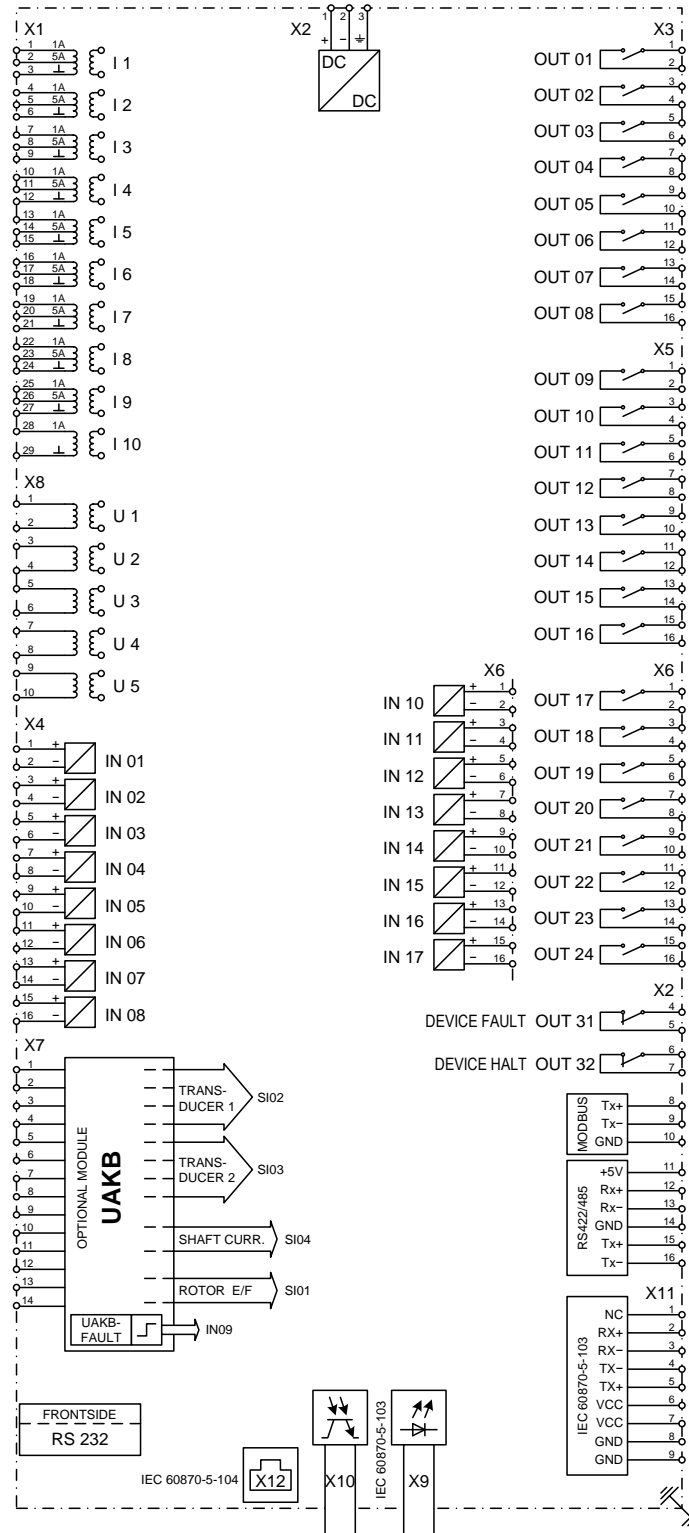


Fig. 23 Terminal assignment DRS-COMPACT2A

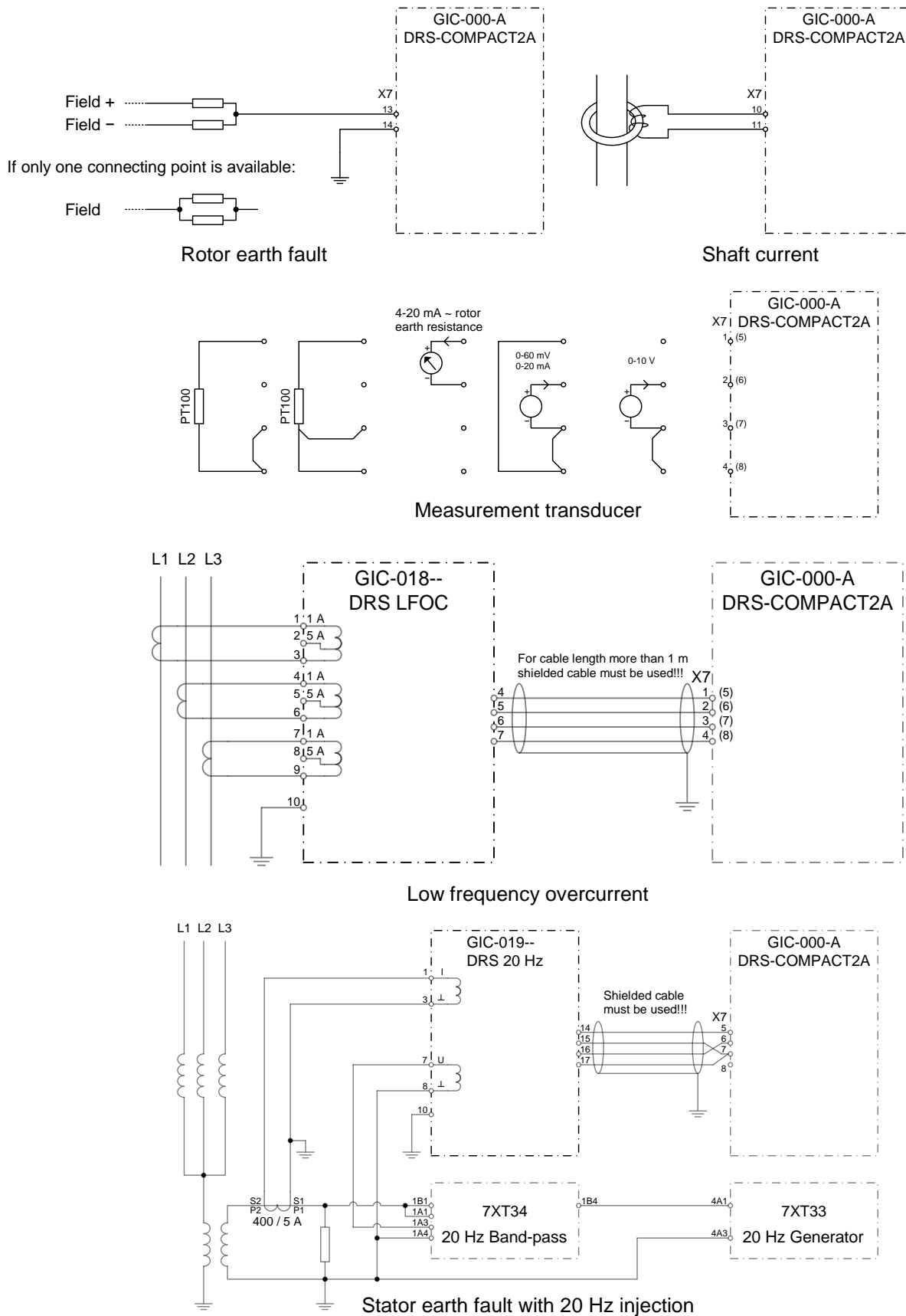


