RELION® REB500

Distributed busbar protection REB500
Version 8.3 IEC
Getting started guide
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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 the REB500 system. Before working on the system, always ensure that it is impossible to come into contact with, or even close to live parts.

- The IEDs of the REB500 system 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 IEDs has to be carefully earthed.

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

The IEDs contain 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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Section 1 Introduction

1.1 This manual

The Getting started guide contains instructions on how to check that the delivered hardware (order code) corresponds to the conditions and requirements of the primary/secondary system.

Furthermore, the sequence of working steps necessary to bring a REB500 into the ready state is listed.

For the sake of an improved comprehensibility all steps are explained on the basis of a sample configuration.

1.2 Intended audience

This manual addresses the protection and control engineers responsible for planning, pre-engineering and engineering as well as the commissioning personnel taking the IED in normal service.

The commissioning personnel must have a basic knowledge of handling electronic equipment.

1.3 Symbols and conventions

1.3.1 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.

1.3.2 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.
  For example, to navigate the options, use ↑ and ↓.
- HMI menu paths are presented in bold.
  For example, select Main menu/Settings.
- Signal names are presented in bold.
  The signal 21120_EXT_TEST_TRIP can be set and reset via the LHMI Test Trip menu.
- Parameter names and parameter values are presented in italics.
  For example, the default value of the Operation setting is Not Inverted.
- Section references are presented with the respective section numbers.
  For example, see Section 1.3.2 for more details about document conventions.
Section 2 Sample Configuration

2.1 Introduction

This section provides a sample configuration that includes one Central Unit and 15 Bay Units with the objective to give vivid examples for the checks and sequences documented in this manual.

2.2 Sample configuration

2.2.1 Configuration Overview

![Diagram of Sample Configuration](image)

Figure 1: Sample Configuration 1CU, 15 BU, 2 Switches
2.2.2 Central Unit

<table>
<thead>
<tr>
<th>Sample Configuration CU</th>
<th>Check see</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>110 VDC</td>
</tr>
<tr>
<td>Redundant power supply</td>
<td>110 VDC</td>
</tr>
<tr>
<td>Number of supported BUs</td>
<td>15 (Software Option Protection System up to 20BU)</td>
</tr>
<tr>
<td>Number of IOs</td>
<td>25 BO and 19 BI</td>
</tr>
<tr>
<td>Communic. IBB-Protocol</td>
<td>IEC61850-8-1 and IEC60870-5-103</td>
</tr>
<tr>
<td>Connection type PSM/ bin</td>
<td>Compression terminals for power suppl. and binary I/Os</td>
</tr>
<tr>
<td>Mounting details</td>
<td>Mounting kit for 6U 3/4 x 19&quot; case</td>
</tr>
</tbody>
</table>

2.2.3 Bay Units

<table>
<thead>
<tr>
<th>Sample Configuration BU (all Bay Units have identical configurations/order codes)</th>
<th>Check see</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>110 VDC</td>
</tr>
<tr>
<td>Number of IOs</td>
<td>19BO/ 21BI plus 6PBO/ 12PBI (precision binary I/Os)</td>
</tr>
<tr>
<td>Local HMI</td>
<td>LHMI: OL3000, IEC 6U 1/2 19&quot;, Basic</td>
</tr>
<tr>
<td>Mounting of LHMI</td>
<td>No detached mounting of LHMI</td>
</tr>
<tr>
<td>Analogue input module</td>
<td>TRM01: 4I, 1/5A — sufficient for BBP, BFP, EFP, PDF</td>
</tr>
<tr>
<td>Connection type analogue</td>
<td>Compression terminals for analogue inputs</td>
</tr>
<tr>
<td>Connection type PSM/ bin</td>
<td>Compression terminals for power suppl. and binary I/Os</td>
</tr>
<tr>
<td>Software options</td>
<td>BFP, EFP, PDF (functions in addition to BBP)</td>
</tr>
</tbody>
</table>

2.2.4 Ethernet switches

<table>
<thead>
<tr>
<th>Sample Configuration Ethernet Switches</th>
<th>Check see</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of required switches</td>
<td>2</td>
</tr>
<tr>
<td>Switch data</td>
<td>110 V DC, redundant power supply module</td>
</tr>
<tr>
<td>Number of transceivers</td>
<td>21</td>
</tr>
</tbody>
</table>

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Section 3 Checks

3.1 Introduction

The following checks shall ensure, that the delivered hardware/software reflected in the Order Code of central unit and bay units correspond to the conditions and requirements of the primary/secondary system.

