Distributed Busbar/Circuit Breaker Failure Protection SIPROTEC 7SS52

Operation
Manual

May 1998

SIEMENS

Distributed Busbar/Circuit Breaker Failure Protection SIPROTEC 7SS52

Operation Manual Order–no. E50410–A0012–U501–A1–7691

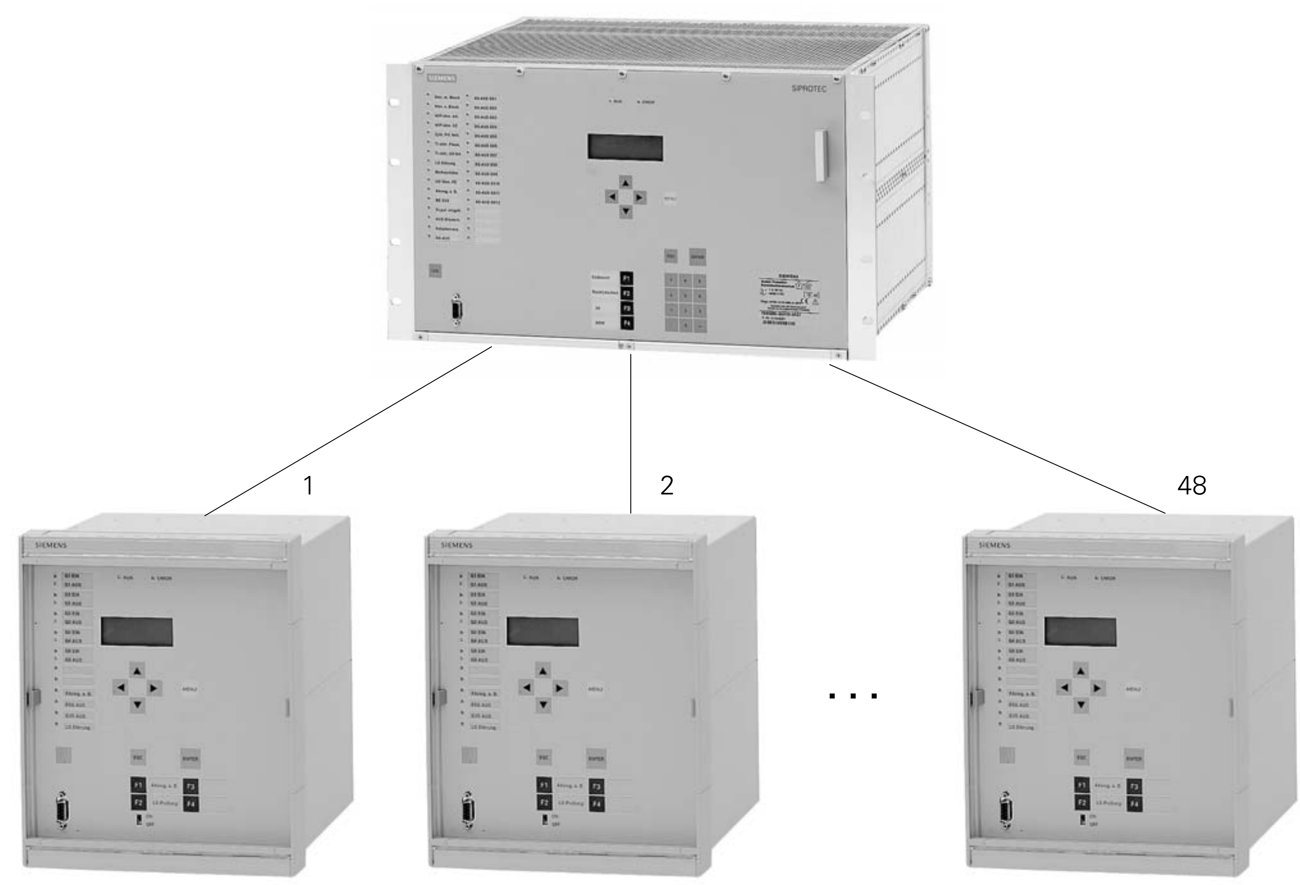


Figure 1 General view (Master unit with distributed bay units connected via fibre–optical cables)

Edition May 1998

Trade marks

All used designations or product names are liable to be trademarks or registered trademarks of the corresponding owner.

Liability waiver

The contents of this manual was checked for conformity with the described hardware and software. Deviations can, how– ever, not be excluded. We can not be held responsible for complete conformity and for eventual errors. The data in this manual are regularly checked and necessary corrections will be included in further editions. We appreciate suggestions.

Copyright

Distribution or reproduction of this document, the use or disclosure of its contents is forbidden, unless express written permission has been given. Violations will lead to claims for damages. All rights for registration of patents or trademarks reserved.

Warranty

The contents of this instruction manual shall not become part nor modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligations of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties nor modify the existing warranty.

Subject to technical alteration

Distributed Busbar/Circuit Breaker Failure Protection SIPROTEC 7SS52 - Operation Manual Order–no. E50410–A0012–U501–A1–7691

The following list is not a complete description of all safety measures required to operate the device or module. Special operating conditions may require additional precautions.

Warning

Hazardous voltages are present in this electrical equipment during operation. Non–observance of the safety rules can result in servere personal injury or property damage.

- The earthing screw of the device must be connected solidly to the protective earth conductor before any other connection is made.
- Hazardous voltages can be present on all circuits and components connected to the supply voltage or to the measuring and test quantities.
- Hazardous voltages can be present in the device even after disconnection of the supply voltage (storage capacitors!)
- CT circuits must not be operated with open secondaries.
- The limit values given in the Technical data must not be exceeded at all, not even during testing and commissioning.
- Only qualified personnel shall work on and around this equipment. For correct and safe operation of this device it is indispensable, that the equipment is transported correctly, stored, assembled and connected properly and thoroughly operated and maintained.

This instruction manual does not purport to cover all details in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the local Siemens sales office.

Qualified personnel has to be trained for assembling, connection, commissioning and operation of the product and has to have qualifications in conformity with their responsibility, such as:

- Training or instruction, respectively authorization to switch on and off, isolate, connect to earth and mark current circuits and devices/systems in conformity with the standards of safety regulations.
- Training or instruction for utilization and care of adeduate safety equipment in conformity with the standards of safety regulations
- Training for first aid

CE–Conformity

This product is in conformity 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 Council Directive 89/336/EEC).

Conformity is provided by tests that have been performed according to article 10 of the Council Directive in accordance with generic standards EN 500B1–2 by Siemens AG

The device is designed and manufactured for application in industrial environment.

The device is designed in accordance with international standards of IEC 255 and the German standards DIN 57435 part 303 (corresponding to VDE 57435 part 303).

Contents

Distributed Busbar/Circuit Breaker Failure Protection SIPROTEC 7SS52 — Operation Manual Order–no. E50410–A0012–U501–A1–7691

page

I Contents

Index of Figures

Index of Tables

1 Introduction

This manual describes the main characteristics and the functioning of the digital distributed busbar and circuit breaker failure protection 7SS52. Please read this manual completely before commissioning the protection system. Each chapter describes an essential part of the protection device and its application.

1.1 Chapter index

Chapter 1: Introduction
This chapter gives an overview of the contents of this manual. Information regarding selection and ordering data is included in this chapter.

Chapter 2: Product description
This chapter outlines the range of applications, the main features and the scope of functions of the 7SS52. In addition this chapter contains the description of the versions, dimensions and configuration.

Chapter 3: Technical data
This chapter contains all relevant technical information as well as the corresponding standards and guidelines.

Chapter 4: Mode of operation
This chapter describes all functions of the 7SS52.

Chapter 5: Instructions for preparation
This chapter contains instructions for transport, configuration and installation and connection of the protection device. In addition setting facilities on the modules are described.

Chapter 6: Operating instructions
This chapter describes in detail handling, testing and commissioning of the protection system.

Chapter 7: Maintenance
Methods for fault analysis and replacement of system components are described in this chapter.

Chapter 8: Repair
This chapter contains information about repair of the 7SS52.

Chapter 9: Storage
This chapter contains information about storage of the 7SS52.

Annex:
The annex consists of various general tables, supported by diagrams and tables for configuration and connection of the protection system.

1.2 Data for selection and ordering

Table 1.1 gives an overview of the available variants of the components (master unit, bay units) of the protection system 7SS52 and their ordering codes.

Necessary ancillary devices and the available documentation for their application with corresponding ordering codes are added.

Table 1.1 Data for selection and ordering

Distributed busbar and circuit breaker failure protection SIPROTEC 7SS52 **MASTER UNIT**	Order–no. 1 8 9 10 11 16 **7SS52 0 0 – ☐☐☐☐0 – 0 A A☐**
Nominal auxiliary voltage converter	
DC 48, 60 V	**3**
DC 110, 125 V	**4**
DC 220, 250 V	**5**
Mechanical design	
in subrack ES902C	**A**
in surface–mounted casing	**B**
in 8MF cubicle	**F**
Fitted for	
8 bays	**A**
16 bays	**B**
24 bays	**C**
32 bays	**D**
40 bays	**E**
48 bays	**F**
Fitted alarm modules	
16 alarms	**1**
32 alarms	**2**
Communication language	
German	**1**
English	**2**

BAY UNIT	Order–no. 1 7 8 9 13 **7SS52 1 ☐ – ☐☐A 0 0 – ☐A A 0**
Nominal current at 50/60 Hz	
1 A	**1**
5 A	**5**
Nominal auxiliary voltage for converter	
DC 60 to 250 V	**5**
Mechanical design	
in casing 7XP2040–2 for flush mounting in panel or cubicle	**C**
in casing 7XP2040–1 for surface mounting on panel	**D**
in casing 7XP2040–2 for flush mounting in panel or cubicle without glass cover	**E**
Supplementary functions	
without	**0**
with overcurrent time protection (in preparation)	**1**

ANCILLARY COMPONENTS **Fibre–optical connections master unit to bay units**	Order–no. **6 X V 8 1 0 0 – 0 B B □ 1 – □ □ □ 0** 1) 2)
FO–Duplex outdoor cable with non–metallic rodent protection, PE sheath 2GG 62,5/125 mm hollow conductor filled,	**6 X V 8 1 0 0 – 0 B C □ 1 – □ □ □ 0** 1)
FO–Duplex indoor cable, stable design 2G 62,5/125 mm; halogen–free and flame–retardant,	
without FSMA plug	**0**
single–end pre–fabricated with FSMA plug	**1**
double–end pre–fabricated with FSMA plug	**2**
100 meter lengths:	
Length 0 m	**0**
Length 100 m	**1**
Length 200 m	**2**
Length 300 m	**3**
Length 400 m	**4**
Length 500 m	**5**
Length 600 m	**6**
Length 700 m	**7**
Length 800 m	**8**
Length 900 m	**9**
10 meter lengths:	
Length 0 m	**A**
Length 10 m	**B**
Length 20 m	**C**
Length 30 m	**D**
Length 40 m	**E**
Length 50 m	**F**
Length 60 m	**G**
Length 70 m	**H**
Length 80 m	**J**
Length 90 m	**K**
1 meter lengths:	
Length 0 m	**A**
Length 1 m	**B**
Length 2 m	**C**
Length 3 m	**D**
Length 4 m	**E**
Length 5 m	**F**
Length 6 m	**G**
Length 7 m	**H**
Length 8 m	**J**
Length 9 m	**K**

e.g. 227 m outdoor cable with plug connector at both ends: 6XV8100–0BB21–2CH0

1) Plain text order required for non–standardized lengths
2) Before delivery, the non–metallic anti–rodent protection is stripped at both ends an a length of 1 meter. Extended stripping lengths have to be ordered by plain text (preferably in steps of 1 meter).

PC communication program DIGSI for busbar protection	Order–no.
German English	**7XS5010–0AA00** **7XS5010–1AA00**
Connection cable 7SS52–PC (9–pole; SUB–D)	**7XV5100–4**

Documentation	
Information leaflet LSA 2.2.7: Distributed busbar and circuit breaker failure protection SIPROTEC 7SS52	**E50001–K5722–A171–A1**
Operation manual: Distributed busbar and circuit breaker failure protection SIPROTEC 7SS52	**E50410–A0012–U501–A1–7691**

Ancillary devices

The following ancillary devices are contained in the delivery of the master unit:

- Extraction handle for boards (1 off)
- FO–Simplex indoor cable, length 0,2 m (2 off)
- FO–coupler (1 off)
- Inscription film
- Torx socket wrench insert T8, T10, T20
- Disk with PC communication program ”DIGSI” and template for arrangement of the text on the inscription strips

2 Product description

This chapter describes application, main characteristics and scope of functions of the 7SS52. It also contains the description of the versions, dimensions and configuration.

2.1 Application

The busbar and breaker failure protection 7SS52 is a selective, reliable and fast protection for busbar short–circuits and circuit–breaker failures in medium–voltage, high–voltage and extra high–voltage switching stations. It is suitable for almost all busbar configurations.

The busbar protection uses a ”per–phase measuring” principle.

The protection system consists of a master unit (ZE) and up to 48 bay units (FE) connected by fibre–optical cables. The latter can be located in the vicinity of the bays (distributed) but also together with the ZE in cubicles (centralized)..

The protection can be used with all types of switchgear with either conventional or linearized CTs.

The modular design facilitates extensions or modifications of the protection system in conformity with the switchgear design.

The 7SS52 is designed for 12 selective bus zones and 12 bus coupler sections (KS)1). The busbar configuration can include up to 24 longitudinal sectionalizers and 4 bus couplers (1 bus coupler = 2 bays).

- By virtue of the universal isolator replica, the 7SS52 can be matched with different busbar configurations in the design phase.
- Compensation of different current transformer ratios is achieved by parameter setting. Intermediate current transformers are thus no more required.
- A busbar short–circuit is detected by evaluating the differential current and the stabilizing current. Appropriate measures ensure correct performance even for extreme CT saturation (duration of current transmission ≥3 ms half period).
- The integrated circuit breaker failure protection (CBF) can be operated in six modes, selectable per bay:
  - current sensor
  - TRIP repetition with current sensor
  - 1–stage CBF (unbalancing)2)
  - 2–stage CBF (TRIP repetition with following unbalancing)
  - TRIP repetition and following unbalancing with pulse trigger
  - Start by external CBF and tripping via the isolator replica

---

1) Sections which serve exclusively for coupling of the bus zones. They do not have any feeders.

2) The current of the feeder with breaker failure is inverted for calculation of the differential current.

2.2 Features

- Powerful 32–bit microprocessor system
- Completely digital measured value processing and control, from the aquisition and digitizing of measured values, recognition of the isolator status and processing of the CB failure protection signals up to the trip decisions for the circuit–breaker
- Easy menu–guided operation via integrated keypad and display panel
- Storage of fault events as well as instantaneous values for fault recording.
- Complete galvanic and disturbance–free isolation between the internal processing circuits of master unit and bay units and the measuring and auxiliary supply circuits of the station by virtue of screened measuring transducers, binary input and output modules and DC converters.
- Disturbance–free and fast data transmission from and to the bay units by fibre–optical links.
- Complete scope of functions for the selective protection of multiple busbar systems.
- Central administration and feeder–dedicated indication of the isolator states.
- Continuous monitoring of measured values as well as of hardware and software of the unit
- Comprehensive self–monitoring provides for fast signalling of unit failure.
- Communication via the V.24 interface and utilization of the program DIGSI for system configuration, settings, parameterizing and reading–out of events and fault recordings.
- Commissioning support by means of measuring and annunciation features.

2.3 Scope of functions

2.3.1 Busbar protection

The numerical busbar protection contains the following functions:

- Busbar protection with up to 12 bus zones, 12 bus coupler sections (KS) and up to 48 bay units.
- Evaluation of the differential current in conjunction with through–current stabilization (refer Fig 2.1).
- Tripping dependent on three independent measurement decisions; 2 based on busbar configuration and 1 isolator–independent (check zone).
- Typical trip time $\leq$ 15 ms.
- High stability even with very high short–circuit currents and CT saturation.
- Zone–selective and phase–selective blocking of the busbar protection by the differential current monitor.
- Characteristics for check zone and bus–selective zones can be set independently from each other.
- Matching to different CT ratios without intermediate matching transformers.
- Selective clearance of short–circuits even on the bypass bus with signal transmission to the remote end.
- Detection and disconnection of short–circuits in the coupler bay between current transformers and circuit–breaker based on current measurement and selective unbalance.
- Direct operation of the circuit breaker by the bay unit.

2.3.2 Circuit–breaker failure protection

The 7SS52 has an integrated circuit breaker failure protection (CBF).

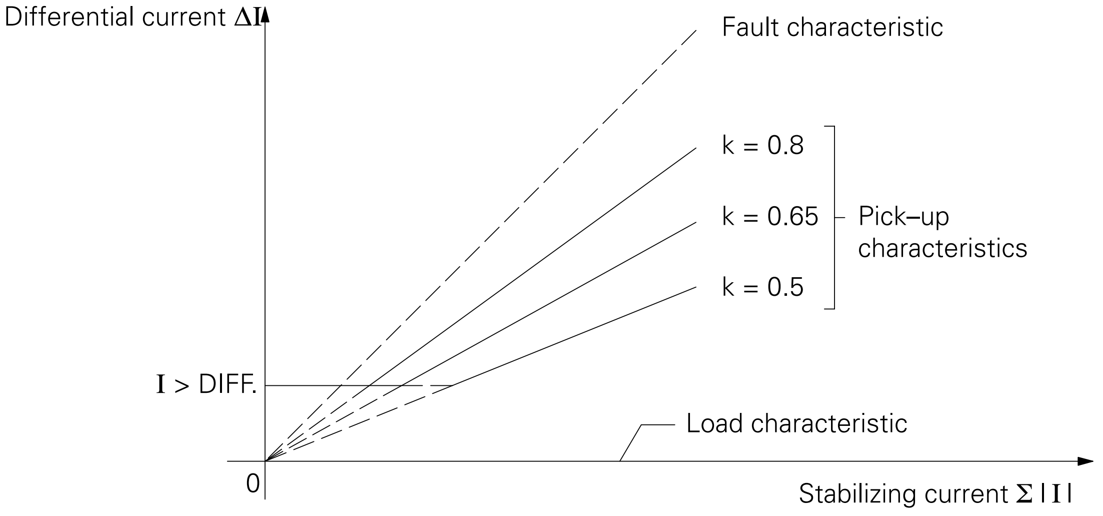
- Six modes are available:

1. Current sensor
   After initiation by a TRIP command from the feeder protection, this signal is checked in the 7SS52 for reset. If the measured current stays above the set threshold after a set time has elapsed, then zone–selective TRIP commands will be issued in the bays considering the isolator replica in the 7SS52.
2. TRIP repetition with current sensor
   When initiated by a TRIP command from the feeder protection, the 7SS52 issues a TRIP command to the circuit breaker of the initiating feeder after a set time delay. In case this second TRIP command is also unsuccessful, tripping as per mode 1 is effected.
3. Unbalancing
   After initiation by a TRIP command from the feeder protection, this signal is checked in the 7SS52 for reset. If the measured current stays above the set threshold after a set time has elapsed, then the polarity of the current in this feeder is inverted (unbalancing). For this function a dedicated set of parameters is available.
4. TRIP repetition with subsequent unbalancing
   When initiated by a TRIP command from the feeder protection, the 7SS52 issues a TRIP command to the circuit breaker of the initiating feeder after a set time delay. In case this second TRIP command is also unsuccessful, unbalancing as per mode 3 is initiated.
5. TRIP repetition with subsequent unbalancing with pulse trigger
   The function is triggered by a trip command from the feeder protection at the remote feeder terminal.

   The proceeding is described in mode 4.

   This mode is used for remote transmission of the CBF–initiating signal.
6. TRIP by external CBF
   In case of a separate circuit breaker failure protection the 7SS52 can generate zone–selective feeder TRIP command utilizing the integrated isolator replica.

- Recognition of a breaker failure in case of a busbar short–circuit by current limit value comparison.
- For all CBF modes, a feeder–selective command to trip the circuit breaker at the remote feeder terminal (transfer trip) is issued by the bay units



Notes:
The pick–up characteristic can be set independently for
- bus–section specific busbar protection,
- check zone,
- circuit–breaker failure protection with forced unbalance.

Figure 2.1 Pick–up characteristics of the busbar and breaker failure protection

2.3.3 Isolator replica

The isolator replica is common for busbar protection and circuit–breaker failure protection.

- The system is laid out for 48 bays, 12 bus sections and 12 bus coupler sections

  The protection system is suitable for configurations with single, double or triple busbars with or without transfer (bypass) bus. Combi–bus operation is possible.

  Up to 4 couplers (1 coupler = 2 bays) can be configured. These can be bus couplers or/and longitudinal sectionalizers.

  With transfer (bypass) or combi–bus operation up to 4 bus sections can be handled. (With "combi–bus operation" the main bus can assume the function of a transfer bus).
- Integrated storage of isolator status on loss of DC supply
- Isolator running time supervision
- The allocation of NOT OPEN = CLOSED eliminates the necessity of calibrated isolator auxiliary contacts.
- Matching to station configuration by operator–guided configuration during commissioning.
- Isolator status indication by means of LEDs in the bay units.

2.3.4 Trip output/reset

The signal processing is distinguished by the following characteristics:

- Feeder–selective TRIP command by the bay units.
- Feeder–selective selectable overcurrent release of the TRIP command.
- Extension of busbar TRIP signal for set time
- Current–controlled reset of TRIP signal

2.3.5 Fault recording

The digitized phase current values of all feeders and the differential and stabilizing currents of the bus zones and the check zone are stored. This fault record, starting 200 ms before the TRIP command and terminating 100 ms after the TRIP command is initiated by a busbar short–circuit, by binary input or by operation from the master unit. The 7SS52 stores up to 2 fault records.

The fault data can be read out via the serial interface of the master unit and analysed by the communication program DIGSI.

2.3.6 Binary inputs, trip outputs, re–assignable alarm relays and LED's

The bay units are the interface link to the station. Each bay unit has

- 4 command relays with each 2 NO contacts
- 1 command relay with 1 NO contact
- 1 alarm relay with 1 NO contact
- 1 alarm relay with 2 NO contacts (device failure, not marshallable)

The functional allocation of the outputs can be marshalled via the keypad of each bay unit.

10 binary inputs are used for recognition of the isolator states. The status is indicated via LEDs.

All binary inputs and corresponding LEDs of the bay unit are freely marshallable.

Up to 2 x 16 alarm relays and LEDs in the master unit can be marshalled with various functions for user–specific output and indication.

Several single alarms can form a group alarm.

Up to 7 fixed allocated binary inputs can be used to control functions of the master unit (e.g. release fault record, acknowledge LED).

2.3.7 Measuring and testing functions

The 7SS52 provides a variety of measuring and testing functions to assist during commissioning and maintenance.

- Display of the feeder currents per phase in each bay unit and in the master unit. In addition the data are available at the serial interface.
- Calculation of differential and stabilizing currents phase–selective and zone–selective. Display of these values in the master unit and for the check zone in the bay unit. In addition the data are available at the serial interface.
- Monitoring of the zone–selective and phase–selective differential currents with zone–selective blokking or alarm output.
- Monitoring of the differential currents in the check zone with blocking of the busbar protection and alarm output.
- Phase–selective trip test including control of the feeder circuit breaker (from master unit or bay unit).
- Removal of one bay from the busbar protection processing via master unit or bay unit, e.g during maintenance works ("bay out of service").
- Cyclic test of measured value aquisition, measured value processing and trip circuit test including the coils of the command relays.

2.3.8 Operational and fault events

The 7SS52 supplies detailed data for the analysis of faults as well as for operational events.

Up to 99 operational events and 40 fault events are stored in a rotating buffer in the master unit.

- Operational events
  Switching operations, (e.g. isolator switching), protection status indications (e.g. start of cyclic test), isolator status irregularities (running time, auxiliary voltage failure, etc.) and other monitoring functions belong to this group of events.
- Fault events
  Trip signals in the event of busbar short–circuits, circuit–breaker failure and transfer trip belong to this group of events.

2.3.9 Self–monitoring

Hardware and software are continuously monitored; irregularities are recognised instantly and annunciated.

High security and availability are achieved by the continuous monitoring of:

1. the isolator status,
2. the trip circuits,
3. the measured currents,
4. the measured value transformation,
5. all supply voltages,
6. the program memories,
7. the program processing.

For diagnosis purposes in the event of device failures, a dedicated data memory is available in the master unit.

2.4 Versions

The busbar and breaker failure protection 7SS52 as a system consists of the components

- master unit
- bay units
- data links (fibre–optical cables).

The master unit can be delivered in a SIPAC 19'' subrack for cubicle mounting or in a casing for surface / wall–mounting. On account of the modular design, different fitting variants can be coordinated with the station configuration. The bay units are built into a 7XP20 casing for cubicle mounting or surface mounting.

Prefabricated glas–fibre optical cables (62,5/125μm) with double–end FSMA plug connectors are used for the data exchange. They are suitable for outdoor installation and can be delivered with specific anti–rodent protection.

Indoor cables may be used for centralized configuration of the bay units.

2.4.1 Bay units

2.4.1.1 7SS521x–5DA00–xAA0 for panel surface mounting

For the variant ”surface mounting” the bay units are delivered in casings type 7XP2040–1.

The casing is completely metal–closed with a removable front cover with acrylic window. The integrated button can be used for reset of the LEDs while the front cover is fitted.

Earthing screws are at the left side of the casing.

The heavy–duty current terminals automatically short–circuit the current transformer when the module is withdrawn.

All signals including the auxiliary voltage are connected to double–level terminals. The device has 28 connection terminals at the bottom side and 50 more terminals at the top side. In each level the terminals are numbered from left to right.

Two FSMA connection points are located on the bottom, next to the terminal strip, for the fibre–optical link to the master unit. Two additional FSMA connection points are prepared for functional extensions of future system developments.
The dimensions of the casing can be seen in figure 2.4.

The device is enclosed by a metalic front cover which is electrically connected to the casing by means of contact spring blades.

The special door mechanism facilitates commissioning and maintenance. The mechanical structure is earthed via a flexible wire connection.

2.4.1.2 7SS521x–5CA00–xAA0 for panel or cubicle flush mounting

With the variant for ”flush mounting” the bay units are supplied in casings type 7XP2040–2.

The casing is completely metal–closed with a removable front cover with or without (ordering code ”E” at the 9th digit instead of ”C”) acrylic window. The integrated button can be used to reset the LEDs while the front cover is fitted. An earthing screw is located on the rear of the casing.
The heavy–duty current terminals automatically short–circuit the current transformer when the module is withdrawn.

All signals including the auxiliary supply are connected to terminals, located on the rear side. For each electrical signal one screw–type and one plug–in connection point is available for station wiring.

The plug–in modules are designated according to their position in a coordinate system. The connections inside a module are numbered from left to right (as seen from the rear), e.g. 1C1 and 1B4 (refer to figure 2.6).

FSMA screw–type connections are located on the rear side for a fibre–optical interface to the master unit.

The dimensions can be seen in figure 2.5.

2.4.2 Master unit

The master unit consists of several modules in double Europe format and is modularly fitted in a SIPAC 19’’ subrack (height 6U)

Degree of protection IP20 is guaranteed. When delivered in a surface–mounted casing, IP55 applies and when mounted in an 8MF–cubicle with swing–out frame, IP54 applies.

2.4.2.1 7SS5200–xAxx0–0AAx in subrack ES902C (SIPAC)

The subrack consists of an aluminum frame covered from all sides by metal plates. These are perforated at the bottom and top to cater for sufficient ventilation.

The modules are electrically interconnected by means of an integrated bus board and plug–in elements.

The subrack’s frontside is covered by a metalic plate. This front plate is hinged and can be opened downwards after loosening the fixing screws.

The subrack holds following modules in double–Europe format:

- Power supply (SV)
  The functional unit is 4 SEP (standard mounting space) wide.
- Input/output module (EAZ1 and EAZ2)
  Up to 2 modules each with 16 alarm relays can be used.

  To each alarm relay an LED on the front plate is allocated.

  The EAZ1 allows processing of up to 7 binary inputs.
- Central processor modules protection (ZPS)
  4 modules (SBK; BSZ1 to BSZ3) of this type with a width of 2 SEP provide the protection function.

Further 1 to 6 modules (depending on the system configuration) are used for the data exchange with the bay units. Each interface communication module (SK) can exchange data with up to 8 bay units.

- Fibre–optical module (LMZ)
  For each SK–module there is an electrical/optical signal converter module, fitted on the device's rear side. The receiver and transmitter connection points per bay unit are numbered on the master unit's rear plate.

  The external electrical connections (SV, EAZ) are designed as connection modules on the device's rear side. For each electrical connection point, there is one screw–type and in parallel one snap–in connector for the station wiring.

  The connection modules are designated according to their position in a coordinate system. The connections inside a module are numbered from left to right, e.g. 1C1 and 5B4 .

  FSMA connectors are provided for the fibre–optical interface to the bay units.

  The optical connection via FSMA plugs to a station control system is prepared.

  The mechanical dimensions can be seen in figure 2.7.

2.4.2.2 7SS5200–xBxx0–0AAx in wall–mounted casing

For the variant with surface–mounted casing the subrack is fitted into a wall–mounted casing.

All electrical and optical connections are made from the bottom side of the casing.

The door of the casing is equipped with a large glas window. The design of the wall–mounted casing with the three components door, swing–out frame and base facilitates installation, operation and service.

The mechanical dimensions can be seen in figure 2.9.

If only fibre–optic cables with anti–rodent protection shall be used, then the number of bay units connected to the wall–mounted master unit should not exceed 36.

2.5 Design

Binary inputs and outputs from and to the protection system are routed via the input/output modules of the bay unit (EFE, SAF) and the master unit (EAZ1 and EAZ2).

The protection system recognizes the information from the station (e.g. remote reset of indications) or from other devices (e.g. initiation of breaker failure protection). Outputs are:

- commands for tripping the circuit breakers, which are exclusively generated by the bay units
- alarms for remote signalling of important events and states
- optical indications (LED).

An integrated keypad together with the built–in alphanumerical LC display allows communication with the master unit as well as with the bay units. These operation elements provide for input or display of all data necessary for processing, such as setting parameters, station data, etc. (refer to chapter 6) as well as read–out of relevant operations and fault events (refer to annex A.1.2).

In addition, communication with the the master unit is possible via the serial interface.

The functional units in the bay unit and master unit are powered by powerful power supply units. The bay unit has a wide–range power supply. For the master unit power supply modules for different input voltage ranges are available.

Short dips or failures of the supply voltage up to 50 ms, which may occur due to short–circuits in the DC supply system of the station, are compensated by a DC storage capacitor (for nominal voltages ≥60 V).

2.5.1 Fitting of the modules

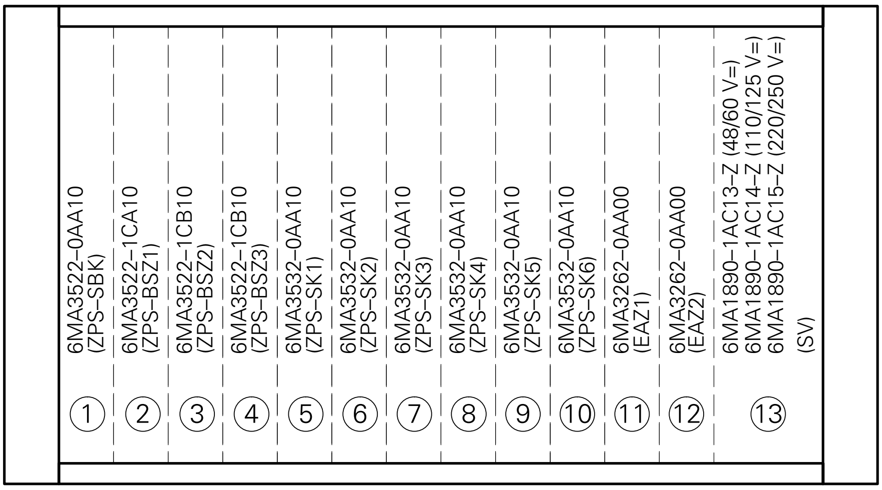
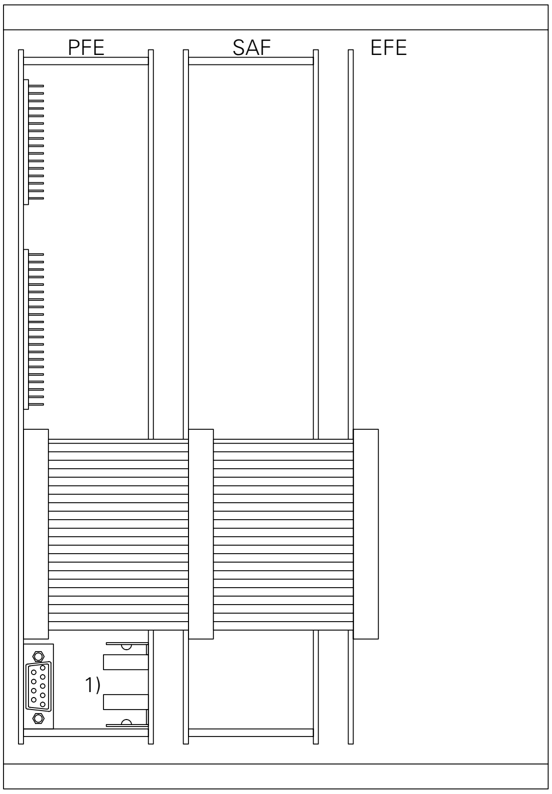


Figure 2.2 Fitting of the modules in the SIPAC subrack



1) No battery has to be fitted!

Figure 2.3 Fitting of modules in the bay unit

2.5.2 Device connections

Table 2.1 Overview of the device connections

Variant	Current connections	Voltage connections	FO connections
Panel surface mounting bay unit	78 terminals with connection cross–sections: max. 4 mm^2 for stranded wires max. 7 mm^2 for solid wires		integrated FSMA plug connector for FO connection, glass fibre 62,5/125 µm
Panel or cubicle flush mounting bay unit	screw connection max. 4 mm^2 in parallel double leaf–spring–crimp contact for max. 2,5 mm^2	screw connection max. 1,5 mm^2 in parallel double leaf–spring–crimp contact for max. 1,5 mm^2	integrated FSMA plug connector for FO connection, glass fibre 62,5/125 µm
Master unit (sub-rack)		screw connection max. 1,5 mm^2 in parallel double leaf–spring–crimp contact for max. 1,5 mm^2	integrated FSMA plug connector for FO connection, glass fibre 62,5/125 µm

2.6 Dimensions

2.6.1 Bay unit

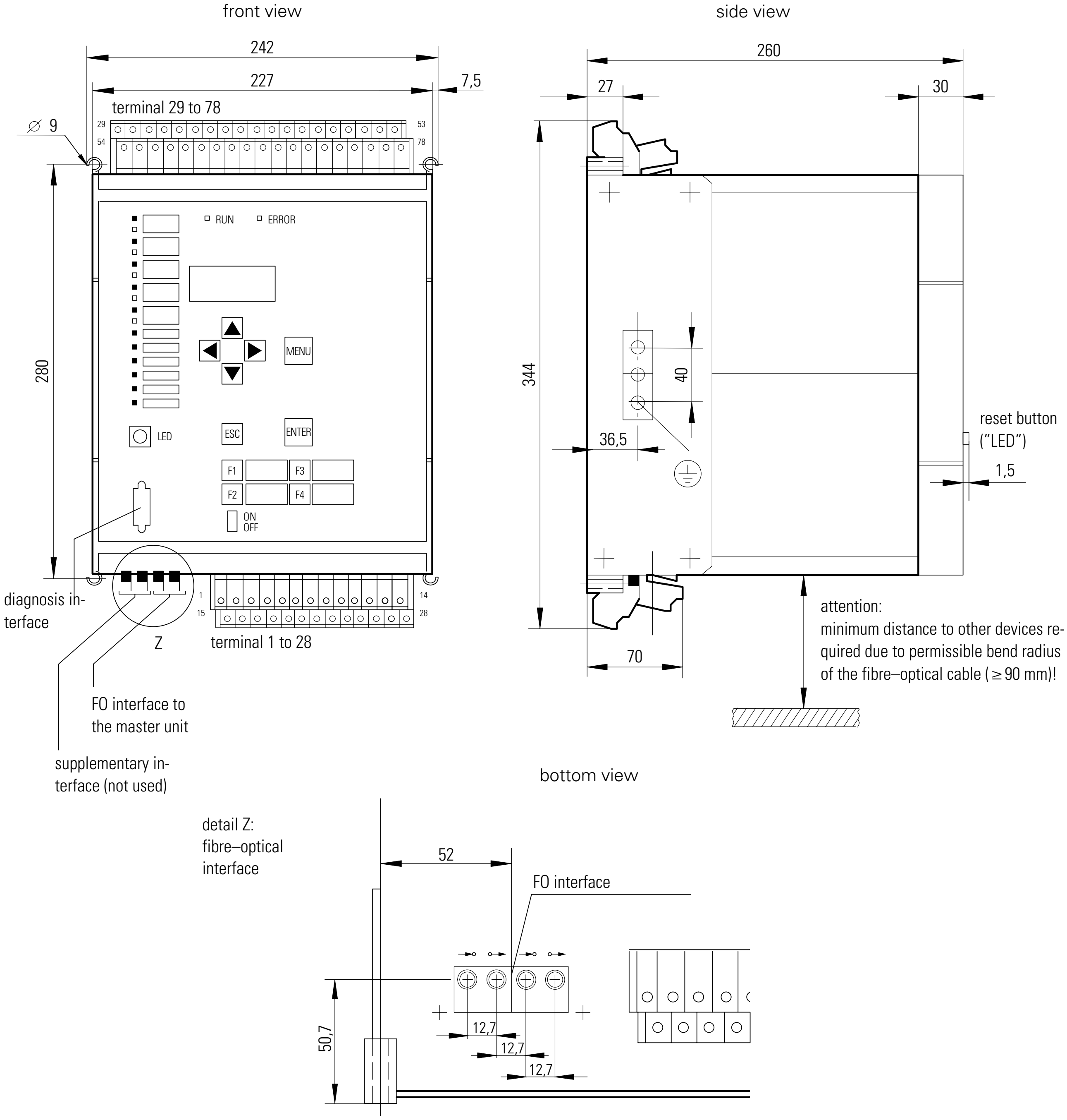


Figure 2.4 Mechanical dimensions 7XP2040–1 for surface mounting (all dimensions in mm)

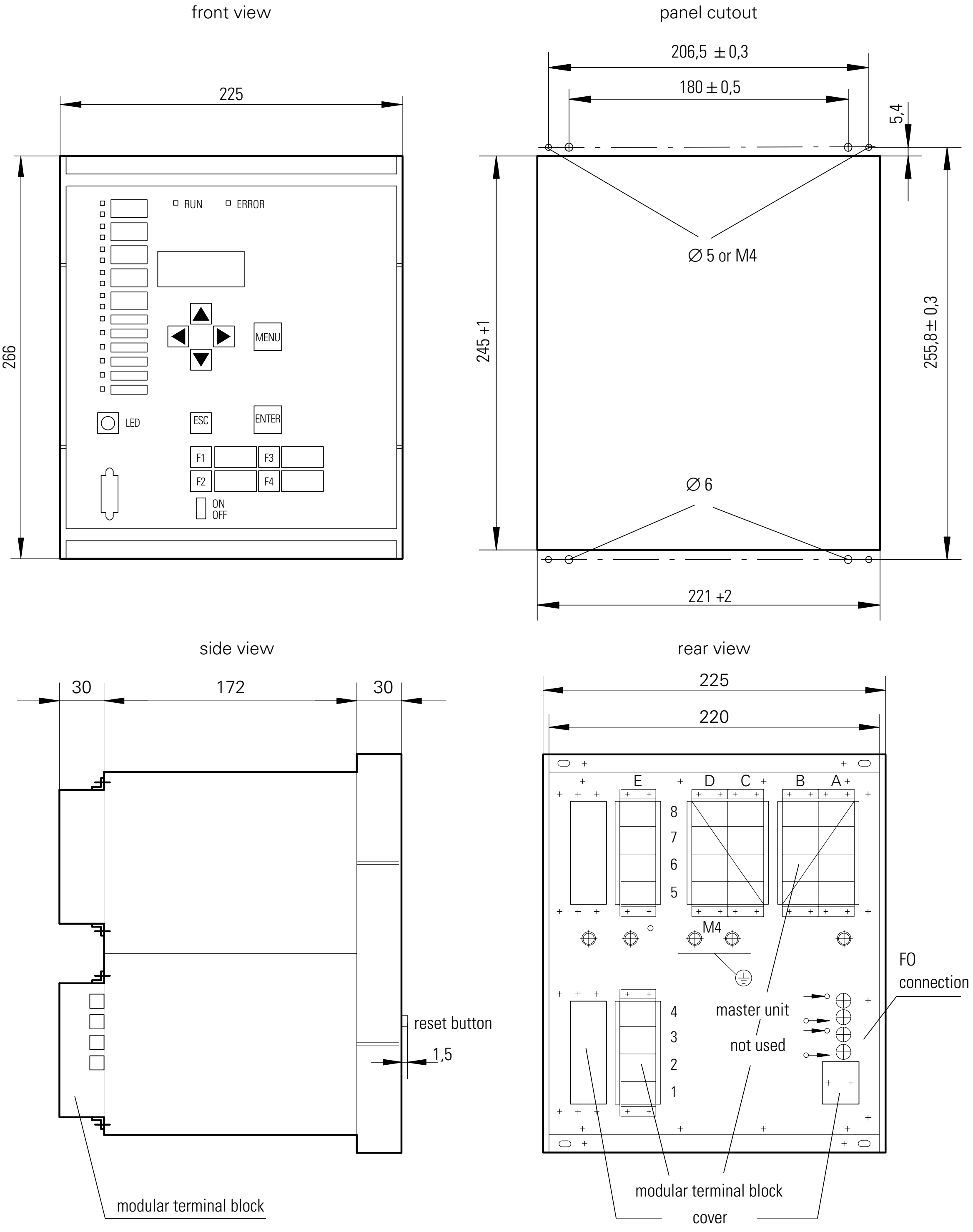


Figure 2.5 Mechanical dimensions 7XP2040–2 for panel or cubicle flush mounting (all dimensions in mm)