Fig. 24 Connection example DRS-COMPACT2A – X7

4.1.8.2. DRS-LIGHT

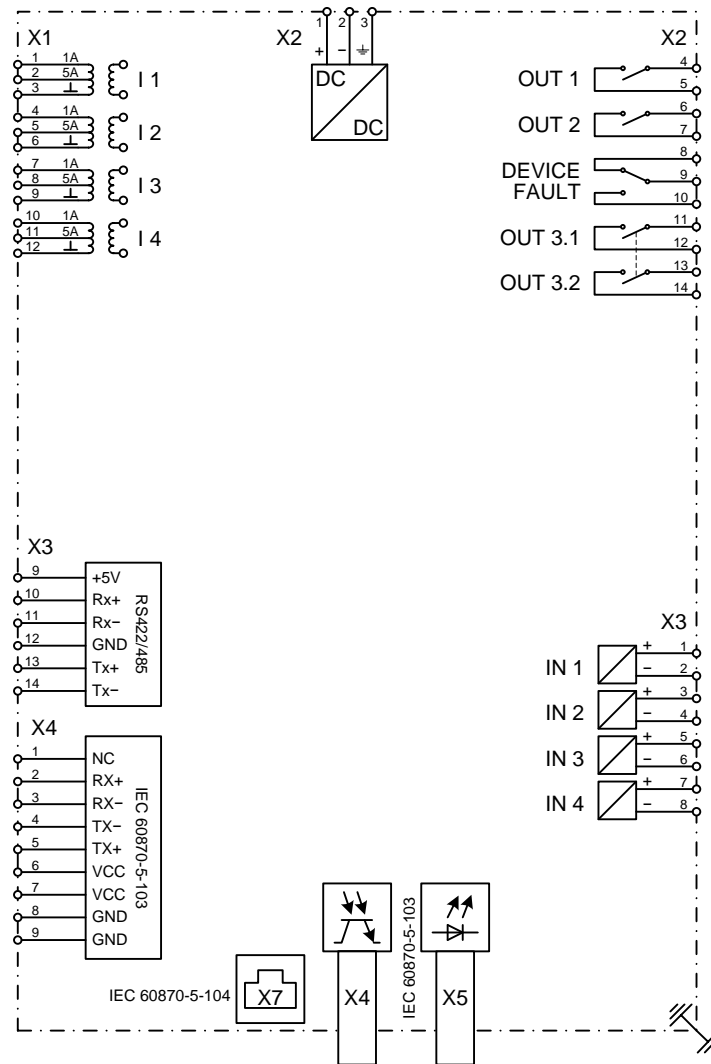


Fig. 25 Connection example DRS-LA4

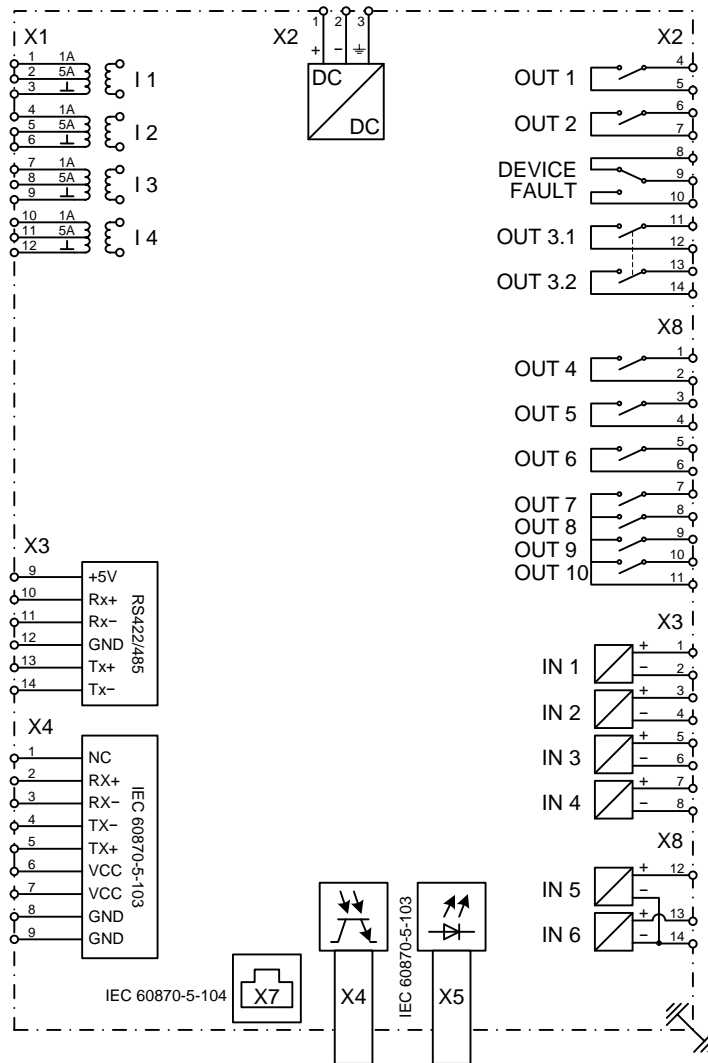


