

REX 521 Protection Relay

Operator's Manual



We reserve the right to change data without prior notice.

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Revision history

Version C/4.9.2002:

- changes in chapters: "REX 521 Protection Relay", "HMI features", "Push-button functions", "Display backlight", "Selecting primary values", "Menu chart", "Measurement menu", "Event menu", "Controlling the breaker", "Setting a parameter", "Test mode"
- new sections: "IRF test" and "Function test"

1. Safety information

	Dangerous voltages can occur on the connectors, even though the auxiliary voltage is disconnected
	National and local electrical safety regulations must always be followed
	The device contains components that are sensitive to electrostatic discharge
	The frame of the device has to be carefully earthed
	Only a competent electrician is allowed to carry out the electrical installation
	Non-observance can result in death, personal injury or substantial property damage
	Breaking the sealing tape on the rear panel of the device will result in loss of warranty and a proper operation will no longer be guaranteed

2. Introduction

The purpose of this manual is to provide the user with the basic information on the REX 521 and to focus especially on explaining the use of the Human-Machine Interface (HMI).

2.1. REX 521 protection relay

The protection relay REX 521 is designed for protection, control, measuring and supervision in medium voltage networks. Typical applications include incoming and outgoing feeders as well as substation protection. The protection relay is provided with energizing inputs for conventional current and voltage transformers. Also a hardware version with inputs for current and voltage sensors is available.

The protection relay is based on a multiprocessor environment. The HMI including an LCD display with different views makes the local use easy and informs the user via indication messages. Modern technology is applied both in hardware and software solutions.

The REX 521 is part of the substation automation concept for Distribution Automation and extends the functionality and flexibility of the concept further.

3. Instructions

3.1. HMI features

- Push-buttons for navigating, [C] clear/cancel and [E] enter
- Language selection
- Setting values are protected by passwords
- Display backlight
- Display contrast
- Display test
- Selection of primary values
- Optically isolated serial communication port

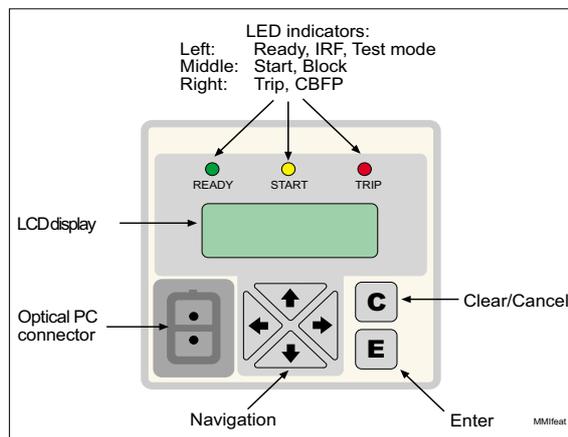


Fig. 3.1.-1 HMI front view

3.1.1. Push-button functions

The HMI includes push-buttons for operating the protection relay.

A quick touch on the arrow button up [↑] or down [↓] is interpreted as one step upwards or downwards in a menu or as the minimum step up or down in setting mode of a parameter.

- The cursor stops at the first and last rows in a menu; pressing the [↑] button at the first row or [↓] button in the last row is ignored.
- If the [↑] or [↓] button is kept pressed, the menus are automatically scrolled faster than with single button pressings.

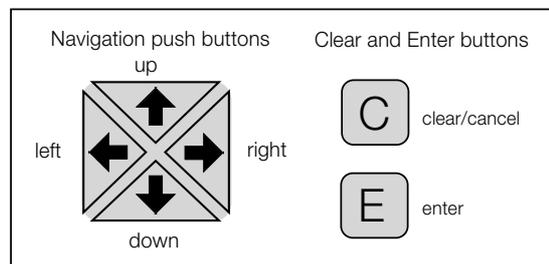


Fig. 3.1.1.-1 Push-buttons

The table below gives a short explanation of the push-buttons and their functions.

Table 3.1.1-1 Push-button functions

Up/Down		These buttons are used for: <ul style="list-style-type: none"> • moving up and down in menus • scrolling active digits of a parameter when entering a new setting value
Left /Right		These buttons are used for: <ul style="list-style-type: none"> • moving left and right in menus • changing the active digit of a parameter when entering a new setting value
Clear/Cancel		This button is used for: <ul style="list-style-type: none"> • leaving setting mode without saving values • returning to the main view from submenus • clearing indication messages • resetting latched output relays (press 5 s, the text "Reset" is displayed on the HMI) • clearing events when the event view is selected (press 2 s)
Enter		This button is used: <ul style="list-style-type: none"> • for entering setting mode of a parameter • for confirming a new value of a setting parameter • in combination with the [↑] or [↓] button for adjusting the display contrast
Clear/Cancel & Enter		These buttons are pressed simultaneously for 5 s for: <ul style="list-style-type: none"> • resetting latched output relays, events and all registered values (the text "Master reset" is displayed on the HMI) • clearing the disturbance recorder data

3.1.2.