The Order Code can be read from a label sticking on the IED's casing or via the local HMI of CU and BUs. The order code can be read from a label sticking on the IED’s casing or via the local HMI of CU and BUs.

LHMI-Menu: Diagnostik_Informtation/Product identifiers/Order Code

3.2 Checks Central Unit

The following checks relate to the REB500 Product Guide, Section Ordering code CU.

3.2.1 Power supply

Check criteria:

- The power supply of REB500 shall reflect the battery voltage (Aux1)
  
  Option 1  100 V AC-240 V AC, 110 V DC-250 V DC, 9 BO
  Option 2  48 V DC-125 V DC, 9 BO

- The CU order code shall reflect this voltage:

Sample configuration  →  REB500 8.2-CU04-S20-A1A2-B1X0-EK-SAA-F-AA-AC

3.2.2 Redundant power supply

Check criteria:

- The necessity of a second (redundant) powers supply shall be checked
- The second power supply shall reflect the battery voltage (Aux2)
  
  Option 1  no redundant power supply
  Option 2  100VAC-240VAC, 110VDC-250VDC, 9BO
  Option 3  48VDC-125 VDC, 9BO

- The CU order code shall reflect redundant power supply with the adequate voltage:

Sample configuration  →  REB500 8.2-CU04-S20-A1A2-B1X0-EK-SAA-F-AA-AC
### 3.2.3 Number of supported BUs

**Check criteria:**

- The number of BUs (inclusive spares) shall be defined.

> Normally, one bay needs one BU. Bays with more than one CT/CB (for example, bus-coupler) need correspondingly more BUs.

- The CU order code shall reflect the total number of BUs:

  ```
  Sample configuration → REB500 8.2-CU04-S20-A1A2-B1X0-EK-SAA-F-AA-AC
  ```

**Configuration steps for the number of BUs, see REB500 Product Guide, Section Ordering code CU.**

### 3.2.4 Number of I/Os

**Check criteria:**

- The number of binary I/Os shall be defined

  - **standard** 19BO/9BI
  - **optional** 28BO/18BI

- The CU order code shall reflect the total number of I/Os:

  ```
  Sample configuration → REB500 8.2-CU04-S20-A1A2-B1X0-EK-SAA-F-AAA-AC
  ```

### 3.2.5 Communication IBB-Protocol

**Check criteria:**

- The necessity of the communication option(s) and the corresponding IBB protocol shall be checked.

  - **Option 1** IEC61850-8-1
  - **Option 2** IEC60870-5-103

- The CU order code shall reflect the communication option(s):

  ```
  Sample configuration → REB500 8.2-CU04-S20-A1A2-B1X0-EK-SAA-F-AA-AC
  ```

### 3.2.6 Type of connectors for power supply and binary I/Os

**Check criteria:**
• The necessary requirements for the connection terminals of the power supply and the binary I/Os shall be checked.

   Option 1  Compression terminals
   Option 2  Ring plug terminals

• The CU order code shall reflect the connection terminal option(s):

   Sample configuration → REB500 8.2-CU04-S20-A1A2-B1X0-EK-SAA-F-AA-AC

3.2.7 Mounting details

Check criteria:

• The mounting variant of the central unit shall be checked.

   Option 1  No mounting defined
   Option 2  Mounting kit for 6U 3/4 x 19" case

• The CU order code shall reflect the mounting option:

   Sample configuration → REB500 8.2-CU04-S20-A1A2-B1X0-EK-SAA-F-AA-AC

3.3 Checks Bay Units

The following checks relate to the REB500 Product Guide Section Ordering code BU. The Bay Units might have different versions and due to this fact different order codes may be found. The checks shall be repeated for each individual order code.