Fig. 26 Connection example DRS-LA4 breaker failure relay

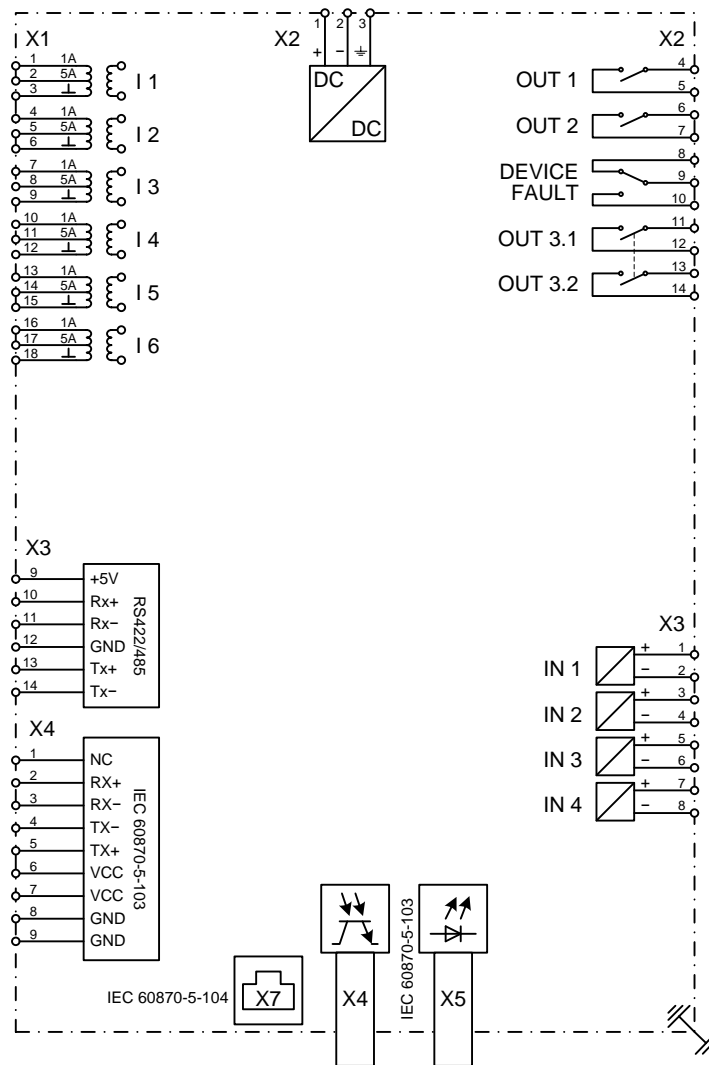


Fig. 27 Connection example DRS-LA6