Selecting language

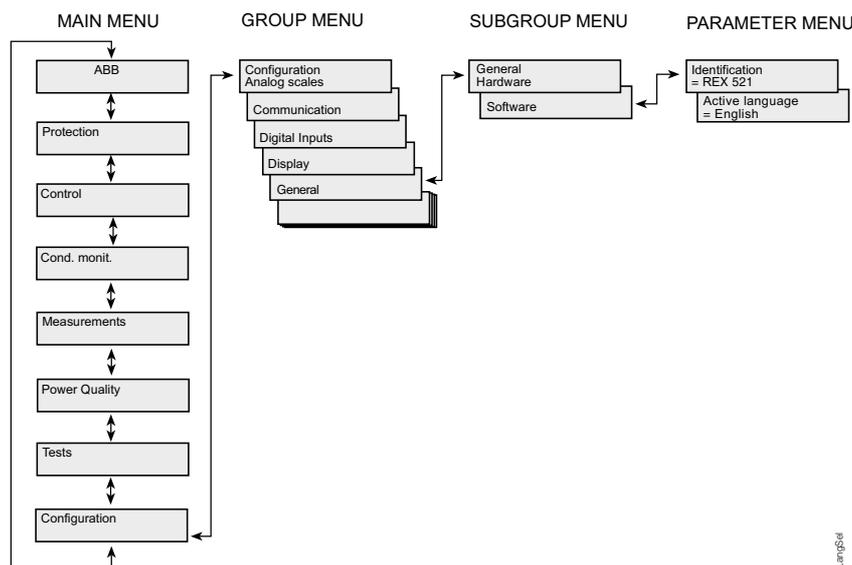


Fig. 3.1.2.-1 Selecting language

1. Select with [↓] and [→] buttons Configuration in the main menu, General in the group menu, Software in the subgroup menu and Active language in the parameter menu.
2. Press the [E] button until the second row of the display starts flashing. Then select the wanted language with [↓] and [↑] buttons.
3. Confirm the selection by pressing the [E] button once more or cancel the selection by pressing the [C] button.

After altering the language, the display menus are shown in the new language and the selection is restored after disconnection of power supply.

3.1.3.

Passwords

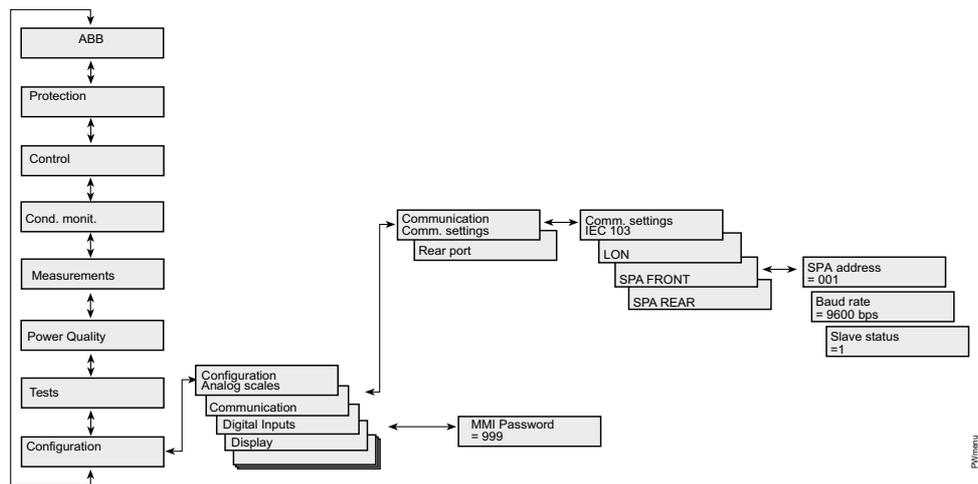


Fig. 3.1.3.-1 Password menus

Setting values are protected by passwords. There are two different passwords, one for protecting the HMI setting values and another for protecting settings through serial communication.

- The default value of the serial communication password is 001 and of the HMI password 999.
- The HMI password is not active until it has been changed from the default value. After changing it, the relay prompts for password whenever the [E] button is pressed in a setting value menu. Once the right password has been given, it stays active until the display is returned to idle state by time-out. To disable the HMI password, change it back to the default value 999.
- In case a password is forgotten, the HMI password can be viewed and changed via serial communication.