3.3.1 Power supply

Check criteria:

• The power supply of REB500 shall reflect the battery voltage.

   Option 1  100VAC-240VAC, 110VDC-250VDC, 9BO
   Option 2  48VDC-125 VDC, 9BO

• The BU order code shall reflect this voltage:

   Sample configuration → REB500 8.2-BU04-C1C2C4-B1X0-CA-SA-AX0-SA5-AP-A

3.3.2 Number of IOs

Check criteria:

• The number of binary I/Os shall be defined and the required performance of the tripping outputs shall be checked.
The optional precision outputs provide an improved tripping time performance.

- The BU order code shall reflect the total number of binary I/Os as well as the need to implement precision binary I/Os:

```
Sample configuration → REB500 8.2-BU04-C1C2C4-B1X0-CA-SA-AX0-SA5-AP-A
```

### 3.3.3 Local HMI

**Check criteria:**
- The need of a Local HMI for each BU shall be checked.

  **Option 1** No LHMI
  **Option 2** LHMI: OL3000, IEC 6U 1/2 19", Basic

- The BU order code shall reflect option for the LHMI:

```
Sample configuration → REB500 8.2-BU04-C1C2C4-B1X0-CA-SA-AX0-SA5-AP-A
```

### 3.3.4 Mounting of Local HMI

**Check criteria:**
- The location (mounting) of the Local HMI shall be checked (if existing)

  **Option 1** No detached mounting of LHMI → means mounted on the front side of the BU
  **Option 2-6** Detached mounting of LHMI incl. Ethernet cable 1-5m

- The BU order code shall reflect the mounting option of the LHMI:

```
Sample configuration → REB500 8.2-BU04-C1C2C4-B1X0-CA-SA-AX0-SA5-AP-A
```

### 3.3.5 Analogue input module

**Check criteria:**

The number of the necessary analogue inputs shall checked. The protection functions used (see Section 3.3.8) are relevant for this criteria (see REB500 Product Guide Analogue Inputs section.)

- **Option 1** TRM01: 4I, 1/5A + 1I, 0.1/0.5A +5U, 100/220V
- **Option 2** TRM01: 4I, 1/5A

- The BU order code shall reflect the version of analogue inputs:
### 3.3.6 Type of connectors for analogue modules

Check criteria:

- The necessary requirements for the connection terminals the analogue inputs shall be checked

  - **Option 1**  Compression terminals
  - **Option 2**  Ring plug terminals

- The BU order code shall reflect the connection terminal option(s):

  Sample configuration → REB500 8.2-BU04-C1C2C4-B1X0-CA-SA-AX0-SA5-AP-A

### 3.3.7 Type of connectors for power supply and binary I/Os

Check criteria:

- The necessary requirements for the connection terminals of the power supply and the binary I/Os shall be checked.

  - **Option 1**  Compression terminals
  - **Option 2**  Ring plug terminals

- The BU order code shall reflect the connection terminal option(s):

  Sample configuration → REB500 8.2-BU04-C1C2C4-B1X0-CA-SA-AX0-SA5-AP-A

### 3.3.8 Software options

Check criteria:

- The software options (optional protection functions) necessary to fulfill the protection scheme of the respective bay shall be defined.
  Options → see REB500 Product Guide Section Ordering code BU

- The BU order code shall reflect the necessary software options:

  Sample configuration → REB500 8.2-BU04-C1C2C4-B1X0-CA-SA-AX0-SA5-AP-A
3.4 Checks Ethernet switches

3.4.1 Number of required switches AFS677

Check criteria:

- The number of switches depends on the number of BUs
  
  1-10 BUs → 1 switch  
  11-24 BUs → 2 switches  
  25-38 BUs → 3 switches  
  39-52 BUs → 4 switches  
  53-60 BUs → 5 switches

- The order of AFS677 shall reflect the number of required Ethernet switches:

  Sample configuration (15 BUs) → Switch AFS677: 2 x 1MRK010500-DA

3.4.2 Switch data/ power supply

Check criteria:

- The power supply of the Ethernet switches shall reflect the battery voltage.