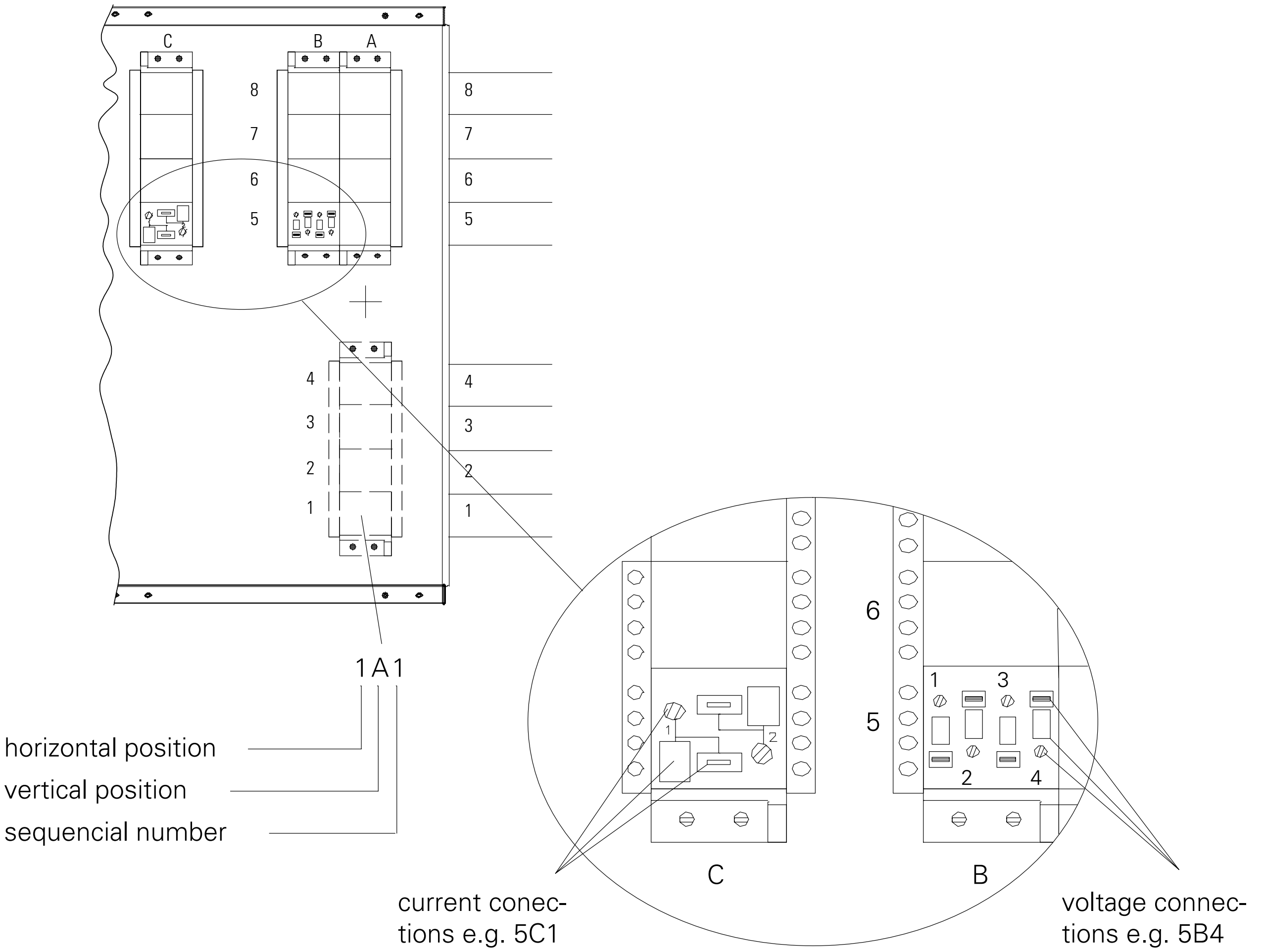


Figure 2.6 Connection plug (rear view) for flush mounted casing (example)

2.6.2 Master unit

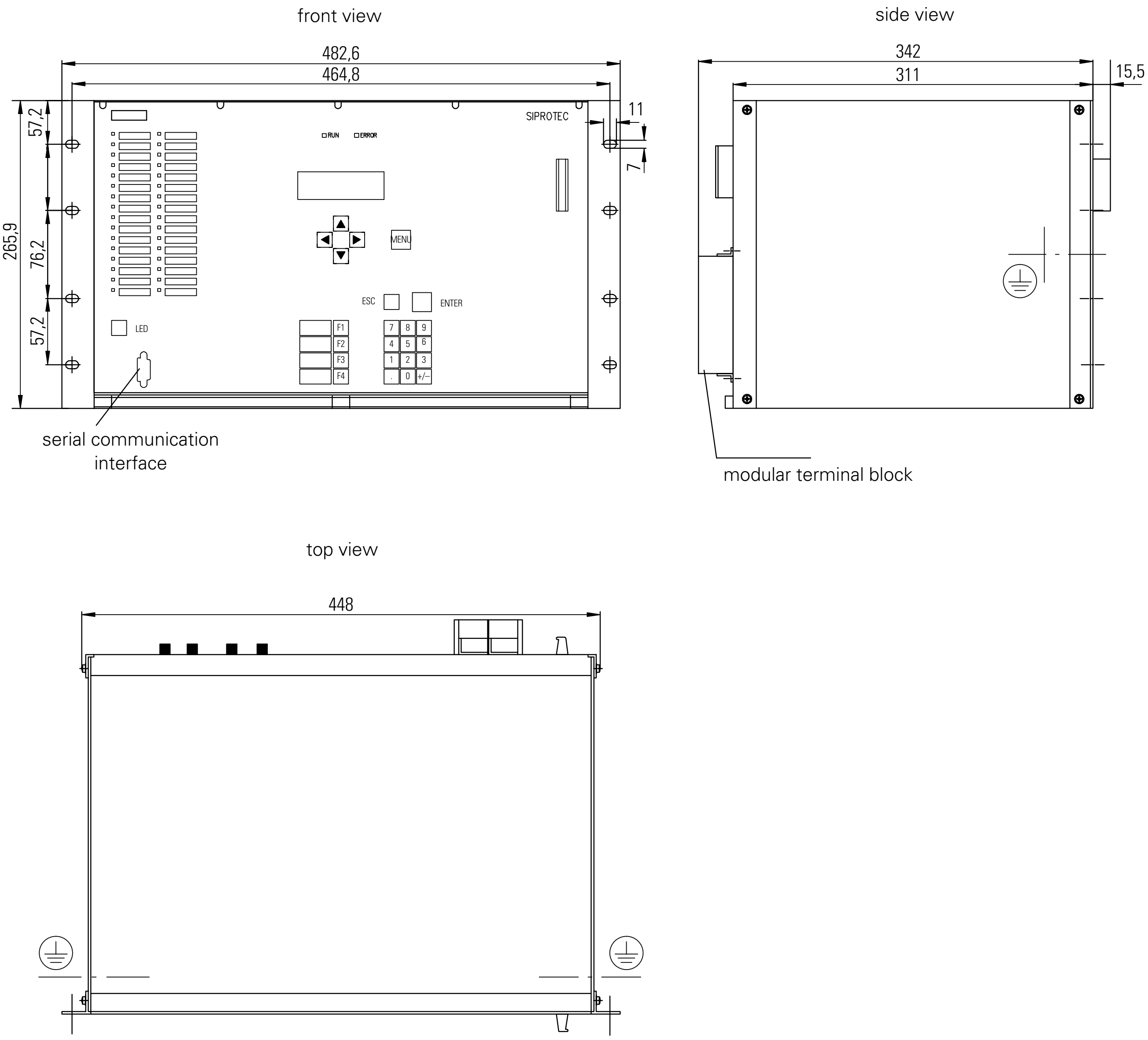


Figure 2.7 Mechanical dimensions of the subrack

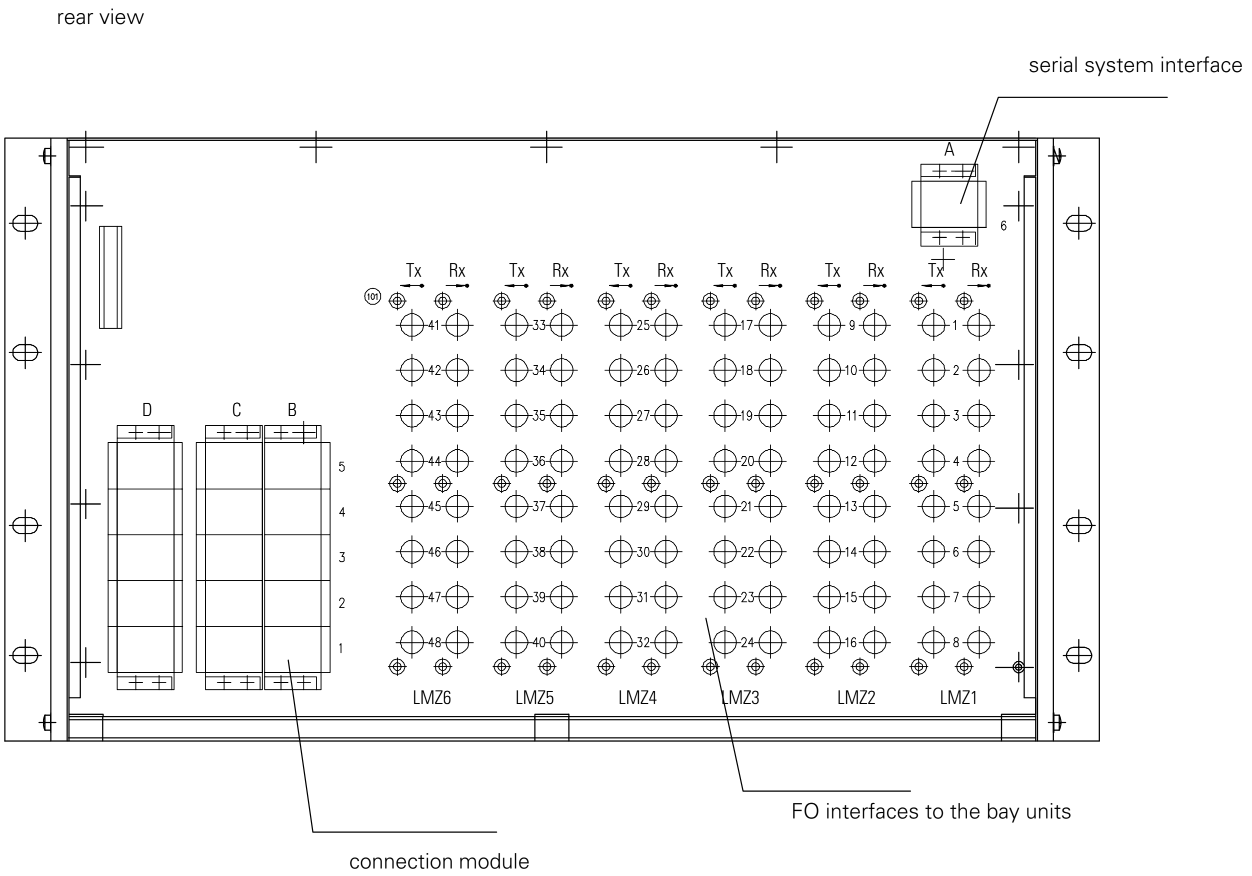
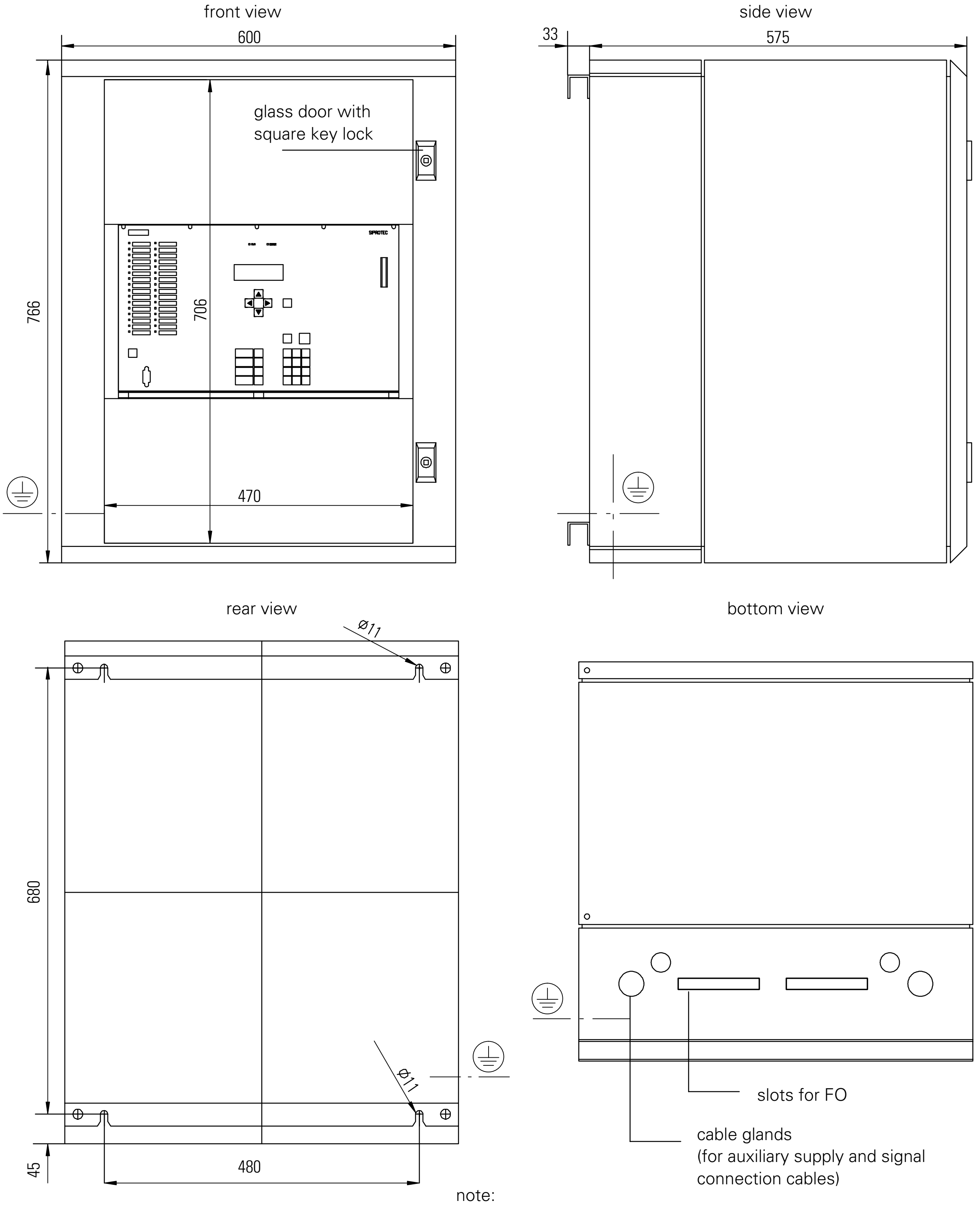


Figure 2.8 Mechanical dimensions of the subrack



note:
earthing connection inside the casing

Figure 2.9 Mechanical dimensions of the surface–mounted casing

3 Technical data

Table 3.1 General device data

Input circuits	Rated current I_N		1 A or 5 A
	Rated frequency f_N		50 / 60 Hz
	Thermal overload capacity in current path		
	continuous		4 x I_N
	for 10 s		30 x I_N
	for 1 s		100 x I_N
	Dynamic overload capacity (1 half–cycle)		250 x I_N
	Burden		
	current inputs at I_N = 1 A		<0,1 VA
	current inputs at I_N = 5 A		<0,2 VA
Voltage supply	Rated auxiliary voltage U_{aux},	master unit	DC 48/60, 110/125, 220/250 V
		bay unit	DC 60 to 250 V
	Permissible tolerance of rated auxiliary voltage U_{aux}		–20 bis +15 %
	max. ripple		≤ 12 %
	Power consumption (dependent on station configuration)		
	quiescent	master unit	35 to 80 W
		bay unit	12 W
	energized	master unit	42 to 92 W
		bay unit	16 W
	back–up time after auxiliary voltage failure		≥ 50 ms (with U_H ≥ 60 V)
Digital inputs	Number	master unit	7
		bay unit	20
	Voltage range		DC 24 bis 250 V (thresholds selectable by plug–in jumpers)
	Nominal control voltage DC		24, 60, 110, 220 V
	Pick–up threshold		0,8 x U_N
	Drop–off threshold		0,65 x U_N
	Current consumption		approx. 1,6 mA/input
Alarm contacts	Number of relays		
	marshallable	master unit	16/32 (each 1 NO contact)
		bay unit	1 (1 NO contact)
	not marshallable	master unit	1 (2 NC contacts)
		bay unit	1 (2 NC contacts)
	Switching capacity MAKE/BREAK		20 W/VA
	Switching voltage		AC/DC 250 V
	permissible current continous		1 A

Table 3.1 General device data (continued)

Command contacts (bay unit)	Number of relays		4 (each 2 NO contacts) 1 (1 NO contact)
	Switching capacity CLOSE OPEN		1000 W/VA 30 W/VA
	Switching voltage		AC/DC 250 V
	permissible current	continuously	5 A
		0,5 s	30 A
Light emitting diodes			
(master unit)	Ready for service	green	1
	Failure indication	red	1
	Marshallable indications	red	16/32
(bay unit)	Ready for service	green	1
	Failure indication	red	1
	Isolator states (marshallable)	red	5
		green	5
	Alarms (marshallable)	red	6
Operate, display	LC–display	master unit	4 lines x 20 characters
		bay unit	4 lines x 16 characters
	Sealed keypad	master unit	24 keys
		bay units	12 keys
Serial interface			
(master unit)	Communication interface front	connection	9pol. subminiatur ISO 2110
		Baud rate	1 200 to 38 400 Baud
(bay unit)	Diagnosis interface	connection	9pol. subminiatur ISO 2110;
		Baud rate	1200 to 19 200 Baud
(bay or master unit)	Interface for high–speed data communication		
	connection		FSMA plug connector
	Baud rate		1 200 kBaud
	fibre–optical cable		glass fibre 62,5/125 μm
	optical wavelength		820 nm
	permissible cable attenuation		max. 8 dB
	transmission distance		max. 1,5 km 1)
	character quiescent status		”light off”
Casings			
(master unit)	Cubicle		IP 54
	Surface–mounted casing (wall–mounted)		IP 55
	SIPAC subrack		IP 20
(bay unit)	Casing (7XP20)	with window pane	IP 51
		without window pane	IP 30
	Terminals		IP 21
	Degree of protection according to EN 60 529		

Note:

1) Determination of the maximum distance

$$l_{max} = \frac{8\ \text{dB reserve line attenuation}}{\text{attenutation factor of FO–cable}}$$

- typ. reserve for ageing and temperature drift 2 to 3 dB
- plug attenuation (FSMA): ca. 0,3 dB/plug
- FO attenuation coefficient ∝ (glass fibre 62,5/125 μm): 3,5 dB/km

Technical data

3

3.1 Standards and guidelines

Table 3.2 Electrical tests

CE conformity, regulations	This product fulfills the regulations of the guideline of the Council of the European Community for harmonization of the legal stipulations of its member countries about the electromagnetic conformity (EMC guideline 89/336/EEC) and about the application within defined voltage limits (low voltage guideline 73/23/EEC). This product is in conformity with the international standards of the group IEC 255 and the national standards DIN 57 435 /part 303. This product was developped and manufactured for utilization in industrial installations according to the EMC standards.	This conformity is the result of a test performed by Siemens AG according to article 10 of the guideline in conformity with the basic technical standards EN 50081 and EN 50082 for the EMC guideline and EN 60255–6 for the low voltage guideline.
Insulation tests IEC 255–5; DIN VDE 0435 part 303 EN 60255–6	High voltage test (routine test), all circuits except auxiliary voltage input	2 kV (r.m.s. value), 50 Hz; 1 min
	High voltage test (routine test), only auxiliary voltage input	2,8 kV DC, 1 min both polarities
	Impulse voltage test (type test), all circuits, class III	5 kV (peak value), 1,2/50 µs, 0,5 J, 3 positive and 3 negative pulses in intervals of 5 s
EMC tests for radio transmission EN 50081–2 (basic technical standard)	Radio disturbance voltage on lines, only auxiliary voltage IEC CISPR 11, EN 55011, DIN VDE 0875 part 11	150 kHz to 30 MHz, limit value class B
	Disturbance field intensity IEC CISPR 11, EN 55011, DIN VDE 0875 part 11	30 bis 1 000 MHz, limit value class B
EMC tests against disturbances IEC 255–6, IEC 255–22 (international product standards) EN 50082–2 (technical basic standards) DIN VDE 0435 part 303 (German product standards for protection devices)	High frequency test (1 MHz–Test) IEC 255–22–1, DIN VDE 0435 part 303; class III	2,5 kV longitudinal; 1 kV transversal; 1 MHz; $\tau = 15$ µs; 400 pulses per s, test duration 2 s; $R_{\text{I}} = 200\ \Omega$
	Attenuated oscillation IEC 15C(SC)102	2,5 kV; 100 kHz, 1 MHz, 10 MHz, 50 MHz; $R_{\text{I}} = 50\ \Omega$
	Discharge of static electricity IEC 255–22–2; IEC 1000–4–2; VDE 0847 part 4–2; EN 61000–4–2; class III	6 kV contact discharge; 8 kV air discharge, both polarities; 150 pF; $R_{\text{I}} = 330\ \Omega$
	Exposure to HF–field, amplitude–modulated IEC 1000–4–3; VDE 0847 part 3; EN 61000–4–3; class III	10 V/m (r.m.s, non–modulated); 80 to 1 000 MHz; 80 %; 1 kHz; AM
	Exposure to HF–field, pulse–modulated IEC 77B(Sec)136; ENV 50204; VDE 0847 Teil 204; class III	10 V/m (r.m.s. value); 900 MHz ± 5 MHz; repetition frequency 200 Hz; ED 50 %
	Fast transient disturbance/burst IEC 255–22–4; IEC 1000–4–4; EN 61000–4–4; VDE 0847 part 4–4; class IV	Protective conductor: 1 kV/5 kHz; all circuits: 4 kV/2,5 kHz; 5/50 ns; 5 kHz, burst duration = 15 ms; repetition rate 300 ms; both polarities; $R_{\text{I}} = 50\ \Omega$, test duration 1 min

Table 3.2 Electrical tests (continued)

EMC tests against disturbances (continued) IEC 255–6, IEC 255–22 (international product standards) EN 50082–2 (technical generic standards) DIN VDE 0435 part 303 (German product standards for protection devices)	High–energy pulse/surge EN 61000–4–5; EN 50082–2; IEC 1000–4–5; auxiliary voltage input DC/signal lines: class III	Auxiliary voltage inputs/signal lines 1 kV sym./2 kV unsym. 5 pulses, both polarities
	HF on lines IEC 1000–4–6; VDE 0843 part 6; EN 61000–4–6; class III	10 V (r.m.s. value); 150 kHz to 80 MHz; 80 %; 1 kHz; AM; R_l = 150 Ω
	Magnetic field with energy–technical frequency IEC 1000–4–8; IEC 255–6; EN 60255–6; EN 61000–4–8; VDE 0847 part 4–8; class IV	30 A/m ; continuously; 300 A/m for 3 s; 50 Hz; 0,5 mT

Table 3.3 Mechanical tests

Mechanical impact IEC 255–21–1, class II; IEC 68–2–6, test Fc	permissible mechanical impact in service (severity 12 acc. to SN 29010 T.2)	sinusoidal 10 to 60 Hz, ±0,075 mm amplitude; 60 to 150 Hz; 1 *g* acceleration; frequency spectrum 1 oktave/min; 20 cycles in 3 axes rectangular to one another
	during transport (severity 23 acc. to SN 29010 T.2)	sinusoidal 5 to 8 Hz; ±7,5 mm amplitude; 8 to 150 Hz; 2 *g* acceleration; frequency spectrum 1 oktave/min; 20 cycles in 3 axes rectangular to one another

Table 3.4 Climatic conditions

Climatic conditions EN 60255–6 IEC 255–6 DIN VDE 0435 Teil 303	permissible ambient temperature	
	in operation	–10 to +55 °C (bay unit) 0 to +55 °C (master unit)
	for storage	–25 to +70 °C
	during transport	–25 to +70 °C
	during start–up	–10 to +55 °C (bay unit) 0 to +55 °C (master unit)
	Humidity in operation	annual average ≤75 % relative humidity, on 30 days per year up to 95 % relative humidity, no condensation permitted

The devices should be assembled such that they are not imposed to direct solar radiation or abrubt change in temperature which might cause condensation.

Commissioning at temperatures ≤0 °C is permissible only if the site conditions ensure that no command output can be activated unless the device temperature has reached 0 °C.

3.2 Service conditions

Static protective devices are designed for use in standard relay rooms and compartments so that with proper installation electro–magnetic compatibility (EMC) is ensured. The following should also be heeded (if applicable):

- All contactors and relays which operate in the same cubicle or on the same relay panel as the digital protection equipment should, as a rule, be fitted with suitable spike quenching elements.
- All external measuring leads in substations from 100 kV upwards should be screened with a screen capable of carrying power currents. No special measures are normally necessary for medium–voltage substations.
- It is not permissible to withdraw or insert individual modules under voltage. In the withdrawn condition, some components are electrostatically endangered; during handling, the standards for electrostatically endangered components must be observed. The modules are not endangered when plugged in.

3.3 Inter–changeability

- **Devices**
  Protective devices in housings or racks fitted at the factory are delivered complete and can be interchanged as a unit with identical ordering codes. The threshold of binary inputs has to be matched with the station data.
- **Modules**
  Plug–in modules are, in general, interchangeable if the type designations up to the oblique stroke are identical (the characters behind the oblique stroke contain internal factory data which do not normally affect the inter–changeability). With modules ZPS, however, the address settings must be checked and with modules EAZ the address setting and threshold setting must be checked and adapted by jumpers.

Should it become necessary to exchange any digital device or module, the complete relay settings should be checked. Respective notes are contained in chapter 6.

3.4 Busbar protection

Table 3.5 Busbar protection

Characteristic		Stabilized differential current measurement
Setting ranges	Overcurrent I/I_{norm} [1]	0,2 to 4,00 (in steps of 0,01)
	Stabilizing factor K for bus–section specific protection	0,5 to 0,8 (in steps of 0,01)
	Stabilizing factor K for the check zone	0 to 0,8 ((in steps of 0,01)
Diff–current supervision **Setting ranges**	Current limit value I/I_{norm} [1]	0,05 to 0,8 (in steps of 0,01) [2]
	Time delay	1,0 to 10 s (in steps of 1) [2]
Tripping time	typical trip time	15 ms

1) I_{Norm} = normalized nominal current referred to the current transformer with the highest ratio (base CT)

2) Identical setting ranges for the zone–selective protection and the check zone

3.5 Circuit–breaker failure protection

Table 3.6 Circuit–breaker failure protection ¹⁾

Control modes			one or two–channel initiation
Modes of operation (with external initiation)			Current sensor, TRIP repeat (1/3–phase) with current sensor, forced unbalance (1–step), with TRIP repeat, forced unbalance (1/3–phase; (2–step), TRIP repeat and unbalance with pulse trigger TRIP by external CBF protection (tripping via isolator mimic of busbar protection
Setting ranges	Overcurrent	I/I_N ²⁾	0,2 to 2,00 (in steps of 0,01)
	Stabilizing factor K		0 to 0,8 (in steps of 0,01)
	Time delay for unbalance/current sensor		0,05 to 1,00 s (in steps of 0,01)
	Time delay for trip signal repeat		0 to 1,00 s (in steps of 0,01)
Circuit–breaker failure protection (for busbar short–circuit)	Overcurrent I/I_N²⁾		0,2 to 2,00 (0,01)
	Time delay		0,05 to 1 s (0,01)

3.6 General data

Table 3.7 General data

Minimum duration of TRIP command	Trip signal storage time	0,02 to 1,0 s (in steps of 0,01)
	Minimum current limit for reset of signal I/I_n²⁾	0,2 to 2,0 (in steps of 0,1)
Overcurrent release of trip signals	Setting range I/I_n	0 to 25 (in steps of 0,01)
Isolator running time	Setting range in s	1 to 180 (in steps of 0,01)
Busbar (BB) configuration	Busbar arrangement (max.)	Quadruple or triple busbar with transfer busbar; up to 4 couplers and 24 sectionalizers, 12 bus sections, 12 coupler bus sections.³⁾
	Number of bays	48 (including bus couplers and sectionalizers)

---

1) selectable feeder–selective

2) Nominal current of the feeder current transformer (1 or 5 A)

3) Sections which serve exclusively for coupling of bus sections; no feeder bays

Note:
1 longitudinal isolator (LT) (without current transformer) = 1 bay
1 sectionalizer or bus coupler = 2 bays

3.7 Ancillary functions

Table 3.8 Ancillary functions

Self–diagnosis functions	Current monitoring per feeder	
	Auxiliary voltage monitoring	
	cyclic test	
	Check of the data transmission between master unit and bay units	
	Memory tests	
Operational measured values		
Bay unit	Feeder currents	$I_{L1}; I_{L2}; I_{L3}; I_E$ in A primary and in % I_N
	range	0 to 1 000 % I_N
	tolerance	typical 2 % of measured value
	Differential and stabilizing currents of the check zone	$I_{dL1}; I_{dL2}; I_{dL3}$ $I_{sL1}; I_{sL2}; I_{sL3}$
	range	0 to 1 000 % I_N
	Frequency	f in Hz
	range	f_N ± 5 Hz
	tolerance	0,1 Hz
Master unit	Feeder currents	$I_{L1}; I_{L2}; I_{L3}$ in % I_N
	range	0 to 1 000 % I_N
	tolerance	typical 2 % of measured value
	Differential and stabilizing currents of all bus sections (separate for ZPS–BSZ1; ZPS–BSZ and ZPS–BSZ3)	$I_{dL1}; I_{dL2}; I_{dL3}$ $I_{sL1}; I_{sL2}; I_{sL3}$ in % I_N
	range	0 to 1 000 % I_N
Event recording	Storage of the last 99 operational events and 40 fault events	
Fault recording	Storage time (from busbar TRIP or external initiation)	–200 to +100 ms

4 Mode of operation

4.1 Operation of complete unit

The digital busbar and breaker failure protection 7SS52 consists of compact bay units which are connected to the master unit by fibre–optical cables. Fig 4.1 shows the basic structure of the protection system.

The protection system is equipped with powerful 16 bit (bay unit) and 32 bit (master unit) microprocessors. All tasks from aquisition of the measured values up to the commands to the circuit breakers are exclusively processed in a digital manner.

In the bay units the feeder or coupler currents are measured time–synchronized, digitalized, preprocessed and transmitted to the master unit via the fast serial interface. The input nominal current can be 1 or 5 A depending on the main current transformer design. The measuring inputs are completely galvanically isolated and low–capacitive by transducers. Suppression of disturbances is achieved by filters which are optimized for the measured value processing with regard to bandwidth and processing speed.

The bay unit captures the isloator positions and bay–related binary signals, processes functions of the breaker failure protection and fulfills autodiagnosis tasks.

Heavy–duty command relays take the protection system's trip commands directly to the circuit breakers. Alarm relays and indications (LED; LC display) allow event indication. In addition operational measured values are displayed.

The master unit is designed as a multi–processor system.

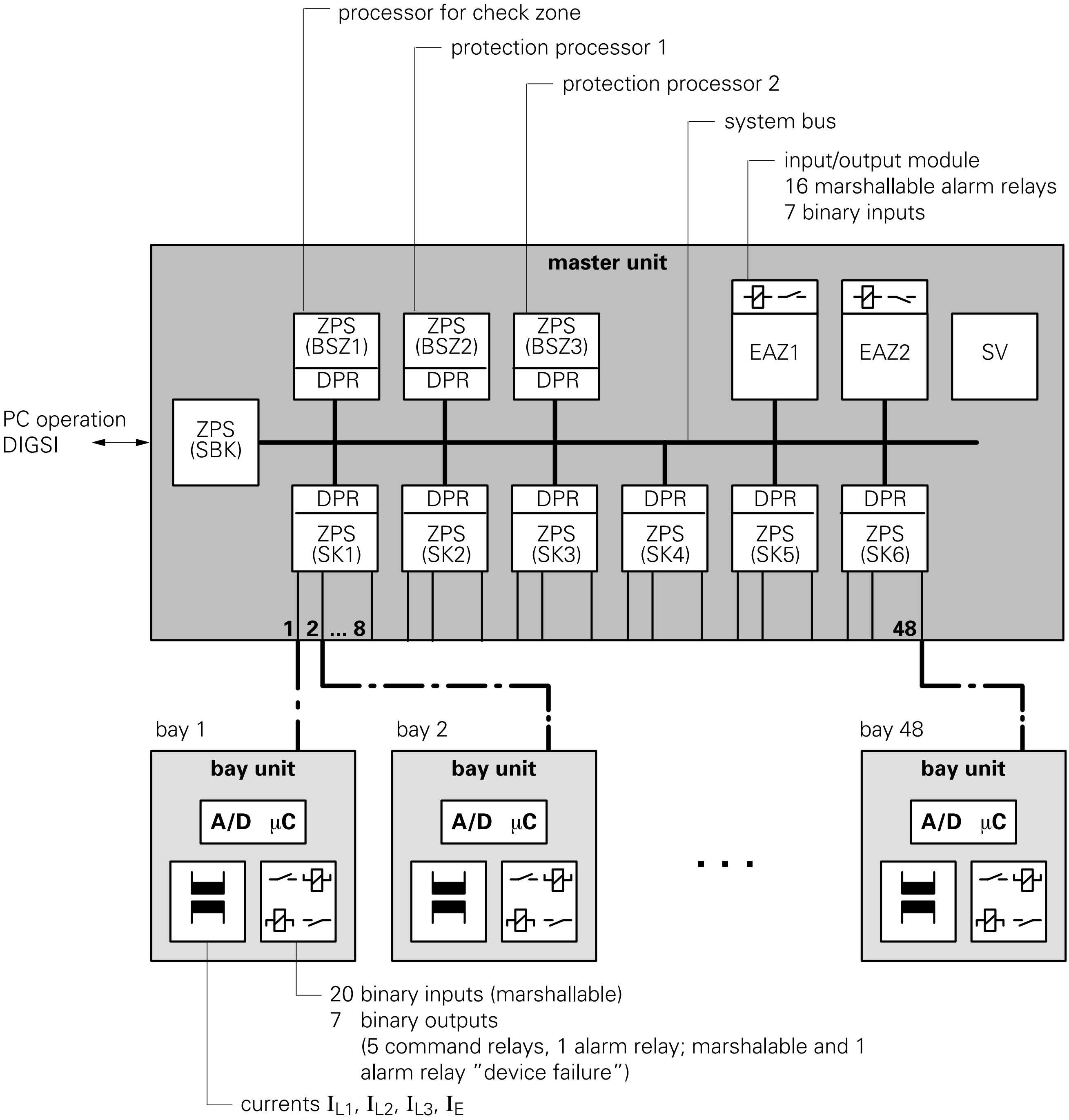
The measured currents are read in from the connected bay units time–synchronized and are processed together with binary information from the protection functions (differential protection, breaker failure protection). The master unit transmits the results of the calculations as well as logical combinations cyclicly to the bay units.

Freely marshallable alarm relays are provided for remote signalling.

The master unit administers all configuration and setting data for the busbar and breaker failure protection functions. Communication is possible via an integrated key–pad with LC display or via the serial interface by means of a PC utilizing the program DIGSI. In addition the program can read out fault data from the protection device and analyse it.

The master unit and bay units contain power supply modules for a reliable power supply on different voltage levels.

4 Mode of operation



BSZ:	processing protection	SK:	serial interface
DPR:	dual–port–RAM	SV:	power supply
EAZ:	input/output master unit	ZPS:	central processor protection
SBK:	control, operation, coupling (master)		

Figure 4.1 General view of the configuration of the protection system 7SS52

4.2 Application functions

The following chapters describe the functions which can be adapted by the user via parameterizing. These include all protection and test functions.

The description of these functions is illustrated by the graphical presentation of the interconnections between input and output functions and input and output signals. For better understanding of these presentations, figure 4.2 shows a legend of the used symbols.

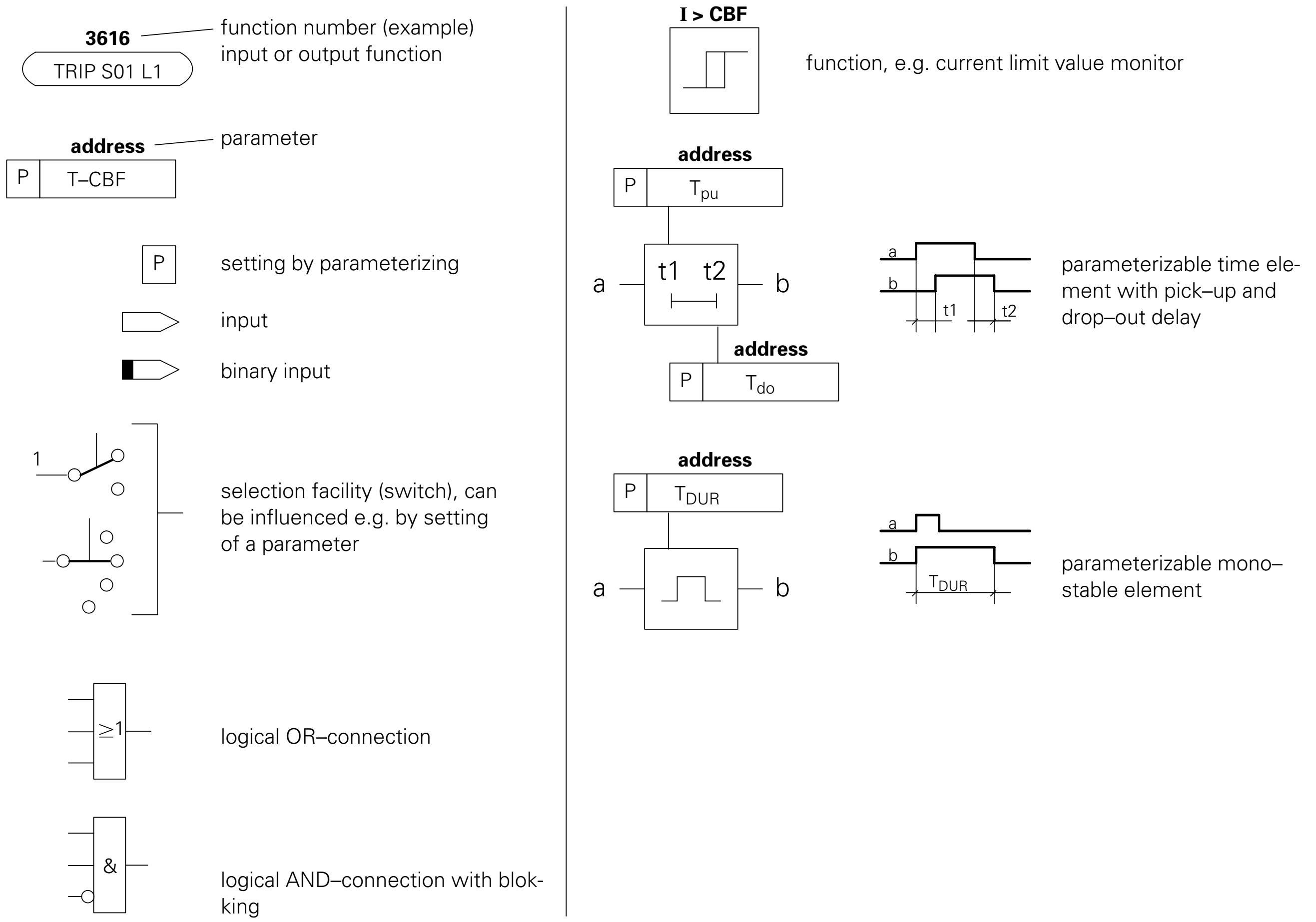


Figure 4.2 Legend of the used symbols

4.3 Busbar protection

The busbar protection represents the main function of the 7SS52. It is characterized by a high measurement accuracy and flexible matching to the existing station configurations. It is supplemented by a series of ancillary functions.

