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This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The product is designed in accordance with the international standards of the IEC 60255 series.
Safety information

The busbar protection system REB500 corresponds to the latest practices and guidelines and complies with the recognized safety rules. Nevertheless, care must always be taken to avoid danger.

Only use the busbar protection system when it is in perfect working order and in strict accordance with these operating instructions.

Dangerous situations can arise if the equipment is used improperly, especially if the user changes the configuration.

Live electrical equipment is in the immediate vicinity of REB500. Before working on the system, always ensure that it is impossible to come into contact with, or even close to live parts.

The busbar protection system REB500 can initiate operation of items of electrical plant (circuit-breakers and isolators). Before working on the equipment, always ensure that unwanted operation is inhibited or has no effect on persons or plant.

Strictly observe all safety precautions (interlocks, locks and blocking devices), especially those issued for the specific station.

Only properly authorized, professionally qualified and correspondingly trained personnel, who have also read and understood the operating instructions, may work on the system.

Dangerous voltages can occur on the connectors, even though the auxiliary voltage has been disconnected.

Non-observance can result in death, personal injury or substantial property damage.

Only a competent electrician is allowed to carry out the electrical installation.
National and local electrical safety regulations must always be followed.

The frame of the IED has to be carefully earthed.

Whenever changes are made in the IED, measures should be taken to avoid inadvertent tripping.

The IED contains components which are sensitive to electrostatic discharge. Unnecessary touching of electronic components must therefore be avoided.

Take care never to open the secondary circuits of CTs conducting current.

There is a danger of contact with live parts when opening REB500 cubicle doors.

Electrostatic discharge can destroy components in the equipment.

Other safety instructions pertaining to particular operations are contained in the respective chapters of the operating instructions.
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Distributed busbar protection REB500
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Section 1  Introduction

1.1  This manual

The operation manual contains instructions on how to operate the IED once it has been commissioned. The manual provides instructions for monitoring, controlling and setting the IED. The manual also provides trouble shooting instructions.

1.2  Intended audience

This manual addresses the operator, who operates the IED on a daily basis.

The operator must be trained in and have a basic knowledge of how to operate protection equipment. The manual contains terms and expressions commonly used to describe this kind of equipment.

1.3  Product documentation

For an introduction into REB500, it is recommended to study the Product Guide and/or the Application Manual.

<table>
<thead>
<tr>
<th>Manual</th>
<th>Document number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Guide</td>
<td>1MRK 505 319-BEN</td>
</tr>
<tr>
<td>Application Manual</td>
<td>1MRK 505 333-UEN</td>
</tr>
<tr>
<td>Technical Manual</td>
<td>1MRK 505 335-UEN</td>
</tr>
<tr>
<td>Operation Manual</td>
<td>1MRK 500 121-UEN</td>
</tr>
<tr>
<td>Commissioning Manual</td>
<td>1MRK 505 336-UEN</td>
</tr>
<tr>
<td>Cyber Security Guideline</td>
<td>1MRK 511 345-UEN</td>
</tr>
<tr>
<td>Communication Protocol Manual, IEC 61850</td>
<td>1MRK 511 342-UEN</td>
</tr>
</tbody>
</table>
1.4 Symbols and conventions

1.4.1 Symbols

The electrical warning icon indicates the presence of a hazard which could result in electrical shock.

The warning icon indicates the presence of a hazard which could result in personal injury.

The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader of important facts and conditions.

The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

1.4.2 Document conventions

A particular convention may not be used in this manual.

- Abbreviations and acronyms in this manual are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons, e.g.:

  To navigate the options, use \[ \text{and } \].
Section 2  System Overview

Figure 1  System overview
The digital busbar protection REB500 is divided into several hardware units. Bay units measure the line and bus-tie breaker currents and may be installed close to the respective CTs. They communicate with the central unit via a process bus. The central unit processes the current signals measured by the bay units and distributes the tripping signals back to the bay units in the event of an internal busbar fault. The system can be controlled by a local HMI (LHMI) on the Central unit and Bay units, by comprehensive external HMI software, or a remote HMI over a station bus connection. Communication with the station automation system (SAS) is possible via the central unit.

When configuring the IP-address for the LHMI Ethernet port to the fixed value of 192.168.0.1, a DHCP server functionality will be activated on this port. A maximum of 10 IP addresses will be assigned automatically, when connected. This functionality is available on the LHMI port only. Information on how to configure different IP-addresses can be found in chapter 3.9.5.2.
Section 3  
HMI500

3.1  
Introduction

This section describes the human/machine interface (HMI) for the protection systems REB500. For a detailed explanation of signals and parameters see “Technical manual”. For a description of fault finding actions see Section 5 “Fault finding”. For details on security settings see “Cyber security guideline”.

HMI500 is a convenient human-machine interface which permits the operator to view measurements and statuses, to set protection functions, to configure the system, to download the latter data to REB500, and to control the disturbance recorder and event memory integrated in the system.

The data are transferred between the PC and REB500 via an Ethernet interface attached to the front of the central or bay units. The PC can be connected of the station bus as well.

Any changes (e.g. settings, configuration etc.) made using HMI500 are stored in a specific customer database (MS Access database file) on the PC and not in the protection system. The database then has to be downloaded from the PC to the protection system (see Section 3.4.1.).

3.2  
Safety instructions

HMI500 permits circuit-breakers and isolators to be operated. Every program operation and the possible consequences must be considered carefully beforehand. If switching operations have to be carried out, the same precautions must be taken as when performing them manually.

Earlier HMI500 versions are incompatible with Version 8.00 of the protection system software.

When the HMI500 software establishes communication with a REB500 system initially user must enter a password. For details about security management, passwords and security options refer to “Security Deployment Guideline” (1KHL020774-Aen)
3.3 Basic setup

3.3.1 Installation

The human-machine interface program HMI500 is supplied on an installation CD. It can be installed on Windows XP or Windows 7.

Insert the CD-ROM in the drive. The CD Navigator starts then automatically. Should the auto-start function on your PC be disabled, select and run the program autostart.exe on the CD to start the CD-Navigator.

Select the preferred language and enter the HMI500 link which is placed under the section “IED Software”. The software installation procedure should start now. During this installation procedure you are requested to read and confirm your acceptance of the license conditions.

The installation program proposes an installation directory. Either confirm the proposed directory or enter a desired one. Make sure that you have appropriate access rights to the respective directory. Clicking “Next” starts the installation.

An HMI500 directory and program icon “HMI500 x.xx ll” are created in the Windows Start menu, x.xx signifying the program version and ll the language.

3.3.2 Uninstallation

To uninstall HMI500 open the Windows control panel and select “Add/remove programs”. In the list of programs select the entry for HMI500 and click on OK to remove the program.

3.3.3 Starting HMI500

The program screens in this section are based on a typical application. Depending on the power system configuration and the options configured while engineering your system, certain menus may be missing or the display appears different.

The first screen to appear after starting the operator program is the “System login” dialog:
The program can be run in a read only mode by ticking the “Read only” check box, i.e. the data can be viewed but not changed.

When the HMI500 software establishes communication with a REB500 system initially user must enter a password.

For details about security management, passwords and security options refer to the “Security Deployment Guideline”.

HMI500 obtains the specific device data from a database in a file, which is stored both in the PC and the protection system. Database files on the PC have the extension *.mdb.

Click on “OK” to continue start-up or on “Cancel” to close the program.

When you click on OK, HMI500 tests communication with the protection system and starts in the on-line mode if communication can be established. Otherwise it starts either in in off-line or simulation mode (see Section 3.9.5.).

Some of the dialogs used by the program are standard Windows dialogs, whose language depends on the language setting of the operating system.

The database that was open during the last session opens automatically. If no database was open before, select “Open” in the “File” menu and then the desired file. An error message is displayed if an attempt is made to open an incompatible file. An existing file in the protection system can also be opened using the “Upload” function in the “File” menu.
3.3.4 Window structure

The structure and handling of the windows in the operator program is similar to other Windows applications.