3.1.4. Display backlight

The back light of the display is normally off. When a button on the HMI is pressed, the back light turns on automatically and the panel is ready for further operations.

- At power up, the back light is also turned on during the display test
- After a time-out period (5 min), the back light is automatically switched off if there has not been any activity on the panel.
- When changing between Local/Remote mode by a digital input, the backlight is turned on for 10 seconds.

3.1.5. Display contrast

The display contrast is temperature compensated, which means that the contrast automatically adjusts itself with temperature to preserve readability.

- To obtain optimal readability, the contrast of the display can be adjusted. Pressing simultaneously the [E] button and [↑] or [↓] button increases or decreases the contrast.

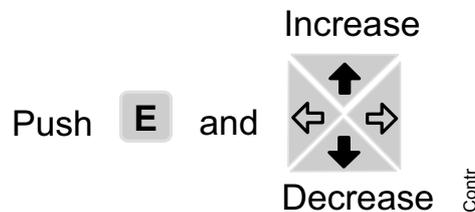


Fig. 3.1.5.-1 Adjusting display contrast

- The display contrast may be adjusted anywhere in the menu structure except in the setting menus where the [E] button is used for entering setting mode.
- The selected contrast value is stored in a non-volatile memory and thus, after an auxiliary power failure, the contrast is restored automatically.

3.1.6. Display test

Upon auxiliary voltage connection, the back light is turned on and a short display test is run. This display test includes all the LEDs and the LCD. The LEDs are tested by turning them on simultaneously while the LCD shows two patterns so that all the pixels are activated. After the test, the display returns to normal state.

- The display test can also be started manually by navigating to Configuration\Display\Test display and then select Test display. Please, refer to section “Menu chart” on page 12.

3.1.7. Selecting primary values

The setting values, input data and recorded values that are relative to some quantity can be obtained directly in amperes and volts. For the relay to know how to convert between primary and per unit values, the setting values describing the measurement devices (CT, VT, VD, RS) need to be properly set.

1. Navigate to Configuration\Display\Primary values and select Primary values instead of the default Per unit values.

2. Navigate to Configuration\Meas. devices and enter the data for all CTs and VTs, VD's and RSs that are in use in that particular hardware. Please refer to Technical Reference Manual, General (1MRS 751108-MUM) sections "Setting the rated values for the protected unit" and "Technical data of the measuring devices".

3.1.8.**Optically isolated serial communication port**

The front panel of the protection relay is provided with an optical serial communication connector. The connector is used for programming the relay with a PC via a RS-232 cable, type 1MKC950001-1.

3.2.

Menu chart

The contents of the menu chart depend on the configuration of the relay. However, the main menu structure is always preserved.