The measurement methods described here below apply for the check zone as well as for the bus–selective protection.

4.3.1 Basic principle

The measurement method relies on Kirchhoff's current law.

This law states that the vectorial sum of all currents flowing into a closed area must be zero. This law applies, in the first instance, to DC current. It applies to AC current for instantaneous values. Thus, the sum of the currents in all feeders of a busbar must be zero at any instant in time.

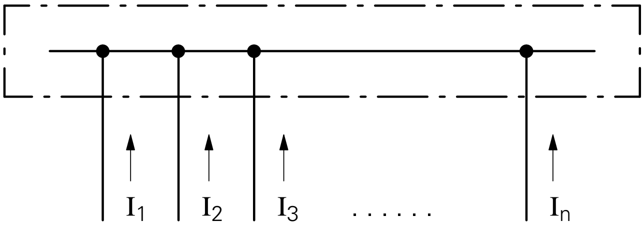


Figure 4.3 Busbar with n feeders.

Assuming that the currents I_1, I_2, I_3 ... I_n flow in the feeders (Fig 4.3) connected to the busbar, the following equation applies in the fault–free condition (the currents flowing towards the busbar are defined as positive, and the currents flowing away from the busbar as negative):

$$I_1 + I_2 + I_3 \ldots + I_n = 0. \qquad (1)$$

If this equation is not fulfilled, then there must be some other – impermissible – path through which a current flows. This means that there is a fault in the busbar region.

This law is superior, as the basis for busbar protection, to any other known way of measurement. A single quantity, the sum of currents, characterizes and can be used to detect faulty conditions. This sum of all currents can be formed at any time and if formed as such, using instantaneous current values, full use of above law can be made. The current sum used for evaluation is available at any instant without interruption and stays at zero, unless there is another path due to a fault whose current is not measured.

The above considerations apply strictly to the primary conditions in a high–voltage switching station. Protection systems, however, cannot carry out direct measurements of currents in high–voltage systems. Protection equipment measurement systems, performing the current comparisons, are connected through current transformers. The secondary windings provide the currents scaled down according to the transformation ratio while retaining the same phase relation. Furthermore, the current transformers, due to the isolation of their secondary circuits from the high–voltage system and by appropriate earthing measures, can keep dangerous high voltages away from the protection system.

The current transformers are an essential part of the whole protection system and their characteristics are an important factor for the correct operation of the protection. Their physical locations mark the limits of the protection zone covered by the protection system.

Since the current transformers transform in direct proportion to the primary currents I_p in the station, the following equation applies for the busbar protection in the fault–free condition:

$$I_{1\,s}\, n_1 + I_{2\,s}\, n_2 + I_{3\,s}\, n_3 \ldots + I_{n\,s}\, n_n = 0 \qquad (2)$$

n_1, n_2, n_3 ... n_n are the CT transfomation ratios I_p/I_s and

I_{1s}, I_{2s} ... $I_{ns.}$ are the secondary currents.

Although such a busbar protection would certainly detect any short–circuit inside the protection zone, the transformation errors of the current transformers, which are unavoidable to some degree, are also liable to cause spurious tripping as a result of an external short–circuit. In that case, for instance with a close–up fault on one of the outgoing feeders, the current flowing into the short–circuit is shared on the infeed side by several bays. The current transformers in the infeeding bays carry only a fraction of the total fault current while the current transformer in the faulted outgoing feeder carries the full current in its primary winding. If the fault current is very high, this set of current transformers may therefore be saturated, so tending to deliver only a fraction of the actual current on the secondary side while the rest of the current transformers, due to the distribution of currents among several bays, perform properly. Although the sum of the currents is zero on the primary side, the sum of the currents in equation (2) is now no longer zero.

In conventional differential protection systems where the sum of the currents is zero on the primary side, for busbars and similar objects, this difficulty is countered by employment of the so–called stabilization (restraining) devices.

If the short–circuit does not occur at the voltage peak of the cycle, a DC component is initially superimposed on the short–circuit current which decays with a time constant governed by the ratio L/R of the impedance from source to fault. With the growing output ratings of the generator units, these time constants in the supply system tend to grow longer. A superimposed DC component speeds up the magnetic saturation in the transformer cores, thus considerably affecting the transformation task.

Several measures – some of which are already known from the conventional protection – have been introduced into the measuring system of the busbar protection 7SS52 to cope with these problems. They supplement the basic principle of monitoring the summation (differential) current. It was thus possible to give the busbar protection system 7SS52 a maximum degree of security against spurious operation for external short–circuits while ensuring, in the event of internal short–circuits, that a tripping signal is initiated within the very short time of less than a half–cycle.

The measuring circuit of the busbar protection system 7SS52 is characterized by the following features:

- Basic principle:
  Monitoring the sum of the currents as the tripping quantity
- Measures taken to guard against the disturbing influences due to current–transformer saturation:

1. Stabilization (against large through currents)
2. Separate evaluation of each half–wave (particularly effective against DC components)

Measures taken to obtain short tripping times:

Separate evaluation of the current transformer currents during the first milliseconds after the occurrence of a fault (anticipating the current transformer saturation).

4.3.1.1 Stabilization

The stabilization has the function of reducing the influence on the measurement of transformation inaccuracies in the various feeders to such a degree that spurious behaviour of the protection system is prevented. The busbar protection 7SS52 solves this problem by forming both the vectorial sum of the CT seondary currents which acts in the operating sense as well as the arithmetic sum of those quantities which has a restraining effect.

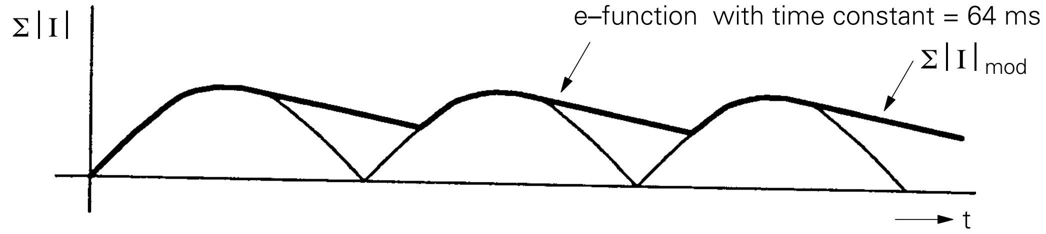


Figure 4.4 Formation of the stabilizing current

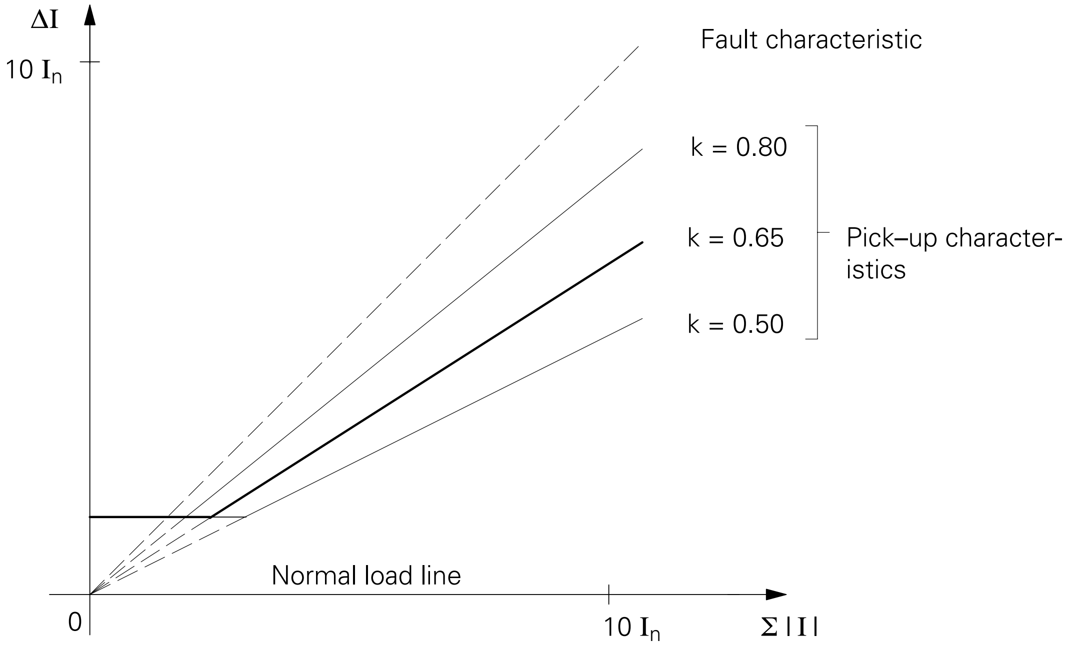


Figure 4.5 Pick–up characteristic of the differential measuring circuit

The vectorial sum

$\Delta I = |I_1 + I_2 \ldots + I_n|$

as the tripping quantity is counterbalanced, by the restraining quantity, whereby

$\Sigma |I| = |I_1| + |I_2| \ldots + |I_n|$

which is the arithmetic sum of the magnitudes of each current.

The criterion for a short–circuit on the busbar is thus:

$|I_1 + I_2 \ldots + I_n| > k \cdot \Sigma |I|_{mod}$

The modified stabilizing quantity $\Sigma |I|_{mod}$ is derived from $\Sigma |I|$ and is illustrated in Fig 4.4.

Fig 4.5 illustrates the characteristic of a stabilized (restrained) differential protection system. In the diagram, the abscissa represents the sum $\Sigma |I|$ of the magnitudes of all quantities flowing through the busbar while the vectorial sum ΔI is plotted as the ordinate. Both axes use rated current as the unit and both have the same scale. If a short–circuit occurs on the busbars whereby the same phase relation applies to all infeeding currents, then $\Delta I = \Sigma |I|$. The fault characteristic is a straight line inclined at 45°.

Any difference in phase relation of the fault currents leads to a (practically insignificant) lowering of the fault characteristic. Since in fault–free operation ΔI is approximately zero, the x–axis may be referred to as the normal load line. The selectable stabilizing factors, e.g. k = 0.50, 0.65, 0.80 for the bus–section specific busbar protection or 0 to 0.8 for the check zone, are represented as three straight lines with corresponding gradient and form the operating characteristic. The measuring system determines whether the total of all currents supplied by the current transformers represents a point in the diagram above or below the set characteristic line. If the point lies above that line, tripping is initiated.

4.3.1.2 Separate evaluation of half–cycles

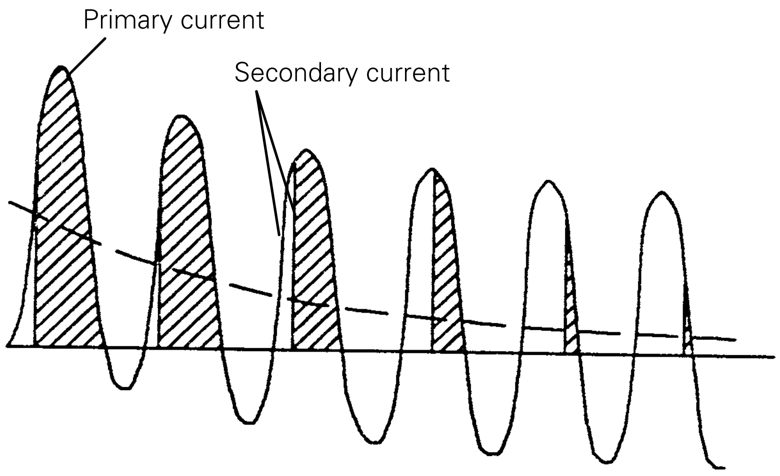
At the instant a short–circuit occurs, the current is usually not symmetrical about the zero line. The peak values of the two half cycles differ to an extent which depends on the time instant on the cycle when the short–circuit began. The short–circuit current contains a DC component which decays according to the function $e^{-t/\tau}$. The time constant τ is a function of the source impedance. Values of approximtely 60 ms are frequently encountered in high–voltage systems while 100 ms and more may be reached in the vicinity of large generators.

Such DC components make it substantially more difficult for the current transformers to perform their function of transformation since such components increasingly polarize the iron core.

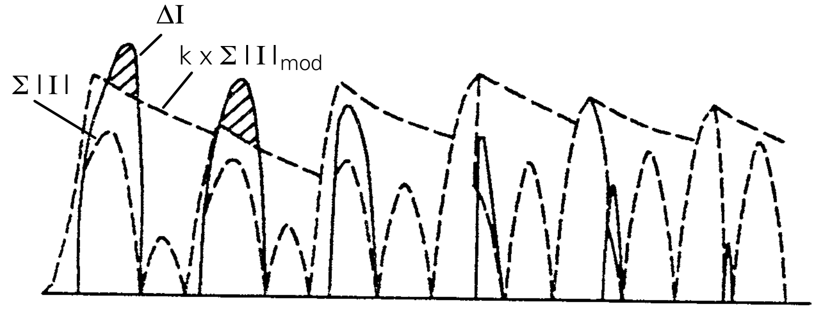
Fig 4.6 illustrates the condition in the extreme case of an initially fully offset short–circuit current. An additional problem in this case is remanence of the current transformer under consideration (remanence, for instance after an auto–reclosure), which is presumed to be present in this case.

Fig 4.6 a) depicts the initially fully offset current. The DC component at the beginning is equal to the peak value of the short–circuit AC current and decays at the rate of τ = 60 ms. The current flows through the current transformer which, under the conditions assumed to be present, would just be able to carry the AC current without saturation if the AC current and thus the magnetic flux in the iron core were not offset. However, on account of the superimposed DC component and the unfavourable magnetic flux at the instant of short–circuit inception, the current transformer will be saturated after about 6 ms. The magnetic flux cannot rise any more. The current transformer no longer delivers current on the secondary side. Only after the zero–crossing of the current, transmission to the secondary side is again possible on acount of the opposite current direction. After that, the currents shown in Fig 4.6 below the axis are correctly transformed. However, the current transformer is only able to transform the current above the axis to an extent that the current/time area is equal to that of the preceding half–cycle below the axis.

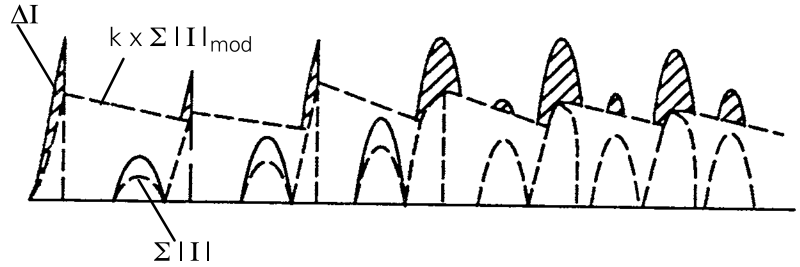
Fig 4.6 b) illustrates the formation of the measured value according to the measurement algorithm employed in the 7SS52 assuming an external short–circuit. The current thus flows through at least two current transformers. One of them is assumed to be able to give a correct replica of the current whereas the other exhibits a behaviour as under 4.6 a). With the stabilizing factor k = 0.65 a tripping condition occurs about 8 ms after inception of the short–circuit. This condition persists for about 4 ms before the restraint prevails again. The reversed current after zero current crossing does not make itself felt in the tripping sense since correct transformation is present. The second half–wave, however, again brings about a tripping condition which now lasts for about 7 ms. Due to the continuing decay of the DC component and recovery of the previously saturated current transformer, the tripping quantity subsequently does not reach the magnitude of the stabilizing quantity.



a) Primary and secondary current of a CT



b) Formation of measured values for an external short–circuit



c) Formation of measured values for an internal short–circuit

Figure 4.6 CT currents and measured values in the event of an initially fully offset fault current; DC component decaying with τ = 60 ms

Fig 4.6 c) illustrates the formation of the measured value on the assumption that the current flows into a short–circuit within the protection zone via the current transformer with the behaviour illustrated under 4.6 a). The stabilization factor k is again assumed to be 0.65. In this case the tripping quantity prevails right from the beginning of the short circuit. But since the current transformer saturates, the tripping quantity disappears after 6 ms; the opposite half–cycle will have no tripping effect. In the following two cycles, a tripping condition will only occur for the current direction which is favoured by the offset. As the process proceeds, the current sets up a tripping condition in all half–cycles.

A comparison of the measured values in cases b (external short–circuit) and c (internal short–circuit) shows, besides a temporary similarity, two essential discriminating features:

1. After a few cycles – when the DC component has decayed somewhat – each half–wave, i.e. the current in both directions, delivers a correct measured value according to the fault location.
2. At the inception of the short–circuit (usually at least for a quarter of a cycle) the correct measured value is formed according to the fault location.

These two facts are utilized by the numerical busbar protection 7SS52 to distinguish between external and internal short–circuits. This is particularly valuable when large short–circuit currents and DC components severely saturate the current transformers forcing the protection to operate under severely aggravated conditions.

A sophisticated combination of the above two distinguishing features stabilizes the operating characteristics of the digital busbar protection 7SS52 even under extremely difficult conditions, namely:

1. high degree of stability even during current transformer saturation,
2. short tripping times for internal short–circuits,
3. correct behaviour and proper response to evolving faults,
4. ease of commissioning and determination of setting values.

At first glance, the stability in the event of external short–circuits appears to be jeopardized by the current conditions shown in Fig 4.6 b). The tripping quantity markedly exceeds the restraining quantity on two occasions.

The 7SS52 includes a logic which enables the protection to decide according to the facts outlined above whether tripping should be initiated after either one or two measurements.

4.3.1.3 Weighted evaluation of the initial values

For normal load currents, the magnetic flux in the current transformer’s iron circuit is relatively small. It is of the order of, at most, a few percent of that value at which the iron saturation begins. This design makes the achievement of high overcurrent factors possible which are needed for the proper behaviour of the associated relay equipment during large short–circuits currents.

Since the magnetic flux under normal conditions is low, a certain time will elapse after short–circuit inception, even under extreme conditions (very large short–circuit current, large DC component with a long time constant) before the magnetic flux in the iron core reaches the saturation level. This process, in both conventional current transformers with a closed iron core as well as in linearized current transformers with an air gap in their cores, will typically last from a quarter–cycle to a half–cycle.

Since the current transformers transform accurately according to ratio before saturation, the secondary currents during the first milliseconds after inception of a short–circuit has the most conclusive information.

For this reason, the busbar protection 7SS52 has software logic which detects the inception of a short–circuit from the currents. Evaluating the current conditions during the next 3 ms determines whether an external or internal short–circuit is present. In case of an internal short–circuit, the measurement initiates the issue of trip signals to the trip coils. For external short–circuits the measurement initiates the change–over between the "2–out–of–2–mode" and the "1–out–of–1–mode". The measurement is usually performed in the 2–out–of–2–mode, under no–fault conditions.The module for weighted evaluation of the initial values, in the following referred to as "accelerated measurement" controls the logic in order to change the operating mode to 1–out–of–1 as soon as it detects a short–circuit in the protected zone. If the measured result indicates an external fault, the 2–out–of–2 mode is maintained for 150 ms by blocking of this changeover.

The accelerated measurement is performed with the stabilizing quantity $\Sigma \mid I \mid$. The rate of change $d [\Sigma \mid I \mid] / dt$ is compared with a set limit in order to detect a short–circuit.

If the set limit value is exceeded, then the criterion of the characteristic Fig 4.5 is checked. If the criterion is met, the protection trips after one measurement ("1–out–of–1"). Otherwise two measurements ("2–out–of–2") are performed and required for a trip.

4.3.1.4 Response threshold, pick–up

The working conditions for the busbar protection may differ widely from one station to another. Great differences exist regarding the design and the switching possibilities of the various substations. The span between the highest and lowest currents liable to occur in the event of a short–circuit may differ from sub–station to substation. The performance data and burden of the current transformers used for connection to the protection also play an essential part. Finally, the starpoint conditions in the high voltage system are of importance with respect to design and setting of the protection. It is for these reasons that the busbar protection system needs a high degree of versatility.

The tripping characteristic is determined by the two settable parameters "stabilizing factor k" and "differential current threshold I>DIFF".

4.3.1.5 Summary of the measuring method

The measuring method of the busbar protection can be summarized as follows:

Tripping occurs, when

1. $\Delta I >$ set limit and
2. $\Delta I > k \times \Sigma \mid I \mid$ and
3. release from "1–out–of–1" or "2–out–of–2".

The measuring method is illustrated in Figs 4.7 and 4.8.

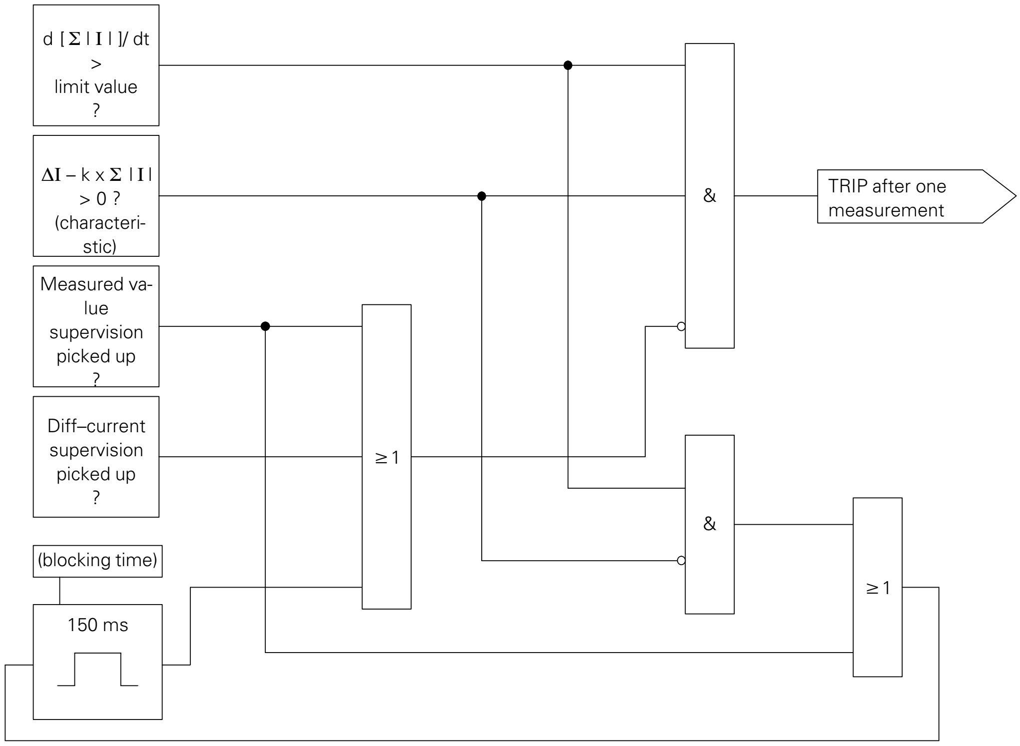


Figure 4.7 Logic for TRIP according to 1–out–of–1 evaluation

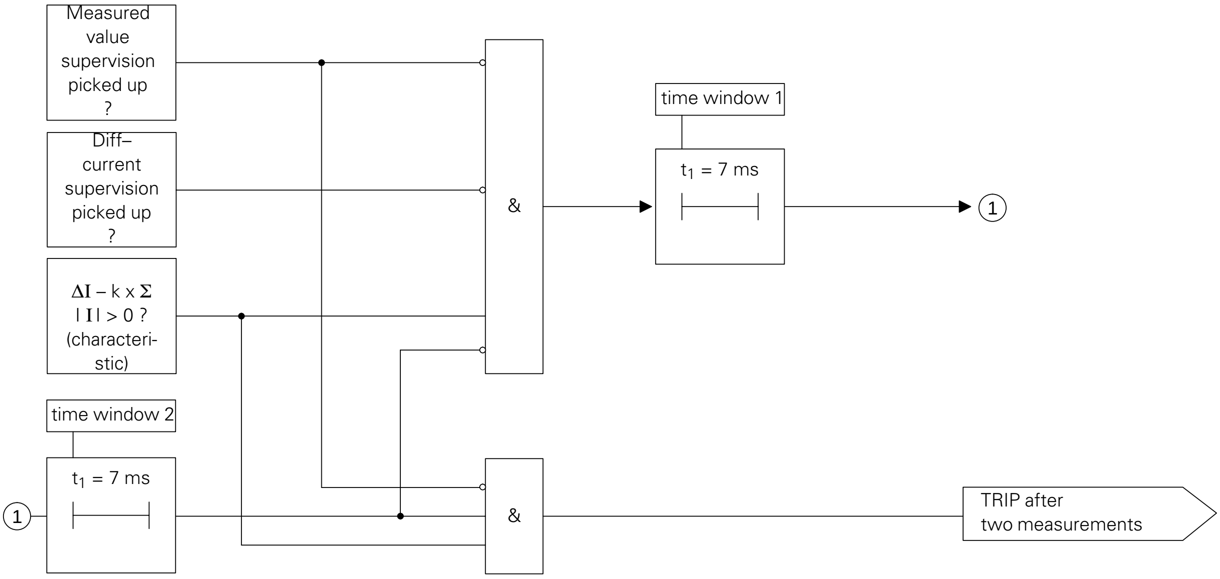


Figure 4.8 Logic diagram for TRIP according to "2–out–of–2 " evaluation

4.4 Special treatment of the stabilizing current for the check zone

Busbar protection via the check zone comprises all bays (with the exception of the bus coupler) regardless of isolator status. In some special cases, isolator status must however be considered for the check zone. If the stabilizing current is calculated in the same manner as for the bus–section specific busbar protection, overstabilization results in multiple busbar systems since the bays which are not connected to the faulty busbar strongly stabilize the protection. Therefore, the stabilizing current is calculated as follows:

$\Sigma \mid I_p \mid$ = sum of the magnitudes of the currents which flow in the direction of the busbar

$\Sigma \mid I_n \mid$ = sum of the magnitudes of the currents which flow away from the busbar

I_{Stab} = lesser of the above two sums.

By forming the stabilizing current in this manner, only half of the total through–flowing load current acts as stabilizing current.

The short–circuit current does not stabilize the "check zone" and only acts as differential current.

This procedure is illustrated in Fig 4.9.

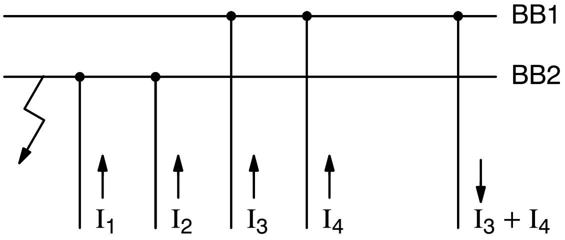


Figure 4.9 Treatment of check–zone

$\Delta I = \mid I_1 + I_2 + I_3 + I_4 - I_3 - I_4 \mid = \mid I_1 + I_2 \mid$

Normal stabilizing current without special treatment:
$I_{Stab} = \mid I1 \mid + \mid I2 \mid + \mid I3 \mid + \mid I4 \mid + \mid I3 + I4 \mid$.

Load currents I_3 and I_4 are considered twice in the stabilizing current, which leads to overstabilization.

Special treatment of the stabilizing current results in the following conditions:
$\Sigma \mid I_p \mid = \mid I_1 \mid + \mid I_2 \mid + \mid I_3 \mid + \mid I_4 \mid$
$\Sigma \mid I_n \mid = \mid I_3 + I_4 \mid$
$I_{Stab} = \Sigma \mid I_n \mid = \mid I_3 + I_4 \mid$; is equal to half the magnitude of the load current.

This stabilizing current is modified for evaluation of the characteristic as mentioned in section 4.3.1.1.

Due to the phase angle differences between short–circuit current and load currents differences may occur in the formation of the sums.

4.5 Isolator mimic

The allocation of the feeders to the busbar sections is determined by the position of the isolators.

Only the OPEN position is evaluated for the allocation of the feeders to the busbars. The CLOSED position is only used for the isolator status supervision (isolator mal–function, isolator intermediate position).

Fig 4.10 shows the basic connection scheme.

The meaning of the isolatur status indications is shown in table 4.1.

Table 4.1 Isolator status indications

isolator status indication		meaning/reaction
CLOSED	OPEN	
1	0	isolator in CLOSED position
0	1	isolator in OPEN position
1	1	isolator failure is indicated ”isolyFlt pla:Axx” actual isolator status according to setting **DA 5403/ZE**
0	0	isolator failure is indicated ”VOLTAGE FAIL:Axx” actual isolator status according to setting **DA 5402/ZE**
		”isolyFlt run:Axx” actual isolator status CLOSED

The isolator monitoring alarms are described in detail in chapter 4.7.8.4 .

The isolator states per feeder are indicated in the bay units by LEDs green or red. The preselection can be seen in chapter 6.4.2.4 .

4.5.1 Preferential treatment during busbar coupling via isolators

If two busbars are solidly linked via the isolators of one feeder, then all feeders which are connected to the linked busbars are allocated to a preferred busbar protection measuring system. In any case, the busbar section with the lowest number is considered to be preferred. At the same time, the coupler bay is taken out of the allocation list with respect to the currents.

4.5.2 Processing of the isolator running status

If an isolator changes position, for instance from the OPEN position, then a certain time (isolator running time) is required before the other position, in this instance the CLOSED position is reached. During this running time, the isolator is considered to be in the CLOSED position. This intermediate status is monitored. If after a set isolator running time (**DA 6301/ZE)** no checkback signal is given, then the isolator assumes faulty status and an alarm is created by the master unit per isolator (isolx: Flt run; Fno. e.g for isolator 3 **75/ZE**). An isolator in running status is considered to be CLOSED.

4.5.3 Isolator treatment during auxiliary voltage supply failure

Usually, the isolator auxiliary voltage is sub–fused in each bay. If the auxiliary voltage is missing, then all the isolators in this bay display the bit pattern 0/0 (neither OPEN nor CLOSED). By cross–checking with the other isolator positions, this fault condition can be detected. The isolators assume mal–function status and the bay with the faulted isolator is either assigned the old positions according to the busbar protection (flip–flop relay characteristic) or all isolators of this bay are considered to be CLOSED. The type of treatment can be chosen via the parameter (**DA 5402/ZE**).

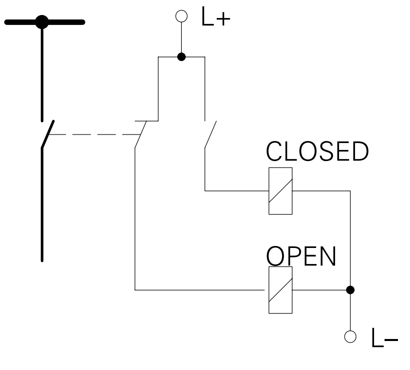


Figure 4.10 Isolator status indications

4.5.4 Treatment of the isolator states in the event of wire breakage

In the event of short–circuits in the feeders, the busbar protection remains stable when wire breakage occurs. This is achieved by processing the isolator status ”CLOSED” even if the indication is missing (see chapter 4.5). In addition, the stability of the protection is increased via the check zone.

However, non–selective busbar disconnection may occur in the event of wire breakage when the isolator is in the OPEN position, the fault occurs on one bus and the second isolator of the feeder is in the CLOSED position. The non–selective disconnection is caused by the preferred treatment. The non–selective disconnection can be prevented by additional measures such as by interlocking the TRIP command with the integrated overcurrent monitoring or by monitoring the pick–up of the feeder protection.

Such wire breakages are annunciated in the 7SS52 as isolator mal–function status (ISOx flt run: Byy).; FNo e.g. for isolator 4 **79/ZE)**.

4.5.5 Bypass transfer–busbar operation

During transfer operation, the feeder connected to the bypass busbar is replaced in the allocation list by the bus coupler. Monitoring of the isolator states in the feeder and coupling bays ensures that the feeder is substituted in the allocation list by the coupler only after the bus or feeder isolator had been opened.

Up to the final bypass operation, intermediate switching positions occur. The allocation of the respective feeder to the busbar section during this time depends on the current transformer arrangement (internal or external).

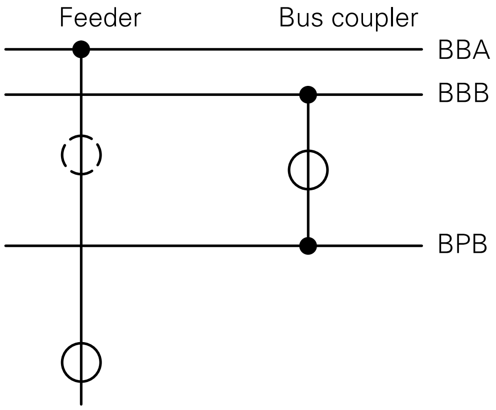
Fig 5.6 shows the plant configuration with transfer bus

The busbar allocation of the feeders are summarized in table 4.2.

Normally the check zone measurement (non bus–selective overall busbar protection) does not require any isolator status information. The coupler’s current, however, has to be included in the check zone measurement, if a feeder with internal CT is connected to the transfer bus.

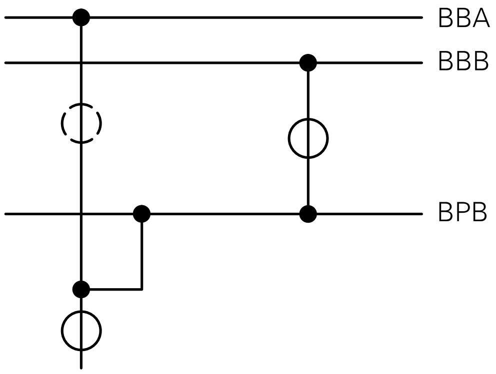
Table 4.2 Allocation of a feeder to a busbar section

1. Feeder and bus coupler on different busbars



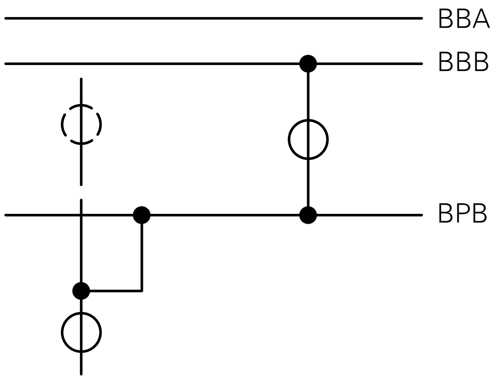
(a) Bypass (transfer) bus under voltage

	Busbar allocation			
CT location	BBA	BBB	BPB	Check zone
external	Feeder	Bus coupler	Bus coupler	Feeder
internal	Feeder	Bus coupler	Bus coupler	Feeder



(b) Feeder simultaneously on bypass (transfer) bus and main bus

	Busbar allocation			
CT location	BBA	BBB	BPB	Check zone
external	Feeder; Bus coupl.	Bus coupler	BBA	Feeder
internal	Feeder	Bus coupler	no protection*)	Feeder; Bus coupl.

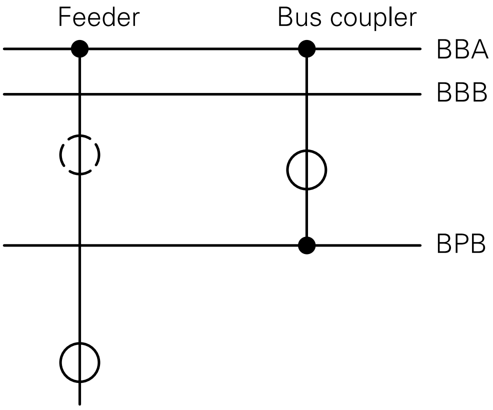


(c) Final condition, bypass (transfer) operation

	Busbar allocation			
CT location	BBA	BBB	BPB	Check zone
external	–	Bus coupler	Feeder; Bus coupl.	Feeder
internal	–	Bus coupler	no protection*)	Bus coupler

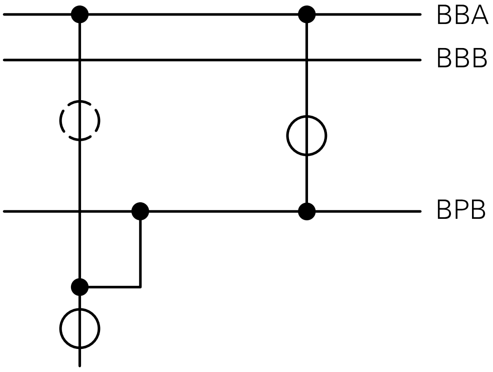
*) The current being fed by the feeder or into the feeder cannot be measured.
The BPB is protected by the feeder protection!

2. Feeder and bus coupler on the same busbar section



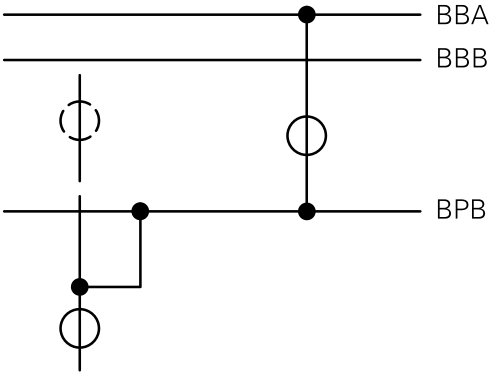
(a) Bypass (transfer) bus under voltage

	Busbar allocation			
CT location	BBA	BBB	BPB	Check zone
external	Feeder; Bus coupl.	–	Bus coupler	Feeder
internal	Feeder; Bus coupl.	–	Bus coupler	Feeder



(b) Feeder simultaneously on bypass (transfer) bus and main bus

	Busbar allocation			
CT location	BBA	BBB	BPB	Check zone
external	Feeder	–	BBA	Feeder
internal	Feeder; Bus coupl.	–	no protection*)	Feeder; Bus coupl.



(c) Final condition, bypass (transfer) operation

	Busbar allocation			
CT location	BBA	BBB	BPB	Check zone
external	Bus coupler	–	Feeder; Bus coupl.	Feeder
internal	Bus coupler	–	no protection*)	Bus coupler

*) The current being fed by the feeder or into the feeder cannot be measured.
The BPB is protected by the feeder protection!

4.5.6 Status of the feeder isolator

The status of the feeder isolator (Q9) in the outgoing feeder can be processed by setting the parameter ”ISOL.5” (**DA XX11/ZE**). For the feeder type ”outgoing feeder”, isolator 5 can only be configured ”existing” or ”non–existing”.

If isolator 5 is configured ”existing”, then the outgoing feeder is considered to be allocated to a bus section, if the corresponding bus isolator and the feeder isolator are CLOSED..

With transfer (bypass) bus operation it is sufficient that after closing of Q7 either the bus isolator Q1 or the feeder isolator Q9 is opened (figure 4.11).