![Figure 3 Dialog buttons](image)

Table 1 summarizes the meaning of buttons that appear in many dialogs:

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK</td>
<td>The new settings are saved in the database on the PC and the dialog closes.</td>
</tr>
<tr>
<td>Apply</td>
<td>The new settings are saved in the database on the PC and the dialog stays open.</td>
</tr>
<tr>
<td>Restore</td>
<td>The changes that have been made are ignored and the old settings restored. The dialog stays open.</td>
</tr>
<tr>
<td>Cancel</td>
<td>The new settings are not saved and the dialog closes.</td>
</tr>
<tr>
<td>Scroll (arrow) buttons</td>
<td>In windows permitting the selection of several bays (or isolators, circuit-breakers etc.), there are four scroll buttons at the bottom for scrolling through the bays.</td>
</tr>
<tr>
<td>Close</td>
<td>The window or dialog is closed and a warning is displayed, if changes have been made which have not been saved.</td>
</tr>
</tbody>
</table>

In many dialogs for setting parameters, there are two tabs:

- Overview: Lists all bays and enables selecting one.
- Details: Shows the settings.

You can view the details of a bay by double-clicking on the bay in Overview or by selecting the bay and clicking on Details.

3.3.5 Main window

The title bar is at the top of the main program window and displays the station name. The menu bar is located immediately below the title bar.
Table 2  Main menu items

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>File</td>
<td>Permits databases to be opened and saved and a database to be uploaded from the protection or downloaded to it.</td>
</tr>
<tr>
<td>View</td>
<td>Contains menu items for viewing the plant diagram, the measurements of each protection zone, inputs and outputs, switchgear statuses, the event list and any tripping that has taken place.</td>
</tr>
<tr>
<td>Configuration</td>
<td>Concerns the definition of the licensed bay protection functions, the communication parameters, the binary input/output configuration, the event text configuration, the configuration of the LEDs on the local HMI and the disturbance recorder configuration.</td>
</tr>
<tr>
<td>Settings</td>
<td>Setting the operating values for the various protection functions, the parameters of the primary system objects (e.g. current transformers, voltage transformers, etc.) and the system parameters including the system behavior.</td>
</tr>
<tr>
<td>Testing</td>
<td>Enabling/disabling either the test or installation mode.</td>
</tr>
<tr>
<td>Tools</td>
<td>Functions for editing data file versions, producing reports, exporting SCS communication data, changing passwords, setting of security options and security account management, selecting operator program options and setting the system time.</td>
</tr>
<tr>
<td>Windows</td>
<td>Provides facilities for arranging open windows (cascade, tile vertically, tile horizontally, arrange icons).</td>
</tr>
<tr>
<td>? (Help)</td>
<td>Information details of the software version.</td>
</tr>
</tbody>
</table>

Status information is displayed on the bar at the bottom of the main window as shown in Figure 4.

<table>
<thead>
<tr>
<th>Field</th>
<th>Content</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Configurator</td>
<td>indicates that configurator mode is active (no target communication possible)</td>
</tr>
<tr>
<td>2</td>
<td>Operator</td>
<td>indicates that operator mode is active (target communication possible)</td>
</tr>
<tr>
<td>3</td>
<td>Online</td>
<td>Successfully established contact with the protection system.</td>
</tr>
<tr>
<td>4</td>
<td>Offline</td>
<td>No connection to protection system.</td>
</tr>
<tr>
<td>5</td>
<td>Simulation</td>
<td>All the functions can be executed without being connected to a protection device. Random values are generated when viewing protection unit data, e.g. event lists or measurements. Simulated faults can also be viewed.</td>
</tr>
</tbody>
</table>

Figure 4  Status bar

Table 3  Status bar content
3.4 File menu

Table 4 summarizes the options available in this menu. The subsequent subsections describe the menu items “Download to protection system...” and “Compare...” in greater detail.

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open...</td>
<td>Opens a database file stored on the computer's file system.</td>
</tr>
<tr>
<td>Save as...</td>
<td>Saves the currently open database to the computer's file system.</td>
</tr>
<tr>
<td>Upload from protection system...</td>
<td>Saves a database from the protection system to the computer's file system.</td>
</tr>
<tr>
<td>Download to protection system...</td>
<td>Sends a database file from the computer's file system to the protection system.</td>
</tr>
<tr>
<td>Compare...</td>
<td>Compares a database file on the computer's file system to the database of the protection system or to another database file on the computer's file system.</td>
</tr>
<tr>
<td>Exit</td>
<td>Terminates the program; displays a warning if there are changes that have not been saved. You then have the choice of saving or discarding them.</td>
</tr>
</tbody>
</table>
3.4.1 Download to protection system

Before downloading proceeds, the tool compares and displays the versions of the new database with the one in the protection system. You may also enter an index and a comment beforehand in menu “Tools/Version” (see Section 3.9.1). Data will only be saved if they are different or the version index is different.

Data can be correctly downloaded as soon as the user has been logged-in to the target device.

After the downloading procedure is complete, the protection system restarts. The valid version can then be verified on the HMI.

The progress of the downloading procedure is shown on the screen. The correct time format must be set via the control panel on the PC for the procedure to be presented correctly. The procedure can be interrupted by the user as far as “Archive data in the protection system”.

Figure 5 Download to protection system and comparison of versions
Various check sums are calculated to establish the integrity of the data in the database and these are examined after the transfer of data has been completed.

Only after all the data have been successfully transferred they are saved in the non-volatile memory. The auxiliary supply of the central unit must not be interrupted during this part of the procedure.

### 3.4.2 Compare

When selecting this menu item, the dialog shown in Figure 7 appears. See Table 5 for an explanation of all items in this dialog.
Figure 7  Comparison of system databases

Table 5  Dialog items of “Compare system database”

<table>
<thead>
<tr>
<th>Dialog Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second database is stored at PC</td>
<td>Compares the currently open system database with another database in the PC, which can be chosen by clicking on “Select file…” .</td>
</tr>
<tr>
<td>Second database is at target</td>
<td>Compares the currently open system database with the database in the protection system. For a faster but less detailed check, tick “Only compare checksum”.</td>
</tr>
<tr>
<td>Show only differences</td>
<td>Limits the scope of the report to the differences actually found.</td>
</tr>
<tr>
<td>Limit number of differences</td>
<td>The number entered here determines the number of differences that can be found before the current comparison operation is aborted.</td>
</tr>
<tr>
<td>Show pre-engineering changes only for feeders and switchgear objects</td>
<td>When this box is checked (default setting), the comparison is restricted to determining whether changes have taken place in relation to the pre-engineering data for bays and switchgear. Generally, the default settings should be retained as otherwise the number of differences that will be discovered increases considerably (events, signals etc., are then also taken into account)</td>
</tr>
<tr>
<td>Write log file</td>
<td>The results of the comparison are stored in a file.</td>
</tr>
<tr>
<td>Compare…</td>
<td>Starts the comparison operation</td>
</tr>
</tbody>
</table>
3.5 View menu

3.5.1 Single-line diagram

This menu item displays a diagram of the plant corresponding to the layout of the connection diagrams created by ABB. The screenshot in Figure 8 shows an example of a single-line diagram.

![Single-line diagram](image)

*Figure 8 Typical single-line diagram*

The name of every item of a plant can be changed by pointing at its symbol and clicking the right mouse button. This opens the “Change label” context menu to open the corresponding dialog. After entering the new name, click on “OK” to confirm.

Click the button “Update Status” or “Update Cyclically” to show the actual bay measurements and the state symbols of the configured breakers and isolators.

It is also possible to display the differential currents of the selected busbar zone. Point on the end of a busbar zone (e.g. BZ1) and click the right mouse button to get the corresponding context menu.

Click the right mouse button in an empty field in the single-line diagram to view a dialog with a list of the symbols used (see Figure 9). The buttons on the right
provide facility for changing the default colors for open, closed or invalid objects to suit your needs.

Figure 9  Updated single-line diagram

3.5.2  Protection zone measurements

This dialog displays the actual values of measured variables for each protection zone (restrained differential current of the bus bar protection function). The protection zones are determined by the positions of the isolators and the bus-tie breakers (bus bar image).

3.5.2.1  Overview

The currently active protection zones are listed in order showing the associated sections of busbar and the differential current per phase or in the neutral. The overview is not updated automatically. Click on “Refresh” to update the list.

A protection zone to which no measurement has been assigned, i.e. no bay unit current is processed by the busbar protection algorithm, is shown as invalid.

Protection zones that have been connected, e.g. via a pair of feeder isolators or a longitudinal isolator, are also presented.
Figure 10  Overview dialog for protection zone measurements

3.5.2.2  Detailed view

The feeders assigned to individual protection zones are listed in the detailed views of the relevant zones. The differential current, the restraint current and the stability factor are also displayed.
3.5.3 Analog input measurements

The bay units and their labels are listed in the overview dialog.