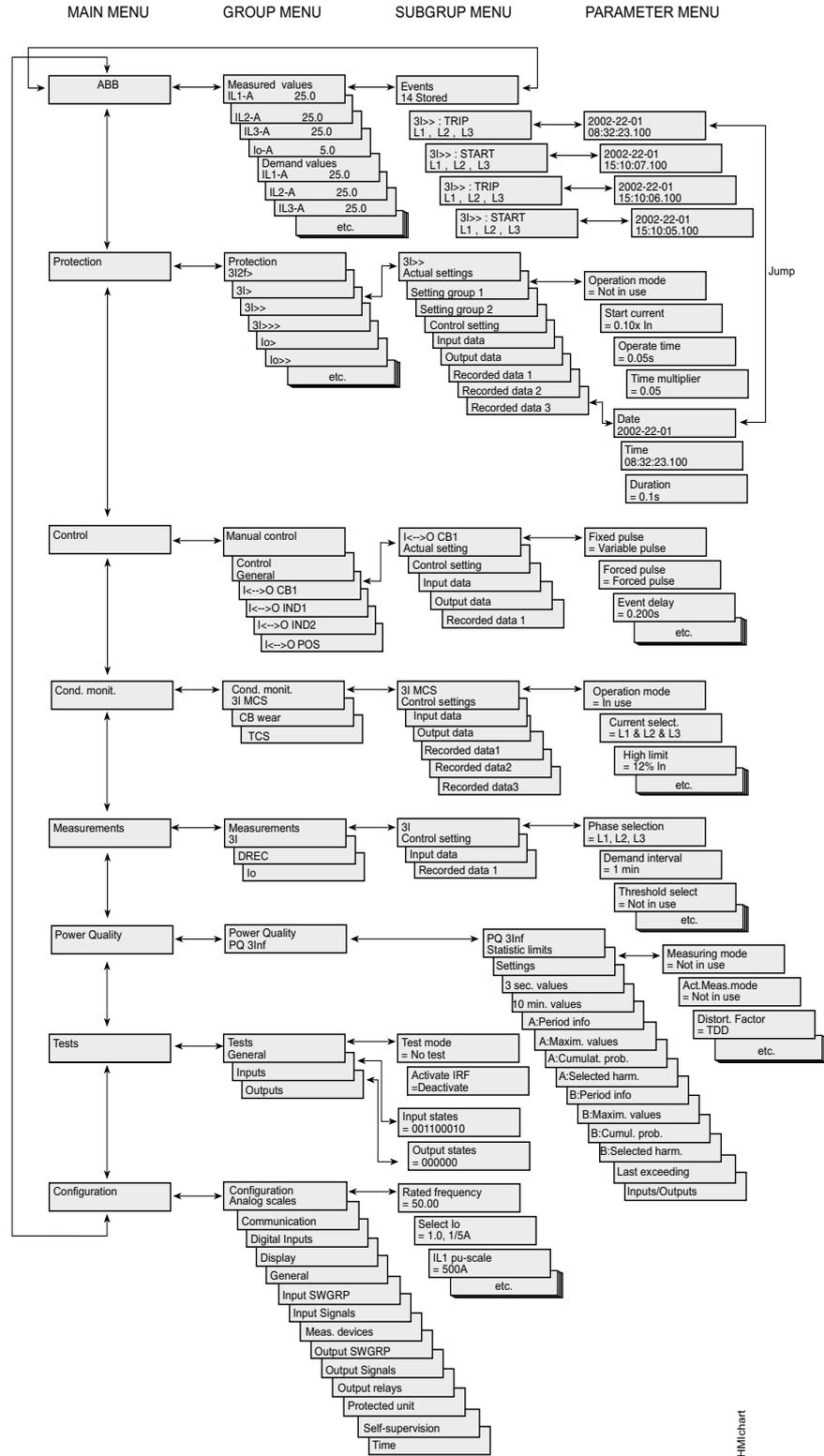


Fig. 3.2.-1 Menu chart structure

3.2.1. Measurement menu

The contents of the measurement menu depend on the measurement function blocks part of the relay configuration.

If a measurement view is selected, it remains active after the time-out period. The same is true with the manual control view. From other views, the display reverts to idle mode at the same time as the back light is switched off.

- If energy measurements are present, accumulated values may be reset by pressing the [C] button for 2 s.

Table 3.2.1-1 Measurement view

Function block	Measurand	View
3I Io	IL1 (A) IL2 (A) IL3 (A) Io (A)	
Uo 3U f	Uo (V) U1 (kV) U2 (kV) U3 (kV) f (Hz)	
PQE	P (kW) Q (kvar) E (kWh, kvarh)	

3.2.2. Event menu

The event menu (Main menu\Measured values\Events) contains the function block name and the event in the same manner as the indication messages (See "Indication messages" on page 18.). The first view of the event menu shows the amount of events (maximum 50). The most recent event is stored on top of the list.

When a certain event is selected, date and time of the event in question can be read by moving one step right with the [→] button. If the event in question is a trip event and its' data in the recorded data menu (Main menu\Protection\...\Recorded data1\...3\) has not been overwritten, it is possible to move directly to the associated recorded data by moving right [→] again in the date and time view. Return to the event view with the [C] button or with the [←] button, like in normal menu navigation. When viewing the recorded data, the return is directed to the event summary view (Main menu\Measured values\Events) if

- the recorded data is overwritten or
- the original event is overwritten in the event list or
- the event list is cleared.

These events are stored in the non-volatile memory, which means that they can be seen also after disconnection of power supply. When displayed, the event list may be cleared by pressing the [C] button for 2 s.