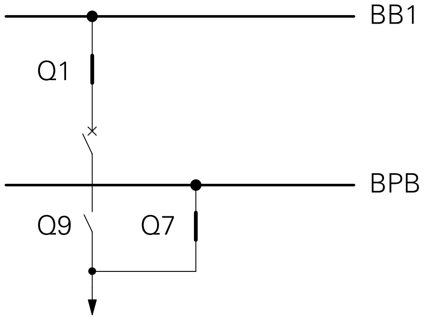


Figure 4.11 Transfer (bypass) bus operation with closed busbar isolator

With parallel feeders a differential current may occur, if one feeder was earthed and an earth fault occurs on the parallel feeder (figure 4.12). The protection sees a current in the zero sequence system of the earthed feeder.

Integrating the feeder isolator (Q9) into the the isolator logic prevents spurious tripping by the 7SS52.

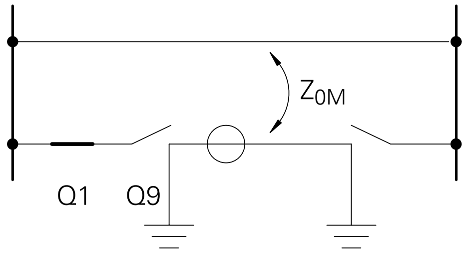


Figure 4.12 Parallel feeders

4.6 Circuit–breaker failure protection

The circuit–breaker failure protection in the 7SS52 detects a failure of the circuit–breaker either in the event of a feeder short–circuit or a busbar short–circuit.

1. In the event of a circuit breaker failure with a feeder short–circuit, the bus section to which the feeder with the defective breaker is allocated, is selectively isolated.

   In addition a transfer trip signal is issued in order to trip the remote feeder terminal, too.
2. In the event of a circuit breaker failure with a busbar short–circuit, the infeed from the remote feeder terminal has to be interrupted. For this purpose the 7SS52 issues a transfer trip signal.

For the breaker failure protection function, the 7SS52 offers separate setting parameters for the differential protection characteristic "STAB.FAC:BF" (**DA 6202/ZE**) and "I>DIFF:BF" (**DA 6203/ZE**).

4.6.1 Circuit–breaker failure protection during a feeder short–circuit

If a circuit breaker failure occurs after a feeder short–circuit, then the bus section with the corresponding feeder has to be isolated. The breaker failure protection in the 7SS52 is activated by a TRIP command from the feeder protection, which is connected to a binary input "CBF Lx" (**FNr. 7020, 7021, 7022/FE**) of the bay unit.

The following reaction by the protection system 7SS52 depends on the operation mode "CBF–OP Axx" (**DA 6601** to **6648/ZE**), selected for each feeder.

Following variants of CBF–operation are utilised:

1. Current sensor
2. Trip repetition with current sensor
3. Unbalancing (1–stage CBF)
4. Trip repetition with following unbalancing (2–stage CBF)
5. Trip repetition with following unbalancing for pulse trigger
6. TRIP from external CBF

The parameter "CBF–BE–MODE" (**DA 6201/ZE**) defines for all feeders whether the CBF–initiation is triggered only by the feeder–selective binary input "CBF Lx" (1–channel) or after additional evaluation of a second binary input "CBF–release" (2–channel). The 2–channel initiation increases the security of the circuit breaker failure protection function. The function of the additionally selectable supervision is explained in chapter 4.7.8.5. The TRIP command is always supplemented by a transfer trip command.

4.6.1.1 Breaker failure protection with current sensor

Initiation of the circuit breaker failure protection (CBF–) function is effected by the TRIP command from the feeder protection. In the operation mode "current sensor", the feeder current is monitored for exceeding the threshold I>CBF (**DA 67xx/ZE)** in the course of the delay time T–CBF (**DA 6204/ZE**).

When this condition is fulfilled, then the 7SS52 issues a three–phase TRIP command to isolate the bus section with the feeder that has initiated the CBF after the time T>CBF has elapsed.

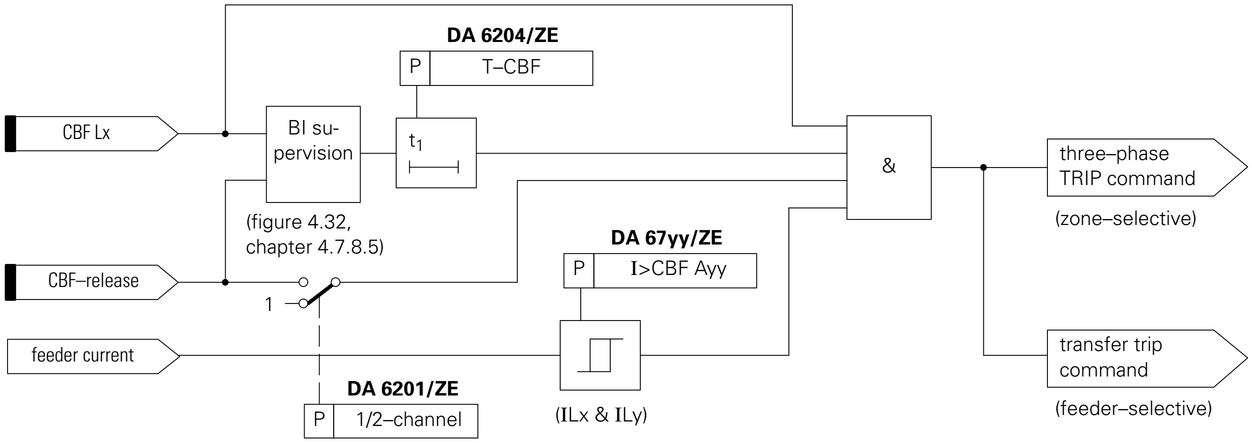


Figure 4.13 Basic scheme "current sensor"

4.6.1.2 TRIP repetition with current sensor

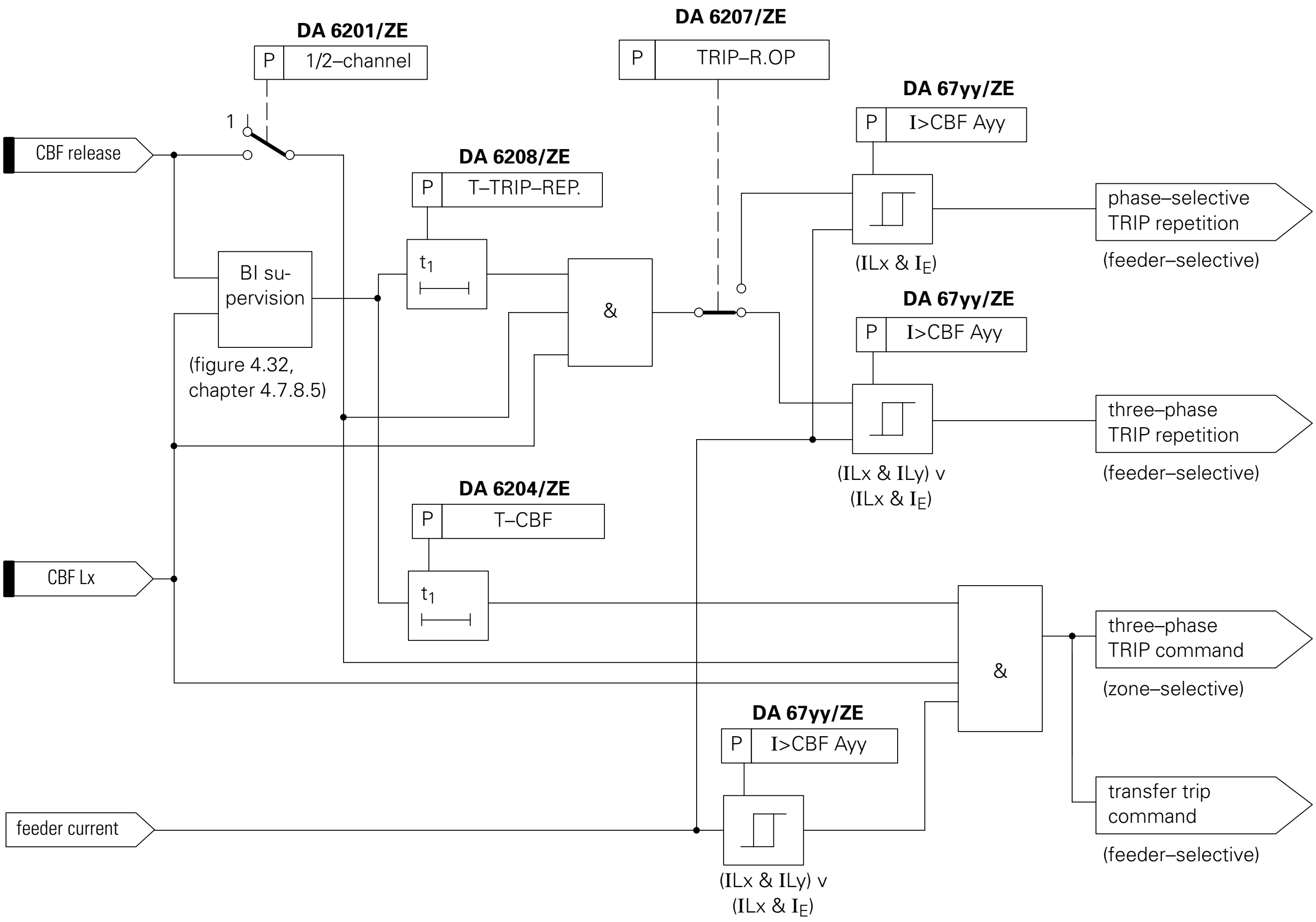


Figure 4.14 Basic scheme "TRIP repetition with current sensor"

After the TRIP repetition time **DA 6208/ZE** has elapsed and if the release criterion is fulfilled, the related bay unit issues a phase–selective or three–phase TRIP command.

The condition for a single–phase TRIP repetition is that both the feeder current in the CBF–initiating phase and the earth current exceed the threshold I > CBF (ILx & IE). Here the parameter TRIP–R–OP: (**DA 6207/ZE**) must be set to ”single–phase”. For three–phase TRIP repetition, the parameter (**DA 6207/ZE**) must be set to ”three–phase”.

In addition at least 2 currents must exceed the current treshold for two–phase or three–phase CBF–initiation [(ILx & ILy) v (ILx & IE)].

If the circuit breaker trips correctly, then the CBF initiation resets and there will be no zone–selective TRIP command.

If the CBF initiation persists, then the time delay of the CBF (**DA 6204/ZE**) elapses. In conformity with the actual isolator replica, all feeders are tripped, which are allocated to the bus section of the CBF initiating bay unit.

A further condition is that the current threshold (**DA 67yy/ZE**), which can be set individually for each feeder, is exceeded during the total time period ”T–CBF”.

If the current falls below the threshold, then the running time T–CBF is interrupted.

4.6.1.3 Unbalancing

This operation mode yields three essential advantages:

- Full protection stability, similar to the busbar protection measurement, is maintained
- No special demands are made on the reset time of the feeder protection; i.e. even with a longer reset time, there is no danger of false tripping since the circuit–breaker has interrupted the current and a differential current is not formed by the unbalancing.
- The circuit–breaker failure protection has its own set of parameter settings for differential current limit and stabilizing factor setting independent of busbar protection. The feeder–selective matching of the differential current limit is obtained by multiplication of the differential current limit by the actual CT ratio. This enables circuit–breaker failure detection even with low–current short–circuits.

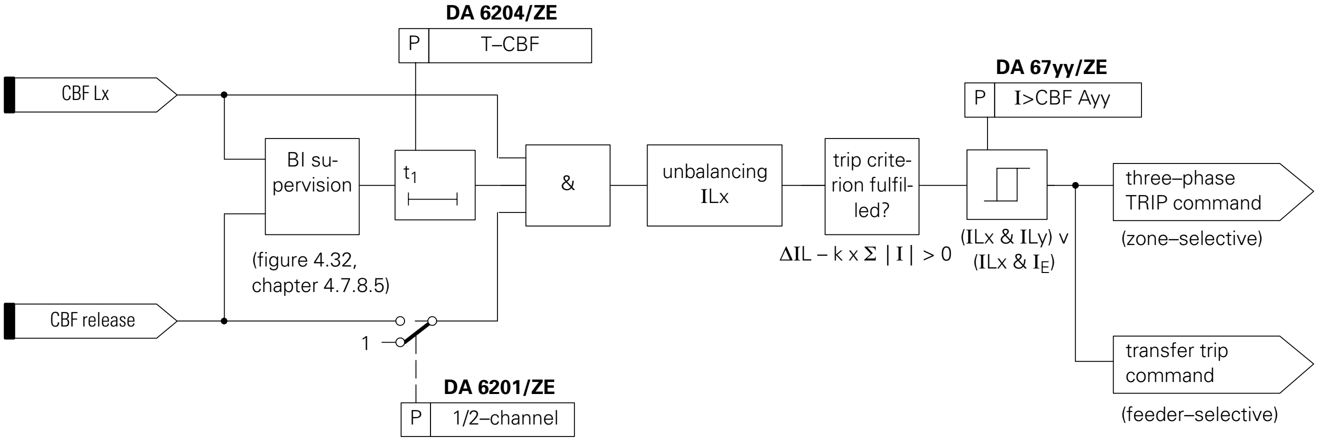


Figure 4.15 Basic scheme ”unbalancing”

After initiation of the breaker failure protection (CBF) by the TRIP command from the feeder protection, the delay time (T–CBF) (**DA 6204/ZE**) is startet.

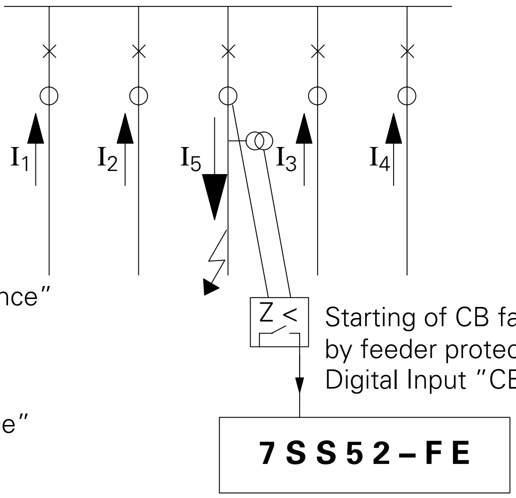
If the CBF initiation is still active after the time T–CBF has elapsed, then the polarity of the feeder current for determination of the differential current ΔI is changed (”unbalancing”) in the protection algorithm. If the TRIP criterion and the current sensor criterion are fulfilled, then a three–phase TRIP command is issued to all feeders of the bus section with the CBF initiating bay unit.

The principle of ”unbalancing” is depicted in figure 4.16. Unbalancing causes a differential current of twice the magnitude of the current in the CBF initiating feeder.

4.6.1.4 Breaker failure protection with TRIP repetition and unbalancing

This operation mode also uses the ”unbalancing” described in chapter 4.6.1.3. Before all feeders of the bus zone with the CBF initiating bay unit are tripped three–phase, the TRIP command is repeated.

This operation mode lends itself well for circuit breakers which have two trip coils.



Starting of CB failure protection
by feeder protection
Digital Input ”CBF Lx”

Differential current before ”unbalance”

$$\Delta I = | \underbrace{I_1 + I_2 + I_3 + I_4}_{= -I_5} + I_5 | = 0$$

Differential current after ”unbalance”

$$\Delta I = | \underbrace{I_1 + I_2 + I_3 + I_4}_{= -I_5} - I_5 | = 2\ I_5$$

Figure 4.16 Principle of unbalancing circuit–breaker failure protection

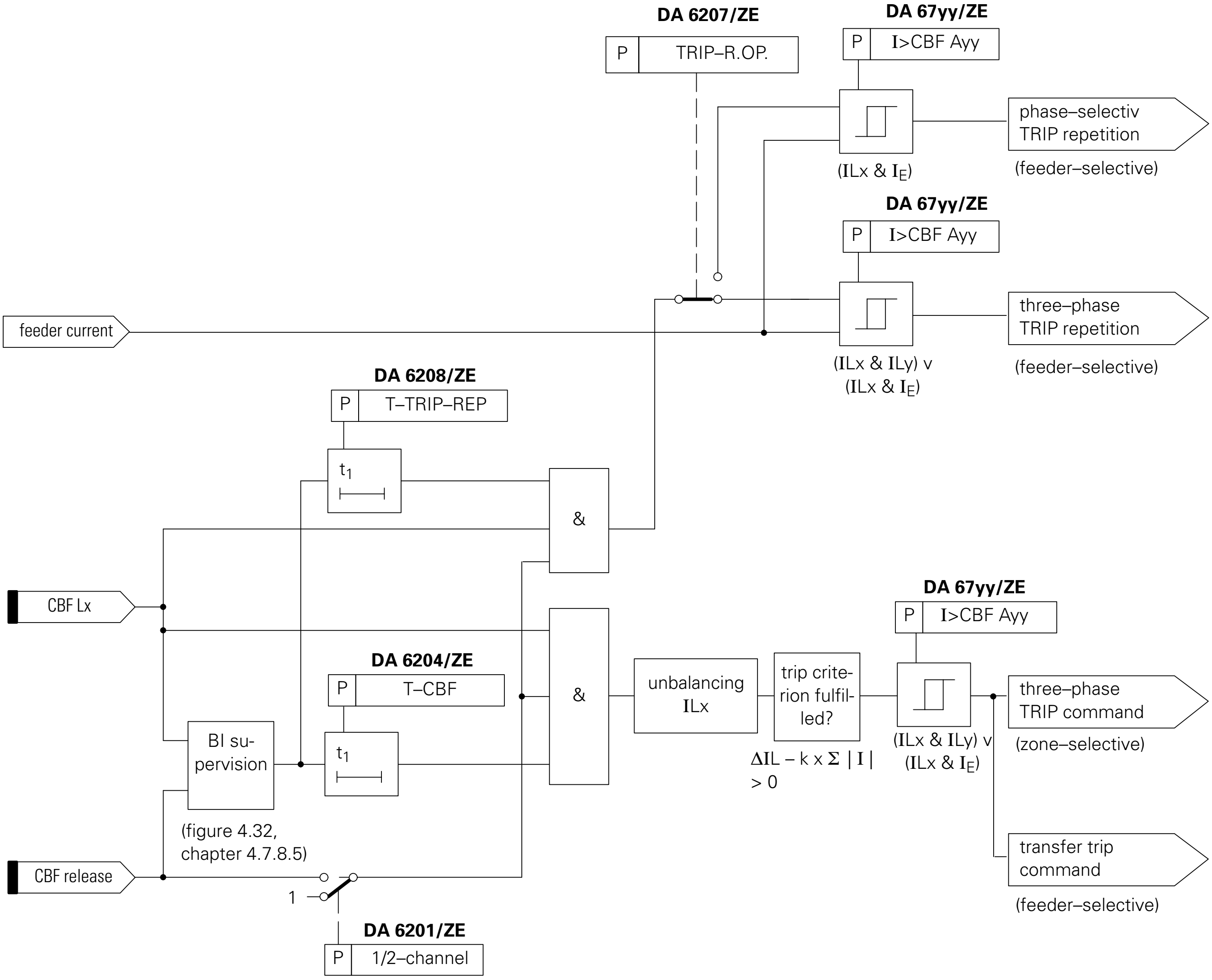


Figure 4.17 Flow–chart for TRIP repetition and unbalancing

In the operation mode "TRIP–rep/unb" (**DA 66xx/ ZE**) the CBF is initiated feeder–selective by the TRIP command. The release signal is usually fault detection by the feeder protection.

Simultaneously the time delay for TRIP repetition T–TRIP–REP (**DA 6208/ZE**) and the time delay for unbalancing T–CBF (**DA 6204/ZE**) are started.

The TRIP repetition time must be shorter than the CBF time delay.

TRIP repetition is issued only when the feeder–selective CBF initiation together with the common CBF release persist after the time delay T–TRIP–REP (**DA 6208/ZE**) has elapsed.

TRIP repetition can alternatively be set to single–phase or three–phase by the common parameter "TRIP–R.OP" (**DA 6207/ZE**) (equivalent to chapter 4.6.1.2).

If the TRIP repetition does not effect reset of the protection, then unbalancing is initiated after the time delay T–CBF (**DA 6204/ZE**) has elapsed (equivalent to chapter 4.6.1.3).

The flow–chart is shown in figure 4.17.

4.6.1.5 Pulse mode

In this operation mode, the breaker failure protection is initiated by the opposite line terminal.

The pulse mode is reserved for special applications. This operation mode may be used, if initiation of the CBF cannot be given by the corresponding feeder protection (e.g. delayed fault recognition; feeder protection inoperative). In these specific cases the CBF can be initiated by the protection at the opposite line terminal via a signal transmission feature in the bay unit.

The devices for transmission provide a signal (pulse) of variable duration. The minimum signal duration of the binary input at the bay unit has to be ≥20 ms. After receiving the initiation signal, the function TRIP repetition is processed.

After the time "T–PULSE" (**DA 6205/ZE**) has elapsed, a TRIP command is issued to the opposite feeder terminal. If the TRIP command does not result in reset of the protection, then unbalancing is started after the time T–CBF (**DA 6204/ZE**) has elapsed.

T–CBF starts only after T–PULSE has elapsed.

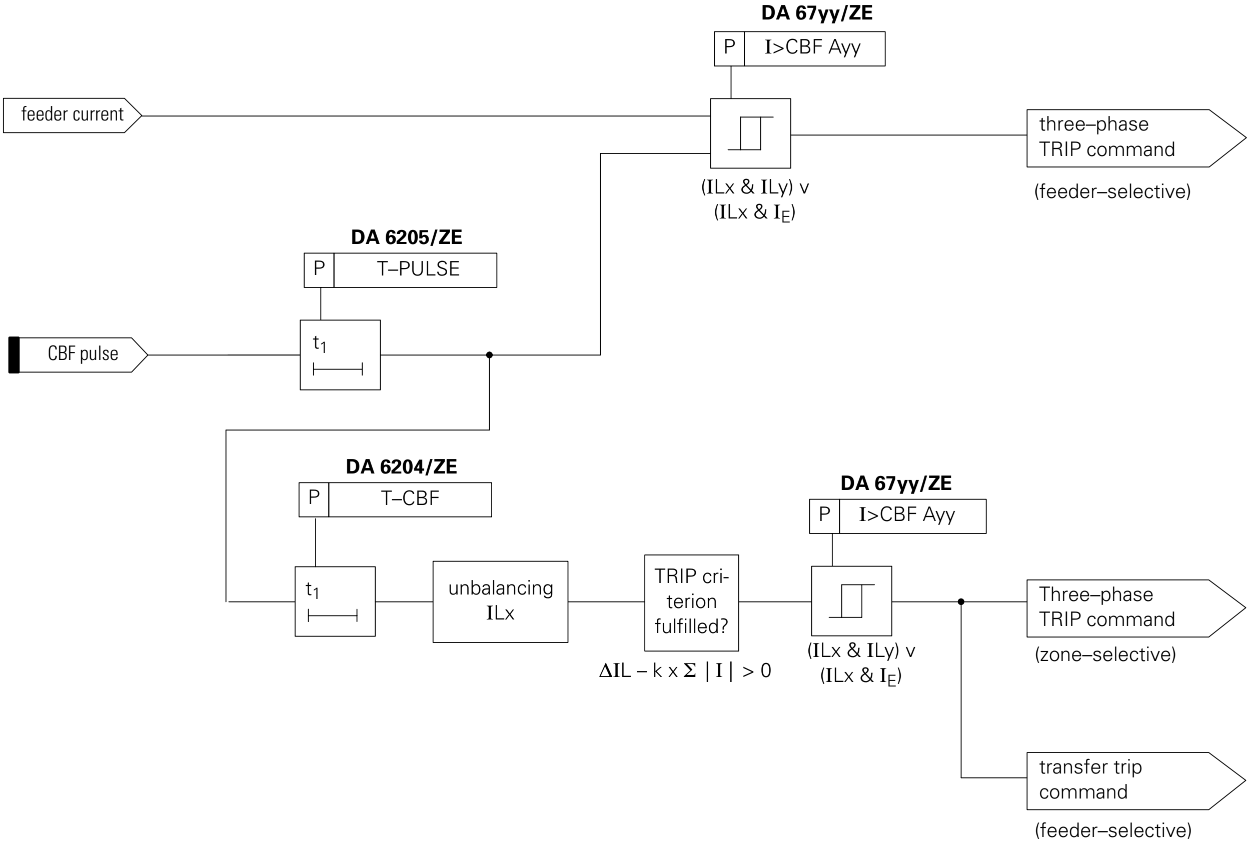


Figure 4.18 Basic scheme "pulse operation"

4.6.1.6 Initiation by external breaker failure protection

In this operation mode, the bus zone to which the feeder with the faulty circuit breaker is connected, is instantaneously isolated according to the isolator replica registered in the master unit. Detection of a circuit breaker failure is done outside the 7SS52, usually by means of a current/time measurement (see also figure 4.19).

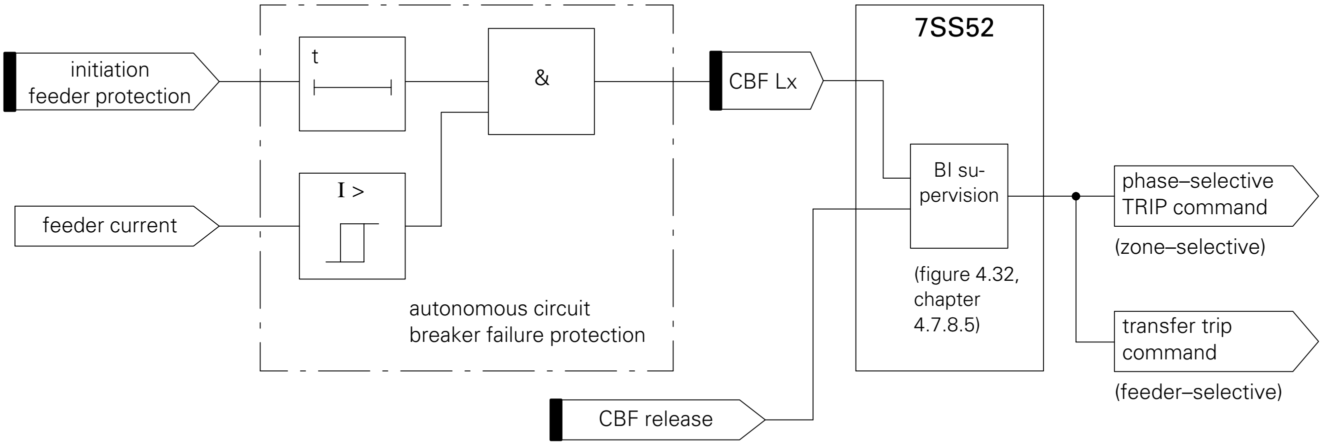


Figure 4.19 Basic scheme "autonomous circuit breaker failure protection"

4.6.2 Circuit–breaker failure protection for busbar faults

Circuit–breaker failure can occur during a busbar short–circuit, too. In this case, the current from the remote end must be interrupted. (refer Fig 4.20).

An inter–trip signal must be transmitted to the remote end circuit–breaker. If signal transmission is not available, then the distance protection at the remote end must clear the short–circuit current via its second zone time (usually 0.5 s).

If signal transmission is used then the current can be interrupted faster, i.e. after the breaker failure time T–BF (**DA 6204/ZE**).

In the 7SS52, the duration of the currents is monitored by the time T–CBF (**DA 6204/ZE**) in all feeders which are to be tripped after a busbar short–circuit. If the current persists above the feeder–selective set threshold I>CBF (**DA 67yy/ZE**) after the breaker failure protection time has elapsed, then the corresponding bay units issue transfer trip commands (refer to figure 4.21).

If the feeder is equipped with line differential protection, this connection (pilot wires or optical fibre connections) can be used to disconnect the remote end either by local unbalancing (polarity inversion) of the feeder current or by forced tripping.

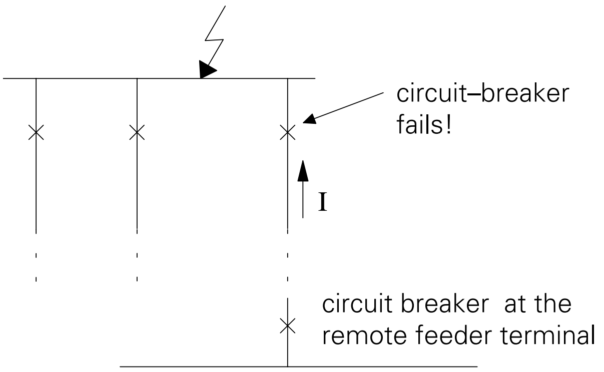


Figure 4.20 Circuit–breaker failure during busbar short–circuit

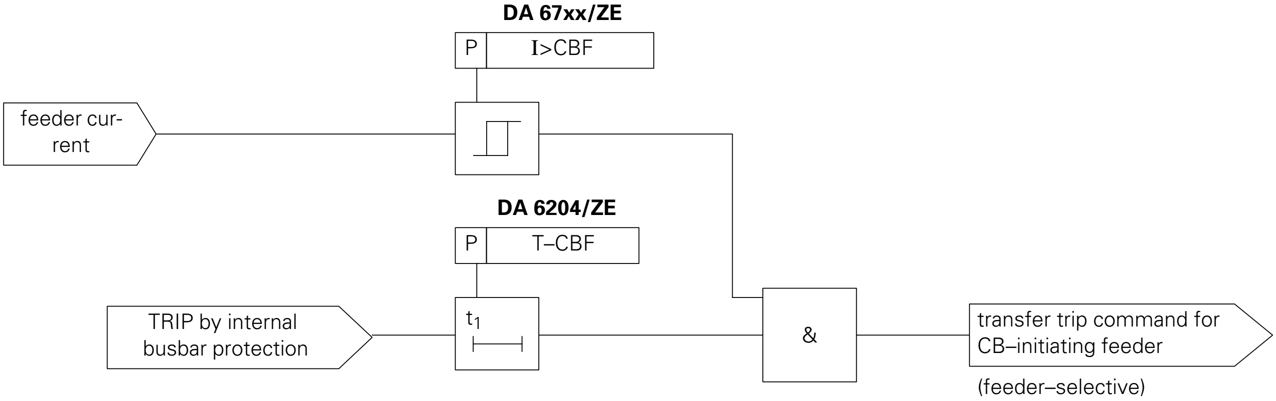


Figure 4.21 Breaker failure protection function with busbar short–circuit

4.6.3 Failure of the bus coupler circuit breaker

If with closed bus coupler a busbar short–circuit occurs (refer to figure 4.22), then a TRIP command is issued to all related feeders of this zone and to both coupling bay units.

Thus bus zone BBA is isolated and the healthy bus zone BBB stays in service.

In the event of a failure of the bus coupler circuit breaker, the busbar protection has to disconnect bus zone BBB, too.

If the current persists in the coupler bay units after the time T–CBF (**DA 6204/ZE**) has elapsed, then breaker failure is assumed .

This results in unbalancing of the coupler bay current.

The trip criterion is thus fulfilled and bus zone BBB is isolated, too..

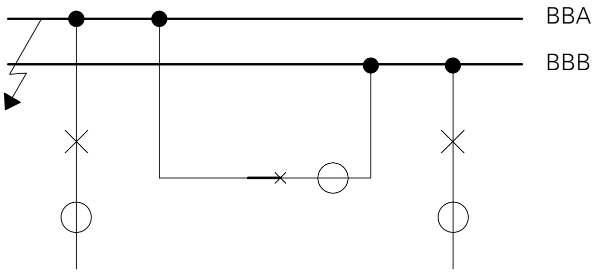


Figure 4.22 Fault on bus zone BBA and failure of the bus coupler circuit breaker

4.7 Ancillary Functions

The ancillary functions of the 7SS52 busbar/circuit breaker failure protection include:

- Overcurrent controlled trip command
- Minimum duration of the trip command
- Detection of short–circuits in the "dead zone" of the bus coupler
- Detection of CLOSE command in the bus coupler
- Event logging
- Storage of short–circuit data for fault recording
- Monitoring functions.

4.7.1 Overcurrent controlled trip command

The busbar protection 7SS52 provides the possibility, in the event of a busbar short–circuit, to only disconnect those feeders which carry currents exceeding a set level. The limit values can be set individually for each bay I > TRIP BAYxx (**DA 65xx/ZE**).If this function is not required, the particular bay setting is set to the value "0". The setting values are always referred to the feeder CT's nominal current.

4.7.1.1 Feeder–selective trip release

The 7SS52 differentiates between a TRIP command due to a busbar fault (BB–TRIP) and a TRIP command due to breaker failure (BF–TRIP).

In the event of a busbar TRIP the breaker failure protection time delay (CBF time delay) is startet. If TRIP release is not given within the CBF time delay (via BI of the bay unit), then no TRIP command is generated and the status "missing TRIP release" is indicated feeder–selective.

The missing "TRIP release" does not influence the internal CBF processing. If the feeder current is still measured after the CBF time delay, then the opposite line terminal is tripped by a transfer signal.

This function is activated by parameter **DA 6107/ZE**.

4.7.2 Minimum duration of the trip command

The 7SS52 extends the feeder–related TRIP commands to a set time duration T–TRIP–DUR (**DA 6106/ZE**). This extensions ensures that the circuit breakers trip reliably.

If the feeder current persists after the minimum duration has elapsed and the threshold I > CBF Axx (**DA 67xx/ZE**) is exceeded, then the TRIP command is maintained.

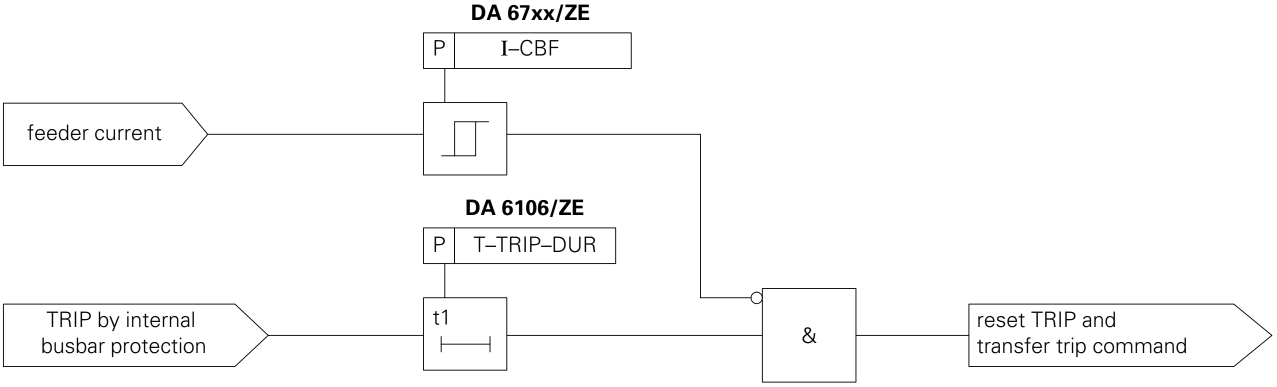


Figure 4.23 Minimum duration for TRIP command

4.7.3 Detection of short–circuit in the ”dead zone” of the bus coupler

In the 7SS52 always 2 bay units (≙ 2 feeders) are allocated to one bus coupler.

For bus couplers with only one coupler current transformer, the current is fed to both bay units.

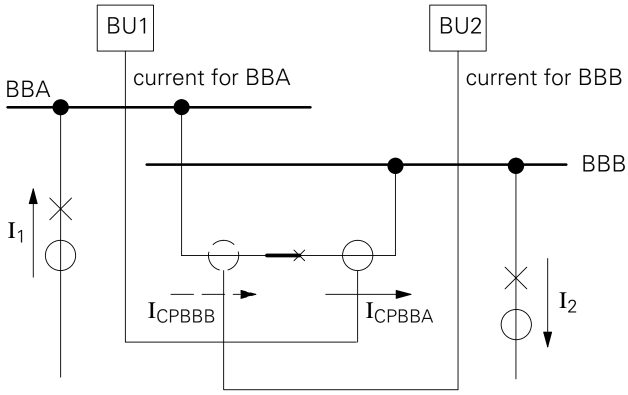


Figure 4.24 Allocation of the bus coupler currents with only one bus coupler current transformer

One bay unit (BU1 processes the measured current. The second bay unit (BU2) inverts the connected current software–wise. The magnitude of the bus coupler current remains unchanged, but the direction is inverted by changing the sign. This inverted current is shown in figure 4.24 as a virtual current transformer (dotted line).

In this example the current I_{CPBBA} flows out of the bus zone BBA. This means the inverted current I_{CPBBB} flows towards bus zone BBB in this example. Thus no fault is seen for bus zone BBA as well as BBB.

Fault processing:

1. In the event of a short–circuit in the bus coupler, between current transformer and closed circuit breaker, bus zone BBA is tripped, because I_1 and I_{CPBBA} flow towards the busbar. Bus zone BBB remains in operation what means that the fault continues to be fed. In order to interrupt the short–circuit current, the second bus zone must be isolated, too.

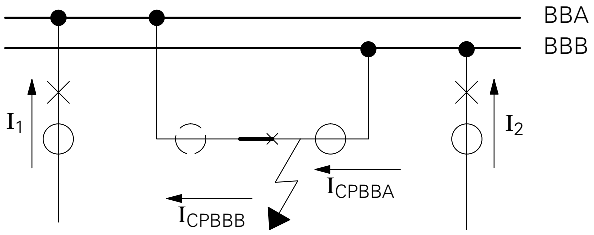


Figure 4.25 Short–circuit in the dead zone

   For this purpose, the bay unit monitors the current in the bus coupler after BBA has been tripped. If the current in the bus coupler persists after the time delay of the breaker failure protection ”T–CBF” has elapsed, then the current I_{CPBBA} is set to zero and the sign of current I_{CPBBB} is inverted (unbalancing). The consequence is tripping of bus zone BBB by the busbar protection.

   Additional connection of the auxiliary contact of the bus coupler circuit breaker allows tripping of the second bus zone even before the breaker failure protection time ”T–CBF” has elapsed.

2. If a short–circuit occurs in the dead zone with open circuit breaker, then the wrong bus zone would be tripped without appropriate countermeasures.

   The reason for the incorrect tripping is as follows:
   $\Delta I_{BBA} = I\ (FEED)_{BBA} - I_{CPBBA} \rightarrow \Delta I_{BBA} > 0$
   $\Delta I_{BBB} = I\ (FEED)_{BBB} + I_{CPBBB} \rightarrow \Delta I_{BBB} = 0$

   Therefore, in the 7SS52, the status of the bus coupler circuit–breaker is used to prevent false tripping. (Fig 4.26).

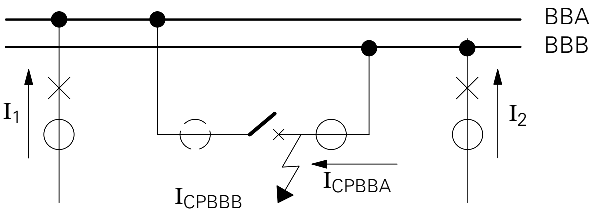


Figure 4.26 Short–circuit in the dead zone with the CB open

When the circuit breaker auxiliary contact (auxiliary contact closed when circuit breaker is open) is connected, then the 7SS52 can react depending on the status of the circuit breaker. When the circuit breaker is open, then the coupler current I_{CPBBA} is set to zero (digitized currents to 0) and the polarity is reversed for I_{CPBBB} (unbalancing by changing the signs of the digitized currents). Thus, ΔI_{BBB} = twice the sum of the currents in feeders on BBB and $\Delta I_{BBA} = 0$.

3. If the bus coupler is equipped with 2 current transformers, so that the bus zones are overlapping (see Fig 4.27), then the digitized currents of the bus coupler are set to zero when the circuit–breaker is open.

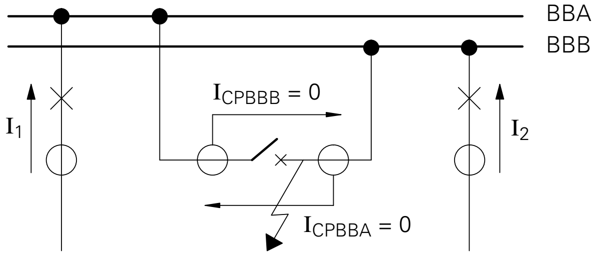


Figure 4.27 Bus coupler with 2 CT's (overlapping measurement)

In this case, BBB is correctly cleared and BBA remains in service.