To display the values of measured variables select a device (row) and click on “Open measurements window”, or double-click on the device (row). Up to eight measurement windows can be open at the same time. “Arrange windows” arranges the windows below each other.

The display can be updated either manually by clicking on “Update measurement” or automatically by clicking on “Update cyclically”. This updates all open measurement windows.

A warning appears in the measurement window if measurements cannot be obtained correctly. Closing the overview window closes all the measurement windows as well.

For the selected bay unit, the phase-angles as well as the analog measurements (see Figure 12) are displayed. The currently valid reference channel, i.e. reference point for displaying phase-angles, is highlighted yellow. The user can change the reference channel by double-clicking on the desired one. The phase-angle display is not available on the other types of bay unit.
3.5.4 Binary input/output status

The binary inputs and outputs are listed in the overview dialog together with their bay labels (see Figure 13).

To view a signal status, select the corresponding device (row) and click “Open status window”, or double-click on the device (row). Up to eight status windows can be open at the same time. “Arrange windows” arranges the windows below each other.

The display can be updated either manually by clicking on “Update status” or automatically by clicking on “Update cyclically”. This updates all open status windows.

A status window shows either inputs or outputs. Two windows can be opened to view the inputs and outputs of a bay at the same time.

The number 1 indicates that the respective input or output is set, and 0 that it is reset. The statuses of all valid values are green; the status of an input or output that has been impressed is yellow (see Section 3.8.); and the statuses of inputs that the supervision function has tagged as being invalid are red. This can also occur briefly when the window is opened.
The signals assigned to each physical channel while configuring the binary inputs/outputs are displayed in the status window. Channels to which no signals were assigned are marked “No signal assigned”.

Closing the overview window closes all the status windows as well.

Further details of the signals assigned to the various binary inputs and outputs can be viewed by opening the “Configuration” menu and selecting “Binary inputs/outputs” (see Section 3.6.3).

3.5.5 Switchgear objects

The detailed view shows the statuses of circuit-breakers and isolators. If neither a closed nor an open position is defined, the status “invalid” is displayed.
### Switchgear objects

**Figure 14**  

<table>
<thead>
<tr>
<th>Switchgear object</th>
<th>Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>T1</td>
<td>closed</td>
</tr>
<tr>
<td>Q2</td>
<td>T1</td>
<td>open</td>
</tr>
<tr>
<td>Q0</td>
<td>T1</td>
<td>closed</td>
</tr>
</tbody>
</table>

**Feeder:** POWER TOWER  
**Device:** BU01  
**ABB reference:**  

---

**Section 3**  
**HMI500**  
**1MRK 500 121-UEN**  
**Operation Manual**  
**Distributed busbar protection REB500**
3.5.6 Protection zone circuit-breakers

The detailed view shows all the circuit-breakers belonging to the respective protection zone.

![Protection zone circuit-breakers, detailed view](image)

These circuit-breakers are intertripped, for example, in the event of a busbar fault in the respective protection zone.

3.5.7 Disturbance recorder

A disturbance recorder is integrated in every bay unit of the system which records the current measurements, the voltage measurements and up to 32 binary input and output signals during up to 40 recording periods (depending on the selected sample rate and recording time).
3.5.7.1 Overview

This tab displays the number of records and the current status of each bay unit. See Table 6 for an explanation of these statuses.

Table 6 Disturbance recorder statuses

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready</td>
<td>Disturbance recorder is ready to record disturbances.</td>
</tr>
<tr>
<td>Recording</td>
<td>A record procedure is in progress.</td>
</tr>
<tr>
<td>Not ready</td>
<td>The disturbance recorder has to be restarted in the detailed view of the bay</td>
</tr>
<tr>
<td>Full memory</td>
<td>Disturbance recorder memory is full</td>
</tr>
<tr>
<td>Not available</td>
<td>Disturbance recorder function is not active for the bay</td>
</tr>
</tbody>
</table>
Press “Shift” and click on the desired fields to select several fields at once. By clicking on the respective buttons below, you can apply a command to all selected bay units at once:

1. Open detailed views (button “Open window”)
2. Start recording
3. Upload records from selected disturbance recorders (Transfer disturbance records to computer)
4. Delete all disturbance records

### 3.5.7.2 Upload disturbance recorder records

![Image](image1.png)

**Figure 17 Transferring disturbance records**

In this dialog you can specify a directory for storing the records on your computer, and whether the disturbance records are to be deleted after successful transfer. By pressing “Upload”, you initiate a single transfer.

In the lower part you can specify a repeated transfer at regular intervals. This part is only available if “Delete disturbance recorder data” is checked.

In case the maximum number of disturbance records has been reached, an ongoing upload of the oldest record could be interrupted by a trigger initiating a new recording.
3.5.7.3 Detailed view ("Open window")

Dialog for viewing individual bay units and processing records.

![Disturbance recorder detailed view](image)

The following data are displayed:

- Status (defined in the overview)
- Number of records available
- Number of free records
- Sampling frequency (see Section 3.6.6 “Configuration / Disturbance recorder”)
- Record file name
- File size

The dialog provides the following facilities:

- Delete disturbance record
- Start disturbance recording
- Upload disturbance records
- Update disturbance records
3.5.7.4  Disturbance recorder file (Detailed view / Upload)

The disturbance records are available in a zipped Comtrade file. The involved disturbance recorder files has the naming convention

`DRyyyyMMddhhmmsfff_aaa_nnnnn.ZIP`

Table 7  Disturbance file names

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyyy</td>
<td>Year of the recording (Trigger time)</td>
</tr>
<tr>
<td>MM</td>
<td>Month of the recording (Trigger time)</td>
</tr>
<tr>
<td>dd</td>
<td>Day of the recording (Trigger time)</td>
</tr>
<tr>
<td>hh</td>
<td>Hour of the recording (Trigger time)</td>
</tr>
<tr>
<td>mm</td>
<td>Minute of the recording (Trigger time)</td>
</tr>
<tr>
<td>ss</td>
<td>Second of the recording (Trigger time)</td>
</tr>
<tr>
<td>fff</td>
<td>Miliseconds of the recording (Trigger time)</td>
</tr>
<tr>
<td>aaa</td>
<td>Station number (1-999)</td>
</tr>
<tr>
<td>nnnn</td>
<td>Fault number (0-65535)</td>
</tr>
</tbody>
</table>

The name of the file can be changed if the records are transferred manually.

3.5.8  Event list

Protection system events are shown in chronological order. By correspondingly setting the event filter, just protection events, system events or test events can be viewed separately. Events with an invalid time tag can be excluded from the display. You can choose between “User-defined” and “System-defined” event texts.
The central unit event list has a maximum length of 1000 records; the bay units 100. In the event of a supply failure, the events stored in the REB500 central unit remain intact for at least 24 hours.

### 3.5.8.1 Load events

The protection system has an event memory for every unit (central unit and bay units).

To upload the latest events to the PC, open the “View” menu and select “Event list”. This opens the “Event list” dialog (HMI500 must be in the on-line mode). Click on the “Refresh” button to upload the events. The protection system stores the events until they are explicitly deleted.

The list viewed on the PC is refreshed either on command or cyclically.

There is **no indication** should the event memory overflow before the events have been uploaded. The events are updated as determined by the system response setting (see “Technical Reference Manual”).

The following information is shown for every event:

- Type of event
  - P = Protection function event
  - S = System event
  - T = Test generator event
- Date event occurred
- Time event occurred
3.5.8.2 Deleting events

An event is marked by clicking on it. Several events can be marked by holding the mouse button and moving the pointer over them. Clicking in the blank field at the top left of the window (next to “Type”) marks all the events in the list.

3.5.8.3 Deleting the PC list

Single events, groups of events or all events can be deleted. Mark events you wish to delete and click on “Delete PC list”. Deleting can take several seconds.

3.5.8.4 Deleting the system list

All the events stored in the protection system are deleted.

3.5.8.5 Deleting events that have been viewed

All the protection events viewed since opening the window are deleted.

3.5.8.6 System events when starting

A number of system signals that are generated when starting the system are recorded as events. Up to the instant that system clocks are automatically synchronized, events may have an incorrect date and time. These events are not displayed if “Only events with a valid time tag” was selected.
### 3.5.9 Security event list

It is possible to upload the security events stored on the protection system devices. The security events can be uploaded by using the “Refresh” button or using the “Update cyclically” button to get the data every four seconds from the target device.