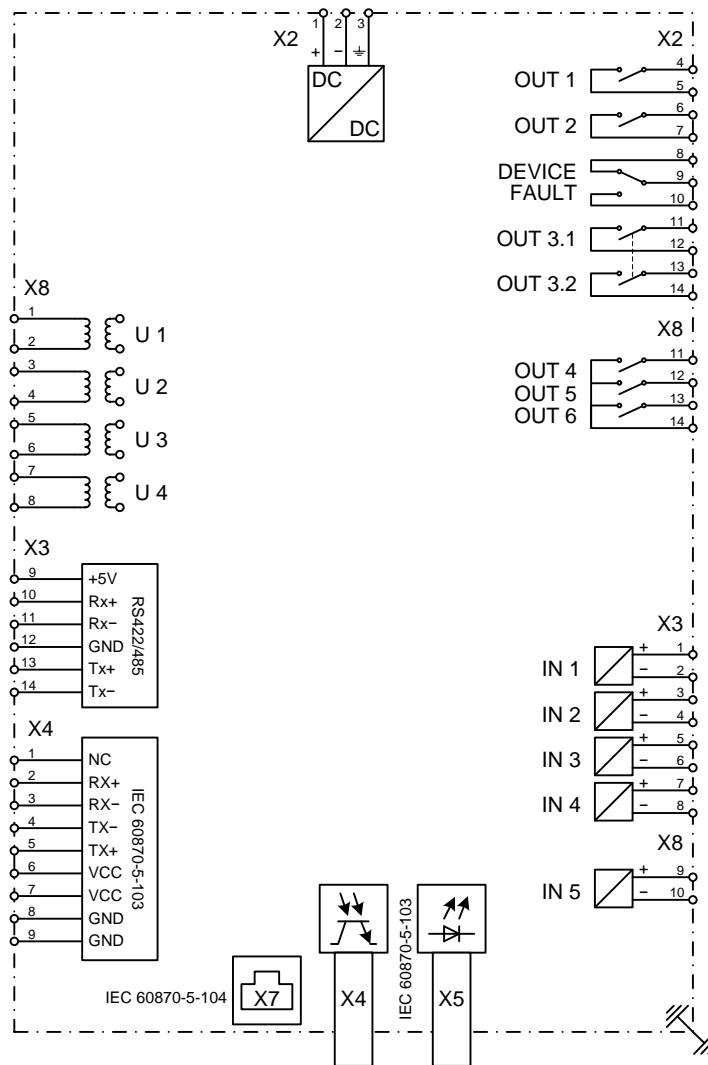


Fig. 28 Connection example DRS-LV42

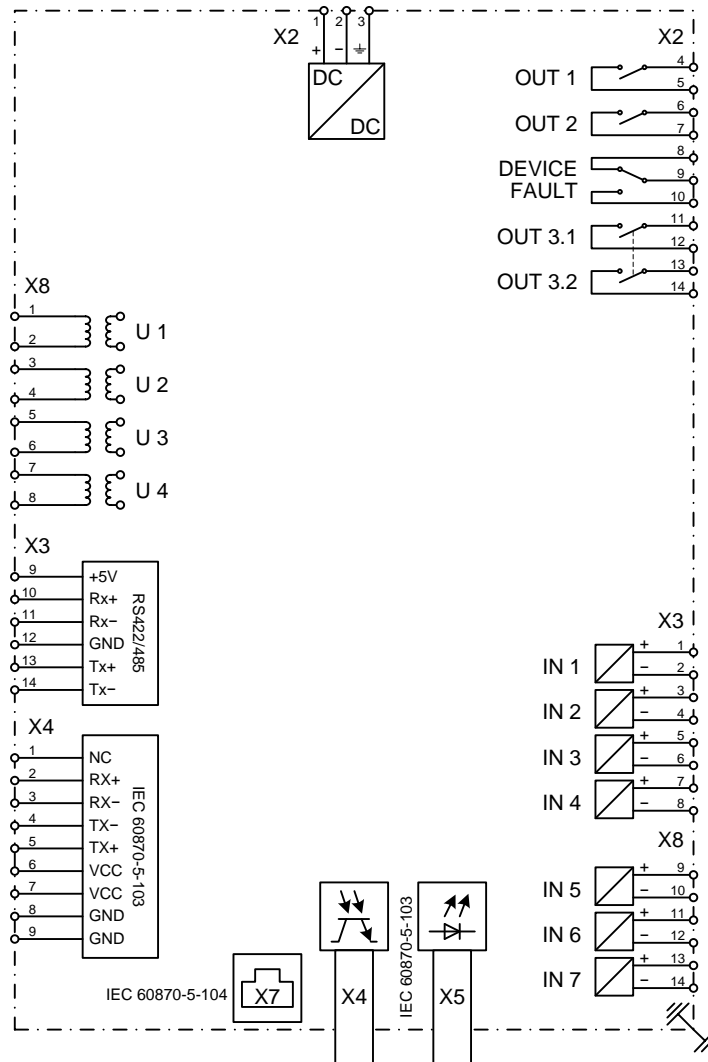


Fig. 29 Connection example DRS-LV4



**NOTICE**

Above hardware type LV4xx is no longer produced. It was replaced by type LV42x (refer Fig. 28 Connection example DRS-LV42).