4.7.3.1 Recognition of the closing command in the bus coupler

In order to detect a short–circuit between current transformer and circuit breaker correctly, the circuit breaker status must be known. (**FNr. 7027/FE**).

If the bus coupler circuit breaker is open, then the current of the coupler bay is unbalanced for the protection of busbar BBB and set to 0 for the protection of busbar BBA (figure 4.28)

This might eventually cause tripping of the healthy bus zone BBA when closing the bus coupler circuit breaker onto a short–circuit on bus zone BBB, because the protection criterion is faster than the circuit breaker status processing. To avoid this, a leading contact for closing the circuit breaker integrates the current of the coupler current transformer into the protection algorithm.

The designer has to select a suitable "leading contact".

Depending on the application, the leading recognition of the close command has to be ensured for manual closing control, eventual remote control of the bus coupler circuit breaker by telecontrol or substation control systems and also reclosing by an automatic reclosing device.

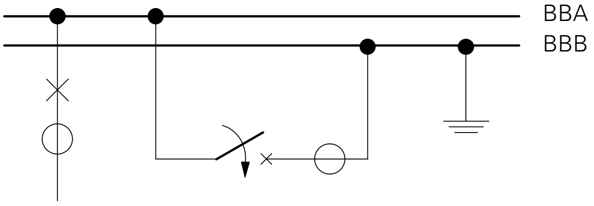


Figure 4.28 Switching onto earthed busbar

4.7.3.2 Recognition of status OPEN of the bus coupler circuit breaker

The OPEN status of the bus coupler circuit breaker is essential for correct reaction in case of faults in the dead zone, too (**FNr. 7026/FE**). If the circuit breaker (CB) is open, then

1. in case of one coupler current transformer, the coupler current of the current transformer allocated to the bus zone is inverted and the second is set to zero
2. in case of two coupler current transformers, both currents are set to zero.

In order to avoid that, after a bus fault, the breaker failure protection is undercut when the circuit breaker reaches its final position, so that eventually a healthy busbar is jeopardized by current transformer remaence, the signal CB–OPEN is processed time–delayed.

The specific processing of the coupler bay currents starts only after the set time delay "T–CB–OPEN" (**DA 6108/ZE**) has elapsed

4.7.4 Recognition of a circuit breaker disturbance

For the purpose of recognizing a disturbance in the tripping mechanism of the circuit breaker, the bay unit provides the function ”CB– disturbance ” (**FNr. 7028/FE**), which can be assigned to a binary input. In the event of a breaker failure and simultaneous indication of ”CB disturbance”, instead of the ”T–CBF” (**DA 6204/ZE**) the time delay ”T–CD–DISTURB” (**DA 6206/ZE**) is started for the circuit breaker failure processing.

As T–CB–DISTURB is usually smaller than T–CBF (**DA 6204/ZE**), the time for starting the CBF function in the 7SS52 is reduced.

The signal CB disturbance is written into the alarm buffer of the ZE as an event (coming/going) (**FNr. 87/ZE**).

4.7.5 Control functions

4.7.5.1 Trip test with circuit breaker

The 7SS52 offers an easy method of testing the trip circuits and the circuit breaker.

The test can be started from the master unit and from each bay unit by control operation (figure 4.29). An additional binary input function ”CB test” (**FNr. 1156/FE**) is provided in the bay unit for a three–phase test.

The related bay must be taken out of operation for performing the circuit breaker test and the bay current must not exceed the threshold I<CB–TEST (**DA 6313/ZE**).

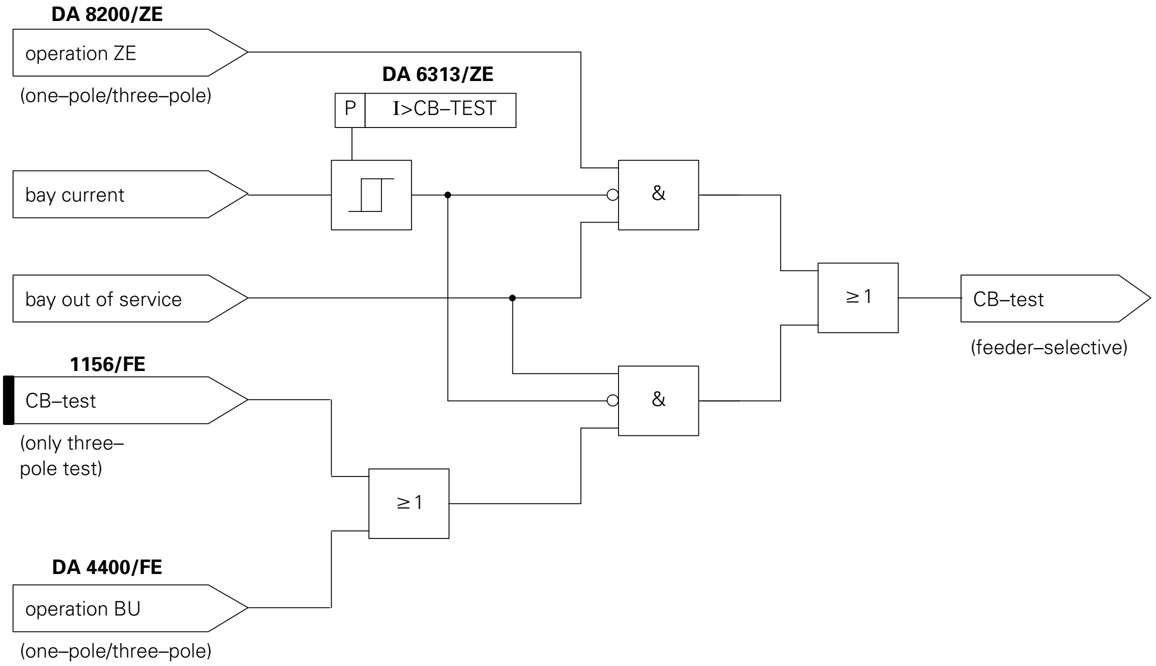


Figure 4.29 Trip test with circuit breaker

4.7.5.2 Bay out of service

For maintenance work in the bay, the bay has to be taken out of service.

Taking the bay unit out of service is possible:

- by operation from the master unit (**DA 6400/ZE**),
- via binary inputs at the related bay unit (**FNr. 7029/FE**) or
- by local operation at the bay unit (**DA 4500/FE**).

In order to avoid tripping of a bus zone in operation by infeed of test currents into the bay unit, the master unit must recognize the taking out of service of a bay. Therefore the control facilities for the bay unit are additionally interlocked. The control "bay out of service" is released for all bay units with parameter (**DA 6317/ZE**) (figure 4.30).

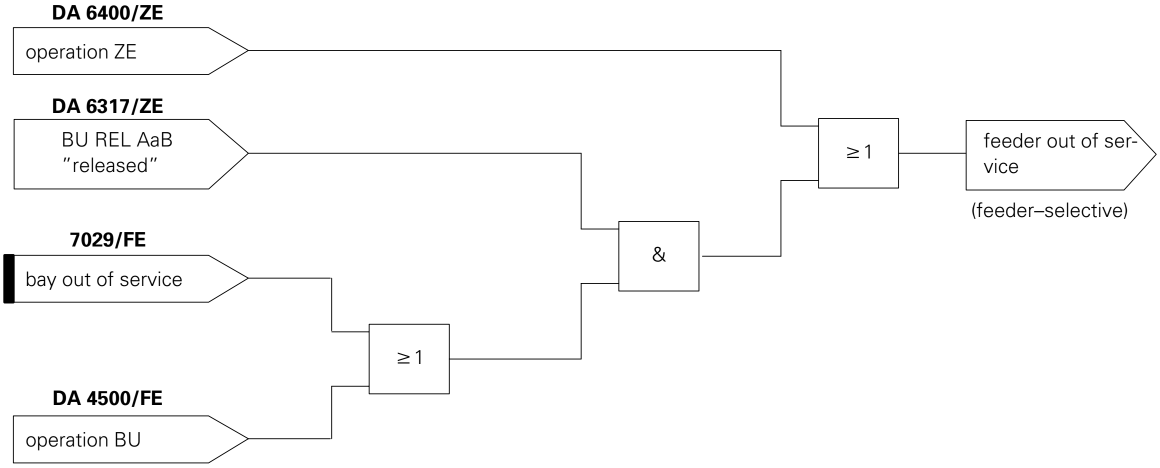


Figure 4.30 Trip test with circuit breaker

If during maintenance work in a bay it must be expected that the auxiliary voltage of the bay unit or for the binary inputs is interrupted or the FO–connection to the master units is interrupted, then the related bay unit has to be taken out of service by the parameter "service" (**DA 64xx/ZE**). All configured isolators of the bay are assumed to have OPEN–status. In case of the bus coupler this status is automatically assumed for both coupler bay units.

The check zone considers all bays, irrespective of whether they are switched on or off, as long as the bay unit is supplied with auxiliary voltage and the data link to the master unit was uninterrupted.

By this measure the danger of spurious tripping is avoided in case of an overfunction of the binary input. The check zone also prevents spurious tripping, if after maintenance works the switch is not returned to service and when switching onto an external short–circuit (short–circuit in the feeder).

In case of maintenance works including current transformer checks, the FO–link to the master unit should be interrupted as an additional measure against overfunction.

4.7.6 Event logging

After a fault in the network, information concerning the response of the protection device and the measured values are important for an exact analysis of the fault. For this purpose the master unit of the 7SS52 contains a memory for fault events (maximum 40 events).

Operational events (e.g. isolator operations) are registered in an operational events memory (up to 99 events).

In addition events and states can be indicated via alarm relays and optically via LEDs in the master unit and the bay units.

4.7.6.1 Alarm relays and indications

The master unit can be fitted with up to two alarm modules (EAZ1 and EAZ2). On each module 16 alarm relays are available for remote signalling. Functions can be allocated to them out of an alarm list.

The alarm relays are unstored and reset after the initiating criterion disappears. On the device's frontplate an optical indication (LED) is provided for each alarm.

The bay unit has 10 LEDs which, pre–set ex works, serve for indication of the isolator states (pre–set CLOSED–red;OPEN–green). Further 6 LEDs indicate protection functions. An alarm relay serves for indication of alarms. The LEDs and alarm relays can at random be marshalled with different functions. The pre–set functions are listed in chapter 6.4.2.4.

Bay unit and master unit have a reset button for local reset of the LED indications. Operating the reset button on the master unit resets all LED indications on all connected bay units.

Configurable binary inputs ">LED–ackn" can be used in the master unit and bay units for remote reset. In addition to the LEDs for alarm indication, each type of device contains an indication "ready for operation" (green) and a failure indication (red).

4.7.6.2 Operation and indication

Operational measured values, operational events and fault events can be read out via integrated operation keys and a LC display. The keypad can also be used for setting protection parameters, configuring the protected object and marshalling binary inputs and outputs.

The master unit has a front–side interface for connecting a PC. Utilizing the communication program DIGSI, menu–guided communication with the protection system is provided. Fault records can be read out and analysed.

The 7SS52 stores up to 40 fault events and 99 operational events. When the event buffer is full, the oldest events are overwritten (ring buffer).
The recordable operations and fault events are listed in annex A.1.2.

Operational measured values (feeder currents, stabilizing and differential currents) are displayed in the master unit (full range) and in the bay units (bay–related measured values) for the purpose of commissioning and test support.

Master unit

- Feeder currents I_{L1}, I_{L2}, I_{L3} of all configured bay units
- Stabilizing and differential currents per phase segregated for ZPS–BSZ1 (**DA 7400/ZE**), ZPS–BSZ2 (**DA 7500/ZE**) and ZPS–BSZ3 (**DA 7600/ZE**) for all bus zones.

Bay unit

- Feeder currents I_{L1}, I_{L2}, I_{L3}, I_E
- Stabilizing and differential currents per phase of the check zone
- Frequency [Hz] (indication for $I \geq 0,1\ I_N$)
  The indicated measured values are refreshed at a rate of 0.5 sec.

The actual isolator replica is available for graphical or tabled indication through DIGSI and the operation interface of the master unit.

In addition, the configured plant can be displayed graphically.

4.7.7 Fault recording

The instantaneous values of the measured quantities are sampled every 1 ms and stored in a cyclic buffer in the master unit.

- Instantaneous values of the currents in all bays (per phase)
- Differential and stabilizing currents of all busbar sections and of the check zone. (per phase)

After starting the fault recording (through a busbar short–circuit, via binary input or by operation) **DA 8400/ZE**), the data are stored from 200 ms before up to 100 ms after the trip command. The master unit stores up to two fault records.

This data can be read out locally by means of a PC and evaluated using the DIGSI software.

Via parameters **DA 6316/ZE** the mode of release of the fault record buffer is defined. With "automatic release" the last fault is recorded and available for read–out. Each new fault record overwrites the previous one.

With "manual release" for the last two faults each record is stored. The fault record buffer has to be erased and thus "released" for writing new records after reading out the data.

The release can be effected through the communication program DIGSI, the integrated keypad (**DA 8300/ZE**) or via binary input.

4.7.8 Monitoring functions

The protection system 7SS52 incorporates comprehensive self–monitoring functions which cover both the hardware and the software. This guarantees a high availability and security against overfunctioning and underfunctioning as well as low demand on maintenance.

4.7.8.1 Hardware monitoring

The complete protection system is cyclicly monitored from the measuring inputs through the data communication between master unit and bay units up to the command relay coils.

Monitoring circuits and processors monitor the hardware for faults and impermissible conditions. Details are as follows:

- Auxiliary and reference voltages.

The processor of the bay unit monitors the offset and reference voltages. The protection is blocked as soon as impermissible deviations occur; permanent faults are annunciated.

The DC–DC converter voltages in the master unit and bay units are also monitored by the converters themselves and faults are annunciated. Failure or disconnection of the auxiliary voltage automatically takes the affected device out of service; this status is annunciated via a NC contact. Transient auxiliary voltage dips of up to 50 ms will not influence the unit.

Failure of the auxiliary voltage in a bay unit results in blocking of the protection system.

- Measured value monitoring

The analog input circuits of the bay unit are cyclicly monitored from the input transducers up to the digitization. This is done by forming the current sum and executing the following plausibility check:

$\Delta i = i_{L1} + i_{L2} + i_{L3} + i_E$
$\Sigma | i | = | i_{L1} | + | i_{L2} | + | i_{L3} | + | i_E |$

The measured value monitoring picks up if

$| \Delta i | >$ I>MV–MONIT (**DA 5106/ZE**) and
$| \Delta i | > k \times \Sigma | i |$

k = 0,125 (stabilizing factor)

The pick–up characteristic is shown in figure 4.31.

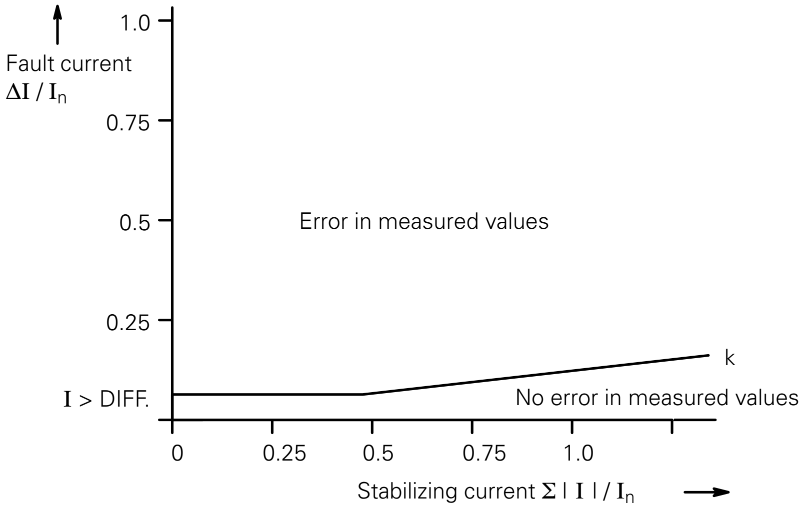


Figure 4.31 Characteristic for measured value supervision

If the supervision detects that the measured values are not plausible, then the analogue measuring circuits are considered faulty, the measured value cycle is accordingly marked and the measurement for that cycle is blocked. If the fault prevails for a longer time, it is annunciated.

- Memory (FE and ZE)

The memory modules are cyclicly tested for faults by the following measures:

- A checksum is formed for the program memory (Flash–EPROM) during start–up and cyclicly.
- For the working memory (RAM), a data pattern is written during start–up and read again.
- For the parameter and configuration data memory (EEPROM), the checksum of the stored quantities is formed and compared with the checksum calculated during each new writing process.
- For the dual–port RAM on the slave modules, the stored parameters are compared with the data on the master module.

- Output trip channels (FE)

The output trip channels are controlled via two command channels and one release channel. Checking of the signal output channels is performed in connection with the cyclic protection test (refer 4.7.8.8).

4.7.8.2 Software monitoring

Watchdog timers are provided on the processor modules to continuously monitor the program sequences. In the event of processor failure or if a program falls out of step the watchdog operates and initiates a reset of the processor system.

Further internal plausibility checks and program sequence monitoring ensure that any fault in processing of the programs will be detected. Such faults also lead to a reset and restart of the processor.

If a fault is not eliminated by restarting, a further restart is initiated. If the fault is still present after three restart attempts, the protection system is automatically taken out of service. The ready–for–service relay on the alarm module (EAZ1) drops off and indicates ”Equipment failure” via its NC contact.

The LED ”failure” on the frontplate of the master unit or the affected bay unit lights up red.

4.7.8.3 Supervision of the external CT circuits/ differential current supervision

Interruptions or short–circuits in the secondary circuits of the current transformers as well as errors in the CT connections and errors in the system configuration of the busbar protection are automatically recognised by the system and annunciated. The differential currents formed in the measuring systems on the protection processing modules ZPS–BSZ 1 to ZPS–BSZ3 are used for this function.

The differential current monitoring can be activated or deactivated by the parameter DIFF.SUP (**DA 6303/ZE**).

Each measuring system is individually supervised. Under no–fault conditions the differential current of each measuring system is approximately 0. If no feeders are assigned to a measuring system, then differential current and stabilizing current are set to 0. The differential current supervision picks up, if the mean value of the differential current exceeds a threshold independently settable for ZPS–BSZ1 I>DIFsup.:CZ (**DA 6306/ZE**) or ZPS–BSZ2/3 I>DIFsup.:BZ (**DA 6305/ZE**) within a selected time T–DIFF–SUP (**DA 6304/ZE**).

If the differential current falls below the threshold before the set time, then the time delay is restarted if it occurs again.

The reaction after pick–up of the differential current supervision can individually be parameterized for ZPS–BSZ1 and ZPS–BSZ2/3 independent of each other.

BSZ1: DIFF.SUP.CZ (**DA 6308/ZE**)
BSZ2/3: DIFF.SUP.BZ (**DA 6307/ZE**)

- Only alarm:
  When the differential current exceeds or falls below the limit, then a general coming/going alarm "disturbance without protection blocking" is generated (**FNo 1/ZE**) a collective alarm for ZPS–BSZ2/BSZ3 (**FNo 92/ZE**) and a specific alarm "I–Diff.–super.:BZz Lx from BSZy" (**FNo 96 – 107; 112 – 123; 128 – 139/ZE**) for BSZ2 and (**FNo 144 – 155; 160 – 171; 176 – 187/ZE**) for BSZ3 or "Diff.–current–sup.:Checkz.Lx" (**FNo 93; 94; 95/ZE**).
- Blocking with automatic release:
  When the differential current supervision picks up, then a general coming alarm "disturbance with protection blocking" (**FNo 0/ZE**) is generated and a selective alarm "I–Diff.–superv.:BZz Lx from BSZy" or "Diff.–current–sup.:Checkz.Lx" coming.

  If the differential current exceeds the set threshold, then bus–zone selective protection blocking is initiated. If the fault is on ZPS–BSZ1 (check zone), then the complete protection is blocked. When the measured value falls below the threshold, then the blocking is cancelled and the going–event is issued.
- Blocking with storage:
  When the differential current supervision picks up, then general coming–alarm "disturbance with protection blocking " is generated and a specific alarm"I–Diff.–super.:BZz Lx from BSZy" or "Diff.–current–sup.:Checkz.Lx" coming.

  If the set threshold is exceeded, then bus–zone selective protection blocking is initiated. If the fault is on ZPS–BSZ1 (check zone, then the complete protection is blocked. The blocking is cancelled when the differential current falls below the threshold and the blocking is additionally cancelled by operation (**DA 8500/ZE**) or by binary input "BloDifSuprel." (**BE4/ZE**).

4.7.8.4 Isolator supervision

The isolator switching positions are recorded as OPEN or CLOSED. The following faulty conditions can arise from these positions:

Isolator CLOSED/OPEN=1/1 :

Isolator status
Annunciation: Isy Flt: Axx (**FNo 66; 70; 74; 78; 82/ZE**)

Isolator CLOSED/OPEN=0/0 :

If this status is signalled for more than one isolator in the same bay, then auxiliary voltage failure is annunciated for this bay.
Annunciation: Aux. Volt. Fail: Axx (**FNo 86/ZE**)

If this status is signalled for only one isolator per bay, then exceeding of the isolator running time is assumed and isolator faulty alarm is issued:
Annunciation: "Isoy Fltrun:Axx" (**FNo 67; 71; 75; 79; 83/ZE**)

y: Isolator designation
xx: Feeder no.

The treatment of the isolator mal–function positions is described in Section 4.5.

4.7.8.5 Supervision of CB failure protection initiation and release

If a binary input "start CBF" (**FNr. 7020** to **7022/FE**) is energized incorrectly, there is a risk of spurious tripping of a busbar in this feeder on acount of the inverted current.

Following monitoring functions can be performed, set by parameters(CBF–BI–MODE **DA 6201/ZE**).

- If the selective CBF–initiation persists longer than 10 x T–CBF (**DA 6204/ZE**) , then the faulty CBF input is blocked and annunciated (CBF/BIFlt:Lx:Ayy).
- If the CBF release signal persists longer than T–CBF–RELsup (**DA 6314/ZE**), then the CBF is blocked and the fault is annunciated (CBF/BI–RELsup>T). As long as this signal is active, the CBF function is blocked for all feeders.
- If the CBF signal from a specific bay is active and no CBF release signal is given after a set time FLT T BF (**DA 6315/ZE**), then the CBF function is blokked selectively and annunciated. (CBF/BIFlt:Lx:Ayy).

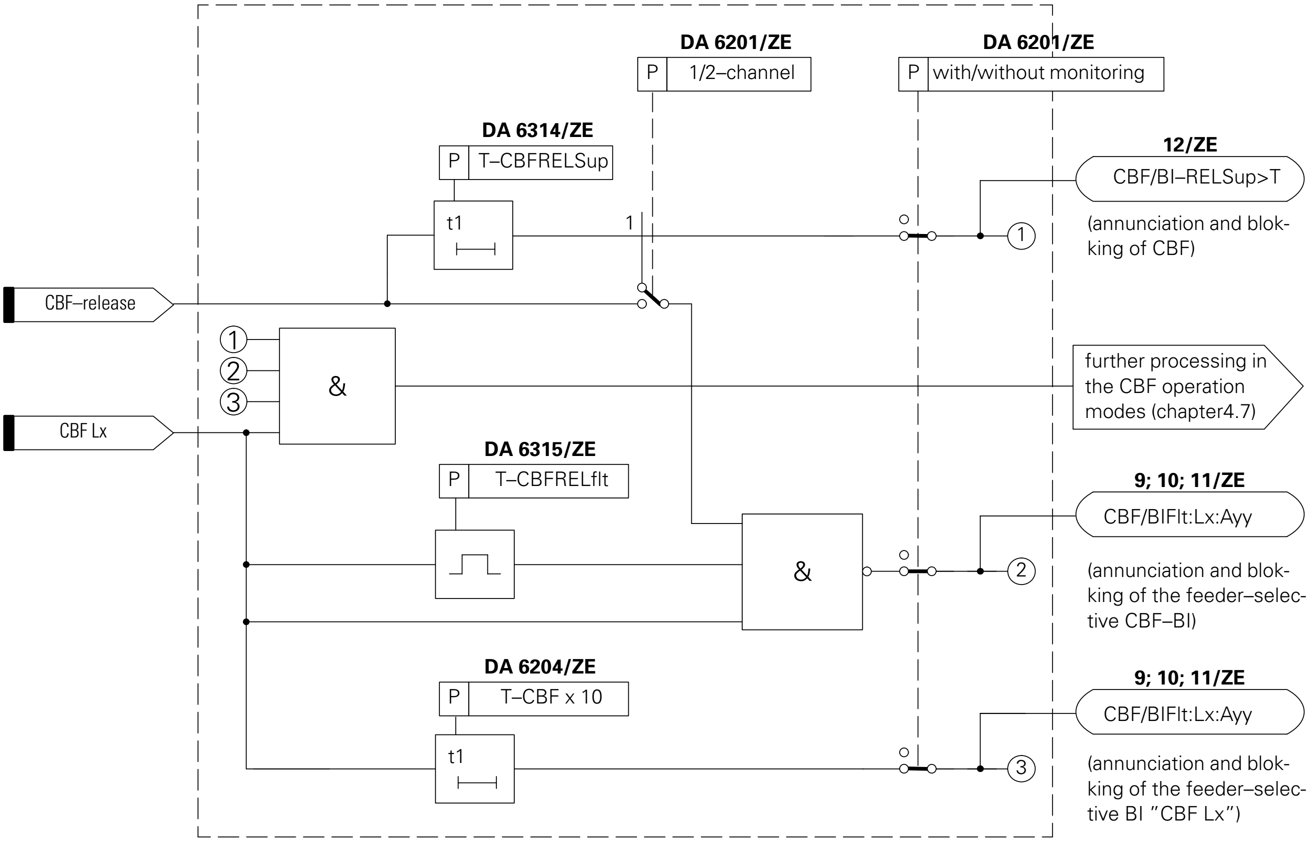


Figure 4.32 Basic diagram

4.7.8.6 Current–controlled reset of the TRIP command

For reset of the TRIP command, it must be ensured that the controlled circuit breaker has really opened and that the tripping current circuit of the bay unit has been interrupted by the circuit breaker auxiliary contact.

Interruption of the tripping current by the command relay causes overload for the contacts and their destruction.

For realisation of the current–controlled command reset, the time steps T–TRIP–DUR (**DA 6106/ZE**) and T–CBF (**DA 6204/ZE**) are started after the TRIP command.

After the TRIP command minimum time has elapsed, the current limit value monitor is activated. If the current falls below the feeder–related threshold $\mathbf{I}$ > CBF (**DA 67xx/ZE**), then the relays for the TRIP and transfer trip command reset.

4.7.8.7 Differential current supervision for linearized current transformers

Linearized current transformers may have angle errors. The secondary current then lags the primary current. If a feeder short–circuit is interrupted by the circuit–breaker (CB interrupts at current zero) then the secondary current continues to flow and decays according to an e–function. The angle error and the time constant depend mainly on the protection burden. The angle error increases and the time constant decreases with increasing burden.

The current which continues to flow in the CT circuit after disconnection is seen by the busbar protection as a differential current. At first, erraneous tripping is prevented by the stabilizing current which decays according to an e–function with a time constant of 64 ms. In order to eliminate erroneous tripping after the stabilizing current has decayed, the 7SS52 supervises the zero–crossings of the differential current. The differential current limit can be parameterized I > ZERO CR (**DA 6310/ZE**). The release of zero crossing supervision is settable ZERO CR SUP (**DA 6309/ZE**). If the zero–crossing does not appear after at least 32 ms f_N = 50 Hz resp. 27 ms f_N = 60 Hz, then a DC current is present and the protection is blocked selectively per busbar zone. The blocking is maintained until the measured value drops below the limit.

4.7.8.8 Cyclic test

The "cyclic test" as part of the autodiagnosis checks cyclicly all measuring systems and connected bay units from the digitized measured values up to the command relays. This test is treated like a real fault and uses the same transmission links for measured values and trip commands. Thus it yields utmost security and reliability.

This test does not influence the protection function.

The test is performed only, if no real fault is detected on the busbar or the connected feeders.

In the event of an internal failure detection, the identical test routine is repeated twice before failure alarm is issued. Failure information contains the affected phase, the measuring channel (ZPS–BSZ1, 2 or 3) and the corresponding feeder "TetsfltLz–y:Axx" (**FNo 196 – 204/ZE**).

The failure reaction can be programmed via the parameter TESTFLT (**DA 6312/ZE**) to "annunciate only" or "protection block" (incl. annunciation).

Table 4.3 shows an overview of the various monitoring functions.

Table 4.3 Summary of the monitoring functions

Supervision	Possible cause and response
1. Current sum (measured value supervision)–FE $\left\| \sum_{n=1}^{4} i_n \right\| >$ **I >MV–SUPER** (DA 5106/ZE) $\left\| \sum_{n=1}^{4} i_n \right\| > 0,125 \times \sum_{n=1}^{4} \left\| i_n \right\|$	Internal unit failure during measured value acquisition (Blocking of protection and annunciation) MV–Super.:Axx (**FNo 192/ZE**) Meas.val–super I (**FNo 161/FE**)
2. Auxiliary voltage supervision	Failure of the DC–DC converter output voltages (Blocking of protection and annunciation)
FE: $(0\ V)_{Digit}$ **>OFFSET SUPV** (DA 5107/ZE) $(15\ V)_{Digit}$**>15 VOLT SUPV** (DA 5108/ZE)	0 V–Super.:Axx (**FNo 195/ZE**) 15 V–Super.:Axx (**FNo 193/ZE**)
ZE: 15 V 24 V	15 V–Super. CU (**FNo 206/ZE**) 24 V–Super. CU (**FNo 207/ZE**)
	Failure of the 5V voltage causes reset of the annunciation device failure and thus blocks the device completely.
3. Cyclic monitoring of the memories (FE, ZE)	After three unsuccessful restart attempts, the protection is blokked.

Supervision	Possible cause and response
4. Permanent monitoring of the program flow by means of watchdog (FE, ZE)	After three unsuccessful restart attempts the protection is blokked.
5. Cyclic test with simulation of a fault current and monitoring of the complete signal processing from the digitized measured values to the control of the command relay coils	after two failure detections, depending on the parameter TEST-FAULT (**DA 6312/ZE**),, either protection blocking and/or annunciation
6. Differential current supervision	current transformer circuit faulty
● Bus–section specific protection $\left| \sum_{m=1}^{n} i_m \right| >$ **I > DIFsup.:BZ** (DA 6305/ZE) for T> **T–DIFF–SUP.** (DA 6304/ZE)	Bus–selective blocking, when parameter DIFF.SUP.BZ (**DA 6307/ZE**) is parameterized to blocking, otherwise only annunciation Id – Sup Syy Lx – z (**FNo 96/ZE** for BZ01, phase L1 and BSZ2)
● Checkzone $\left| \sum_{m=1}^{\text{all except bus coupler}} \right| >$ **I > DIFsup.:CZ** (DA 6306/ZE) for T > **T–DIFF–SUP.** (DA 6304/ZE)	Blocking, if parameter DIFF.SUP.CZ (**DA 6308/ZE**) is parameterized to blocking, otherwise only annunciation Id – Sup. Lx CKZ (**FNr. 93; 94; 95/ZE**)
7. Supervision of isolator status	
● Operating position Isolator CLOSED/OPEN = 0/0 for t > **Isol Op Time** (DA 6301/ZE)	wire breakage or faulty status annunciation1) ISOyFltrun:Axx (**FNo. 67/ZE** for ISOL. 1)
● Aux. Voltage failure All isolator positions of one bay = 0/0	Feeder aux. voltage miniature circuit breaker tripped annunciation1) U–aux.flt:Axx (**FNo. 86/ZE**)
● Implausible isolator status Isolator CLOSED/OPEN = 1/1	annunciation1) ISOyFlt:Axx (**FNo. 66/ZE** for ISOL. 1)
8. Supervision of the digital input "CB failure protection "CBF Lx" and "CBF–release"	
for t > 10 x **T–CBF** (DA 6204/ZE) resp.	Annunciation and blocking of the binary input of the affected feeder CBF/BIFlt.:Lx:Ayy (**FNo 9; 10; 11/ZE**); Monitoring is activated when a signal is received at the BI CBF bay–selective for the time t> limit value;
for t > **T–CBF–RELFlt** (DA 6315/ZE)	Monitoring is activated, if not both BI CBF bay–selective and CBF release are received within the time window t= limit value.
for t > **T–CBF–RELSup** (DA 6314/ZE)	Annunciation and blocking of the CBF CBF/BI–RELSup > T (**FNo 12/ZE**)
9. Cyclic check of the data transmission links (FO) between master unit and bay unit	Blocking of the protection system and annunciation after two recognitions of a transmission error. Flt.coup.mast. (**FNo 190/FE**)

---

1) If parameter **Isol Mal Resp = protection block(DA 6302)** is set, then the protection is blocked.

5 Installation instructions

Warning

The fault free and safe operation of the unit is subject to suitable transport, appropriate storage, mounting and installation. Warnings and instructions contained in the equipment manual must be observed.

In particular, the General Installation and Safety Regulations for work in electrical plant (e.g. DIN, VDE) must be observed. Non–observance can result in death, body harm or substantial damage.

5.1 Unpacking and repacking

The protection system, consisting of the master unit, the bay units and connection leads is packed in the factory such that the requirements of IEC 255–21 are fulfilled.

Unpacking and repacking must be performed with the usual care, without force and only with the aid of suitable tools.

The units must be visually checked to ensure that they have not been mechanically damaged.

5.2 Preparations

The operating conditions must be in accordance with VDE 0100/5.73 and VDE0105 part 1/7.83.

Caution

The modules of digital protection equipment contain CMOS circuits. These must not be withdrawn or inserted under live conditions! The modules must be handled with care so that any possibility of damage due to static discharges is prevented. When handling individual modules, the recommendations relating to the handling (of **e**lectrostatically **e**ndangered **d**evices) must be observed. In the installed condition the modules are not endangered.

5.2.1 Connection of the bay units in the bus coupler bay

Two bay units of the 7SS52 are allocated to a bus coupler. Both bay units are totally identical in their design and occupy 2 bays in the configuration scheme of the protection. The allocation does not depend on the number of current transformers (one or two) in the bus coupler. With only one current transformer in the bus coupler, the current inputs of both bay units are connected in series. (refer to Fig 5.1).

For the bay unit without current transformer, **DA XX04/ZE** has to be set to ”no CT existstent”.

The setting of the parameter **DA XX05/ZE** for the bus coupler bay with the current transformer is identical to that one of the feeder bays of the corresponding busbar.

If the current inputs are wired according to Fig 5.1, then the direction of the current has to be inverted for the bus coupler bay without current transformer. This can be done by means of parameter ”CT–POL” (**DA XX05/ZE**). The setting will be different to that one of the bay with current transformer.

An example can be seen in Fig 5.2.

The parameter ”current transformer ratio” (**DA XX06/ZE**) has to be set identical for both bus coupler bay units.

Recognition of the isolator status is carried out separately via the binary inputs of each bay unit.

For the mostly used version of a bus coupler with only one circuit breaker, the trip command and transfer trip contacts of both bay units must be connected in parallel.

In this case, the connection of further binary input functions (e.g. CBF initiation, CBF release, TRIP release, CB fail) has to be done in parallel.

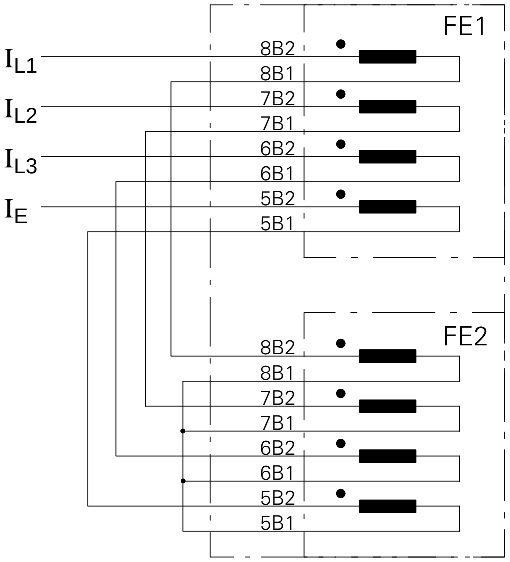


Figure 5.1 Connection of the current inputs of the bay units in bus couplers with only one current transformer

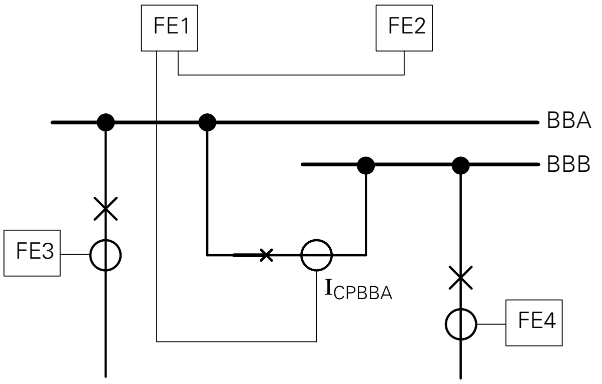
5.2.2 Installation and connection

5.2.2.1 Version for panel surface mounting (FE, ZE)

- The bay unit as well as the surface–mounted casing of the master unit are each fitted to the panel by 4 screws (dimension drawings can be seen in chapters 2.6.1 and 2.6.2)
- A solid low–ohmic and low–inductive operating earth has to be connected to the earthing point of the casings side–wall using a screw M4. Earth tapes according to DIN 72333 form A are suitable for this.
- Screw–type terminals are provided for the electrical connections. For the connection of the optical signals, fibre–optical cables with pre–fabricated FSMA plugs are used.

  The surface–mounted casing of the master unit has cable glands at the bottom side.

  They ensure the degree of protection of the casing and the strain–relief for the cables.



FE	Direct address	Setting
1	0105	line–side
2	0205	busbar–side
3	0305	line–side
4	0405	line–side

Figure 5.2 Example current transformer polarity

5.2.2.2 Bay unit for panel or cubicle flush mounting

- Open both inscription strips in the front cover, making accessible 4 elongated holes.
- Insert unit into the panel cutout or cubicle mounting frame and fix with four screws (dimension drawings are shown in chapter 2.6.1).
- Connect earthing screw at the unit's rear side with the protection earth of the panel or cubicle.
- A solid low–ohmic and low–inductive operating earth has to be connected to the earthing point of the casings rear wall using at least one screw M4. Earth tapes according to DIN 72333 form A are suitable for this.
- Make electrical connections via the snap–in or screw–type connection modules of the unit. Special care has to be paid to the designations of the snap–in connection modules.
- The fibre–optical connection is carried out by means of FSMA screw connections.

5.2.2.3 Subrack version of the master unit

- The subrack with degree of protection IP 20 is suitable for mounting in panels and cubicles.
- It is fixed from the front side by at least four screws. Make sure that the fixing flanges at both sides fully contact the surface (dimension drawings are shown in chapter 2.6.2).
- Connect earthing terminal on the casing's outside (refer to Fig 2.7) with the protection earth of the panel or cubicle.
- A solid low–ohmic and low–inductive operating earth via the earthing terminal is essential.
- Make electrical connections via the snap–in or screw–type connection modules of the unit. For the connection of the optical signals fibre–optical cables with pre–fabricated FSMA plugs are used.

  The FO cables have to connected in the sequence of the programmmed bay units. The marking system at the device's rear side supports the connection.

5.2.2.4 Cubicle version of the master unit

- For installation attention has to be paid to secure fixing of the cubicle to the floor.
- The cubicle must be solidly earthed low–ohmic and low–inductive. Earthing must be done by using the screw–type connection of the cubicle which is marked with the earthing symbol. In case of more than one cubicle, all cubicles must be connected solidly low–ohmic with each other.

5.2.3 Check of the nominal data

Matching of the nominal data of the units (FE and ZE) with the station data has to be checked. This applies in the first place to the auxiliary voltage and the current transformers' nominal current. The meaning of the ordering code is explained in chapter 1.2.

5.2.4 Matching of the control voltage for the binary inputs

When delivered, the binary inputs are configured for 220 V control voltage (no jumper fitted).

For each binary input of the module EFE of the bay unit or EAZ1 of the master unit, different switching thresholds can be selected by means of each 3 jumpers.

The voltage ranges may be selected for each binary input independent of the others.