See “Cyber security guideline”

### 3.5.10 Reset latching relays

All latched signals are reset and the corresponding display on the local control unit is deleted.

*Figure 20  Reset latching relays*
### 3.6 Configuration menu

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>see section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>3.6.1</td>
<td>Providing the communication option is selected, the protection system can be connected with a station automation system (SAS) or station monitoring system (SMS) via an interbay bus (IBB) connection.</td>
</tr>
<tr>
<td>Device structure</td>
<td>3.6.2</td>
<td>Opens a new window that gives an overview of the configured devices with its details.</td>
</tr>
<tr>
<td>Binary inputs/outputs</td>
<td>3.6.3</td>
<td>Used to configure the binary inputs/outputs while engineering the protection system. The data entered are normally provided in the questionnaire filled in by the user. This dialog has three tabs: Overview, Inputs, and Outputs.</td>
</tr>
<tr>
<td>Event text configuration</td>
<td>3.6.4</td>
<td>In this window all the event signals configured in the REB500 are displayed. For each event signal a user specific text can be configured (32 characters). The user can sort the list as per ABB reference or the standard text.</td>
</tr>
<tr>
<td>LMI LED…</td>
<td>3.6.5</td>
<td>The local HMI of the REB500 IEDs has a certain number of LEDs. Each of them can be assigned to an input or output signal.</td>
</tr>
<tr>
<td>Disturbance recorder</td>
<td>3.6.6</td>
<td>Used to configure the disturbance recording of currents and binary inputs and outputs in each bay. Voltages can also be recorded.</td>
</tr>
</tbody>
</table>
3.6.1 Communication

3.6.1.1 SCS Configuration

This dialog contains station control system (SCS) settings to define the interbay bus (IBB) connection. For communication details refer to the "Communication Protocol Manual".
3.6.1.2 SCS Diff Current Parameters

![SCS Diff Current Parameters](image1)

This input mask contains the parameters for sending differential current to station control system (SCS). Specific setting for bus zones is possible.

3.6.1.3 Ethernet communication settings

![Ethernet communication settings](image2)

This input mask for setting the connection parameters of the Ethernet devices.
3.6.2 Device structure

The device structure is configured by ABB when engineering the system. This dialog is only for information as the configuration cannot be changed.

The “Overview” tab lists the central unit and all the bay units along with their device label and device type.

![Device structure](image)

*Figure 24 Configuration / Device structure*
3.6.3 Binary inputs/outputs

3.6.3.1 Overview

The overview tab shows a list with all configured devices providing binary inputs/outputs. See Table 8 for an explanation of the columns.

Table 8 Binary inputs/outputs overview columns

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB ref.</td>
<td>Internal designation for the bay or central unit</td>
</tr>
<tr>
<td>Feeder</td>
<td>in which the bay unit is located, user's label for the bay</td>
</tr>
<tr>
<td>Device</td>
<td>IED device label</td>
</tr>
<tr>
<td>Module</td>
<td>IED device type</td>
</tr>
</tbody>
</table>

For further information about the input or output configuration refer to 3.6.3.2 or 3.6.3.5.

3.6.3.2 Inputs

This tab contains another two sub tabs “Overview” and “Details”. The additional buttons “New signal”, “Delete” and “OC event config” are enabled when the “Overview” tab is active. When the “Details” tab is active only the “New signal” button is enabled.
3.6.3.3 Inputs Overview tab

The upper part of this tab contains the general input layout. The auxiliary supply voltage for each group of optocouplers (with a common pole) is placed below this.

The combo box is used to select a new value for the auxiliary supply voltage (battery voltage).

In the matrix below, all the input signals assigned to the device are listed.

Delete a Signal:
Select a row in the list and click the button “Delete”.

Optocoupler event configuration:
Select a column (e.g. OC08) and click the button “OC event config.”.

In addition to events generated by function signals, a physical input can also be configured as an event. This is of advantage, for example, when several signals are assigned to a physical input or when ambivalent signals from isolators or circuit-breakers need to be recorded.

To configure a physical input as an event select it in the list and click on “OC event config.” to open the “Configuration of events” window.

![Configuration / Binary module - Central unit inputs](image)

Figure 26 Configuration / Binary module - Central unit inputs
3.6.3.4 Inputs Details tab

Figure 27 Configuration / Binary module - Bay unit inputs

Figure 28 Configuration / Binary module - Inputs - Details
Signal allocation

The “Details” dialog provides facility for allocating optocoupler inputs to the logical input signals and the event memory of every input/output.

The abbreviations C.x and O.x denote the CLOSE and OPEN auxiliary contacts on the isolator or circuit-breaker respectively as they appear in the “Details” dialog. Where an isolator or a circuit-breaker is only equipped with a single auxiliary contact, the “One auxiliary contact” mode must be selected.

This mode is not recommended because the status of the isolator or circuit-breaker cannot be properly monitored with just one auxiliary contact.

The signals are configured at the time the protection system is engineered and are generally not changed subsequently.

Only the CLOSED signal field is visible when the “One auxiliary contact” mode is selected. The function of the OPEN signal is achieved by inverting the CLOSED signal. In this case, we recommend connecting the auxiliary contact supply to the corresponding input so that its integrity is supervised.

Inversion

The signals of optocoupler inputs can also be inverted.

Configuring events

Every signal can also be saved as an event in one or more event memories (see Section “Technical Reference Manual”)

More check boxes and input fields appear when the “Recording” radio button is selected. They determine whether the event is recorded on the positive or negative-going edge or on both edges. The user can enter a text (up to 32 characters) defining the event, but if none is entered the system assigns a default event text. At least one event memory in the “Send event to” (= save event in) field must also be selected either in the CU and/or BU event memories. Furthermore, events can be assigned to the event lists of IEC 60870-5-103 interbay bus (IBB) 1 or 2. As the 61850 model is implemented as defined by the standard, no custom assignments can be made for the IBB associated with 61850.

Minimum input signal duration

Provision is made for prolonging the input signals in steps of 1 ms (reset delay).
New Signal

The button “New signal” opens a dialog with a list for selecting and adding a new signal.

Clicking on the arrow to the right of the “Signal type” field opens a list of available signals. The effective list depends on the functions ordered by the user. The list can include as a maximum the following groups:

- General signals
- Busbar protection (BBP)
- Breaker failure protection (BFP)
- End fault protection (EFP)
- Time-overcurrent protection (OCDT)
- Disturbance recorder (DR)
- CB pole discrepancy protection (PDF)
- Voltage release (UV)

Clicking on the arrow button to the right of the signal name field opens a list of the signals available according to the filter group and device selected.

Signals that can only be assigned once will disappear from the list as soon as the user has assigned them.

The new signal can be configured as described above.

3.6.3.5 Outputs

The procedures for configuring binary inputs and outputs are almost identical, in particular creating new signals and deleting existing ones. Therefore only the differences are dealt with in this section.
Most of the CU signals only occur once. There is an output signal “Trip BB zone” for each section of busbar (bus zone), therefore the respective zone must be given when selecting this signal.

### 3.6.3.6 Outputs Overview tab

**Figure 29** Configuration / Binary module - Outputs - Overview – CU

**Figure 30** Configuration / Binary module - Outputs - Overview – BU
The overview of the BU outputs shows which signals are assigned to which output relays. An output relay can be controlled by several signals (e.g. relay CR02 by “TRIP” and “BFP TRIP”).

For reasons of safety, it is impossible to mix tripping commands and signals, i.e. tripping commands can only be combined with tripping commands and control signals with control signals.

Tripping commands:

- 21105_EXTERNAL TRIP
- 21110_TRIP
- 23105_BFP TRIP
- 25105_OCDT TRIP
- 27105_PDF TRIP

The remaining signals and all the CU signals are control signals.

It is recommended to configure tripping signals for operating circuit-breakers either to latch or to operate with a reset delay of at least 100 ms.

3.6.3.7 Outputs Details tab

![Configuration / Binary module - Outputs - Details - CU](image)
Signal delay

Every output signal can be configured either to latch (until reset by a signal) or to have a defined reset delay. A reset delay can be entered in the field “t” and can be changed by clicking with the mouse.

Blocking output signals throughout the system

In the case of all the output signals being blocked by the self-supervision function or a signal applied to the blocking CU or BU input “Block output relays”, the statuses of the selected output signals cannot change. This setting determines whether a signal is really blocked or is generated anyway.