  Option 1 110/250 V DC
  Option 2 24/36/48 V DC

- The necessity of a second (redundant) powers supply shall be checked

  Option 1 no redundant power supply
  Option 2 redundant power supply

- The order code of switch AFS677 shall reflect the power supply data:

  Sample configuration → Switch AFS677: 2 x 1MRK010500-DA

3.4.3 Transceivers

Check criteria:

- A sufficient number of transceivers shall be ordered

  Calculation of the number of transceivers:

  up to 10  → n BUs +2  
  up to 24  → n BUs +6  
  up to 38  → n BUs +8  
  up to 52  → n BUs +10

- The order code shall reflect the number of transceivers:
The type the delivered transceivers (SFPs → small form-factor pluggable) shall be checked:

- correct → M-SFP-SX/LC (ordering no. 943014501)
- not correct → M-FAST SFP-MM/LC (ordering no. 943 945-501)
Section 4 Sequences

4.1 Introduction

Putting into operation of a REB500 system needs a number of predefined work steps (Sequences).

The following instructions does intend to ensure, that the delivered REB500 system including the Ethernet switches are in the ready state, once the work has been completed.

4.2 Setup Ethernet switches (AFS677)

Sequence of work steps:

4.2.1 Use binding instructions

The binding instructions in the form of the REB500 Application Note Switch configuration guideline shall be followed. See REB500 Product CD, Configurator Mode, Section Application Notes.

4.2.2 Check power supply

The connections of the power supply inputs shall be checked with regard to the input voltage, the polarity and the redundancy concept (redundant or not redundant).

- Not redundant types:
  
  | 1MRK010500-AA | AFS677 | 24/36/48V DC |
  | 1MRK010500-CA | AFS677 | 110/250 V DC / 110/230 V AC |

- Redundant types:
  
  | 1MRK010500-BA | AFS677 | 24/36/48V DC |
  | 1MRK010500-DA | AFS677 | 110/250 V DC / 110/230 V AC |

Sample Configuration (see Figure 1):

Redundant power supply 110 V DC → 1MRK010500-DA AFS677

- Power supply shall be switched on
- Power LED (P) of switches shall be glowing green.

4.2.3 Adjust IP address of AFS switches

Each AFS switch shall be adjusted with a prescribed IP-address. The REB500 Application Note "Switch configuration guideline", Section "Switch configuration" provides the list of IP-addresses and the description of the configuration process.

Sample Configuration (see Figure 1):
This work step presupposes that the software AFS Finder is installed on your PC. For details, see *REB500 Application Note Switch configuration guideline*, Section *Check firmware version*.

### 4.2.4 Check firmware version of AFS switches

The firmware version loaded on of the AFS switches shall be checked. Unless the firmware is not up to date, the AFS switch shall be load with the latest version. All switches require the same software version.

The firmware update is made via a web-based interface (Explorer). The *REB500 Application Note Switch configuration guideline*, Section *Update firmware version* provides a detailed instruction for this work step, as well as the source of the current firmware version.

### 4.2.5 Load specific master/slave configurations

The master/slave specific configuration files shall be load to the AFS677 switches. The *REB500 Application Note Switch configuration guideline*, Section *Switch configuration* provides the binding instructions.

Depending on whether switches do have redundant or not redundant power supply, different configuration files are needed.

- **Not redundant power supply use files from REB500 Product CD:**
  \Content REB500\2_Add-ons\Switch-Configuration\AFS677\Configuration\1MRK010500-AA, 1MRK010500-CA

- **Redundant power supply use files from REB500 Product CD:**
  \Content REB500\2_Add-ons\Switch-Configuration\AFS677\Configuration\1MRK010500-BA, 1MRK010500-DA

Sample Configuration (see *Figure 1*, AFS677 with redundant power supply):

Use configuration files from folder “1MRK010500-BA, 1MRK010500-DA”

Switch 1 → Master_2.cli
Switch 2 → Slave_1.cli

### 4.3 Setup REB500 system (CU and BU’s)

Sequence of work steps:
4.3.1 Fibre optic connections between CU and switches

The process bus between REB500 CU and the AFS677 switches shall be connected to a ring-bus configuration in accordance with the binding guidelines (see REB500 Application Note Switch configuration guideline, Section Network topology).