The jumpers for setting the desired control voltage are listed in tables 5.1 and 5.2. Only one jumper may be fitted per binary input

Table 5.1 Control voltage for the binary inputs on the EFE (bay unit) in relation to the fitted jumper

	Nominal switching threshold			
Name	24 V	60 V	110 V	220 V
BI 1	X37	X36	X35	–
BI 2	X40	X39	X38	–
BI 3	X43	X42	X41	–
BI 4	X46	X45	X44	–
BI 5	X49	X48	X47	–
BI 6	X52	X51	X50	–
BI 7	X55	X54	X53	–
BI 8	X58	X57	X56	–
BI 9	X61	X60	X59	–
BI 10	X64	X63	X62	–
BI 11	X67	X66	X65	–
BI 12	X70	X69	X68	–
BI 13	X73	X72	X71	–
BI 14	X76	X75	X74	–
BI 15	X79	X78	X77	–
BI 16	X82	X81	X80	–
BI 17	X85	X84	X83	–
BI 18	X88	X87	X86	–
BI 19	X91	X90	X89	–
BI 20	X94	X93	X92	–

Table 5.2 Control voltage for the binary inputs on the EAZ1 (master unit) in relation to the fitted jumper

	Nominal switching threshold			
Name	24 V	60 V	110 V	220 V
BI 1	X31	X21	X11	–
BI 2	X32	X22	X12	–
BI 3	X33	X23	X13	–
BI 4	X34	X24	X14	–
BI 5	X35	X25	X15	–
BI 6	X36	X26	X16	–
BI 7	X37	X27	X17	–

For modifying the jumper selection, the module EFE has to be withdrawn from the casing of the bay unit (refer to Fig 2.3 on page 2 – 10).

First the auxiliary voltage has to be disconnected, then the unit’s front plate can be opened. Remove the front–side plug connector of the module EFE (refer to Fig 5.3) and withdraw the module.

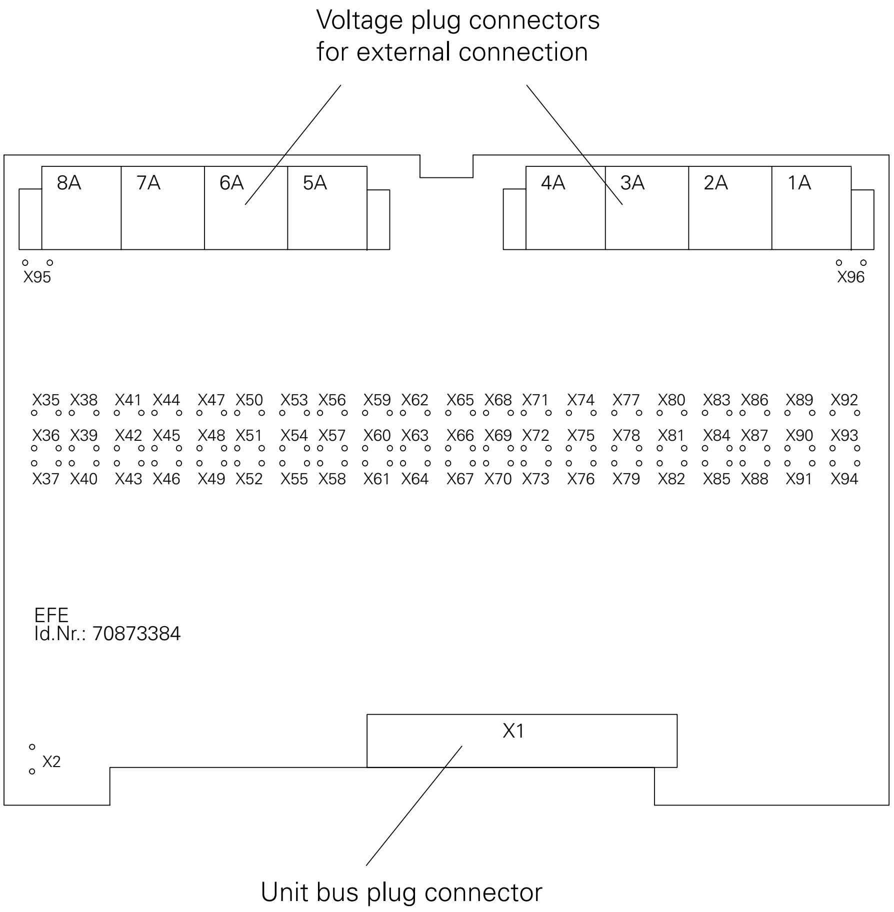


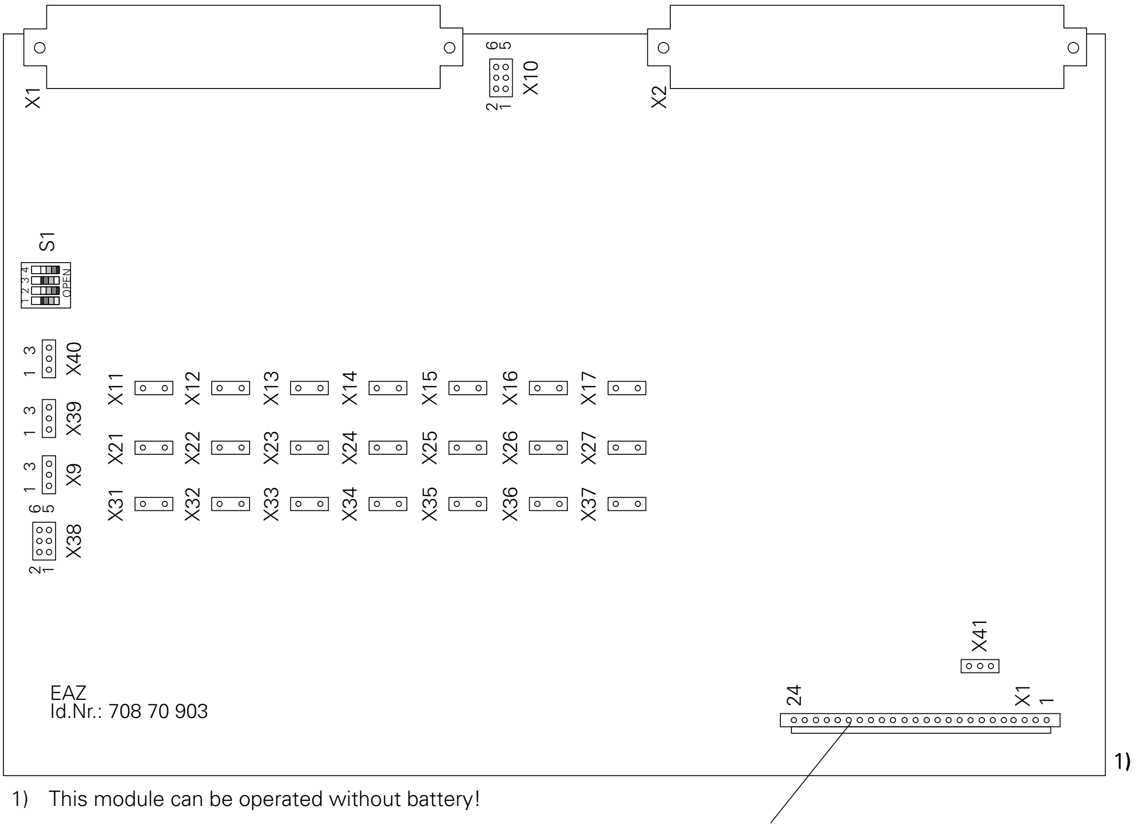
Figure 5.3 Location of the jumpers on the module EFE (bay unit)

For modifying the jumper selection, the module EAZ1 has to be withdrawn from the subrack (master unit).

Open the front plate. The mounting location of EAZ1 can be seen in Fig 2.2 on page 2 – 9.

The module may be withdrawn only after the auxiliary supply of the ZE was disconnected!

For withdrawing the module, remove the plug connector to the front plate and press down the locking bolt of the module at the bottom guide rail.



1) This module can be operated without battery!

Plug connector for LED control

Figure 5.4 Location of the jumpers on the module EAZ1 (master unit)

The switch S1 on this module is used for identification as EAZ1 or EAZ2. The corresponding setting can be seen in table A.9.4 in the annex.

5.2.5 Coding of the ZPS modules

The module ZPS is a component of the master unit. It can be used as master (ZPS–SBK) or slave (ZPS–BSZ or ZPS–SK) in the multi–processor system. The hardware configuration is unaffected by this selection. For an unequivocal definition of the task, the respective module is coded by means of switches.

The codes are listed in table A.9.3 (refer to annex). The location of the switches is depicted in Fig 5.5.

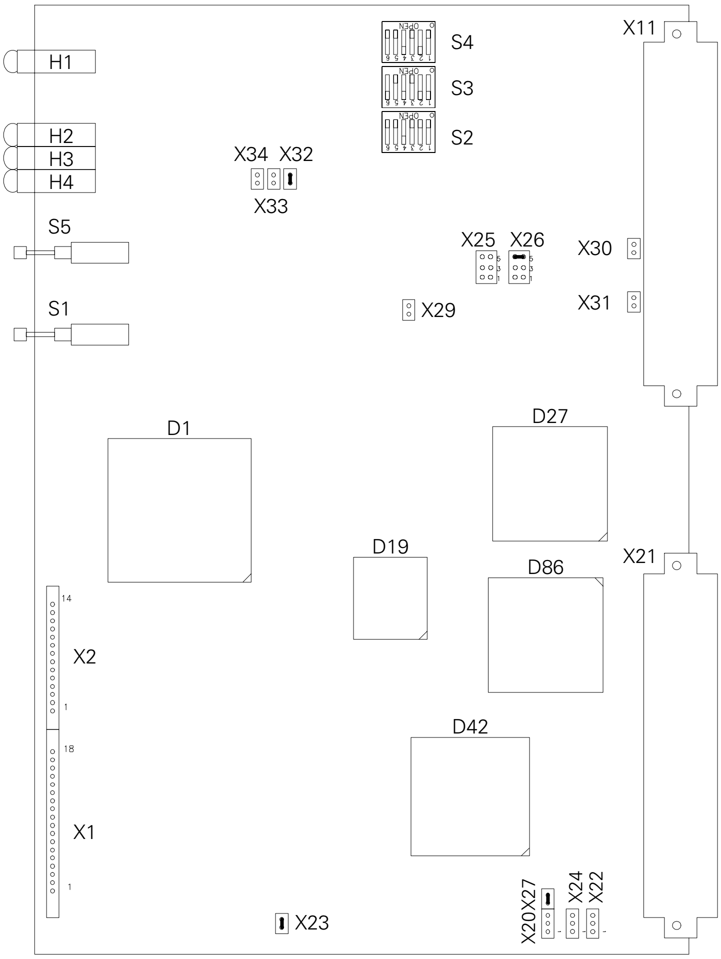


Figure 5.5 Location of the coding switches and jumpers on the module ZPS

It is recommended to verify the switch positions and jumpers before fitting the module. All settings are listed in tables A.9.2 and A.9.3 in the annex. The locations of the switches and jumpers are shown in Fig 5.5.

5.2.6 Checking the connections

Warning

The following checking procedure is partially performed in the presence of dangerous voltages. The procedures should only be performed by appropriately qualified personnel who are familiar with the safety regulations and safety precautions and follow these.

The connections are shown in annex A.1.4. The configuration options for the binary inputs are described in chapters 5.4 and 6.

Before switching on the protection system, all electrical and optical external connections have to be chekked for correct interface:

- Switch off the MCB for the DC supply in the power supply rack
- Check the continuity and correctness of all current transformer circuits against the plant and connection diagrams:

– Are the current transformers correctly earthed?

– Are the polarities of the current transformers connections consistent?

– Is the phase relationship of the current transformer consistent?

- Fibre–optical connections between master unit and bay units.

Attention

It must be ensured that each ZPS–SK module in the subrack is connected to an LMZ module.

- Check the tripping circuits through to the circuit breakers (no primary switching as yet).
- Check the control wiring to and from other devices.
- Check the signal circuits.
- Measure the auxiliary voltage at the cubicle terminals ; check its polarity and the polarity of the digital input connection.

  If connections are correct, then the auxiliary voltage MCB can be closed.

After the protection system has run up successfully, the disturbance indication (LED red) extinguishes and the operation indication (LED green) lights up on the master unit as well as on each connected bay unit.

5.3 Configuration examples

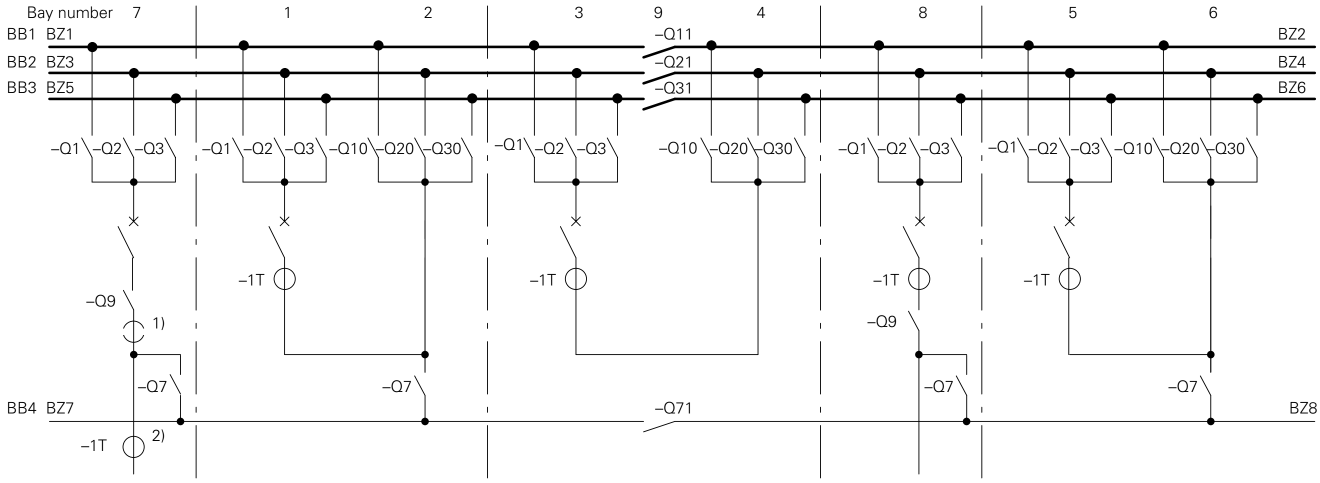
The 7SS52 can be used for protecting busbar configurations with up to 3 main busbars and one transfer (bypass) busbar or 4 main busbars and up to 48 bays. For configuration of the up to

- 12 busbar sections (including up to 4 transfer busbar sections) and
- 12 bus coupler sections

the busbar sections are numbered from left to right from 1 to 12 and the bus coupler sections from 13 to 24, beginning with the 1st main busbar up to the transfer busbar or 4th main busbar.

As an example, Fig 5.6 shows the configuration data for a triple busbar with transfer busbar. For each main busbar the number of corresponding busbar sections is parameterized (**DA 4900/ZE**).

A bus coupler section is a busbar section serving ex– clusively for coupling busbar sections and containing no feeders. They normally appear in combiantion with bus couplers. An example is shown in Fig 5.7.



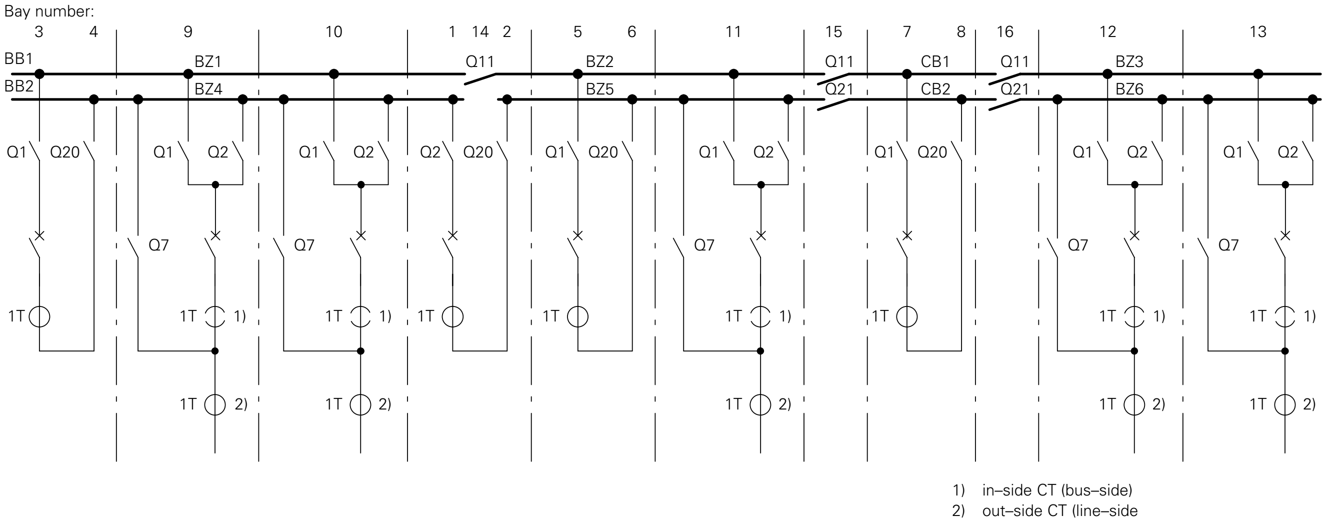
Configuration:

DA 5404	BB–ISOLAT4 = TB–Isolator
DA 4900	BB–configuration
DA 4901	BB01/BZ01
DA 4902	BB01/BZ02
DA 4903	BB02/BZ03
DA 4904	BB02/BZ04
DA 4905	BB03/BZ05
DA 4906	BB03/BZ06
DA 4907	BB04/BZ07
DA 4908	BB04/BZ08

1) in–side CT
2) out–side CT

Bay (XX)	**Type of bay**	**Designation**	**ISOL1: Axx (DA XX07)**	**ISOL2: Axx (DA XX08)**	**ISOL3: Axx (DA XX09)**	**ISOL4: Axx (DA XX10)**	**ISOL5: AXX (DA XX11)**	**CT location (DA XX04)**
01	Coupler	2.1	BZ1	BZ3	BZ5	non existent	non existent	BB–side
02	Coupler	2.2	BZ1	BZ3	BZ5	BZ7	non existent	no CT
03	Coupler	3.1	BZ1	BZ3	BZ5	non existent	non existent	BB–side
04	Coupler	3.3	BZ2	BZ4	BZ6	non existent	non existent	no CT
05	Coupler	5.1	BZ2	BZ4	BZ6	non existent	non existent	BB–side
06	Coupler	5.2	BZ2	BZ4	BZ6	BZ8	non existent	no CT
07	Outgoing feeder	1.0	BZ1	BZ3	BZ5	BZ7	existent	line–side
08	Outgoing feeder	4.0	BZ2	BZ4	BZ6	BZ8	existent	BB–side
09	Sectionalizer	3.2	BZ01/BZ02	BZ03/BZ04	BZ05/BZ06	BZ07/BZ08	non existent	no CT

Figure 5.6 Triple busbar with transfer bus (TB)



Configuration:

DA 5404	BB–ISOLAT4 = TB–Isolator (setting valid for TB and combi–bus operation)
DA 4900	BB–configuration
DA 4901	BB01/BZ01
DA 4902	BB01/BZ02
DA 4903	BB01/AB01
DA 4904	BB01/BZ03
DA 4905	BB02/BZ04
DA 4906	BB02/BZ05
DA 4907	BB02/AB02
DA 4908	BB02/BZ06

Bay (XX)	Type of bay	Desig–nation	ISOL1: Axx (DA XX07)	ISOL2: Axx (DA XX08)	ISOL3: Axx (DA XX09)	ISOL4: Axx (DA XX10)	ISOL5: Axx (DA XX11)	CT location (DA XX04)
01	Coupler	4.1	non existent	BZ4	non existent	non existent	non existent	BB–side
02	Coupler	4.3	non existent	BZ5	non existent	non existent	non existent	no CT
03	Coupler	1.1	BZ1	non existent	non existent	non existent	non existent	BB–side
04	Coupler	1.2	non existent	BZ4	non existent	non existent	non existent	no CT
05	Coupler	5.1	BZ2	non existent	non existent	non existent	non existent	BB–side
06	Coupler	5.2	non existent	BZ5	non existent	non existent	non existent	no CT
07	Coupler	8.1	AB1	non existent	non existent	non existent	non existent	BB–side
08	Coupler	8.2	non existent	AB2	non existent	non existent	non existent	no CT
09	Feeder	2.0	BZ1	BZ4	non existent	BZ4	non existent	line–side
10	Feeder	3.0	BZ1	BZ4	non existent	BZ4	non existent	line–side
11	Feeder	6.0	BZ2	BZ5	non existent	BZ5	non existent	line–side
12	Feeder	10.0	BZ3	BZ6	non existent	BZ6	non existent	line–side
13	Feeder	11.0	BZ3	BZ6	non existent	BZ6	non existent	line–side
14	Sectionalizer	4.2	BZ01/BZ02	non existent	non existent	non existent	non existent	no CT
15	Sectionalizer	7.0	BZ02/AB01	BZ05/AB02	non existent	non existent	non existent	no CT
16	Sectionalizer	9.0	AB01/BZ03	AB02/BZ06	non existent	non existent	non existent	no CT

Figure 5.7 Double busbar with combi–bus (AB)

The bays (bay units) can be configured as bus couplers, feeders or sectionalizers (**DA XX01/ZE**).

The number of bays in a station is defined by the first bay configured as ”non–existent” (**DA XX03/ZE**).

Depending on the size of the station, the hardware design of the master unit can be adapted in steps of 8 connections for bay units.

One bay unit is allocated to each feeder and each sectionalizer. The station configuration can include up to 4 bus couplers and 24 sectionalizers. Two bay units are allocated to each bus coupler.

For further explanations about connection and setting of the bus coupler bays please refer to chapter 5.2.1.

For configuration of the bays the following sequence is binding:

- Bus coupler bays before feeder bays before sectionalizers.

Up to 5 isolators can be connected to each bay unit. Isolators 1 to 3 are allocated to the busbar isolators. Isolator 4 can be configured as busbar isolator or transfer bus isolator, depending on the setting **DA 5404/ZE**.

Pre–requisite for protecting the transfer (bypass) bus or combi–bus is the line–side (out–side) location of the current transformer in the feeder bays (Fig 5.7) and release via parameter **DA 5401/ZE**.

The parameter ”CT location” (**DA XX04/ZE**) is evaluated only for transfer bus or combi–bus operation. For bus coupler bays, its setting has no influence on the protection function.

The parameter ”CT polarity” (**DA XX05/ZE**) offers the same setting options as the parameter **DA XX04/ZE**.

The setting is determined by the station–specific location of the current transformers. The CT polarity defines the direction of the current flow for evaluation in the protection program.

In Fig 5.7 the setting ”line–side” has to be selected for all feeder bays. The current transformer of the 1st bus coupler measures the current for bay 1. As a consequence, an identical CT polarity is selected in relation to the feeder bays. The virtual current transformer for bay number 2 is set in opposite direction ”bus–side” (refer also to chapter 5.2.1).

Isolators 1 to 4 can be used as sectionalizers, depending on the type of bay. In bay units of the type ”sectionalizer”, isolators 1 to 4 can only be used as sectionalizers. A maximum of 24 sectionalizers can be configured per station.

From each isolator, an auxiliary contact is wired to the bay unit for recognition of the OPEN–status and one auxiliary contact for the CLOSED–status.

The binary inputs BI 1 to BI 10 are pre–selected (refer to chapter 6.4.2.2). The LED indications allocated to the binary inputs are GREEN for the OPEN–status and RED for the CLOSED–status.

The functions can freely be allocated to the binary inputs as well as to the LEDs in the bay unit.

The isolators existing in each bay are identified by parameters **DA XX07** to **DA XX10/ZE**. The allocation of the isolators to the bus sections is done by the bus section number (refer also to chapter 6.2.3.3).

Isolator 5 is exclusively used as feeder isolator in the bay type ”outgoing feeder” and is configured via parameter **DA XX11/ZE**.

In the status ”bay out of service” all configured isolators of this bay are assumed by the 7SS52 to be OPEN. In case of bus coupler bays, this applies automatically for both bay units.

5.4 Marshalling possibilities

The binary inputs of the bay units and master units comprise:

1. isolator– CB status;
2. CB failure protection;
3. Bay out of service;
4. reset of indications (ZE und FE)
5. release of blockings (ZE)
6. memory functions (ZE)

The binary outputs comprise:

1. trip signals (FE)
2. alarms with associated LED indications. (FE and ZE)

Marshalling of alarms and indications is performed by means of the communcation programm DIGSI or the integrated keypad.

The preset configuration of the alarm relays and LEDs is described in chapter 6.

Table 5.3 Binary inputs and outputs

Inputs and outputs	Bay unit	Master unit
Alarm relay		
• marshallable	1	16 (32)[1]
• fixed	1	2
Command relay		
• marshallable	5	–
Binary inputs		
• marshallable	20	–
• fixed	–	7
LED indications		
• marshallable	16	16 (32)[1]
• fixed	2	2

1) hardware design of the master unit with EAZ 1 and EAZ 2

6 Operating instructions

⚠ **Warning**

All safety precautions which apply to work in electrical installations must be observed during testing and commissioning.

6.1 Setting the master unit

The master unit can be operated through the integrated keypad in a dialogue device–user. All parameters required for operation can be entered and all the information can be read out from here. Via the front serial interface, comfortable communication is possible using the PC–program DIGSI.

6.1.1 Integrated keypad/display panel

An LC display with 4 lines of 20 characters each plus background illumination is available for display.

During the dialogue, the upper line in the display field shows a four–digit number followed by a bar. This number represents the **setting address**, called the direct address (DA). The first two digits refer to the address block; this is followed by a two–digit address number.

The background illumination is switched on by operating any key. It is switched off automatically, when operation is interrupted for 10 minutes.

The keypad comprises 24 keys with the following meanings:

Numerical keys for the input of numbers:

0 to 9	Digits 0 to 9 for numerical inputs
.	Decimal point
+/–	Change sign key: input of negative numbers

Function keys for text parameters:

F1	Password: the master unit verifies the authorization of the operator by code word (not required for read–out of alarms)
F2	Backspace erasure of erraneously entered characters
F3	Yes–key: operator confirms the displayed question
F4	No–key: operator negates the displayed question or requests an alternative to the proposed function or value

Keys for scrolling in the display:

▶	Forwards scrolling: the display shows the next operating position
◀	Backwards scrolling: the display shows the previous operating position
▲	Forwards scrolling blockwise: the display shows the beginning of the next operation block
▼	Backwards scrolling blockwise: the display shows the beginning of the previous operation block

Confirmation keys:

ENTER	Enter key: – Confirmation of new data after modification – Acknowledge an LCD display

Control keys:

ESC	– Exit the fault buffer
LED	– Start LED indication test and – Reset the LED indications
MENU	Direct addressing: if the address number is known, then the operation address can be selected directly

6.1.2 Communication software DIGSI

The communication software DIGSI offers comfortable setting and monitoring of the protection systemwith a PC.

Connection between PC and master unit is done via the front–side operation interface.

Beside setting of the protection parameters and marshalling of alarms, the software DIGSI also allows analysis of the fault records which are stored in the protection.

6.1.3 Operating pre–requisites

For most operational functions, the input of a codeword (password) is necessary. This applies for all entries via operator keypad or operator interface which concern the following functions :

- setting of operational parameters (thresholds, functions),
- marshalling of alarms,
- system design parameters for station configuration.

The codeword (password) is not required for the read out of event list operational data, fault data and setting values (address blocks 61 to 67).

To indicate authorized operator use, press key ”F1”, enter the three–digit codeword (see below) and confirm with the ”ENTER” key. Codeword (password) entry can also be made retrospectively when an attempt to alter a parameter is responded to with the display ”NOT AUTHORIZED”.

Codewords:

1. ”123” – for changing parameter settings (address blocks 61 to 67)
2. ”987” – for changing system design parameters and parameter settings (address blocks 01 to 54 and 61 to 67)

```
Enter  Password:
@@@
```

```
Passw.  accepted
```

```
PASSWORD  WRONG!
```

The entered characters do not appear in the display, instead only a symbol @ appears. After confirmation of the correct input with”ENTER” the display responds with **PASSW. ACCEPTED**.

If the codeword is not correct, the display shows **PASSWORD WRONG**. Pressing the **”F1”** key allows another attempt at codeword entry.

If the codeword (password) is accepted, parameterizing can begin. In the following sections, each operational address is shown in a box and is explained.

6.2 Setting the protection

6.2.1 Introduction

For setting the operational parameters, it is necessary to enter the codeword (password) (see 6.1.3). The codeword is required in order to change the settings but not to read out the settings.

There are three types of display:

- Addresses without request for operator input
  The address is identified by the block number followed by 00 (e.g. **4000** for block **40**). Displayed text forms the heading of this block. No input is expected. By using keys▼ or ▲ the next or previous block can be selected. By using keys◀ or ▶ the first or last address within the block can be selected and the addresses stepped trough.
- Addresses which require numerical input
  The display shows the four–digit address, i.e. block and running number (e.g. **6104** for block **61**, running number **4**). The meaning of the parameter is displayed behind the bar. The second line shows the value of this parameter. When the relay is delivered a value has been preset. In the following sections these default values are marked. If this value is to be retained no other inputs are necessary. The next (or previous) parameter within the block or the next (or previous) block can be accessed by paging. If the value needs to be altered it can be overwritten using the numerical keys and if applicable the decimal point and/or the change sign (+/–) key. The permissible setting range is given next to the associated box. Values outside this range are rejected. The setting steps correspond to the last decimal place shown in the setting box. Inputs with more decimal places than permitted will be truncated down to the permissible number. The value must be confirmed with the enter key **"ENTER"** !

  The display then confirms the accepted value. The final transfer of the new parameter, however, occurs only after completion of the parameter setting process (refer below).
- Addresses which require text input
  The display shows the four–digit address, i.e. block and running number (e.g. **5102** for block **51** running number **2**).The meaning of the parameter is displayed behind the bar. The second line shows the text of this parameter. When the relay is delivered, a text has been preset. In the following sections these texts are marked. If it is to be retained no input is necessary. The next (or previous) parameter within the block or the next (or previous) block can be accessed by paging. If the text is to be changed, then this is performed by the "No"–key **"F4"**. One of the alternative choices which are tagged to the display boxes in the following sections then appears. If the alternative text is not desired, the **"F4"** key is pressed again, etc. The alternative which is chosen is confirmed with the enter key **"ENTER"**.

The following sections include the parameterizing of all setting values with explanations. The arrows▲▼ and ◀ ▶ next to the display boxes indicate the method of moving from block to block or within a block. If the meaning of a parameter is unclear it is usually best to retain the preset value. Addresses not in use are skipped (passed over).

If the parameter address is known then direct addressing is possible. This is achieved by depressing key **"MENU"**, followed by the four–digit address and subsequently pressing the enter key **"ENTER"**. After direct addressing, paging by means of keys ▲▼ and ◀ ▶ is possible.

The parameterizing process can be ended at any time by depressing one of the keys ▲▼which changes the parameter block. The displayed question "CHANGE COMPLETED?" is then answered with the Yes–key **"F3"**

In general, the question as to the completion of parameterizing appears each time a new block is chosen. If further parameters are to be changed the question should be answered by pressing the No–key **"F4"** .

After completion of the parameterizing process, the changed parameters which so far have only been stored in volatile memories are then permanently and securely stored in EEPROMS.

Note

The keypad which is integrated in the master unit lends itself well for setting, modifying and display of selected direct addresses. For the initial setting of the protection system or for modification of a larger number of parameters, communication via PC with the program DIGSI yields higher comfort and efficiency.

6.2.2 Initial displays – blocks 00 and 01

When the protection unit is switched on or the operator terminal is connected, firstly the **DA 0000/ZE** and the type identification of the unit is displayed.

▲▼

```
0000 7SS52 V1.50
```

The unit introduces itself with its type number and the version of firmware with which it is equipped.

From **DA 0100/ZE** onwards the design data begin.

▲▼

```
0100 DESIGN DATA:
Config. Bay 01?
```

Beginning of the design data block

6.2.3 Station lay–out data

Design data is mainly plant specific data which requires no change during normal service.

This group comprises station configuration, number of existing bays, CT ratios and polarities, type of feeder (bus coupler, outgoing feeder, sectionalizer).

6.2.3.1 Reading–out of design data

Reading–out of design data is accessed with codeword (password) either by paging or by direct addressing.

6.2.3.2 Changing of station data

As with the parameters, this data can be changed individually or as a complete block. The changing procedure is characterised by:

1. The codeword for reading–out and changing is ”987”
2. After the completion of the changes a re–start is initiated

6.2.3.3 Station configuration – block 01

The protected station configuration is programmed by design data

---

▲▼
```
XX00 DESIGN DATA:
Config. Bay XX?
```

Beginning of the block for bay XX

▶◀
```
XX01 TYPE:BXX
=feeder bay
```

Type of feeder
= Coupler
= Feeder Bay
= Section–Isolat

Bays 1 to 48 in the 7SS52 are treated separately if a bus coupler is present. Per station, a maximum of 4 bus couplers and 24 sectionalizers is permissible.

The following software–related convention must be observed:

Bus coupler before feeder before sectionalizer.

▶◀
```
XX02 DESIGNA:BXX
=YY.0
```

Bay position number
Bay (YY) in which the feeder is located

smallest value: **0.0**
highest value: **99.9**

▶◀
```
XX03 BAY STA :BXX
=existent
```

Bay setting

= existent
= non–existent

The system software is designed such that if one feeder is parameterized as ”non–existent” all further feeders are ignored (i.e. the other feeders are regarded as non–existing).

Therefore, it is necessary to parameterize the feeders without gaps.

The number of ZPS–SK–modules is determined by the number of bays (bays of the type ”sectionalizer” are not considered) (8 bays per ZPS–SK).

A bus coupler occupies two consecutive bays.

◀▶
```
XX04 CT LOC:BXX
=line side
```

Current transformer mounting location

= line side
= bus side
= non–existent

In plants with bypass (transfer) busbar, the current transformers are arranged either on the busbar side or on the line side of the feeder isolator (Q9). The setting must be made appropriately. Since this parameter is only important for stations with bypass busbar it can be ignored for stations without bypass busbar (refer to chapter 5.3).

```
◀ XX05 CT POL:BXX
▶ =line side
```

Current transformer starpoint

= line side
= bus side

This parameter considers the polarity (earthing of CT starpoint).

```
◀ XX06 CT NORM:BXX
▶ =1.000
```

Current transformer ratio (normalizing factor)

minimum setting: **0.001**
maximum setting: **1.000**

This parameter is used to match the different CT ratios.

The basis for the setting is the CT with the highest transformation ratio.

This CT is given the setting value 1. The ratios of the CTs of the other feeders are matched to this CT and set accordingly.

Example:

Feeder no.	CT ratio	Normalizing factor (xx06)
1	500/1	0,500
2	300/1	0,300
3	500/1	0,500
4	600/1	0,600
5	400/1	0,400
6	1000/1*	1,000

* reference CT

A maximum of 5 isolators (ISOL.1 to ISOL.5) can be assigned per bay. Isolators ISOL.1 to ISOL.4 of a feeder and a bus coupler can be configured as busbar isolators (**DA xx07/ZE – DA xx10/ZE**). Isolator ISOL.4 can be configured depending on the setting in **DA 5404/ZE** as busbar isolator or transfer–bus isolator.

The isolators ISOL.1 to ISOL.4 are allocated to one or two of the bus sections BZ01 to BZ12 or bus coupler sections CS01 to CS12.

```
◀ XX07  BB–ISO1:BXX
▶ =on  BZ01
```

Legend:
BZ = Bus zone
ISO = Isolator
CS = Bus coupler section (sections which serve exclusively for coupling of the bus sections; they have no feeder bays)

Allocation of the feeders to the bus sections or bus coupler sections:

Input:		display indication:
0	≙	not existing
1 to 12	≙	connected to BZ01 to BZ12
13 to 24	≙	connected to CS01 to CS12
1.2 to 23.24	≙	sectionalizer at BZ01/BZ02 to CS11/CS12
101 to 124	≙	at BZ01 ”CLOSED2 to CS12 ”CLOSED”
101.2	≙	at BZ01/BZ02 ”CLOSED”
123.24	≙	at CS11/CS12 ”CLOSED”

minimum setting: **000.00**
maximum setting: **124.24**

Isolator sections are indicated separately behind the decimal point.

Additional programming defines whether the isolator status is allocated to digital inputs of the bay unit (FE) or assumed to be ”CLOSED” (CLOSED–simulation).

The configuration for CLOSED is done by adding a leading ”1” (before the first bus zone) with the input (e.g. 102 ≙ at BZ02 ”CLOSED”, 115 ≙ at CS03 ”CLOSED”, 103,07 ≙ at BZ03/BZ07 ”CLOSED”).

```
◀ XX08  BB–ISO2:BXX
▶ non  existent
```

identical to ISO1

```
◀ XX09  BB–ISO3:BXX
▶ non  existent
```

identical to ISO1

```
◀ XX10  BB–ISO4:BXX
▶ non  existent
```

identical to ISO1

Isolator ISO.4 can be configured depending on the setting in **DA 5404/ZE** as bus isolator or transfer bus (TB) isolator.
To start TB operation, the corresponding setting (**DA 5401/ZE und 5404/ZE**) is valid exclusively for ISO.4.

```
◀ XX11  BB–ISO5:BXX
▶ non  existent
```

Recognition of the feeder isolator status
(applies only to bay type ”outgoing feeder”)

= non existent
= existent

6.2.3.4 Common data station configuration – block 54

▲▼
```
5400 DESGN DATA:
Common configur?
```

Beginning of the block for common configuration data

►◄
```
5401 PROT TR BUS
=blocked
```

Selective protection for bypass (transfer) busbar

= released (this setting is sensible only for configurations with outside CT's, see also section 4.5.5)

= blocked

◄►
```
5402 BAY DC FAIL
=OLD isol status
```

Treatment of isolator status in the event of auxiliary voltage failure for isolator status

= OLD isol status

= Isol CLOSED

◄►
```
5403 ISOL ST 1/1
=OLD isol status
```

Treatment of isolator status for "Signals for isolator status CLOSED/OPEN on simultaneously"

= OLD isol status

= Isol CLOSED.

◄►
```
5404 BB-ISOLAT 4
=BB-Isolator
```

Configuration of isolator ISOLAT4

= BB–Isolator (busbar isolator)

= TB–Isolator (transfer bus isolator)

6.2.3.5 Configuration of the busbar – block 49

For the purpose of performing the configuration of the busbar in a clear and effective manner, the application of the communication program ”DIGSI” is recommended.

The 7SS52 is designed for a maximum of 12 bus sections (protection zones) BZ1 to BZ12 (incl. a maximum of 4 transfer bus sections).

Figures 5.6 and 5.7 show two different busbar configurations with their corresponding design data as examples.

In addition, a maximum of 12 bus coupler sections CS1 to CS12 (sections which serve exclusively for coupling of busbar sections) can be configured (CS1 to CS12 may not contain feeder bays).

For configuration (entering data) the bus zones are counted consecutively from left to right, starting with the first main bus up to the transfer bus or the fourth main bus, from 1 to 12. In the same way the coupler sections are counted from 13 to 24. For each main bus the number of corresponding bus sections and coupler sections is defined.

```
▲ 4900 CONFIGURAT:
▼ =BB–Configurat.?
```

```
▶ 4901 BB/BZorAuxZ
◀ =BZ01/BZ01
```

```
▶ 4902 BB/BZorAuxZ
◀ =non existent
```

to

```
▶ 4924 BB/BZorAuxZ
◀ =non existent
```

Parameters **DA 4901/ZE** to **DA 4924/ZE** are only utilized by the communication software DIGSI and have no influence on the protection function. DIGSI allows a graphical display of the plant configuration based on the input data.

Input:		display indication
0	=	non existent
1 – 4.01 – 12	=	BB01 to BB04/BZ01 to BZ012
1 – 4.13 – 24	=	BB01 to BB04/AB01 to AB12

minimum setting: **0.00**
maximum setting: **4.24**

The maximum plant configuration contains 4 main busbars,12 bus sections und 12 bus coupler sections.