Relay output

The current signal is assigned to the output relays with checked check boxes. Other signals of the same type (tripping command or control signal) may also be assigned to the same relay.

Unavailable output relays (grey) already have signals of the other type assigned to them. The remaining relays are available for other signals.

Event configuration

The configuration of an output signal event is the same as for an input signal event. An event is generated when the output signal is set, respectively reset.
Configuring output relay events

An event is generated when an output relay picks up or resets, i.e. this type of event takes any reset delay that has been set or blocking by another signal into account.

Select an output relay in the overview dialog first by clicking on its label above the signal list (its column is then highlighted). Now open the event configuration dialog by clicking on the “CR event config.” button.

As in the case of the binary input signals in Section 3.6.3.2., the binary output signals are configured at the works.
3.6.4 Event text configuration

In this window all the event signals configured for REB500 are displayed. For each event signal a user specific text can be defined (maximal 32 characters). The user can sort the list as per ABB reference or the standard text.

![Event text configuration](image.png)

3.6.5 HMI LEDs

This dialog contains the list of bay units and the central unit (“LMI LED configuration”). The unit specific configuration dialog (“LED statuses on the local HMI”) is opened by selecting the desired bay unit or central unit with the left mouse button and then clicking on “Continue” or directly by simply double clicking on the unit line.
3.6.5.1 New signal

A LED is assigned to a signal by marking it in the dialog and clicking on “New signal” or alternatively by double clicking on the LED line. A list of possible signals is then presented to enable one to be chosen.
3.6.5.2 Delete signal

The assignment of a signal is cancelled by marking it in the dialog and clicking on “Delete signal”.

3.6.5.3 Caption

The name in the “Caption” column proposed by the program can be edited by selecting it with the mouse. A caption can have a maximum of 20 characters.

3.6.5.4 Mode

The user can determine the response of the LED by clicking in the “Mode” column. The following modes are possible:

- Status: The current status of the signal is displayed.
- Latching: The status of a LED is stored until one of the following occurs
  - A bay protection function picks up
  - A station protection function trips
  - It is reset via the local HMI
  - It is reset by HMI500
  - It is reset by a binary signal

The “Status LED on LMI” dialogue is saved by clicking “Ok”. The dialogue “LED statuses on the local HMI” is active again and a print of the LED labels can be started by clicking “Print Labels” now. Before initiating a print job the “Print Range” as well as the “Label Orientation” shall be adjusted.
3.6.6 Disturbance recorder

3.6.6.1 Analog inputs

The currents measured by the four analog inputs are always recorded. The five voltage inputs may only be recorded providing they have been licensed and engineered (optional).

The recording time is doubled if the voltage channels are not activated.

The dialog has three tabs:

Overview

The overview shows all the bay units and their basic disturbance recorder configurations. A bay unit is selected by clicking on it with the mouse.

License status

This dialog lists all the licensed bay units and the duration of recording (see Figure 40).

Configuration

The configuration dialog shows a bay unit together with its recording mode and signals.

3.6.6.2 Recording

The following disturbance recorder settings can be made (see Figure 37).

- Sampling frequency (50 Hz/60 Hz): 1000/1200 Hz, 2000/2400 Hz or 4000/4800 Hz. The maximum recording time is automatically adjusted to suit.

- Number of records “n”: The maximum recording time available is divided by this setting into “n” equal time periods. For example, assuming 3 records have to be made for a sampling frequency of 2000Hz, then 13.33 seconds each can be recorded.

- Acquisition time: This setting determines how much time before the triggering point is included in the record. The recording time must be at least 0.2 s to record the pre-fault and 0.3s for the post-fault history.

3.6.6.3 Signals

All binary signals (input, output or internal signal) can be recorded. For this purpose, they must be configured for recording and identified by their signal labels.
Up to 32 binary signals per bay can be selected for recording. Of these, up to 12 can be configured to trigger the start of recording. Triggering can take place on the lagging or leading edge of a signal. If “both edges” is selected, both lagging and leading edges are active (see Figure 38).

Once recording has been started, the complete recording period that has been set is recorded.

In addition to the normal bay unit binary signals, there are up to ten general purpose input signals that can be configured for recording and for triggering the disturbance recorder (“16705… 16750_Start DR_x”).

**Sorting binary signals**

The order of the binary signals in the list can be changed by clicking on the “Signal iD” column of the respective signal and moving it to a new position. All other signals are sorted automatically in relation to the signal that has been moved.

The order of the signals in the list is the order in which they are transferred when uploading disturbance data.

Since circuit-breakers and isolators equipped with two auxiliary contacts (CLOSE and OPEN) can have more than two statuses (open, in motion, closed and undefined), the disturbance recorder does not record their positions. The disturbance recorder and the evaluation software can only process binary signals (i.e. with two possible values).

Possible solution: Configure one of the “x.Start DR” signals to be connected in parallel to the CLOSE auxiliary contact on the isolator.

**Trigger operation**

Recording commences when at least one of the triggering conditions is fulfilled. The trigger then remains disabled until the record has been completed and is then enabled again. You must therefore set the recording period such that all the signals you want to record can be recorded.

The trigger inputs are scanned every 16 ms. A trigger signal must have a pulse duration of at least 16 ms to be certain that it will be detected.
Figure 37 Disturbance recorder - Configuration

Figure 38 Disturbance recorder - Configuration - Signals
Figure 39 Disturbance recorder - Overview

Figure 40 Disturbance recorder - License status
3.7 Settings menu

In general, the settings are described in the Technical Manual. Detailed explanations and examples can be found in the Application Manual. Table 9 provides pointers to the respective sections in the Technical Manual and in the Application Manual.

Not all settings are available for all systems. Some settings depend on the scope of supply (marked ○ in column Av) while others are always available (●).

Table 9 Settings menu items

<table>
<thead>
<tr>
<th>Setting menu item</th>
<th>Av</th>
<th>Technical Manual section</th>
<th>Application Manual section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breaker failure protection</td>
<td>○</td>
<td>5.1</td>
<td>9</td>
</tr>
<tr>
<td>Time overcurrent protection</td>
<td>○</td>
<td>5.2</td>
<td>-</td>
</tr>
<tr>
<td>End fault protection</td>
<td>○</td>
<td>5.3</td>
<td>-</td>
</tr>
<tr>
<td>CB pole discrepancy</td>
<td>○</td>
<td>5.4</td>
<td>-</td>
</tr>
<tr>
<td>Overcurrent release</td>
<td>○</td>
<td>6.2.1</td>
<td>-</td>
</tr>
<tr>
<td>Voltage release</td>
<td>○</td>
<td>6.1</td>
<td>-</td>
</tr>
<tr>
<td>Circuit-breakers</td>
<td>●</td>
<td>3.1</td>
<td>-</td>
</tr>
<tr>
<td>Isolators</td>
<td>●</td>
<td>3.2</td>
<td>-</td>
</tr>
<tr>
<td>Current transformers</td>
<td>●</td>
<td>3.3</td>
<td>-</td>
</tr>
<tr>
<td>Voltage transformers</td>
<td>○</td>
<td>3.4</td>
<td>4</td>
</tr>
<tr>
<td>Busbar protection</td>
<td>●</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Release logic / matrix</td>
<td>●</td>
<td>6.2.2</td>
<td>-</td>
</tr>
<tr>
<td>System response</td>
<td>●</td>
<td>3.5</td>
<td>-</td>
</tr>
<tr>
<td>Activate/deactivate device</td>
<td>see Commissioning Manual</td>
<td>see Commissioning Manual</td>
<td></td>
</tr>
<tr>
<td>CB inspection</td>
<td>●</td>
<td>3.6</td>
<td>-</td>
</tr>
<tr>
<td>Event memory</td>
<td>●</td>
<td>3.7</td>
<td>-</td>
</tr>
<tr>
<td>Time</td>
<td>●</td>
<td>3.7</td>
<td>-</td>
</tr>
</tbody>
</table>

3.8 Testing menu

3.8.1 Test mode

Switching to the test mode while the protection is in operation should only be undertaken by especially trained personnel. Incorrect manipulations can cause false tripping, for example, by inadvertently operating a tripping relay, simulating an incorrect isolator or circuit-breaker status or activating a tripping input (e.g. External TRIP).
The test generator is activated by opening the “Testing” menu, selecting “Test mode” and entering a valid password. A tick appears next to the menu item, “Test mode” is added to the status line at the bottom of the screen and the “Test mode” dialog opens.