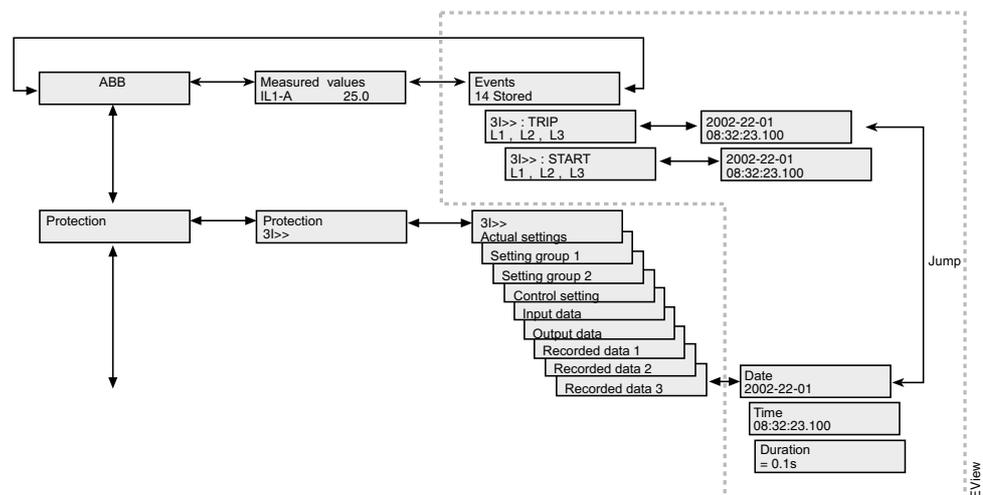


Fig. 3.2.2.-1 Event view

3.2.3. Manual control

3.2.3.1. Local/Remote position selection

The control position can be changed in Control\Manual control\Local/Remote.

- The control mode can be selected by pressing the [E] button and using the [↑] and [↓] buttons.
- The [E] button confirms the selected mode and the [C] button cancels the selection and keeps the current mode.

For password handling, refer to section "Passwords" on page 9.

Table 3.2.3-1 Control positions

Control position	Description
Control off	Local and remote operations are inhibited. The current state of the object is shown in the control menu.
Local	Object can be controlled from the HMI and the digital inputs. Remote control is inhibited.
Remote	Object can be controlled via remote communication. Control from the HMI and digital inputs is inhibited and the object state is shown in the control menu.
External input	The digital input programmed for selector Local/Remote is used for selecting between local and remote modes. When selected the mode will be displayed as <code>Local (ext.)</code> or <code>Remote (ext.)</code> depending on the digital input state.

The selected control position remains the same during auxiliary power-off.

3.2.3.1.

Controlling the breaker

The object control menu is in `Control\Manual control\Control CB`. Only the current position of the breaker is shown and no control is possible in remote or control off mode. In local mode the state of the breaker is shown and the possible target states can be scrolled with `[→]` and `[←]` buttons. Possible target states are open and closed. When the desired target state is selected the object can be selected by using the `[E]` button.

Message `=Preparing...` can be briefly shown before the text `=Are you sure?` is displayed. The operation can then be confirmed with the `[E]` button and cancelled with the `[C]` button. If the operation is cancelled the text `=Aborted` is displayed for three seconds and then the current state of the breaker is shown. The same happens if the `=Are you sure?` has been displayed for 30 seconds.

Notice that an adjustable timeout in `Control\General\Select timeout` restricts the time between the object selection and the control request. If the timeout is shorter than 30 seconds and it elapses before the operation is confirmed, controlling the object will not be possible before the object is selected again. If the operation is confirmed, the appropriate transition text (`=Opening...` or `=Closing...`) is shown for at least four seconds after which the current state of the object is shown.

The current state of the interlocking of the object can prevent the select or execute request. In that case the text `=Interlocked` is displayed for three seconds. The attempted operation is cancelled and after the three seconds the current state of the object is displayed.