Legend:

BB (main busbar number) = 01 to 04

BZ (bus zone number) = 01 – 12

AUXZ (coupler section number) = 13 – 24

6.2.3.6 System data

▲▼
```
5000 CHANGE
SYST/DESGN DATA?
```

▶◀
```
5100 SYST.DATA:
System state ?
```

Note:
The configuration data **DA 5101; 5103; 5106; 5107 and 5108/ZE** are pre–set by the manufacturer. Under normal conditions they need not be changed.

▶◀
```
5101 REBOOT
=blocked
```

Initial software loading (only for diagnostic purposes)
= blocked
= released (initial program loading is to be performed – after reboot, function has to be blocked again)

▶◀
```
5102 LED COL ISO
=red for CLOSED
```

Change of the islator status interpretation for the protection processing in all bay units.
= red for CLOSED (and green for OPEN)
= green for CLOSED (and red for OPEN)
(Attention!
Modification of the ex–works–settings only for test purpose)

▶◀
```
5103 FAULT RESPO
=released
```

Unit response to system fault (infinite loop operation)
= released (unit blocked and in monitor state)
= blocked (unit operating despite system fault – only permissible for testing and fault finding)

▶◀
```
5104 AUT LED ACK
=blocked
```

Automatic acknowledgement of LED indications
= blocked (The LED status is stored. Reset by digital input or operator panel)
= released (All LED indications are updated with each new TRIP–command)

▶◀
```
5105 FREQUENCY
=50 HZ
```

Setting of the system nominal frequency
= 50 Hz
= 60 Hz

▶◀
```
5106 I>SUM SUPV
=.50 I/IN
```

Limit value for measured value supervision
(Plausibility check in the bay units)
(I_N: nominal current of bay CT)

minimum setting: **0.20**
maximum setting: **1.00**

```
▶ 5107 OFFSET SUPV
◀ =0.10 V
```

Limit value for 0 V (Offset) supervision of the analog/ digital converter in the bay units

minimum setting: .... **0.00** V
maximum setting: .... **0.50** V

```
▶ 5108 15 V SUPV
◀ =1.50 V
```

Limit value for 15 V–auxiliary voltage supervision in the bay units

minimum setting: .... **0.00** V
maximum setting: .... **2.50** V

```
▶ 5200 SYST.DATA:
◀ Serial link ?
```

Setting for the serial interface

```
▶ 5201 TERMBAUD CU
◀ =19200 Baud
```

Baud rate for data exchange between master unit and PC

minimum setting: .... **1200** Baud
maximum setting: .... **38400** Baud

```
▶ 6316 FLTREC RELE
◀ =automatic
```

Refreshing the fault buffer

= automatic

Always the last fault record is stored and available for read–out. A previously stored fault record is overwritten

= manual

After storing two fault records, the fault recording function remains blocked until released by operation **DA 8300/ZE** or binary input (>fltrec rele.). If released, both buffers are erased irrespective of their contents.

```
▶ 6317 RELE BOS BU
◀ =released
```

Control facility ”bay out of service”

= blocked
= released

The bay–selective control facility ”bay out of service” can be released from the master unit for all bay units by binary input or by operation.

When set to ”blocked”, an attempt to take a bay out of service locally at a bay unit will be inhibited with the indication ”NOT PERMISSIBLE”.

6.2.4 Settings

All operational parameters which start with address 6XXX are settings and can be read out and changed during normal operation. After completion of the parameter changing process, a restart is initiated.

Read–out of parameters can be performed without the input of a codeword either by paging or by direct addressing. The address selection is supported by function keys.

Changing of parameters can only be done after the codeword "987" has been entered.

6.2.4.1 Settings for the busbar differential protection

The busbar differential protection represents the main function of the 7SS52.

6.2.4.1.1 Settings for the pick–up characteristic – block 61

The parameters for the pick–up characteristic consist of

1. differential current limit I > Diff and
2. stabilizing factor STAB FAC.

These values can be set individually for the bus–section specific protection and the check zone.

```
▲ 6000 CHANGE
▼ SETTINGS ?
```

```
▲ 6100 SETTINGS:
▼ BB–Diff.Protec?
```

```
► 6101 STAB.FAC:BZ
◄ =0.65
```

Stabilizing factor for the bus–section specific protection (common for all buses)

minimum setting: **0.10**
maximum setting: **0.80**

```
► 6102 I>DIFF:BZ
◄ =1.00 I/Ino
```

Diff–current limit for the bus–section specific protection (common for all buses)

minimum setting: **0.20**
maximum setting: **4.00**

I_{no}: normalized nominal current referred to the base CT (CT with the highest transformation ratio, see also parameter **DA 6105/ZE**)

```
6103 STAB.FAC:CZ
=0.50
```

Stabilizing factor for the check zone

minimum setting: **0.00**
maximum setting: **0.80**

```
6104 I>DIFF:CZ
=1.00 I/Ino
```

Diff–current limit for the check zone

minimum setting: **0.20**
maximum setting: **4.00**

```
6105 NORM BAS IN
=400.0 A
```

Nominal current of the basic CT (≙ reference val. I_{no}).

This parameter is the normalizing factor for setting the differential current thresholds and the differential current supervision thresholds.

minimum setting: . . . . **20.0** A
maximum setting: . . . . **3000.0** A

```
6106 TRIP EXTEND
=0.10 s
```

TRIP command extension

The TRIP command extension time is started by the TRIP command.

The TRIP commands of all bays are extended to the set time as a minimum.

The TRIP command is reset only after the set time has elapsed and the current sensor of the bay has dropped off.

minimum setting: . . . . **0.02** s
maximum setting: . . . . **1.00** s

```
6107 BI TRIPENAB
=non existent
```

Binary input ”feeder–selective TRIP release for busbar short–circuit (refer to chapter 4.7.1.1)

= non existent
= existent

```
6108 T-CB OPEN
=0 s
```

Time delay for special treatment of the currents in the coupler bay

minimum setting: . . . . **0.00** s
maximum setting: . . . . **1.00** s

In order to detect faults in the dead zone, the OPEN status of the bus coupler circuit breaker is used.

The special treatment of the currents in the coupler bay applies only after the set time delay has elapsed (refer to chapter 4.7.3.2).

6.2.4.1.2 Settings for the differential current supervision – block 63

The parameters for the differential current supervision consist of:

1. Diff–current limit I > SUPERV and
2. T–SUPERV (time delay, after which blocking becomes effective).

The current limits can be set individually for the bus–section specific protection and the check zone. The time delay is common to all.

```
▲ 6300 SETTINGS:
▼ Supervision ?
```

Start of the block ”supervision parameters”

```
▶ 6303 DIFF SUPERV
◀ =active
```

Differential current supervision function
= active
= inactive

The differential current supervision must be switched on during normal service. Disconnection is only intended for testing purposes (e.g. checking the pick–up characteristic).

```
▶ 6304 T-DIFF sUPV
◀ =2 s
```

Time delay for blocking of protection or alarm

minimum setting: .... **1** s
maximum setting: .... **10** s

```
◀ 6305 I>SUPERV:BZ
▶ =0.10 I/Ino
```

Differential current limit for the bus–section specific protection

minimum setting: .... **0.05** I/I_{no}
maximum setting: .... **0.80** I/I_{no}

```
◀ 6306 I>SUPERV:CZ
▶ =0.10 I/Ino
```

Differential current limit for the check zone

minimum setting: .... **0.05** I/I_{no}
maximum setting: .... **0.80** I/I_{no}

```
▶ 6307 DIFF SUP BZ
◀ =alarm only
```

Reaction for pick–up of the bus–section specific differential current supervision (refer to chapter 4.7.8.3)
= alarm only
= Block w aut rel (Blocking with automatic release)
= Block. w. store (Blocking with storage)

```
▶ 6308 DIFF SUP CZ
◀ =alarm only
```

Reaction for pick–up of the differential current supervision for the check zone (refer to chapter 4.7.8.3)
= alarm only
= Block w aut rel (Blocking with automatic release)
= Block w store (Blocking with storage)

6.2.4.2 Settings for the circuit breaker failure protection – blocks 62, 66 and 67

```
▲ 6200 SETTINGS:
▼ Bkr.Fail Protec?
```

```
▶ 6201 BF BI MODE
◀ =1–chanelWithSup
```

Selection of the type of supervision of the CBF start (refer to chapter 4.7.8.5)

= 1–chanel no sup

= 1–chanel with sup
(feeder–selective supervision of the signal duration)

= 2–chanel no sup
(additional supervision of the CBF–release signal.)

= 2–chanel with sup

```
▶ 6600 SETTINGS:
◀ I>BF OpMode 01–48
```

Parameter block for feeder–selective setting of the circuit breaker failure operation mode

```
▶ 66XX BF OPMD:BXX
◀ =BZ unbalance
```

Setting address of the CBF operation mode for feeder XX (1 to 48)

= non existent
= TRIP fr ext CBF (TRIP from external circuit breaker failure protection)
= unbalance
= TRIP rep/unb (TRIP repetition with following unbalancing)
= I> sensor
= TRIP rep/I> sens (TRIP repetition with current sensor)
= TRIP/UNB pulse (TRIP repetition with following unbalancing by pulse)

The operation modes are explained in chapter 4.6.1.

```
6202 STAB FAC:BF
 =.50
```

Stabilizing factor for the differential protection principle with CBF mode of operation set to ”unbalance”, ”TRIP rep/unb” and TRIP/UNB pulse”

minimum setting: **0.00**
maximum setting: **0.80**

```
6203 I>DIFF :BF
=2*I>BF (DA 6700)
```

Differential current threshold with CBF mode of operation set to ”unbalance”, ”TRIP rep/unb” and TRIP/UNB pulse”

The setting value is defined by the feeder–selective parameter **DA 67XY** (current limit value for recognition of breaker failure).

The parameters **DA 6202/ZE** and **DA 6203/ZE** are identical for both the bus–section specific protection and the check zone protection.

```
6204 TIME UNB BF
=.25 s
```

Time delay for circuit breaker failure processing

minimum setting: . . . . **0.05** s
maximum setting: . . . . **1.00** s

```
6205 T-BF IMPULS
=.50 s
```

Time delay for the three–phase TRIP repeat command after external breaker failure initiation (mode of operation TRIP/UNB pulse)

minimum setting: . . . . **0.05** s
maximum setting: . . . . **1.00** s

```
6206 T-CB FAULT
=.10 s
```

Time delay after external initiation of breaker failure protection and signalling >CB fail (**FNr. 7028/FE**) instead of ”T–CBF” (**DA 6204/ZE**).

minimum setting: . . . . **0.00** s
maximum setting: . . . . **1.00** s

```
6207 TR REPOPMOD
=single-phase
```

Operation mode of TRIP repetition for single–phase initiation
= single–phase
= three–phase

```
6208 T-TRIP REP
=.12 s
```

Time delay for ”Trip repeat”

minimum setting: . . . . **0.00** s
maximum setting: . . . . **1.0** s

```
▲ 6700 SETTINGS:
▼ I>BF Bay 01-48?
```

Start of the block for feeder–selective setting of the current threshold for recognition of breaker failure and for command reset

```
▶ 67XX I>BF BAY XX
◀ =.50 I/IN
```

Setting address of the current threshold for recognition of breaker failure in feeder XX (1 to 48)

minimum setting: . . . . **0.10** I/I_N
maximum setting: . . . . **2.00** I/I_N
$I_N \hat{=}$ Nominal current of the feeder CT

6.2.4.3 Settings for the supervisory functions – block 63

The parameters for this function can be divided into four groups:

1. Supervision of the breaker failure protection release (refer to chapter 4.7.8.5)
2. Isolator supervision (see chapter 4.7.8.4)
3. Supervision function for the linearized current transformers (refer to chapter 4.7.8.7)
4. Supervision function from the internal cyclic tests (see chapter 4.7.8.8)

```
▲ 6300 SETTINGS:
▼ Supervision ?
```

6.2.4.3.1 Settings for breaker failure protection supervision

```
▶ 6314 MON T BF CI
◀ =1.00 s
```

Supervision time for the signal duration of the CBF release

minimum setting . . . . **0.02** s
maximum setting: . . . . **10.00** s

```
▶ 6315 FLT T BF CI
◀ =.06 s
```

Time delay after which the CBF release signal is analysed

minimum setting: . . . . **0.06** s
maximum setting: . . . . **1.00** s
(refer to chapter 4.7.8.5)

6.2.4.3.2 Settings for isolator supervision

```
6301 ISO TRA TIM
=7.00 s
```

Isolator operating time

minimum setting: .... **1.00** s
maximum setting: .... **180.00** s

```
6302 ISO MAL RES
=alarm only
```

Protection response for isolator mal–function (supervision criteria: running time, breaker faulty and auxiliary voltage failure)

= alarm only
  ("ISOyFlt:Axx", "ISOyFlt run:Axx" or "Aux voltflt:Axx").
= Block w aut rel (Blocking with automatic release)

Upon recognition of an isolator failure, the protection is blocked and the failure is signalled.

Blocking is automatically cancelled when the isolator failure no longer persists

= Block w store (Blocking with storage)
  Upon recognition of an isolator failure, the failure is signalled and the protection is blocked. Blocking is cancelled only when the failure does not exist any longer and the blocking is acknowledged via operation (**DA 8600/ZE**) or via binary input "BlISOFltRel" (**BE5/ZE)**.

6.2.4.3.3 Settings for linearized current transformers

```
6309 ZERO CR SUP
=active
```

Zero crossing supervision
= inactive
= active

After an external fault has been switched off by an external protection device, a demagnetizing DC component may be present in linearized CT's (TPZ–cores), which resembles an internal fault.

In order to avoid unwanted tripping, the differential current can be monitored to detect a plain DC component. Release of the zero crossing supervision is a prerequisite.

```
6310 I>ZERO CR
=.50 I/Ino
```

Threshold of the differential current for checking the current zero crossing

minimum setting: .... **0.20** I/I_{no}
maximum setting: .... **4.00** I/I_{no}

The DC monitoring is performed for each measuring system. The differential current is compared with the set threshold . For the selective protection zones and the check zone, a common limit can be parameterized. Tripping is blocked, unless the measured value falls below the limit within a fixed time. The status is indicated. Blocking is maintained until the measured value falls below the limit. (refer to chapter 4.7.8.7).

6.2.4.3.4 Settings for protection and circuit breaker test

▶◀
```
6311 AUTO TEST
=active
```

Cyclic testing (refer to chapter 4.7.8.8)
= active
= inactive

Testing must be operative during normal service, disconnection is only permissible for testing purposes.

▶◀
```
6312 TEST FAULT
=alarm only
```

Response for pick–up of the cyclic tests
= alarm only
= block prot.

After failure clearance, the protection blocking can be released via **DA 8600/ZE** or the protection system is reactivated by restart.

▶◀
```
6313 I<MAN TRIP
=.05 I/IN
```

Current threshold for performing the circuit breaker test (refer to chapter 4.7.5.1)

minimum setting: . . . . **0.00** I/I_N
maximum setting: . . . . **0.50** I/I_N

6.2.4.4 Settings for the overcurrent release of the TRIP command – block 65

▲▼
```
6500 SETTINGS:
I>TripBay 01-48?
```

This parameter prevents the trip signal to be issued unless the current in the bay has exceeded the set limit value.

The setting is referred to the respective CT ratios.

If ”0” is set for a bay, then tripping occurs regardless of bay current.

▶◀
```
65XX I>TRP BAY XX
=.00 I/IN
```

Current limit value for bay XX (01 to 48)

minimum setting: . . . . **0.00** I/I_N
maximum setting: . . . . **25.00** I/I_N

6.2.5 Operational control features

During normal service of the station protection, it may be desirable to influence the device temporarily. An example may be to take a bay out of service during maintenance work.

This taking out of service can be performed at the bay unit via binary input or at the bay unit or master unit via operation.

6.2.5.1 Binary inputs

The input/output module EAZ1 has 7 binary inputs (BI 1 – 7).

The binary inputs have fixed allocations.

Table 6.1 Allocation of the binary inputs

Binary inputs	Short text	Logical function
1	>LED acknowl	LED acknowledgement
2	>Flt rec freeze	Freeze in fault record buffer (generate fault record)
3	>Flt rec rel	Release fault record buffer (erase the stored fault records)
4	>BloDifSup rel	Release blocking after pick–up of differential current supervision
5	>BloISO Flt rel	Release blocking after isolator failure
6	>Eventbuf erase	Erase contents of the operations and fault record buffer
7	free	

`>Release flt rec`

The binary input erases stored fault records. New fault records can now be stored.

`>Flt rec freeze`

The binary input generates a fault record. Pre–fault and post–fault times here refer to the binary signal input.

`>Blo Dif Sup rel`

The binary signal releases the protection which had been blocked by the differential current supervision.

This function is active only when the parameters **DA 6307/ZE** and/or **DA 6308/ZE** are set to ”blocking with storage”.

`>BloISO Flt rel`

The binary input causes release of the protection blocking initiated by isolator failure.

This function is only active if the parameter **DA 6302/ZE** is set to ”Blocking with storage”.

6.2.5.2 Taking bays out of service – block 64

▲▼
```
6400 SETTINGS:
StatusBay 01-48?
```

Alternative to control via binary inputs, each bay can also be taken out of service via parameterizing.
The correct codeword (password 987) must be entered in order to parameterize the status of a bay to ”inactive” for ”out of service”

▶◀
```
64XX STATUS B XX
=active
```

Bay–selective parameter for taking bays XX (01 to 48) out of service
= active
= inactive

6.2.5.3 Test and control functions

▲▼
```
8000 CONTROL /
TEST ?
```

The following tests can be started via the master unit’s keypad or via PC. Activation of the tests is done with a dialog.

▲▼
```
8100 TEST:
Auto testing ?
```

For protection testing, a test routine is started, which covers the complete protection system from measured value acquisition up to the trip circuits.

This test is useful only when the cyclic protection test is switched off (**6311/ZE**).

Start the test by depressing the YES key ”F3”

```
PLEASE WAIT !
```

After successful test performance, the protection test is automatically switched off.

```
AUTO TESTING:
=executed, all ok
```

In case of detection of faults, the event is recorded in the fault buffer and in the operations events buffer. The display shows the text ”Fault ! → alarm”.

Reading out and interpreting the fault buffer is described in chapter 7.2.5.

A circuit–breaker trip test can be performed.

The pre–requisite for trip testing is:

- that the respective bay must be taken out of service (see Section 4.7.5.2).
- feeder current < I < CB–TEST (**DA 6313/ZE**)
- no TRIP command was generated by the ZPS–BSZ1 (CZ).

The third condition is not fulfilled with busbar short–circuit nor with pick–up of the differential current supervision.

The CB test command is reset after a fixed time of 5 s.

```
▲ 8200 TEST:
▼ Manual trip ?
```

Answer with YES key"F3" if circuit–breaker testing should be performed, otherwise proceed with ▲ ▼.

```
MAN TRIP
BAY.PH?
```

Request to enter the bay number and the phase, e.g. input "4.2" (bay 4, phase L2). The input has to be concluded with the "ENTER" key.

A three–phase test is performed if only the bay number is indicated.

```
bay in service !
```

Prior to performing a CB test, the corresponding bay must be taken out of service (e.g. via **DA 6404/ZE**).

```
MAN TRIP BAY.PH?
=04.L2?
```

The inscription appears after entering the bay number and phase number, as well as bay out of service "F3"
Interrupt with NO key "F4"

```
MANUAL TRIP
=executed !
```

If test was successful.
Otherwise the following text appears:

= TEST repeat
= Bay non exist

```
▲ 8300 CONTROL:
▼ ReleasFltRecBuf?
```

The fault record function is activated. With the release command, the fault record buffer is ready for recording measured values of a subsequent fault.

If two fault records are stored, both will be erased.

This command is executed by depressing key "F3".

```
RELS FLT REC BUF
=executed !
```

Confirmation

```
▲ 8400 CONTROL:
▼ FreezeFltRecBuf?
```

Answering this question with key ”F3” generates a fault record. Pre–fault and post–fault time periods refer to initiation via keypad or the program DIGSI.

```
FREEZFLT REC BUF
=executed !
```

Confirmation

```
▲ 8500 CONTROL:
▼ ReleasBloDifSup?
```

The busbar protection which was blocked by pick–up of the differential current supervision, can be released by this parameter.

This control is useful only if the parameters **DA 6307/ZE or 6308/ZE** were set to ”block with storage”.

The question ”release blocking by pick–up of the differential current supervision?” has to be answered by key ”F3” and the command is executed.

```
RELS BLO DIF SUP
=executed !
```

Confirmation

```
▲ 8600 CONTROL:
▼ ReleasBloIsoMal?
```

Release blocking by pick–up of the isolator failure supervision (running time, status, auxiliary supply failure) and by test failure (refer to chapter 4.7.8.4). This control is reasonable only if the parameter **DA 6302/ZE** is set to ”Block with storage”.

Start via key ”F3”

```
RELS BLO CB MALF
=executed !
```

Confirmation by display indication

```
▲ 8700 CONTROL:
▼ Reset annun buf?
```

This command under **DA 8700/ZE** erases the event buffers (operation events **DA 7100/ZE** and fault events **DA 7200/ZE**)

Start by key ”F3”

```
RESET ANNUNC BUF
=executed !
```

Confirmation

6.2.6 Alarms

6.2.6.1 Introduction

After a fault, annunciations and events provide an overview of important fault data and an insight as to how the protection unit functioned. This information is also important when protection functions are tested during commissioning. Furthermore, they provide information about switching operations, about measured data and about the protection system itself during normal service.

For reading out recorded events via the master unit no codeword input is necessary.

The events generated in the 7SS52 are presented to the user in various ways.

- Indications by means of LEDs on the front plates of the master unit
- Binary outputs (alarm relays) from modules EAZ1 and EAZ2
- Information via display or via communication program DIGSI

In the event of auxiliary voltage failure all event memories are reset.

The alarms listed in appendix A.1.2 can be marshalled to the LEDs and to the digital outputs. Furthermore, several alarms can be marshalled to one digital output (group alarm). The communication software DIGSI supports marshalling. This requires assignment of the function no. (acc. to appendix A.1.2) which corresponds to the alarm. For creating group alarms, the function numbers are listed consecutively.

The most common collective alarms are already available in the system with defined F–No.

Further collective alarms are created by programming the required F–No to one relay or LED.

Table 6.2 List of the available collective alarms

F–No	Collective alarm	Substitute for F–No
30	TRIP command	16 – 27; 32 – 43; 48 – 59
92	Diff. current supervision for busbars	96 – 107; 112 – 123; 128 – 139; 144 – 155; 160 – 171; 176 – 187
84	Isol. status flt: both on	66; 70; 74; 78; 82
85	Isol. status flt: run time	67; 71; 75; 79; 83
215	Request bay	208 – 214
205	Failure in auto. testing	196 – 204

In order to call up events via the operator panel the following possibilities exist:

- paging in blocks by key ▲ forward and ▼ backwards, up to address 7100 (operations events) or 7200 (fault events)
- direct addressing via the ”MENU” key, address 7100/7200 and enter key ”ENTER”

6.2.6.2 Marshalling of binary outputs and LED–indications

The master unit has, depending on its version, 16 alarm relays and 16 LED–indications (version with EAZ1) or each 32 alarm relays and LEDs (full version with EAZ1 and EAZ2).

Marshalling can be performed via the communication program DIGSI. The functional numbers are used for allocation of the functions.

After the DIGSI menu item ”MARSHALLING RELAYS” has been called up, the further control is done by keys.

”Y”	Question answered with ”YES” process continues
”N”	Jump to the next menu item by negation
”I”	Information about handling
”CTRL” and ”C”	Interrupt marshalling
< rnr >	comment to entering the desired event/function number

For operation only capitals may be used.

Faulty inputs cause backstep to the next higher menu level.

Following menus are offered after selecting marshalling:

1. Change Rel/LED–allocation?

   (Menu for allocation of the same function number for the alarm relay and corresponding LED.)
2. Change relay allocation?
   (separate allocation of functions possible.)
3. Change LED allocation?
   (separate allocation of functions possible.)
4. Indicate correlation event number (E–No)/alarm?

   (List of all alarms, indication of the corresponding function numbers and supplementary information about actual marshalling.)
5. Indicate correlation relay/alarm?

   (overview of the present status of marshallings for all alarm relays and LEDs.)
6. Test alarm relays?

   Option for separate control of each alarm relay in combination with corresponding LED.

   Control is reset after a short time.

Several logical alarm functions can be marshalled to one output.

Annex A.1.2 shows a list of all possible alarm functions together with their function number (F–No).

The preselection for the LEDs and alarm relays is identical upon delivery and can be seen in table 6.2.

For the LED display, the alarm function defines whether the display is operated memorized ”m” or non–memorized ”nm”.

Table 6.3 Preset LEDs and alarm relays

LED– and alarm relay–No	Logical function	FNo.	Short text (indication at the LC–display)
1	Failure with protection blocking	000	Err.: PROT BLOCK
2	Failure without protection blocking	001	Err.: PROT ACTIVE
3	Diff current supervision selective[1]	92	Id–sup BZ01 L1 –2 to Id–sup BZ12 L1 –2 Id–sup BZ01 L2 –2 to Id–sup BZ12 L2 –2 Id–sup BZ01 L3 –2 to Id–sup BZ12 L3 –2 Id–sup BZ01 L1 –3 to Id–sup BZ12 L1 –3 Id–sup BZ01 L2 –3 to Id–sup BZ12 L2 –3 Id–sup BZ01 L3 –3 to Id–sup BZ12 L3 –3
4	Diff current supervision check zone	093 – 095	diff sup CKZ L1; 2; 3
5	Cyclic test failure identified[2]	205	Flt aut L1 –1; 2; 3:BXY Flt aut L2 –1; 2; 3:BXY Flt aut L3 –1; 2; 3:BXY
6	Isolator failure (plausibility check CLOSED, OPEN simultaneously, running time supervision)	084 085	Isoly Flt pla: BXY Isoly Flt run: BXY (y = 1 ... 5)
7	Isolator failure–auxiliary voltage failure	086	Bay DC Fail:BXY
8	Circuit breaker failure	087	CB fail:BXY
9	Measured value supervision	192	Meas in sup:BXY
10	Supply voltage supervision FE	193 195 206 207	15V–superv:BXY 0V–superv:BXY 15V–superv. CU 24V–superv. CU
11	Bay out of service	015	out of serv.:BXY
12	Binary input breaker failure, time exceeded	009 – 012	BF BI err:L1; 2; 3:BXY
13	Fault record buffer blocked	089	Flt rec blocked
14	TRIP repeat	028 044 060	TripRepL1; 2; 3:BXY
15	Breaker failure/transfer trip	029	transf Trp:BXY
16	TRIP busbar "high–speed TRIP"[3]	030	TRPBZ01 L1 = zzz – TRPBZ12 L1 = zzz TRPBZ01 L2 = zzz – TRPBZ12 L2 = zzz TRPBZ01 L3 = zzz – TRPBZ12 L3 = zzz zzz = Fault–no
17	Busbar protection TRIP command BZ1	016 032 048	TRPBZ01 L1; 2; 3 = zzz
18	Busbar protection TRIP command BZ2	017 033 049	TRPBZ02 L1; 2; 3 = zzz
19	Busbar protection TRIP command BZ3	018 034 050	TRPBZ03 L1; 2; 3 = zzz
20	Busbar protection TRIP command BZ4	019 035 051	TRPBZ04 L1; 2; 3 = zzz
21	Busbar protection TRIP command BZ5	020 036 052	TRPBZ05 L1; 2; 3 = zzz
22	Busbar protection TRIP command BZ6	021 037 053	TRPBZ06 L1; 2; 3 = zzz
23	Busbar protection TRIP command BZ7	022 038 054	TRPBZ07 L1; 2; 3 = zzz
24	Busbar protection TRIP command BZ8	023 039 055	TRPBZ08 L1; 2; 3 = zzz
25	Busbar protection TRIP command BZ9	024 040 056	TRPBZ09 L1; 2; 3 = zzz
26	Busbar protection TRIP command BZ10	025 041 057	TRPBZ10 L1; 2; 3 = zzz
27	Busbar protection TRIP command BZ11	026 042 058	TRPBZ11 L1; 2; 3 = zzz
28	Busbar protection TRIP command BZ12	027 043 059	TRPBZ12 L1; 2; 3 = zzz

---

1) FNo. 92: Diff. current supervision selective
Collective alarm comprises the single alarms according to table 6.2 on page 6–24.

2) FNo. 205: Periodical test alarm
Collective alarm comprises all single alarms according to table 6.2 on page 6–24.

3) FNo. 30: "high–speed TRIP"
common alarm for TRIP command alarm FNo. 16 – 27; 32 – 43 and 48 – 59. Recognition of the alarm "high–speed TRIP" runs with a resolution of 1 ms. Marshalling of this function to alarm relays is possible.

LED– and alarm relay–No	Logical function	FNo.	Short text (indication at the LC–display)
29	Request bay [4]	215	req restart RqChangCTPol:BXY request BOS:BXY req man Trp L1; L2; L3:BXY
30	no TRIP command release [5]	014	no Trip Releas:BXY
31	not marshalled		
32	not marshalled		

---

[4] FNo. 215: ”request bay”
Collective alarm comprises all single alarms according to table 6.2 on page 6–24.

[5] FNo. 14: ”no TRIP command release”
This alarm indicates the missing TRIP release via binary input at a bay unit. The supervision is active only if DA 6107/ZE was set to ”existent”.

```
▲ 7000  READOUT
▼ ANNUNCIATIONS  ?
```

Beginning of the alarm blocks

The events/indications are grouped as follows:

Block 71	Operational indications – Isolator status indications – Unit supervision annunciations
Block 72	Fault events
Block 73	Isolator mimic This address block contains the configuration of the bays to the bus sections according to the actual isolator replica recognized by the bay units. The isolator replica is cyclicly refreshed. Processor modules ZPS–BSZ 2 and 3 are responsible for the zone–selective busbar protection based on this configuration. Disturbances and failures in the isolator states are detected independently and stored.
Block 74	Measured values from the check zone (ZPS–BSZ1) for commissioning – Differential and stabilizing currents
Block 75	Measured values from ZPS–BSZ2 for commissioning of the 12 busbar sections – Differential and stabilizing currents
Block 76	As for block 75 for ZPS–BSZ3

Annex A.1.1 shows some examples for the alarms.

The 7SS52 can store 2 fault records with a duration of 300 ms each. All feeder currents, the differential and stabilizing currents of the 12 bus sections and the check zone are recorded. The resolution of the measured value is 1 ms.

Reading out and presentation of the fault record are supported by the communication program DIGSI.

6.2.7 Operational event recording – block 71

Operational events yield information about the status of the protection system during service. Important events and status changes are chronologically listed from **DA 7100/ZE**. Time information is shown in minutes. Up to 99 operational events are stored. If more events are issued the oldest are overwritten.

The input of the codeword (password) is not required for reading out the operational events buffer. The values are not updated during read–out. Only after re–entering block 71 the updated values are displayed.

After selection of **DA 7100/ZE** and scrolling with keys ◀ ▶ the operational events are displayed.

Events and alarms can be recorded as they come (pick–up) (C) or when they go (drop–off) (G).

The operational events for the 7SS52 are summarized in Appendix A 1.2.

There are two types of operational events:

- Isolator events (changes of status; failures):

Table 6.4 Isolator events (changes of status; failures)

Event name	Supplementary information
Isol ON	Time + isol. name + bay no.
Isol OFF	Time + isol. name + bay no.
Isol Flt pla	Time + isol. name + bay no.
Isol Flt run	Time + isol. name + bay no.
Bay DC Fail	Time + bay no.

Notes:

1. For each change of isolator status one event is generated, i.e. either
   - the new isolator status or
   - a faulty status.
2. Isolator status events are only registered as ”Coming”

and

- Supervisory events

  Operational events are events which are generated by the continuous self–monitoring process, or which indicate conditions which are not directly connected with protection fault processing.

  Supervisory events are registered as ”Coming” or ”Going”.

  Each event is tagged with the current relative time counter. The start of the relative time refers to the instant of the device start–up.

Table 6.5 Supervisory events

Event name	Short text	Supplementary information
Disturbance with protection blocking	Err:PROT BLOCK	Time + C/G
Disturbance without protection blocking	Err:PROT ACTIVE	Time + C/G
Diff current supervision: BZ–01	Id–sup BZ01	Time + C/G + ZPS–BSZ–No + phase
Diff current supervision: BZ–02	Id–sup BZ02	Time + C/G + ZPS–BSZ–No + phase
Diff current supervision: BZ–03.	Id–sup BZ03	Time + C/G + ZPS–BSZ–No + phase
Diff current supervision: BZ–04	Id–sup BZ04	Time + C/G + ZPS–BSZ–No + phase
Diff current supervision: BZ–05	Id–sup BZ05	Time + C/G + ZPS–BSZ–No + phase
Diff current supervision: BZ–06	Id–sup BZ06	Time + C/G + ZPS–BSZ–No + phase
Diff current supervision: BZ–07	Id–sup BZ07	Time + C/G + ZPS–BSZ–No + phase
Diff current supervision: BZ–08	Id–sup BZ08	Time + C/G + ZPS–BSZ–No + phase

Event name	Short text	Supplementary information
Diff.–current–supervision: BZ–09	Id–sup BZ09	Time + C/G + ZPS–BSZ–no. + phase
Diff.–current–supervision: BZ–10	Id–sup BZ10	Time + C/G + ZPS–BSZ–no. + phase
Diff.–current–supervision: BZ–11	Id–sup BZ11	Time + C/G + ZPS–BSZ–no. + phase
Diff.–current–supervision: BZ–12	Id–sup BZ12	Time + C/G + ZPS–BSZ–no.+ phase
Diff.–current–supervision: Checkzone	diff sup CKZ L1	Time + C/G + phase
REBOOT	REBOOT	Time + C
DEVICE RESTART	DEVICE RESTART	Time + C
Voltage failure	VOLTAGE FAIL	Time + C
Restart after configuration	RESTART AFT CONF	Time + C
Setting	Setting	Time + C/G
Configuration	Configuration	Time + C/G
Failure: CBF–DI–time exceeded resp. –release outside time–window	BF BI err	Time + C/G + bay–no. + phase
Failure: CBF–DI–release time exceeded	BF COM BIN MON T	Time + C/G
LED–acknowledgement	LED–acknowl	Time + C
Fault record existent	Flt rec freezed.	Time + C/G
Fault record blocked	Flt rec blocked	Time + C/G
Failure with protection test BSZ 1	Flt aut L1 – 1	Time + C/G + bay–no. + phase
Failure with protection test BSZ 2	Flt aut L1 – 2	Time + C/G + bay–no. + phase
Failure with protection test BSZ 3	Flt aut L1 – 3	Time + C/G + bay–no. + phase
MCT–supervision I–SUM	Meas in sup	Time + C/G + bay–no.
15–V–supervision FE	15V–superv	Time + C/G + bay–no.
0–V–supervision FE	0V–superv	Time + C/G + bay–no.
15–V–supervision CU	15V–superv. CU	Time + C/G + bay–no.
24–V–supervision CU	24V–superv. CU	Time + C/G + bay–no.
Bay out of operation	out of serv.	Time + C/G + bay–no.
Circuit breaker failure	CB fail	Time + C/G + bay–no.
Request start–up 1)	req restart	Time + C + bay–no.
Request change CT polarity 2)	Rq Chang CT Pol:	Time + C + bay–no.
Request bay out of service 3)	Request BOS	Time + C/G + bay–no.
Request CB test 4)	req man Trp	Time + C/G + bay–no. + phase

Explanations for the supplementary information:

”Time”:	Relative time value (32 Bit counter, revolving)
”C/G”:	Coming–/Going – designation
”Bay–no.”:	(1 to 48)
”ZPS–BSZ–no.”:	(ZPS–BSZ–1 / ZPS–BSZ–2 / ZPS–BSZ–3)
”Phase”:	L1, L2, L3

Explanations for the selected alarms:

1) A bay unit which was out of service and switched off with switched on protection system, is switched on again. Here the bay unit requests transmission of the actual settings from the master unit. The alarm ”request start–up” is issued. The protection system initiates a restart.
2) Changing the CT polarity in the bay unit via parameter **DA 1101/FE** issues an alarm with indication of the bay number.
3) The alarm is issued for control ”bay out of service” in one of the connected bay units.
4) A single or three–phase circuit breaker test is initiated in a bay unit. As a consequence, the master unit generates an alarm with indication of the bay number.

The following table shows a list of events (F–No.) which cause the collective alarm ”Failure with/without protection block”.

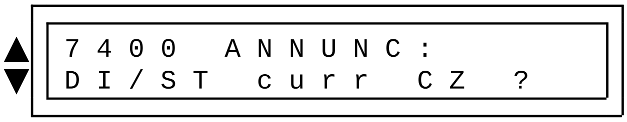
Table 6.6 Collective alarms ”Failure with/without protection block”

Event name	Collective alarms ”Failure with/without protection block”
Isolator failure (device failure, run–time failure) Isolator failure auxiliary voltage missing	Reaction depends on setting of the parameter **DA 6302/ZE**
Diff current supervision busbar	Reaction depends on setting of the parameter **DA 6307/ZE**
Diff current supervision check–zone	Reaction depends on setting of the parameter **DA 6308/ZE**
Measured value supervision 15–V–supervision FE 0–V–supervision FE 15–V–supervision CU 24–V–supervision CU	”Failure with protection block”
Failure during protection test	Reaction depends on setting of the parameter **DA 6312/ZE**

6.2.8 Measured values for commissioning – blocks 74, 75, 76, 78

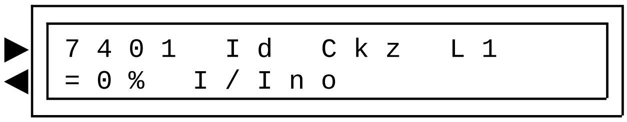
During commissioning the correct polarity of the current transformers must be checked. For this measurement, the bus–section specific differential and stabilizing currents are required.

Blocks **7400/ZE, 7500/ZE** and **7600/ZE** allow display of the currents. The differential currents are displayed as rms values and the stabilizing currents as average values (rms value = 1.11 x average value for sinusoidal measured currents).



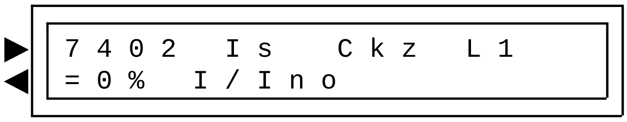
```
▲ 7400 ANNUNC:
▼ DI/ST curr CZ ?
```

Measured values of the check zone (ZPS–BSZ1)



```
► 7401 Id Ckz L1
◄ =0% I/Ino
```

Differential current in relation to the normalized nominal I_{no} for phase L1
The differential currents of the other phases are available under separate addresses **DA 7403** (L2) and **DA 7405** (L3)



```
► 7402 Is Ckz L1
◄ =0% I/Ino
```

Stabilizing current for phase L1
DA 7404 (L2)
DA 7406 (L3)

```
▲ 7500 ANNUNC:
▼ DI/ST curr BSZ2?
```

Measured values of the bus zone–selective calculation (ZPS–BSZ2)

```
▶ 75YY Id BZXXLz–2
◀ =0% I/Ino
```

Differential current per phase (z) separately displayed for each of the 12 bus sections (XX) Display starting with YY = 01 for L1 and busbar section 01. Each further value in address YY + 2.

```
▶ 75YY Is BZXXLz–2
◀ =0% I/Ino
```

Stabilizing current per phase (z) for each of the 12 busbar sections (XX).
Bays starting with YY = 02 for L1 and bus section 01. Each further value in address YY + 2.

```
▲ 7600 ANNUNC:
▼ DI/ST curr BSZ3?
```

Measured values of the bus zone–selective calculation (ZPS–BSZ3)

```
▶ 76YY Id BZXXLz–3
◀ =0% I/Ino
```

Differential current
(equivalent to **DA 75YY** Id)

```
▶ 76YY Is BZXXLz–3
◀ =0% I/Ino
```

Stabilizing current
(equivalent to **DA 75YY** Is)

In addition to the display of the differential and stabilizing currents, the currents of all bays can be displayed as percentage values.

```
▲ 7800 ANNUNC:
▼ Bay currents?
```

Start of the address block for display of the bay currents. Continue by depressing key ”F3”, interrupt with ”F4”

```
I Bay No.?
```

Input of the desired bay no. XX and confirm with key ”ENTER”

```
I Bay No.XX
=u v w % I/IN
```

Display of the bay currents for phases L1 (u), L2 (v) and L3 (w). The values refer to the nominal current of the bay current transformer. Each new operation of the ”ENTER”– key updates the display.