To enable a start to be made, the **password** is set to “Test” when the program is supplied.

The test generator is used in conjunction with the “Status of binary inputs/outputs” dialog (has to be opened by the operator), (see Section 3.5.4).

When the test generator is active, the statuses of the tripping commands cannot change.

![Test mode](image)

**Figure 41** Test mode

**Table 10** Buttons in Test mode dialog

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unblock all relays</td>
<td>Restores the relays to normal operation and their statuses can change again.</td>
</tr>
<tr>
<td>Block all relays</td>
<td>Prevents the statuses of all relays for which outputs have been configured from being changed.</td>
</tr>
<tr>
<td>Force security events</td>
<td>See Cyber security guideline</td>
</tr>
<tr>
<td>Block all tripping relays</td>
<td>Prevents the statuses of all relays from being changed with the exception of 41810_In service, 41835_Test generator active and 41410_Output relays blocked.</td>
</tr>
<tr>
<td>Reset all overridden relays</td>
<td>Returns all inputs and outputs which had statuses impressed on them for test purposes to their original states.</td>
</tr>
</tbody>
</table>
An output relay can be set or reset either directly (e.g. by setting an output relay) or indirectly (e.g. via an input or by a protection function).

The greatest care must be taken when using the test mode, especially when the protection system is in operation.

Blocking by the test generator takes precedence over all other functions, i.e. neither a protection function nor an External TRIP signal can initiate a trip.

Unblocking by the test generator takes precedence over all other functions, i.e. blocking by an isolator or differential current alarm or a signal applied to an optocoupler input is cancelled.

3.8.1.1 Using the test generator

In order to set or reset binary inputs and outputs using the test generator, it is necessary to open the “Status of binary inputs/outputs” dialog. Providing the test mode is active, the status of an input or output can be changed by simply double-clicking on it.

Regardless of whether they are logical 0 or logical 1, inputs and outputs are normally green, those with impressed statuses yellow and invalid ones red. Impressed statuses are green after the display is refreshed.
### 3.8.1.2 Shutting down the test generator

The test generator is deactivated by clicking on the menu item “Test mode” a second time. All the relays are then restored to their original statuses, any latching is reset and blocking by the test generator is cancelled.

### 3.8.2 Installation mode

This mode is activated by opening the “Testing” menu, selecting “Installation mode” and entering a valid password.

A tick appears next to the menu item, “Installation mode” is displayed on the status line at the bottom of the screen and the “Installation mode” dialog opens.

Click on “Installation mode” in the “Testing” menu to reset the installation mode. The tick in the menu item is reset.

To enable a start to be made, the password is set to “**Install**” when the program is supplied.
Figure 43  Installation mode menu

Table 11  Buttons in Installation mode menu

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delete data base in the protection system</td>
<td>All the data in the protection system are deleted, i.e. the project database (MDB file) in the protection system is deleted.</td>
</tr>
<tr>
<td>Restart the protection system</td>
<td>Reinitializes the protection (CU and all BU’s)</td>
</tr>
<tr>
<td>Debug mode</td>
<td>In the debug mode, the protection system generates additional internal program events. As a rule, the debug mode is only used by the ABB engineering department for test purposes.</td>
</tr>
</tbody>
</table>
3.9 Tools menu

3.9.1 Version

This menu item is for administering the database for the specific protection system, which contains information such as settings, event texts, configuration of the binary inputs and outputs etc. Parts of the database can be edited on the PC using HMI500 and then downloaded to the protection. The database has a version number and index that are displayed in the HMI main menu.

**Version**: X.YY, date of the last change, description

The version is purely numerical, i.e. X {0...9} and Y {0...9}. It is assigned by ABB while processing the contract and determined at the time the system is accepted by the user. The user cannot change it subsequently.

**Index**: XX, date of the last change, description

The index only comprises letters, i.e. X {A...Z}. The user must change the index and its description if he changes the REB500 settings in order to document and distinguish different sets of settings. When a new index is assigned, the current date on the PC is recorded as the date of the last change.

![Figure 44 Version](image)
3.9.2 File verification

Starts the file verification command, that checks data consistency within several tables of the project file. The result is displayed in a separate window.

3.9.3 Reports

![Figure 45 Reports](image)

The “Reports” dialog is opened by selecting “Reports” in the “Tools” menu. It contains a list of the various kinds of reports.

Either a desired report can be printed on its own or all the reports can be printed by activating the “Print all reports” check box.

The difference between the options in the “Printing quality” field is that the data are presented in tabular form if the “Normal” radio button is active.

Unless a printer is actually installed on the PC, the “Reports” menu item is grey and inactive. A printer does not, however, have to be connected.

3.9.4 Export SCS data

This menu item exports any communication data contained in the database. The menu is only active if under menu “Configuration \ Communication” a SCS interface is configured (see 3.6.1).
In the case of the optional IEC 61850-8-1 and IEC 60870-5-103 communication protocols, the “Export” button creates files that can be used to configure the communication interface at the remote end.

3.9.5 Settings

3.9.5.1 HMI500 settings

Some of the operator program functions can be customized:

![HMI500 settings](image)

Figure 46 HMI500 settings

3.9.5.2 Communication

Communication can be established with a REB500 system either via HMI front connector or via the station bus.

Settings are provided for the TCP/IP address of the REB system to which communication is being established.

It is possible to change between the communication modes On-line, Off-line and Simulation. Selecting “On-line” causes HMI500 to check whether communication with REB500 system can be established.

The checkbox “Enable security menu” and its influence to the sub-menus “Tools / Security option” and “Tools / Security account management” is described under “Security deployment guideline.

3.9.5.3 Parameters for reading and exporting event data

Settings are provided for the period for cyclically reading events and the separator for an ASCII file when exporting events.
3.9.5.4  **Database locations**

HMI500 creates a number of configuration databases. The following dialog provides facility for defining the directories where the databases are located and changing the database names. Default directories are created during the installation of HMI500 and it is recommended that these not be changed.

3.9.5.5  **PSM support (option)**

HMI500 automatically displays this directory when E_Wineve (installation file available on REB500 Product CD) is installed on the PC. The directory enables you to verify the response of E_Wineve after disturbance recorder data have been transferred.

1. Check the box “Send notification after automatically uploading data” to obtain notification as to which disturbance recorder data have been sent. For this purpose, E_wineve has to have been started in the batch mode.
2. Check the box “Evaluate after manually uploading data from the protection system” to be offered the possibility of evaluating disturbance recorder data using E_wineve after they have been manually transferred.
3. The button “Select PSM” provides facility for locating the E_wineve installation to be used for evaluating disturbance recorder data.

![Figure 47 PSM support settings](image)

3.9.6  **Security account management**

The menu is only active if the HMI500 communication is online with the protection system. See “Security deployment guideline”
3.9.7 Change password

See “Security deployment guideline”

3.9.8 Security options

See “Security deployment guideline”

3.9.9 Security log servers

See “Security deployment guideline”

3.9.10 Close all sessions

This menu command closes all open sessions on the target device.

3.9.11 Set system time

The system clock in the protection system is equipped with a standby battery and runs independently with an accuracy of 50 ppm (4.3 s per day) if not synchronized periodically by an external reference. In this case, this menu is used for setting the date and time of the protection system. Initially, the date and time displayed in this menu item are those effective on the PC. The settings in the fields can be incremented or decremented by clicking on the appropriate arrow to the right of the value. Click on “Set time” to set the new date and time on the protection system.

Figure 48 Setting the system time
4.1 Introduction

REB500 includes continuous comprehensive self-supervision and diagnosis of the software and hardware components. By setting up a proper signaling scheme while commissioning the system, most failures are signaled externally (see Section 3.6.3 “Binary input/output signals”). They can include internal REB500 as well as external failures in primary and secondary systems that influence the response of the protection. Other failures that are not detected (e.g. interrupted tripping circuit) are located and cleared while carrying out periodic inspection and maintenance (see “Commissioning manual”. Checks and measurements while the system is in normal operation (no active alarms) are therefore unnecessary.

Normal operation without any faults is also indicated by the fact that only the green protection LED is lit and the alarm page LED is not lit on the local HMI.

An alarm (external or on the local HMI) can concern a failure in the REB500 system (e.g. hardware failure) or in the associated primary plant (e.g. incorrect isolator status signal).

Should the system generate an alarm, inform the trained maintenance personnel responsible.

4.2 Safety instructions

Checks and maintenance on the REB500 system may only be carried out by properly trained personnel.