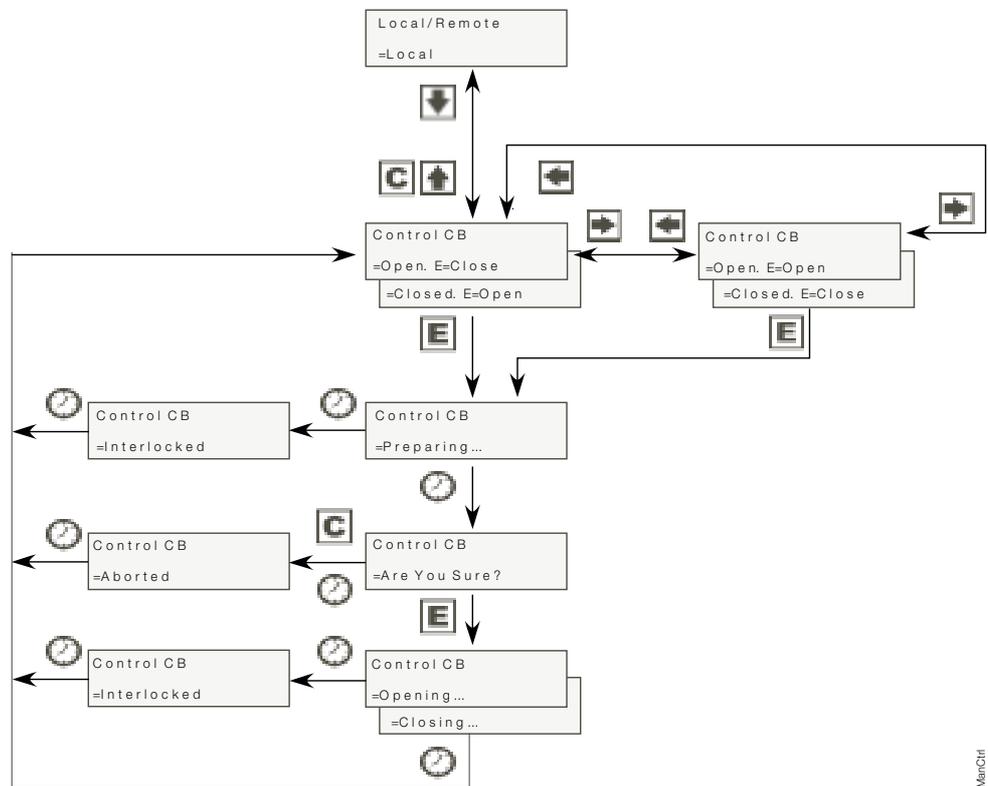


Fig. 3.2.3.-1 Manual control

Table 3.2.3-2 Manual control messages

Message	Meaning
Aborted	The current operation was aborted either by user or state change in object status or timeout.
Are you sure?	Waiting for confirmation for the selected operation. [E] accepts it and [C] cancels it.
Closed	Object state is closed. Control is not possible due to remote or control off state.
Closed. E=Close	Object state is closed. [E] will close it.
Closed. E=Open	Object state is closed. [E] will open it.
Closing...	Object is being closed.
External change	Local/remote state controlled by digital inputs has changed. Only in external input mode. Cancels current operation if any.
Failed	Executing the control request failed. The reason was not interlocking.
Interlocked	Selecting the object or executing the control request failed due to interlocking.
Not allowed	Selecting the object failed. The reason was not interlocking.
Not local	Attempted to control the object in remote or control off state.
Open	Object state is open. Control is not possible due to remote or control off state.
Open. E=Close	Object state is open. [E] will close it.
Open. E=Open	Object state is open. [E] will open it.
Opening...	Object is being opened.
Preparing...	Object is being selected.
Undefined	Object state is undefined. Control is not possible.
Unresolved	Object state is unknown.

3.2.4. Setting a parameter

The setting parameters are listed in the CD-ROM Technical Descriptions of Functions (1MRS750889-MCD).

1. Navigate to the right parameter using the buttons [↑], [↓] and [→], [←] and the menu chart structure as reference.
2. Activate setting mode by pressing the [E] button.
3. If the HMI password has been changed from the default, it is now prompted. Enter the valid password changing the active digit by the buttons [←] and [→] and setting the digit value by the buttons [↑] and [↓].
4. Once the password has been entered, press the [E] button to confirm. Now the selected setting value starts flashing.
5. Enter the new setting value using the buttons [↑], [↓] and [→], [←].
6. Press the [E] button to confirm.
7. If the new value is within the allowed limits, it is now stored in the non-volatile memory and restored after disconnection of power supply.
8. If an illegal setting value is confirmed, a message in the display tells the user that the setting is out of range by showing the message `Invalid value`, and the previous parameter value remains unchanged. The `Invalid value` message is also shown when trying to set a parameter which requires test mode and the relay is not in test mode.

3.2.5. Setting bit masks

Event masks and switchgroups are presented as bit masks with a checksum. Most of the events can be included in or excluded from the event reporting by altering the bits of the event masks. Switchgroups are used for changing the connections of inputs and outputs to the relay function blocks.

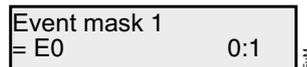


Fig. 3.2.5.-1 Bit mask in setting mode

When navigating in menus containing bit masks, only the checksum is shown. If setting mode is entered, the single bit presentation (bit 0, value 1, in the example above) appears in the rightmost lower corner of the display. The contents of the bit mask may be altered by entering single bit values. However, the new values are not valid until setting mode has been exited by pressing the [E] button.

1. Navigate to the right parameter using the buttons [↑], [↓] and [→], [←] and the menu chart structure as reference
2. Activate setting mode by pressing the [E] button.
3. If the HMI password has been changed from the default, it is now prompted. Enter the valid password changing the active digit by the buttons [←] and [→] and setting the digit value by the buttons [↑] and [↓].
4. Once the password has been entered, press the [E] button to confirm. Now the selected setting value starts flashing.
5. Enter the new setting value using the buttons [↑], [↓] and [→], [←].
6. Press the [E] button to confirm.

When entering single bit values, the bit to be edited may be shifted by pressing the [→] button when the cursor is located in the rightmost corner of the display. In that way, the cursor does not have to be moved back and forth between the bit number and the value during the setting period, thus simplifying the procedure.