Each port used on switches shall be equipped with a transceiver (see Section Transceivers).

Sample Configuration (see Figure 1)

Connections:
- CU-Port X1 → Switch-Master2 Port 11
- CU-Port X1001 → Switch-Master2 Port 12
- Switch-Master2-Port 15 → Switch-Slave1 Port 15
- Switch-Master2-Port 16 → Switch-Slave1 Port 16

(Ring bus configuration)

4.3.2 Fibre optic connections between bay units and switches

Each bay unit shall be connected to a port of a AFS677 switch in accordance with the binding guidelines (see REB500 Application Note Switch configuration guideline, Section Network topology).

Each port used on the switches shall be equipped with a transceiver (see Section 3.4.3).

Sample Configuration (see Figure 1)

Connections:
- Bay Units 1-10 Port X1 → Switch-Master2 Port 1-10
- Bay Units 11-15 Port X1 → Switch-Slave1 Port 1-5

After the REB500 system including the Ethernet switches is energized (see Section 4.2.2 and Section 4.2.3), the ready state of the communication shall be checked:

- On central unit side, the green control LEDs of the used ports shall flash.
- On switch side, the green control LEDs shall be glowing green permanently.

4.3.3 Power up system

The connections of the power supply inputs of the central unit and each bay unit shall be checked:

- The input voltage level and polarity shall be checked.
- The redundancy concept (central unit redundant or not redundant) shall be verified.

Sample Configuration:
- Power supply central unit 110 V DC, redundant
- Power supply bay units 110 V DC

- Power supply of central unit and bay units supply shall be switched on.
- After the start up time, the green READY LED of central unit and bay units shall flash.

For more information about energizing procedure of the IEDs, see REB500 Commissioning Manual, Section Overall Procedure.
4.3.4 Device ID of the BUs

The bay units shall obtain a unique Device-ID (BU-side), which is necessary for the device allocation.

The system configuration file (setfile-side) contains a list of Device-IDs to be used for the individual devices (BUs).

- Open the system setfile xxxx.mdb with the HMI500-REBWIN tool menu: Configuration
- Network to get the list of Device-IDs.

![Figure 2: HMI500 → Listing of Device IDs](Image)

- During the start-up phase of a bay unit, the maintenance menu can be accessed (press ENTER in local HMI, when asked during startup routine) to set the individual Device-IDs. The last octet of the IP Address LAN_IF_2 shall reflect the Device-ID (xxx-xxx-xxx-11).
- Adjust the Device-ID for each individual bay unit.
- Continue start-up of the bay units by leaving the maintenance menu.
- Check the Device-ID adjusted in the first bay unit by using the Local HMI. The last octet stands for the Devices-ID of the respective BU.

⚠️ If the Device-ID configuration in the system configuration file diverges from the configuration of the bay units, this leads into malfunction.

4.3.5 Download Configuration using HMI500_REBWIN

- Open the current system configuration file (see Section 4.3.4) with the HMI500_REBWIN tool.
- Download the system configuration file to the REB500 systems (Central unit).
For more information about the download, see *REB500 Operation manual*, Section *File menu*.

- Following the download of a setfile, the REB500 system to the central unit all IEDs shall be rebooted. After a successful reboot, the green READY LEDs shall be glowing permanently on all IEDs.

### 4.3.6 Check Firmware version on BU and CU

- Check that the firmware version on BUs and CU is identical by using the Local HMIs. LHMI-Menu: *Diagnostics/Information/Product identifiers/Firmware Version/8.x.x.xxx*
# Section 5  Source of Information

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Section 6  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.

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. 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).