Only properly trained and authorized personnel should be in possession of the HMI500 password.
4.3 Operation

4.3.1 Introduction

Operation in the case of the busbar protection system is confined to supervising the proper function of the system and assessing the system data.

There are different ways of viewing operating, disturbance and tripping data:

- local HMI
- PC running HMI500
- remote HMI
- station automation system (SCS)

(see Section 2 “System Overview”)

4.3.2 Viewing data on the local HMI

The local HMI provides a quick overview of the status of the protection (normal operation, alarms and trips) without having to connect a PC.

It is fitted in every central unit and as an option in the bay units. On the front, it has a 320 by 240 pixel display, three protection LEDs, 19 pushbuttons and 15 signalization/alarm LEDs. The local HMI enable the equipment to be operated and controlled simply and conveniently where it is installed. An interface is also provided for connecting a PC via RS45.

Whether on the central unit or a bay unit, the local HMI enables the following to be viewed:

- current and voltage measurements
- statuses of inputs and outputs
- alarms (generated by the respective bay unit)
- system (or respective bay unit) settings
- settings of all the specific bay unit protection functions
4.3.3 Protection Indicator LEDs

There are three LEDs on top of the display: green, yellow, and red.

<table>
<thead>
<tr>
<th>LED</th>
<th>IEC label</th>
<th>ANSI label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>green</td>
<td>Ready</td>
<td>Normal</td>
<td>Flashes while the system is being initialized. Continuously lit during normal operation.</td>
</tr>
<tr>
<td>yellow</td>
<td>Start</td>
<td>Pickup</td>
<td>Not used.</td>
</tr>
<tr>
<td>red</td>
<td>Trip</td>
<td>Trip</td>
<td>Indicates a trip. Remains lit until applying a binary signal to the reset input or selecting the HMI function “Reset latching”.</td>
</tr>
</tbody>
</table>

4.3.4 LED signals

The local HMI contains 15 additional LEDs, each of which can be assigned to any output signal and configured to latch or not to latch as required.

Refer to section 3.6.5 “HMI LEDs”
4.3.5 LCD backlight

If none of the buttons are operated for a time corresponding to the backlight timeout, the display backlight switches off and the main menu is displayed with the cursor at the topmost menu position. It switches on again automatically as soon as a button is pressed.

The currently configured backlight supervision timeout can be viewed and modified in menu “Display Settings”.

4.3.6 Buttons

Table 13 lists the nine supported buttons. They are used primarily to navigate through the menu structure. Any of them switches the display backlight on again if it was switched off.

<table>
<thead>
<tr>
<th>Button</th>
<th>Name</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up</td>
<td>Move up and down in menu tree and in pages. Move selection in dialogs and alarm panel.</td>
<td></td>
</tr>
<tr>
<td>Down</td>
<td>Scroll active digits, characters, or enumerators of a parameter when entering a new setting value.</td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>Move left and right in menu tree (change menu tree level) and in pages. Change the active digit or character in parameter when entering a new value.</td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enter</td>
<td>Enter the setting mode of a parameter. Confirm a new value of a setting parameter. Confirm selection in dialogs.</td>
<td></td>
</tr>
<tr>
<td>Escape</td>
<td>Cancel currently ongoing operation.</td>
<td></td>
</tr>
<tr>
<td>Menu</td>
<td>Navigate directly to the main menu.</td>
<td></td>
</tr>
<tr>
<td>Clear</td>
<td>Navigate to the view for clearing or acknowledging alarms, trips and LEDs.</td>
<td></td>
</tr>
<tr>
<td>Multipage</td>
<td>At first push it navigates to the alarm page. At second push it navigates to the alarm LED panel, which displays the text associated with the corresponding signalization LED on the right panel side. For setting the LED signals see Section 3.6.5</td>
<td></td>
</tr>
</tbody>
</table>

Table 13 Local HMI - Used Buttons
The following buttons are not used on the local HMI:

<table>
<thead>
<tr>
<th>Button</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Login" /></td>
<td>Login</td>
</tr>
<tr>
<td><img src="image2" alt="Open" /></td>
<td>Open</td>
</tr>
<tr>
<td><img src="image3" alt="Close" /></td>
<td>Close</td>
</tr>
<tr>
<td><img src="image4" alt="LR" /></td>
<td>LR</td>
</tr>
<tr>
<td><img src="image5" alt="Help" /></td>
<td>Help</td>
</tr>
<tr>
<td><img src="image6" alt="Function Key" /></td>
<td>Function Key</td>
</tr>
</tbody>
</table>

### 4.3.7 Menu structure

The menu structures of central unit and bay unit are similar. The central unit has additional menu items for system settings and specific bay units.

#### 4.3.7.1 Menu structure of the central unit

- Alarms
- Trips
- Clear
  - Reset all latched LEDs and lists
  - Acknowledge Alarms
- Measurements
  - Bus zones
    - BZ 1..N
    - Diff. current
  - Binary inputs
    - OC01..OCxx
Section 4
Local HMI

Binary outputs
CR01..CRxx

- Settings
  System response
  Busbar protection

- Configuration
  LAN IP settings
  Process bus
  HMI
  IEC61850

System Information
  Station Name
  IEDProdType
  System frequency
  Index to last DB change
  Date of last DB change
  Firmware version

LED Text
  LED Text 1..15

- Display settings
  Language
  LHMI
  Display Timeout
  Contrast Level
  Key Parameters

- Test
  LED Test

- Diagnostic Information
  CPU Load
  Module Check

- Bay units
  Bay unit 1..N
  Measurements
    Currents
    Voltages
    Binary inputs
    OC01..OCxx
  Binary outputs
    CR01..CRxx
Switchgear objects
Settings
  Busbar protection
  Breaker failure protection
  Overcurrent protection
  End fault protection
  Pole discrepancy prot.

4.3.7.2 Menu structure of the bay unit

- Alarms
- Trips
- Clear
  Reset all latched LEDs and lists
  Acknowledge Alarms
  Reset blocking signals

- Measurements
  Currents
  Voltages
  Binary inputs
    OC01..OCxx
  Binary outputs
    CR01..CRxx

Switchgear objects

- Settings
  Busbar protection
  Breaker failure protection
  Overcurrent protection
  End fault protection
  Pole discrepancy prot.

- Configuration
  LAN IP settings
  Process bus
  HMI

System Information
  IEDProdType
  System frequency
  Index to last DB change
  Date of last DB change
  Firmware version

LED Text

- Display settings
4.4 Alarms

The yellow LED on the Multipage button signals the alarm state:

- Off: No pending alarm in list
- On: Pending alarms in list, acknowledged
- Flashing: New alarm in list, not yet acknowledged

Eventual system alarms can be viewed in the alarm list (Menu “Alarms”).

The operator can acknowledge an alarm using the menu item “Clear”/
“Acknowledge Alarm” or the or equivalently by pressing the “clear” button.

The following alarms can be displayed:

- Busbar protection blocked
- Breaker failure protection blocked
- End fault protection blocked
- OCDT blocked  Overcurrent protection blocked
- Pole discrepancy protection blocked
- Bay unit alarm
- Contacts blocked
- Inspection/Maintenance
- Inspection alarm
- Auxiliary voltage failed
- Trip transferred
- Circuit breaker alarm
- Isolator alarm
Section 4
Local HMI

Operation Manual
Distributed busbar protection REB500

- Test generator active
- Contacts blocked
- HW configuration mismatch
- Pow.sup. fault
- Power supply 2 failed
- AC Fail
- Major error
- BU problem
- CU problem
- General alarm

Viewing the event list and disturbance records is recommended should an alarm occur. The corresponding procedure is described in 3.5.7. “Disturbance recorder” respectively 3.5.8. “Event list”.

Avoid performing switching operations in the event of the following alarms before the failure has been analyzed by correspondingly trained personnel:

- Isolator alarm
- Switch inhibit
- Differential current alarm
- Inspection and maintenance

Non-observance of this precaution can cause mal-operation in normal operation or a failure to trip in response to a fault.

Isolator alarm may only be acknowledged by appropriately trained and authorized personnel. Non-observance of this precaution can cause mal-operation in normal operation or a failure to trip in response to a fault.

4.5 Trips

The trips generated by REB500 can be viewed in the trip list together with the protection functions that caused them (Menu “Trips”).