To find the meaning of each event, refer to Event List for REX 521 (1MRS752000-RTI) on the CD-ROM Technical Descriptions of Functions (1MRS750889-MCD).

3.3. Indication messages

There are two different kinds of indication messages:

- A text message together with a LED indication.
This type of messages are related to information from the protection functions and information concerning the condition of the protection relay (self-supervision).
- A text message without a LED indication.
This type of messages are related to condition monitoring, alarms and warnings or help texts appearing when certain display operations are performed.

Indication messages have a certain priority. If different types of indications occur simultaneously, the message with the highest priority appears on the display. Priority order of the messages:

1. Internal fault, CBFP
2. Trip
3. Start, Block
4. Help messages

Indication messages may be cleared with the [C] button, until the display reverts to the menu active before the events.

Help messages are displayed when certain operations are done. For example, when resetting output relays, events and registered values by pressing the [C] and [E] buttons for 5 s, a help text describing the operation is displayed at the same time.

3.3.1. Protection indications

When a protection function starts, the symbol of the protection function and the text START are displayed. The corresponding yellow LED indicator is also lit. In case of three-phase or two-phase protection functions, the faulted phases are displayed as well.

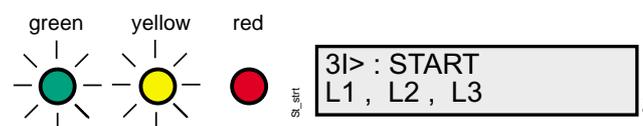


Fig. 3.3.1.-1 Indication of start

If a started protection function is blocked, the name of the function and the text BLOCK are displayed. Now, the yellow LED indicator is flashing.

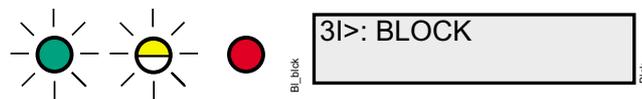


Fig. 3.3.1.-2 Indication of blocking

If a protection function trips, the name of the function and the text `TRIP` appear on the display. The red LED indicator is lit. The faulted phases are displayed in this case.

Should the protection function deliver a delayed trip for circuit-breaker failure protection (CBFP), the red indicator starts blinking.

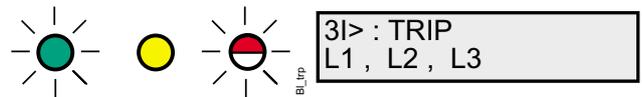


Fig. 3.3.1.-3 Indication of trip

3.3.2.

Self-supervision

The protection relay is provided with an extensive self-supervision system. The self-supervision system handles run-time fault situations and informs the user about existing faults over the display and the serial communication.

When a fault has been detected, the green `READY` indicator starts blinking. At the same time, the self-supervision (IRF) output relay is activated.

Additionally, a fault indication text `INTERNAL FAULT` appears on the display and an event is generated.

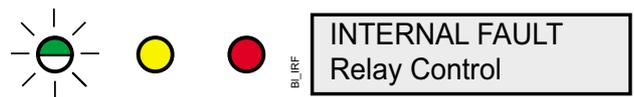


Fig. 3.3.2.-1 Indication of fault

The fault indication has the highest priority and no other indication can overrun it. The fault indication text is displayed until it is cleared by pressing the [C] button or until a reset occurs.

The green `READY` indicator continues blinking as long as the fault is present.

Should the fault disappear after a reset, the indicator stops blinking and an event is generated over the serial communication. The self-supervision (IRF) output relay is returned to its normal state.

3.3.3.

Condition monitoring indication

If the relay configuration includes condition monitoring functions that are not directly related to any protection function or to the internal relay condition, indication messages with the message `SUPERV` and an explanatory text appear if faults are found.

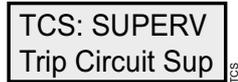


Fig. 3.3.3.-1 Condition monitoring indication

3.4. LED indicators

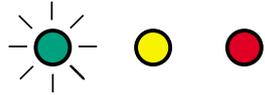
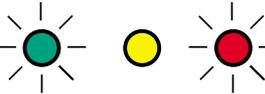
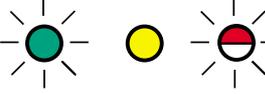
3.4.1. Green indication LED (READY)

<p>Non-active LED: OFF</p>	<p>Auxiliary supply voltage has been disconnected. Check that the auxiliary voltage is disconnected before taking any further action.</p>
<p>Steady LED: READY</p>	<p>Normal operation.</p>
<p>Blinking LED: IRF or TEST MODE</p>	<p>Internal relay fault (IRF) has occurred or the relay is in test mode¹⁾. Internal faults are accompanied by an indication message, provided the HMI panel is operative.</p> <p>¹⁾ - Relay - Function block</p>