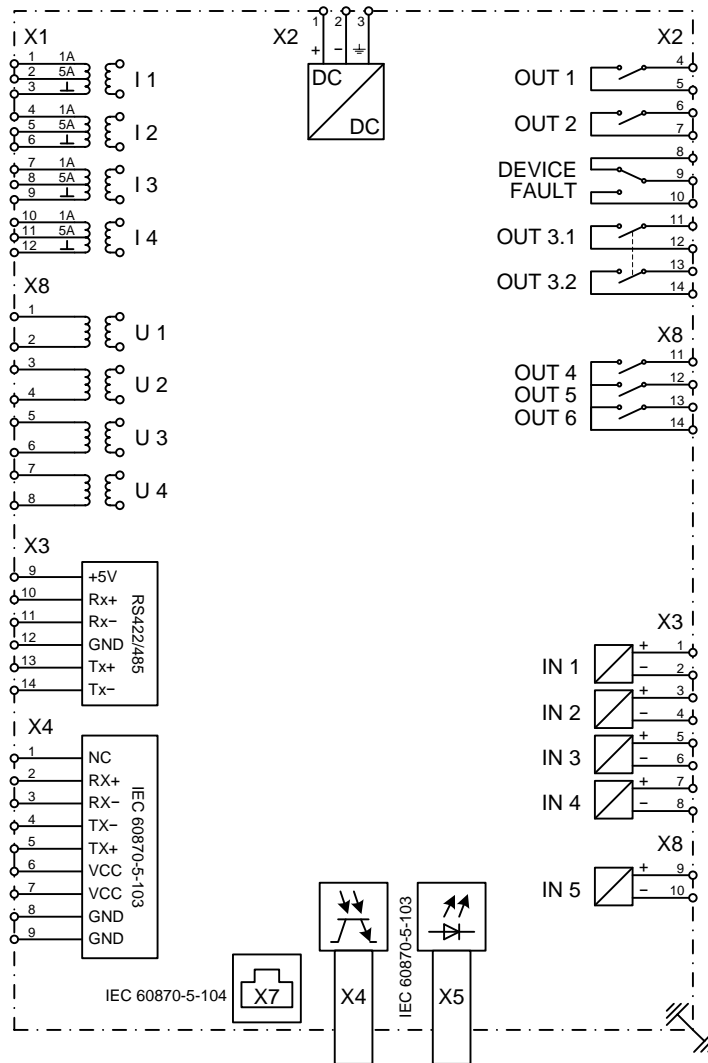


Fig. 30 Connection example DRS-LP82



### 5. Further documents

Document		Item Number
DRS	Protective Functions Library	DID-001-1
DRS-COMPACT2A	Local Operation Using Keypad and Display	DIC-006-1
DRS-COMPACT2A	Operating & Maintenance Manual	DIC-025-1
DRS	Description of the Multifunction System UAKB	DIC-033-1
DRS-LIGHT	Short Technical Description	MIL-001-1
DRS-LIGHT	Local Operation Using Keypad and Display	DIL-001-1
DRS-LIGHT	Operation Manual	DIL-000-1
DRS-WIN4	Operation Manual	DID-038-1 or SID-401-1.XX/93

The listed documents are available only in English and German.

Visit also the download area for these manuals, further documentation, drivers and contact information.<sup>5</sup>

<http://www.andritz.com/index/hydro/hy-downloads/hy-drs-download.htm>


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<sup>5</sup> Address as valid on 2013-02-22



**LED Indications for DRS-COMPACT2A / DRS-LIGHT**

Please mark the LED status in the figure below:

● for steady light  
 for flashing light

**DRS-COMPACT2**



-   1
-   2
-   3
-   4
-   5
-   6
-   7
-   8
-   9
-   10
-   11
-   12
-   13
-   14

**DRS-LIGHT**



-   1
-   2
-   3
-   4
-   5

Legend

- ye yellow LED
- rd red LED
- gn green LED
- 1<sup>st</sup> row relay status indication
- 2<sup>nd</sup> – 14<sup>th</sup> row protective function alarm and trip indication (DRS-COMPACT2A)
- 2<sup>nd</sup> – 5<sup>th</sup> row protective function alarm and trip indication (DRS-LIGHT)

If all LED are dark please check the power supply of the relay:

(DRS-COMPACT2A / DRS-LIGHT: relay terminals -X2:1 '+',-X2:2 '-')

- YES
- NO

If YES is selected continue with the following instructions otherwise check the DC circuit for the relay power supply.

**Display Indications for DRS-COMPACT2A / DRS-LIGHT**

Is there any information displayed at the display:  YES  
 NO INFORMATION / DISPLAY IS DARK

If YES is selected continue with the following instructions.

Please enter the displayed information in the figure below:

If the display shows *DRS FAULT !* in the first row press



And enter the information now displayed in the figure below:

**Connection to PC for DRS-COMPACT2A / DRS-LIGHT**

Is it possible to connect to the relay with the operating software *DRS-WIN*:  YES  
 NO

If *YES* is selected continue with the following instructions.

Please choose the item *DRS Fault Status* in menu *System* and enter the displayed information below:

.....

Please save the event protocol to the hard disc and attach it to this report.  
Please save the disturbance records to the hard disc and send it to an ANDRITZ HYDRO representing.

**Address for delivery of relays for fault investigation and repair works**

ANDRITZ HYDRO GmbH  
Mr. Alexander Rach / Dep. AT-PRT  
Eibesbrunnergasse 20  
1120 Vienna  
Austria