The red Protection indicator LED signals the trip state:

- Off: No pending trip in list
- On: Pending or latched trips in list

The protection system and all signals can be reset by choosing “Clear” / “Reset all latched LEDs and Lists” on the LHMI, or equivalently by setting the signal 31810_External reset, e.g. generated by pressing the reset button.
The following trips can appear on the local HMI:

- TRIP
- Breaker failure protection trip t1
- Breaker failure protection trip t2
- Breaker failure protection remote trip
- Overcurrent protection trip
- Pole discrepancy protection trip
- End fault protection trip
- EXTERNAL trip
Section 5 Troubleshooting

5.1 Safety Instructions

All work on the REB500 busbar protection system must be carefully planned. Errors when manipulating the system cannot only destroy components, they can also cause false tripping and serious interruption to the power supply.

Precautions must be taken in the immediate area when working on the central unit or one of the bay units to exclude any possibility of persons coming into contact with live parts.

A danger of electrical shock also exists when measuring currents and voltages.

When replacing electronic modules, take the necessary precautions to prevent damage to components due to electrostatic discharge (ESD).
5.2 List of faults and corrective actions

5.2.1 Useful LEDs on the IEDs and switches

The Fault and Power (P) LED of the Switch are found on the left side of the switch. The green link LED for optical and electrical connection is located on the electrical connector. The same LEDs are also available on the back side of the switch.

![LED Indication on the back side of the switch](image)

The Ready LED is on the top of the BU/CU. The Alarm Indicator LED is located in the right lower corner of the IED, integrated within the alarm button (see Section 4.3.3 and 4.3.6).
### Faults during startup

<table>
<thead>
<tr>
<th>Description</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( \text{CU/BU} \rightarrow \text{Green Ready LED Off} )</td>
<td>Power missing</td>
<td>Check power supply of CU/BU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hardware failure</td>
</tr>
<tr>
<td>2. ( \text{CU/BU} \rightarrow \text{Green Ready LED Flashing} )</td>
<td>System is starting</td>
<td>Wait up to 3 minutes for Startup</td>
</tr>
<tr>
<td>3. ( \text{CU/BU} \rightarrow \text{Alarm Indicator LED On} )</td>
<td>Check 5.2.3 “Alarm and Event list entries”</td>
<td>Check 5.2.3 “Alarm and Event list entries”</td>
</tr>
<tr>
<td>4. ( \text{CU/BU} \rightarrow \text{System Restart} )</td>
<td>Erroneous Setfile</td>
<td>Verify Setfile</td>
</tr>
<tr>
<td></td>
<td>Hardware failure</td>
<td></td>
</tr>
<tr>
<td>5. ( \text{CU/BU} \rightarrow \text{No LHMI activity, all LEDs off} )</td>
<td>Ethernet cable plugged into X0</td>
<td>Remove cable from X0</td>
</tr>
<tr>
<td></td>
<td>Hardware failure</td>
<td></td>
</tr>
<tr>
<td>6. ( \text{Switch} \rightarrow \text{Power LED Off} )</td>
<td>Power missing</td>
<td>Check power supply of the switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hardware failure</td>
</tr>
<tr>
<td>7. ( \text{Switch} \rightarrow \text{Power Fault LED On} )</td>
<td>Redundant power missing</td>
<td>Check power supplies of the Switch</td>
</tr>
<tr>
<td></td>
<td>Wrong Ethernet connect</td>
<td>Check 5.2.4 “Optical fiber connections faults”</td>
</tr>
<tr>
<td></td>
<td>between switches</td>
<td></td>
</tr>
<tr>
<td>8. ( \text{14205_Block EFP always On} )</td>
<td>Signal ‘11505_Close command CB’ missing</td>
<td>Configure signal 11505</td>
</tr>
</tbody>
</table>

### Alarm and Event list entries

<table>
<thead>
<tr>
<th>Description</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. General alarm CU/BU</td>
<td>Check 5.2.4 “Optical fiber connections faults”</td>
<td>Check 5.2.4 “Optical fiber connections faults”</td>
</tr>
<tr>
<td></td>
<td>Wrong BU address</td>
<td>Correct BU address</td>
</tr>
<tr>
<td>2. Differential current alarm CU</td>
<td>CT circuit fault</td>
<td>Check 5.2.5 “Electrical connection faults (wrong current or voltage values)”</td>
</tr>
<tr>
<td></td>
<td>Busbar image error</td>
<td>Check isolator image</td>
</tr>
<tr>
<td></td>
<td>Hardware failure</td>
<td>Replace CU/BU</td>
</tr>
<tr>
<td>3. Isolator alarm BU</td>
<td>Wrong binary connection to auxiliary contacts</td>
<td>Check connection diagrams and connections to the auxiliary contacts</td>
</tr>
<tr>
<td></td>
<td>Wrong battery voltage configured</td>
<td>Correct setting (setfile)</td>
</tr>
<tr>
<td></td>
<td>Hardware failure</td>
<td>Replace BU</td>
</tr>
</tbody>
</table>
### Troubleshooting

#### Distributed busbar protection REB500

### Section 5

## Troubleshooting

<table>
<thead>
<tr>
<th></th>
<th>Invalid Time Stamps</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td></td>
<td>Wrong time synchronization type and/or parameter</td>
<td>Check time synchronization type and/or parameter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong time master configuration</td>
<td>Check time master configuration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong LWL connections</td>
<td>Check LWL connections to time master</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong hardware installed</td>
<td>Replace Hardware with configured type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong LWL connections</td>
<td>Check LWL connections to time master</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong hardware type configured</td>
<td>Change the configuration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Hardware Mismatch Alarm</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td></td>
<td>Wrong time master configuration</td>
<td>Check time master configuration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong LWL connections</td>
<td>Check LWL connections to time master</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong hardware installed</td>
<td>Replace Hardware with configured type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong LWL connections</td>
<td>Check LWL connections to time master</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong hardware type configured</td>
<td>Change the configuration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>IP address conflict</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td></td>
<td>Ethernet interface LAN0 has address configured which already exists in the network connected to this interface</td>
<td>Change configured IP address</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>RPB Interruption Alarm on BU</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Process Bus connection interrupted</td>
<td>Check process bus connection (see Section 2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CU is offline (e.g. during a CU restart)</td>
<td>Wait until CU is up and running again (up to 3 Minutes)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BU is stuck in standalone mode</td>
<td>Restart the BU</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>RPB Interruption Alarm on CU</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>At least one of the two process bus links of the CU is interrupted</td>
<td>Check both process bus links (see Section 2)</td>
<td></td>
</tr>
</tbody>
</table>

## 5.2.4 Optical fiber connections faults

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Process Bus: No link LED for a connected BU</td>
<td>Optical fiber defect, or wrong type</td>
<td>Check, replace optical fibers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optical fiber wrong connection</td>
<td>Check connection</td>
</tr>
</tbody>
</table>

|   | IEC 61850 Bus No link LED for a connected station control system | Optical fiber defect, or wrong type | Check, replace optical fibers |
|   |                                                                | Optical fiber wrong connection  | Check connection                    |

|   | IEC 103 RX/TX LED dose not blink | Optical fiber defect, or wrong type | Check optical fibers |
|   |                                    | Optical fiber wrong connection  | Check optical fiber connections |
|   |                                    | Wrong IEC 103 Configuration     | Check IEC 103 Configuration       |
### 5.2.5 Electrical connection faults

<table>
<thead>
<tr>
<th>Description</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Binary inputs on CU/BU do not work</td>
<td>Wrong battery voltage configured</td>
<td>Correct setting (setfile)</td>
</tr>
<tr>
<td></td>
<td>HW Failure</td>
<td>Replace CU/BU</td>
</tr>
<tr>
<td>2. Binary Output do not work</td>
<td>Blocking inputs of the IED set</td>
<td>Reset blocking inputs</td>
</tr>
<tr>
<td></td>
<td>Hardware failure</td>
<td>Replace CU/BU</td>
</tr>
<tr>
<td>3. Wrong current or voltage values</td>
<td>CT VT settings</td>
<td>Check CT VT settings</td>
</tr>
<tr>
<td></td>
<td>Wrong CT/VT connections</td>
<td>Check connection diagram</td>
</tr>
<tr>
<td>4. Analogue measurement supervision alarm</td>
<td>Wrong CT connections</td>
<td>Check wiring of BU analogue inputs</td>
</tr>
<tr>
<td></td>
<td>Bay Unit (analogue part) is defective</td>
<td>Replace BU</td>
</tr>
</tbody>
</table>
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