3.4.2. Yellow indication LED (START)

<p>Non-active LED: OFF</p>	<p>Normal operation mode. No function has started.</p>
<p>Steady LED: START</p>	<p>A protection function has started and an indication message is displayed. The start indication can be selected to be of latching/non-latching type. Non-latching means that the indicator is deactivated when the fault disappears while latching means that the indicator remains lit until cleared by pressing the [C] button. Should several protection functions start within a short time, the last start is indicated on the display.</p>
<p>Blinking LED: BLOCK</p>	<p>A protection function is blocked. The blocking indication disappears when the blocking is removed or when the protection function is reset. A message indicating which function has been blocked appears on the display. Should several protection functions be blocked within a short time, the last blocked function is indicated on the display. Blocking indications have higher priority than start indications.</p>

3.4.3. Red indication LED (TRIP)

<p>Non-active LED: OFF</p> 	<p>Normal operation mode. No function has tripped.</p>
<p>Steady LED: TRIP</p> 	<p>A protection function has tripped and an indication message is displayed. The trip indication is latching, i.e. it must be reset by pressing the [C] button or via the serial communication. If several protection functions trip within a short time, the indication of the first tripping remains on the display until the time determined by the "new trip indication" setting value has expired. After this, a new trip indication overwrites the old one. This setting value can be set to indefinite; in this case, the first trip indication remains on the display until reset.</p>
<p>Blinking LED: TRIP (CBFP)</p> 	<p>Trip with CBFP (circuit-breaker failure protection). The indication is reset by pressing the [C] button.</p>

4. Test mode

Digital inputs, output relays and IRF relay may be tested by setting the parameter `Test mode` to `Testing` in the menu `Main menu\Tests\General`.

When test mode is activated, the green `READY` indicator is blinking. See `Technical Reference Manual, General (1MRS 751108-MUM)` for further information.

Test mode can be cancelled by setting the parameter to `No test` or by disconnecting the power supply.

If the user does not cancel the test mode, it remains active and the Ready LED remains blinking.

4.1. I/O test

The picture below shows the menu used for digital input testing (`Tests\Inputs`) in the hardware variant with nine digital inputs. The digits correspond to the inputs `DI1...DI9`, starting from the right side.

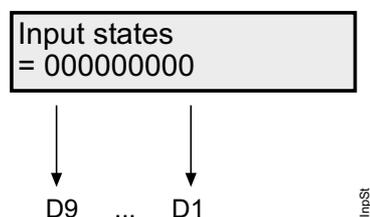


Fig. 4.1.-1 Digital input testing

The following picture shows the menu used for output relay testing `Tests\Outputs`. Observe that the self-supervision relay is activated in another menu and is thus not included in this menu. The relays are activated in the order: `SO`, `PO` and `HSPO`, starting from the right side.

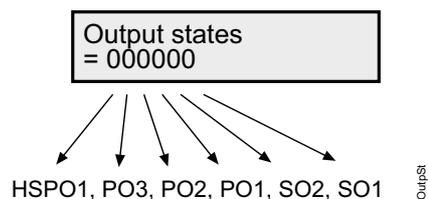


Fig. 4.1.-2 Output relay testing

4.2.**IRF test**

The IRF relay may be tested by activating the IRF relay in the menu `Main menu\Tests\General\Activate IRF`.

4.3.**Function block test**

The outputs (Start and Trip) of a function block can be activated locally via the HMI or externally via serial communication. This is possible without setting the relay in test mode as described in “Test mode” on page 22. The outputs are activated by using control parameters of the function. For further details of functions, refer to the CD-ROM Technical Descriptions of Functions (1MRS750889-MCD).

5. References

Manuals for the REX 521

- Technical Reference Manual, Standard Configurations 1MRS 751802-MUM
- Technical Reference Manual, General 1MRS 751108-MUM
- Installation Manual 1MRS 750526-MUM
- Technical Descriptions of Functions (CD-ROM) 1MRS 750889-MCD

Parameter and event lists for the REX 521

- Parameter List for REX 521 1MRS 751999-RTI
- Event List for REX 521 1MRS 752000-RTI
- General Parameters for REX 521 1MRS 752156-RTI
- Interoperability List for REX 521 1MRS 752157-RTI

Tool-specific manuals

- CAP505 Installation and Commissioning Manual 1MRS 751273-MEN
- CAP505 Operator's Manual 1MRS 751709-MEN
- Tools for Relays and Terminals, User's Guide 1MRS 752008-MUM

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