6.2.9 Fault events– block 72

Fault events are created by the protection device with reference to busbar faults and stored consecutively in the event buffer from address **7200/ZE**, with added relative time tags.

For each fault event a fault number is allocated. Registration of the fault event starts with the trip command. A maximum of 40 events can be stored. If more events occur, the oldest event will be overwritten.

Table 6.5 shows a list of the fault events.

Table 6.7 Fault events

Event name	Short text	supplementary information
Trip command BZ – section 1	TRP BZ01 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 2	TRP BZ02 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 3	TRP BZ03 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 4	TRP BZ04 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 5	TRP BZ05 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 6	TRP BZ06 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 7	TRP BZ07 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 8	TRP BZ08 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 9	TRP BZ09 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 10	TRP BZ10 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 11	TRP BZ11 = zzz	Time + C + Phase + fault–no.
Trip command BZ – section 12	TRP BZ12 = zzz	Time + C + Phase + fault–no.
Breaker failure/transfer trip	transf Trp:BXY	Time + C + Phase + feeder–no.
TRIP–repeat	Trip Rep:BXY	Time + C + Phase + feeder–no.

Explanations for the supplementary information:

"Time":	Relative time value (32 Bit counter revolving)
"Fault–no.":	16 Bit counter, revolving

Remarks:

Fault events are only registered "Coming"

6.3 Operating the bay unit

The bay unit is operated via the integrated keypad in a user–device dialog.

All parameters relevant for operation of the protection system 7SS52 (settings, configuration data) and the protection reactions (operational and fault events, fault records) are administered in the master unit.

The operation function of the bay unit is used for marshalling of inputs and outputs, for display of measured values, for starting tests and changing selected parameters.

6.3.1 Keypad/display

For display an LC display with 4 lines, each with 16 characters and background illumination is provided.

During the dialogue, a 4–digit number will be seen in the display, followed by a bar. This number represents the setting address. The first two digits indicate the operation block, followed by a two–digit sequence number.

The background illumination is switched on by any key. It is automatically switched off, if no operation is carried out over a period of 10 minutes.

The keypad comprises 12 keys with the following meanings:

Keys for scrolling in the display:

▶	Forward scrolling: the next operating position is shown in the display
◀	Reverse scrolling: the previous operating position is shown in the display
▲	Forward scrolling block–wise: the beginning of the next operating block is shown in the display
▼	Reverse scrolling block–wise: the beginning of the previous operating block is shown in the display

Control keys:

ENTER	Enter–key: ● Confirmation of new data for changing the configuration or parameterizing and after entering the password; ● Entering the next lower level of the operating tree ● Switch–over between ordering number and operational measured value in the 4–line mode
ESC	● Leaving the operating level ● jumps back to the next higher level in the operating tree
LED	● Execute LED test; ● Reset LED indications and operational measured value display in the 4–line mode
MENU	not used

Functional keys:

F1	Direct access into the operating tree for executing the alarm ”bay out of service” to the master unit
F2	Initiate circuit breaker test

The functional keys F1, F2, F3 and F4 are used as numerical keys (1, 2, 3, 4) for entering the password.

6.3.2 Prerequisite and language for operation

The request to enter the password appears automatically as soon as the operating tree enters branches which require a password (e.g. modification mode with parameterizing and configuration, execution of test functions. The input of the password is terminated by the ENTER–key. Keys F1 to F4 may be used for the password.

User password:

Sequence of keys:
F3 – F1 – F3 – F1 – F3 – F1

No password is required for reading out operational data, alarms and settings.

```
ENTER CODEWORD:
@@@@@@
```

```
CW ACCEPTED
```

```
CODEWORD WRONG
```

The entered characters do not appear in the display. Instead each one @ is displayed. After confirmation of the input by ”ENTER”, the display shows **CW ACCEPTED** with the correct password.

If the code was wrong, then **CODEWORD WRONG** is displayed. The password may be entered again after twice depressing the key **ENTER** .

If the password was accepted, then the parameterizing may start. In the following, each operating address will be shown in a box and will be explained.

The communication language can be selected via direct address **DA 7101/FE**. Optionally German or English may be chosen.

Fig 6.1 shows an overview for the operating tree of the bay unit. Selected settings and configuration functions can be changed by calling up blocks

`1100`	Network data
`6000`	Marshalling of binary inputs and outputs
`7100`	Integrated operation

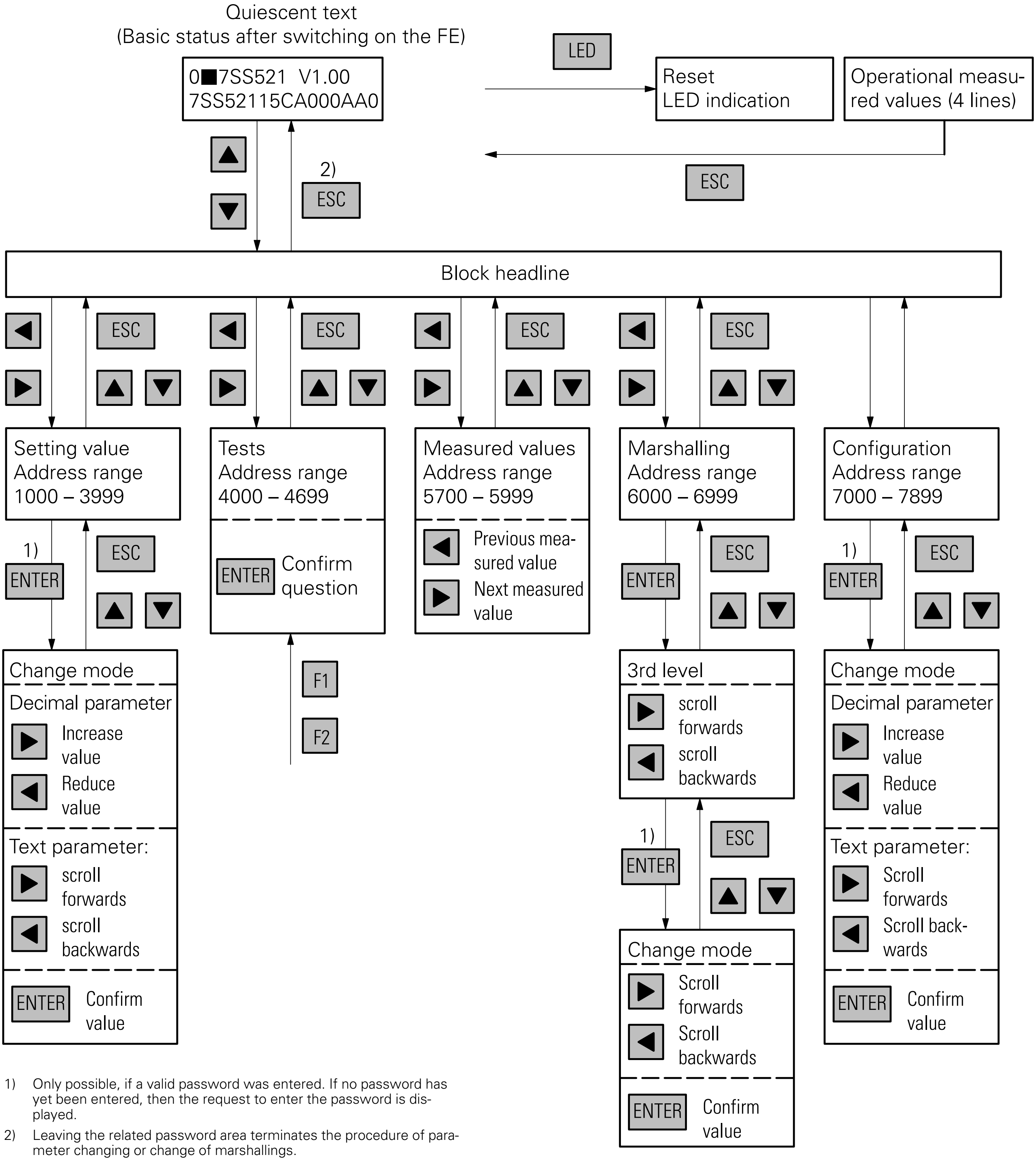
Test and control functions are available under the block address

`4000`	Tests.

Change of settings and executing control functions require entering of the user password.

Operational measured values can be displayed under block adress **5700**.

`5700`	Operational measured values



1) Only possible, if a valid password was entered. If no password has yet been entered, then the request to enter the password is displayed.

2) Leaving the related password area terminates the procedure of parameter changing or change of marshallings.

Figure 6.1 Operating tree bay unit

6.4 Device settings

6.4.1 Settings via the integrated operation – block 71

In block 71 the quiescent indications for the display can be defined. Password is required.

```
▲ 7000■OP.  SYSTEM
▼ CONFIGURATION
```

Start of configuration blocks

```
▲ 7100■ INTEGRATED
▼ OPERATION
```

Start of the block ”integrated operation”

```
▶ 7101■LANGUAGE
◀ ENGLISH
```

Operating language
= GERMAN
= ENGLISH

```
▶ 7120■OPER.  1st  L.
◀ IL1
```

Quiescent display in the 4–lines mode for the 1st display line. All operational measured values from chapter 6.4.4 can be selected in the change mode by repeated depressing of the horizontal arrow keys ◀ ▶ and confirmed by depressing the key ”ENTER”..

= IL1
= IL2
= IL3
= IE
= IDL1
= IDL2
= IDL3
= ISL1
= ISL2
= ISL3

```
▶ 7121■OPER.  1st  L.
◀ SECONDARY
```

The parameter defines the selected operational measured value for the display. The differential and stabilizing currents are displayed only as percentage (”secondary”) values.

= SECONDARY (display in xxxx.x %)
= PRIMARY (display in xxxx.x A)

The selection of the quiescent displays in the 4–lines mode is carried out in the same manner for the fur–ther lines 2 ... 4.

The selection of the measured values is stored in the **DA 7122/7123/FE** (2nd line), **DA 7124/7125/FE** (3rd line) and **DA 7126/7127/FE** (4th line).

6.4.2 Marshalling of binary inputs, binary outputs and LED indications

6.4.2.1 Introduction

It is the purpose of the marshalling to allocate logical functions to the hardware binary inputs, command and alarm relays and LEDs.

The ex works pre–set alarms can be seen in the general diagrams (annex A.1.2).

The allocation of the inputs and outputs in conformance with the requirements of the specific application is carried out via the integrated keypad and starts with
DA 6000/FE.

Marshalling starts with selection of the desired binary input, relay or LED. By depressing the "ENTER"–key, the third level of the operating tree is reached. Input of password is requested.

In the third level a marshalling point (out of 20 available) can be selected by operating the horizintal arrow–keys ◀ ▶ . This means, for each binary input, relay or LED, 20 logical functions can be marshalled. After selecting the marshalling point, the change mode is entered by depressing the key "ENTER" twice. In the change mode, the desired event is marshalled to this marshalling point by means of the horizontal arrow keys ◀ ▶ . The selected functional marshalling is terminated with the key "ENTER".

When marshalling functions to binary inputs, an additional selection is carried out during scrolling, whether the input functions in a "working–current" or "quiescent–current" mode. When marshalling the LEDs, the options "memorized" or "not memorized" can additionally be selected.

The third level is left with the key "ESC" or one of the vertical arrow keys.

Repeated operation of the "ESC"–key means leaving the password area. In case of changes in the settings, the question is asked whether the new settings shall be stored.

▲▼ 6000 ■ MARSHALLING

Start of the marshalling blocks

6.4.2.2 Marshalling of the binary inputs – block 61

The bay unit has 20 binary inputs, designated with "BINARY INPUT 1" to "BINARY INPUT 20". Marshalling of the binary inputs is carried out in address block 6100. For each binary input function, working–current or quiescent–current can be selected.

A – working–current:
An input is activated by a NO contact, i.e. control voltage at the input terminals activates the marshalled function;

R – quiescent current:
An input is activated by a NC contact, i.e. control voltage at the input terminals cancels the function, without control voltage it is active.

Table 6.6 gives an overview of the marshallable input functions with corresponding function numbers (FNo).

Note:

Marshalling of one logical function to 2 or more binary inputs is not supported (no logical connection). Each logical function is allocated to one binary input.

Marshalling of several different functions to one binary input, however, is allowed.

The general diagrams in annex A.1.2 and table 6.7 show the pre–set binary inputs upon delivery.

```
▲  6100 ■ MARSHALLING
▼  BINARY INPUTS
```

Start of the block ”marshalling of binary inputs”

```
▶  6101 ■ BINARY
◀  INPUT 1
```

Depressing key ”ENTER” displays the marshalled function. Repeated depressing of the ”ENTER”–key starts the change mode.

```
▶  1 ■ INPUT  1
◀  >Isolator 1-on NO
```

Binary input 1 is pre–set for isolator status ON for isolator 1 (refer to table 6.8).

Working–current (A) is selected.

```
▶  2 ■ INPUT  1
◀  not allocated
```

Input 1 is not allocated to any further functions. Alarm numbers 2 to 20 are pre–set for ”not marshalled”, FNo 001.

The change mode is left by depressing the key ”ESC”.

Table 6.8 Marshallable binary input functions

FNo	Short text (indication on LC–display)	Logical functions
1	not marshalled	No function allocated to input
5	>LED–ackn	>Reset LED indication
1156	>CB test	>Start three–pole circuit breaker test
7000	>Isol1–Closed	>Isolator status signal Closed for isolator 1
7001	>Isol1–Open	>Isolator status signal Open for isolator 1
7002	>Isol2–Closed	>Isolator status signal Closed for isolator 2
7003	>Isol2–Open	>Isolator status signal Open for isolator 2
7004	>Isol3–Closed	>Isolator status signal Closed for isolator 3
7005	>Isol3–Open	>Isolator status signal Open for isolator 3
7006	>Isol4–Closed	>Isolator status signal Closed for isolator 4
7007	>Isol4–Open	>Isolator status signal Open for isolator 4
7008	>Isol5–Closed	>Isolator status signal Closed for isolator 5
7009	>Isol5–Open	>Isolator status signal Open for isolator 5
7020	>CBF L1	>Circuit breaker failure initiation for phase L1
7021	>CBF L2	>Circuit breaker failure initiation for phase L2
7022	>CBF L3	>Circuit breaker failure initiation for phase L3
7023	>CBF pulse	>Circuit breaker failure initiation via pulse
7024	>CBF Rel	>Circuit breaker failure release signal
7025	>TRIP Rel	>Trip command release
7026	>CB Open	>Bus coupler circuit breaker in OPEN status
7027	>CB CLOSE Com	>CLOSE command for bus coupler circuit breaker
7028	>CB disturb	>Circuit breaker disturbed
7029	>Bay out serv	>Control bay out of service

Table 6.9 Pre–set binary inputs

Direct address	1st display line	2nd display line		FNo	Note
6100	MARSHALLING	>BINARY INPUTS			
6101	BINARY INPUT 1	>Isol1–Closed	A	7000	Isolator status signal Closed for isolator 1
6102	BINARY INPUT 2	>Isol1–Open	A	7001	Isolator status signal Open for isolator 1
6103	BINARY INPUT 3	>Isol2–Closed	A	7002	Isolator status signal Closed for isolator 2
6104	BINARY INPUT 4	>Isol2–Open	A	7003	Isolator status signal Open for isolator 2
6105	BINARY INPUT 5	>Isol3–Closed	A	7004	Isolator status signal Closed for isolator 3
6106	BINARY INPUT 6	>Isol3–Open	A	7005	Isolator status signal Open for isolator 3
6107	BINARY INPUT 7	>Isol4–Closed	A	7006	Isolator status signal Closed for isolator 4
6108	BINARY INPUT 8	>Isol4–Open	A	7007	Isolator status signal Open for isolator 4
6109	BINARY INPUT 9	>Isol5–Closed	A	7008	Isolator status signal Closed for isolator 5
6110	BINARY INPUT 10	>Isol5–Open	A	7009	Isolator status signal Open for isolator 5
6111	BINARY INPUT 11	>CBF L1	A	7020	Circuit breaker failure initiation for phase L1
6112	BINARY INPUT 12	>CBF L2	A	7021	Circuit breaker failure initiation for phase L2
6113	BINARY INPUT 13	>CBF L3	A	7022	Circuit breaker failure initiation for phase L3
6114	BINARY INPUT 14	>CB–CLOSE com	A	356	Close command for bus coupler circuit breaker
6115	BINARY INPUT 15	>CBF rel	A	7024	Circuit breaker failure protection release signal
6116	BINARY INPUT 16	>CB test	A	1156	start three–pole circuit breaker test
6117	BINARY INPUT 17	>CB Open	A	7026	Bus coupler circuit breaker in Open status
6118	BINARY INPUT 18	not marshalled	A	1	No function is allocated to input
6119	BINARY INPUT 19	>CB disturb	A	7028	Circuit breaker failure disturbed
6120	BINARY INPUT 20	>Bay out serv	A	7029	Control bay out of service

A: working–contact
R: quiescent–contact

6.4.2.3 Marshalling of the alarm relay – block 62

The bay unit has one freely marshallable alarm output, designated with ALARM RELAY 1. Marshalling is carried out under **DA 6201/FE**.

Several logical functions (up to 20) can be marshalled to the alarm output.

Table 6.8 shows the complete list of all available alarm functions with indication of the function number FNo.

Alarms beginning with ">" are direct checkback signals of the binary inputs and are identical to them. They appear as long as the corresponding binary input is active.

The alarm relay is pre–set with "Bay out serv" (**FNro 7080/FE**).

Table 6.10 Marshallable output functions

FNo	Short text (indication on LC–display)	Logical functions
1	not marshalled	No function allocated to output
5	>LED–ackn	>reset LED indications
161	Meas val SupI	Measured value supervision I
190	Fail com.CU	Data communication to master unit disturbed
356	>CB CLOSE com	>Close command to bus coupler circuit breaker
1156	>CB test	>start three–pole circuit breaker test
7000	>Isol1–Closed	>Isolator status signal Closed for isolator 1
7001	>Isol1–Open	>Isolator status signal Open for isolator 1
7002	>Isol2–Closed	>Isolator status signal Closed for isolator 2
7003	>Isol2–Open	>Isolator status signal Open for isolator 2
7004	>Isol3–Closed	>Isolator status signal Closed for isolator 3
7005	>Isol3–Open	>Isolator status signal Open for isolator 3
7006	>Isol4–Closed	>Isolator status signal Closed for isolator 4
7007	>Isol4–Open	>Isolator status signal Open for isolator 4
7008	>Isol5–Closed	>Isolator status signal Closed for isolator 5
7009	>Isol5–Open	>Isolator status signal Open for isolator 5
7020	>CBF L1	>Breaker failure protection initiation for phase L1
7021	>CBF L2	>Breaker failure protection initiation for phase L2
7022	>CBF L3	>Breaker failure protection initiation for phase L3
7023	>CBF pulse	>Breaker failure protection initiation via pulse
7024	>CBF Rel	>Breaker failure protection release signal
7025	>AUS Rel	>Trip command release
7026	>CB OPEN	>Bus coupler circuit breaker in Open status
7028	>CB Disturb	>Circuit breaker disturbed
7029	>Bay out serv	>Control bay out of service
7030	BBP start	Busbar protection common start
7040	BBP TRIP L123	Busbar protection trip command L123
7050	CBF TRIP L123	Breaker failure protection trip command L123
7051	CBF TRIP L1	Breaker failure protection trip command L1
7052	CBF TRIP L2	Breaker failure protection trip command L2
7053	CBF TRIP L3	Breaker failure protection trip command L3
7060	CB aut TRIP L1	Circuit breaker test phase L1
7061	CB aut TRIP L2	Circuit breaker test phase L2
7062	CB aut TRIP L3	Circuit breaker test phase L3
7070	BBP TRANSTRIP	Busbar protection transfer trip signal
7080	Bay out serv	Bay out of service

6.4.2.4 Marshalling of the LED indications – block 63

The bay unit has 18 LEDs for optical event indication.

16 LEDs are freely marshallable and named LED 1 to LED 16.
Each LED can be allocated to several alarms as well as several LEDs can be allocated to one alarm.

In addition to the logical function, it is defined whether the indication shall be memorized ”m” or not memorized ”nm”.

The marshallable alarm functions are listed in table 6.8 and are identical to the alarm relay functions.

The pre–set LED allocations upon delivery can be seen in table 6.9.

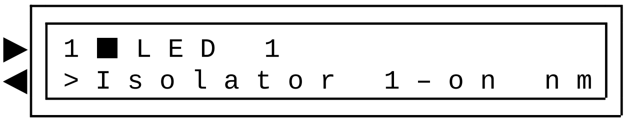
```
6300■MARSHALLING
LED INDICATORS
```

Start of the block ”marshalling of LED”

```
6301■LED1
```

Marshalling for LED 1

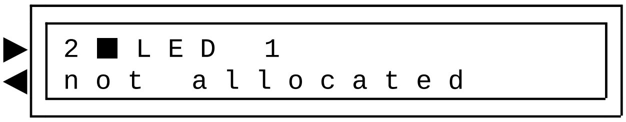
Depressing key ”ENTER” starts the change mode. Password is required.



```
1■LED 1
>Isolator 1–on nm
```

Only 1 alarm function is pre–set for LED 1 (**FNo 7000**).

The indication is not memorized (nm).



```
2■LED 1
not allocated
```

The level is left by depressing key ”ESC”.

The pre–set allocations of LED indications 2 to 16 can in the same way be selected and displayed and, if so desired, changed.

Table 6.11 Pre–set LED indications

Direct address	1st display line	2nd display line		FNo	Note
6300	MARSHALLING	>LEDs			
6301	LED 1	>Isol1–Closed	nm	7000	Isolator status signal Closed for isolator 1
6302	LED 2	>Isol1–Open	nm	7001	Isolator status signal Open for isolator 1
6303	LED 3	>Isol2–Closed	nm	7002	Isolator status signal Closed for isolator 2
6304	LED 4	>Isol2–Open	nm	7003	Isolator status signal Open for isolator 2
6305	LED 5	>Isol3–Closed	nm	7004	Isolator status signal Closed for isolator 3
6306	LED 6	>Isol3–Open	nm	7005	Isolator status signal Open for isolator 3
6307	LED 7	>Isol4–Closed	nm	7006	Isolator status signal Closed for isolator 4
6308	LED 8	>Isol4–Open	nm	7007	Isolator status signal Open for isolator 4
6309	LED 9	>Isol5–Closed	nm	7008	Isolator status signal Closed for isolator 5
6310	LED 10	>Isol5–Open	nm	7009	Isolator status signal Open for isolator 5
6311	LED 11	not marsh		1	No function is allocated to output
6312	LED 12	not marsh		1	No function is allocated to output
6313	LED 13	Fail com.CU	nm	190	Data communication link to master unit disturbed
6314	LED 14	BBP TRIP L123	m	7040	Busbar protection trip command L123
		CBF TRIP L123	m	7050	Breaker failure protection trip command L123
		CBF TRIP L1	m	7051	Breaker failure protection trip command L1
		CBF TRIP L2	m	7052	Breaker failure protection trip command L2
		CBF TRIP L3	m	7053	Breaker failure protection trip command L3
		CB aut TRIP L1	m	7060	Circuit breaker test phase L1
		CB aut TRIP L2	m	7061	Circuit breaker test phase L2
		CB aut TRIP L3	m	7062	Circuit breaker test phase L3
6315	LED 15	BBP TRANSTRIP	m	7070	Busbar protection transfer trip command
6316	LED 16	Bay out serv	nm	7080	Bay out of service

nm: not memorized
m: memorized

6.4.2.5 Marshalling of the command relays – block 64

The bay unit contains 5 command relays, which are designated by COMMAND RELAY 1 to 5. Several functions can be marshalled to one command relay. In the same way it is possible to marshall each logical function to more than one command relay. The functions listed in table 6.8 can be marshalled to the command relays, too. The command relays are in the first place determined for TRIP commands and transfer trip signals. Depending on the station configuration and the requirements they may, however, also be used as additional alarm relays.

The pre–set functions upon delivery of the devices are summarized in table 6.10.

```
▲ 6400■MARSHALLING
▼ TRIP RELAYS
```

Start of the block ”marshalling of the command relays”

```
▶ 6401■TRIP
◀ RELAY 1
```

Marshalling for command relay 1

Depressing the ”ENTER”–key opens the change mode. Password is required.

4 functions are pre–selected for command relay 1.

```
▶ 1■TRIP REL. 1
◀ CBF Trip L1
```

- (**FNo 7051/FE**) Trip command by circuit breaker failure protection for phase L1

```
▶ 2■TRIP REL. 1
◀ BB Trip L123
```

- (**FNo 7040/FE**) Trip command by busbar protection three–phase

```
▶ 3■TRIP REL. 1
◀ CBF Trip L123
```

- (**FNo 7050/FE**) Three–phase trip command by circuit breaker failure protection function

```
▶ 4■TRIP REL. 1
◀ CB Test L1
```

- (**FNo 7060/FE**) Trip command to circuit breaker in phase L1 issued by the test function

```
▶ 5■TRIP REL. 1
◀ not allocated
```

- no further command functions for command relay 1

Exit from the change mode by depressing key ”ESC”.

In the same manner, display and modification of the pre–set allocation for command relays 2 to 5 can be done after selecting the appropriate address.

Table 6.12 Pre–set command relay functions

Direct adress	1st display line	2nd display line	FNo	Note
6400	MARSHALLING	COMMAND RELAY		
6401	COMMAND RELAY 1	CBF TRIP L1	7051	Breaker failure protection trip command L1
		BBP TRIP L123	7040	Busbar protection trip command L123
		CBF TRIP L123	7050	Breaker failure protection trip command L123
		CB test TRIP L1	7060	Circuit breaker test phase L1
6402	COMMAND RELAY 2	CBF TRIP L2	7052	Breaker failure protection trip command L2
		BBP TRIP L123	7040	Busbar protection trip command L123
		CBF TRIP L123	7050	Breaker failure protection trip command L123
		CB test TRIP L2	7061	Circuit breaker test phase L2
6403	COMMAND RELAY 3	CBF TRIP L3	7053	Breaker failure protection trip command L3
		BBP TRIP L123	7040	Busbar protection trip command L123
		CBF TRIP L123	7050	Breaker failure protection trip command L123
		CB test TRIP L3	7062	Circuit breaker test phase L3
6404	COMMAND RELAY 4	BBP TRIP L123	7040	Busbar protection trip command L123
		CBF TRIP L123	7050	Breaker failure protection trip command L123
		CBF TRIP L1	7051	Breaker failure protection trip command L1
		CBF TRIP L2	7052	Breaker failure protection trip command L2
		CBF TRIP L3	7053	Breaker failure protection trip command L3
		CB test TRIP L1	7060	Circuit breaker test phase L1
		CB test TRIP L2	7061	Circuit breaker test phase L2
		CB test TRIP L3	7062	Circuit breaker test phase L3
6405	COMMAND RELAY 5	BBP TRANSF TRIP	7070	Busbar protection transfer trip command

6.4.2.6 Setting of function parameters – block 11

Setting of the operation parameters requires password input (refer to chapter 6.3.2). The settings can be displayed without password, but not altered.

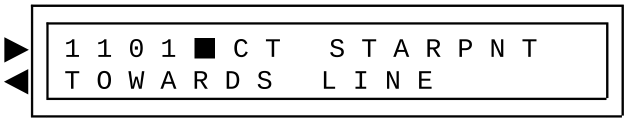
After the password is accepted, parameterizing can be started.

As a commissioning support, the current transformer starpoint can also be changed locally in the bay unit in parallel to the setting in the master unit (**DA xx05/ZE**).

```
▲  1000 ■
▼  PARAMETERS
```

```
▲  1100 ■
▼  POWERSYSTEM DATA
```

Start of the block ”power system data”



```
►  1101 ■ CT STARPNT
◄  TOWARDS LINE
```

Setting for the current transformer polarity

- towards line
- towards bus

6.4.3 Test and control function – block 40

The bay units allow easy testing of the trip circuits and the circuit breaker by means of the local operation facilities.

The three–phase test is initiated through the bay unit by depressing function key F2 (direct addressing to **DA 4404/FE**). Pre–requisites for the test routine are that no protection function is active, that the bay is out of service and that the bay current is below the setting value I < CB–TEST (**DA 6313/ZE**).

The circuit breaker test can also be initiated per phase. For this purpose go to direct address **DA 4404/FE** and then scroll back by "◀" until reaching the desired test option.

```
▲ 4000 ■
▼ TESTS
```

Address block for tests and commissioning support

```
▶ 4400 ■ CB TEST
◀ LIVE TRIP
```

After selection of the desired test it is initiated by depressing key "ENTER".

```
▶ 4401 ■ CB TRIP
◀ CB POLE L1 ?
```

Circuit breaker test

- phase L1

```
▶ 4402 ■ CB TRIP
◀ CB POLE L2 ?
```

Circuit breaker test

- phase L2

```
▶ 4403 ■ CB TRIP
◀ CB POLE L3 ?
```

Circuit breaker test

- phase L3

```
▶ 4404 ■ CB TRIP
◀ CB THREE-POLE ?
```

Circuit breaker test

- three–phase

The test is initiated by confirmation of the question with key "ENTER".

The test result is shown in the display. Depressing key "ESC" or the vertical arrow keys means leaving the test block and jumping back to the higher operation level.

For any maintenance work in the bay, it has to be taken out of service.

First of all, local operation must be authorized for all bays from the master unit under address **DA 6317/ZE** .

Depressing the function key "F1" leads directly to the operation "bay out of service" (**DA 4501/FE**). If the bay already is out of service, then function key "F1" puts back the "bay in service".

```
▲ 4500■COMMUNICATI
▼ ON CONTROL UNIT
```

```
▶ 4501■Com. CU
◀ BAY OUT OF SER. ?
```

Start command ”bay out of service” by depressing key ”ENTER”. Repeat this operation. The result is shown in the display as a feedback ”BAY OUT OF SER.!”.

```
▶ 4502■Com. CU
◀ Bay in service ?
```

Starting the control function by key ”ENTER” executes the related function. The display shows the check-back information

6.4.4 Read out of operational measured values – block 57

Display of operational measured values is requested under address block 5700. For each address, one measured value is displayed. Password is not required.

Apart from this, four operational measured values can be displayed simultaneously, one value per display line. These operational measured values are displayed by depressing the LED–pushbuton. Exit from this mode by any other key.

The measured values which shall be displayed in the 4–line mode, are selected in parameter block **DA 7100/FE** (refer to chapter 6.4.1).

The displayed measured values are refreshed at a rate of 0.5 s.

Current values are displayed in percent of nominal quantities. Frequencies are displayed in Hertz.

The following operational measured values can be displayed:

```
▲ 5000■
▼ ANNUNCIATIONS
```

Annunciation block

```
▲ 5700■OPERATIONAL
▼ MEASURED VALUES
```

Start of the block ”operational measured values”

```
▶ 5701■MEAS. VALUE
◀ IL1[%]=100.0%
```

Current of phase L1
(display in xxxx.x %)

```
▶ 5702■MEAS. VALUE
◀ IL2[%]=101.0%
```

Current of phase L2

Current of phase L3

```
▶ 5703■MEAS. VALUE
◀ IL3[%]=101.5%
```

Earth current

```
▶ 5704■MEAS. VALUE
◀ IE[%]=1.1%
```

Phase–related operational measured value of the differential current. Display in percent.

```
▶ 5705■MEAS. VALUE
◀ IDL1[%]=0.1%
```

The differential current display for phases L2 and L3 follow under direct addresses **DA 5706/FE** and **DA 5707/FE**.

Phase–related operational measured value of the stabilizing current of the check zone.

```
▶ 5708■MEAS. VALUE
◀ ISL1[%]=0.1%
```

The stabilizing currents for phases L2 and L3 are displayed after selecting addresses **DA 5709/FE** and **DA 5710/FE**.

Nominal frequency in Hertz.

```
▶ 5711■MEAS. VALUE
◀ f[Hz]=50.1 Hz
```

Example for the ”4–line mode”

The display is requested by the pushbutton LED or from the initial display (**DA 0000/FE**) by depressing key ”ENTER”.

Selection of the measured values for display is done in adress block 71 (refer to chapter 6.4.1).

```
IL1[%]=100.1%
IL2[%]=100.3%
IL3[%]=101.0%
IE [%]=  1.0%
```

Example for display of absolute and percentage values.

```
IL1    =1000.3A
IL2    =1001.5A
IDL1[%]=  10.1%
ISL1[%]= 102.5%
```

6.5 Testing and commissioning

6.5.1 General

Pre–requisite for commissioning is the completion of the installation procedures detailed in chapter 5.

Warning

During the operation of electrical equipment, dangerous voltages are present on certain parts of the plant. Therefore, bodily harm and/or severe damage to equipment may occur if every action is not carried out with the utmost care.

Only qualified personnel which is thoroughly familiar with the relevant safety precautions and safety measures as well as with the warnings contained in this equipment manual should be permitted to work with this protection system.

In particular, the following should be observed:

- Before making any other connections, the unit must be earthed at the protective earth connection.
- Dangerous voltages may be present on parts which are connected to the power supply and to the measuring inputs.
- Dangerous voltages can still be present even after the supply voltage has been disconnected (capacitor storage).
- The limit values stated in the chapter "Technical Data" must not be exceeded; this applies also for testing and commissioning.

Danger

The secondary terminals of current transformers must be short–circuited, before the secondary circuit to the bay unit is opened!
If a test switch is installed which automatically short–circuits the current transformer secondary leads, then it is sufficient to move this switch to the "Test" position. The short–circuit switch must, however, be checked beforehand.

It is recommended to perform testing with the actual setting values of the protection system. If these are not (or not yet) known then testing should be carried out with the preset values. The following testing procedures are based on the preset setting values; for other setting values formulae have been provided.

For functional testing, one or two three–phase symmetrical current sources, with individually adjustable current are required.

Remark

The measuring accuracy which can be achieved depends on the electrical performance data of the test sets. The accuracy stated in the "Technical Data" can only be achieved if the reference conditions according to DIN VDE 0435/part 303 or IEC 255 are met and if precision instruments are used. Generally, tests using secondary test sets are to be regarded as being functional tests.

During all tests it is important to check that the proper indications appear on the LEDs and the proper signals appear at the outputs of the remote signalling relays.

6.5.2 Testing the pick–up values of the busbar protection

6.5.2.1 Test set–up

- For the purpose of testing the pick–up characteristic for the bus–selective function of the protection system, two bays (no sectionalizers or bus couplers) with identical normalizing factor (identical current transformer ratio) are connected to the same busbar (if necessary by simulation of isolator status). A different test set–up is required for the check zone (6.5.2.3).
- The test currents are injected directly into the bay units' measuring inputs. The nominal current of the bay unit is 1A or 5A, depending on the version.

  Fig 6.2 illustrates the set–up for the bus–section specific protection.

  The test set is disconnected by the feeder trip signals.

  The test set–up for the check zone is illustrated in Fig 6.3.

  If bus–selectivity is to be tested, then a few bays can be connected to the second bus (if necessary by simulation of isolator status).

6.5.2.2 Bus–zone specific protection

The check zone must be set more sensitive than the bus–section specific protection, so that the release from the check zone is issued before the release from the bus–section specific protection.

Example:

The characteristic for the bus–section specific protection with diff–current limit (**DA 6102/ZE**) = 2.0 I_{no} and stabilizing factor (**DA 6101/ZE**) = 0.8 should be tested.

The setting for the check zone is then: diff–current limit (**DA 6104/ZE**) = 0.5 I_{no} and stabilizing factor (**DA 6103/ZE**) = 0.5.

Settings:

- The diff–current supervision must be switched off, i.e. the parameter DIFF SUPERV (**DA 6303/ZE**). must be changed over to "inactive" so that the diff–current supervision does not block the protection during testing.
- The differential current limit and the stabilizing factor must be set as required for the bus–section specific protection and the check zone.
- The overcurrent limits "I>TRIP" for the related bays (block 65) have to be set to 0.

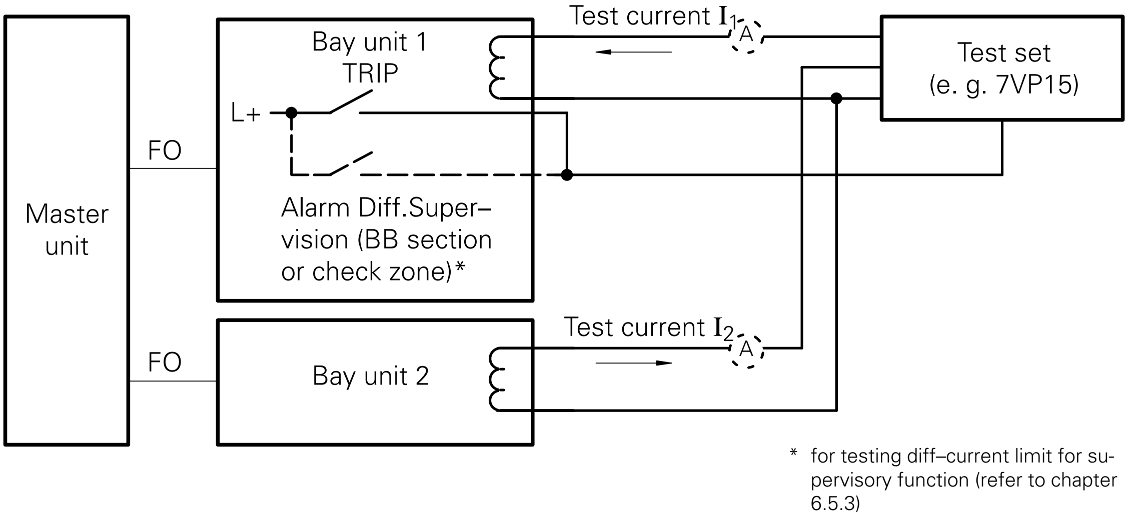


Figure 6.2 Test set–up for testing the characteristic for the bus–section specific protection

Test steps:

1. Test currents I_1 and I_2 must have a phase difference of 180°. To check the phase angle, an identical current (0.5 I_N) is injected through feeder 1 and feeder 2 from the test set.

   With the correct phase angle and connection, the diff–current must amount to almost zero and the stabilizing current must be 2 x the test current. If the differential current is not zero, then the polarity of the current in one feeder must be reversed. Display of the differential and stabilizing currents via the corresponding block addresses 74; 75 and 76.

2. With $I_2 = 0$, the current I_1 is increased until a trip signal is initiated. The current in feeder 1 is then the diff–current limit (**DA 6102/ZE**).

3. A constant current I_1, which is smaller than the set diff–current limit, is fed into feeder 1 from the test set. The current I_2 in feeder 2 is slowly increased until the protection picks up.

   Differential current is then $\Delta I = | I_1 + I_2 |$ and the stabilizing current $\Sigma | I | = | I_1 | + | I_2 |$.
   Stabilizing factor $k = \Delta I / \Sigma | I | = | I1 + I2 | / (| I1 | + | I2 |)$

4. For the characteristic $| I_2 - I_1 | = k [| I_1 | + | I_2 |]$
   Since I_1 and I_2 have a phase angle difference of 180° the following is obtained

   $I_2 (1 - k) = I_1 (1 + k)$ resp. $I_2 = I_1 \frac{1 + k}{1 - k}$
   with k = 0.8 it follows that $I_2 = 9 I_1$

5. The test is repeated with different constant currents I_1(correct shape of the characteristic is given in Fig 6.4).

6.5.2.3 Check zone

The bus–section specific protection must be set more sensitive than the check zone, so that the release from the bus–section specific protection is issued before the trip from the check zone.

Example:

The characteristic for the check zone with diff–current limit (**DA 6104/ZE**) = 2.0 I_{no} and stabilizing factor (**DA 6103/ZE**) = 0.8 is to be checked.
The setting for the bus–section specific protection is then the diff–current limit (**DA 6102/ZE**) = 0.5 I_{no} and stabilizing factor (**DA 6101/ZE**) = 0.8.

Settings: as under 6.5.2.2

Test set–up:

For the tests, three bays (with the same normalizing factor) were used. Sectionalizing isolators, couplers and sectionalizers must not be used for the tests.

Bays 1 and 2 are connected via the isolators to the same busbar (if necessary by simulation of isolator status).

The current inputs in the 7SS52 for these bays are connected with opposite polarity (refer Fig 6.3). The third bay 3 is connected to a different busbar (if necesssary by simulation of isolator status).

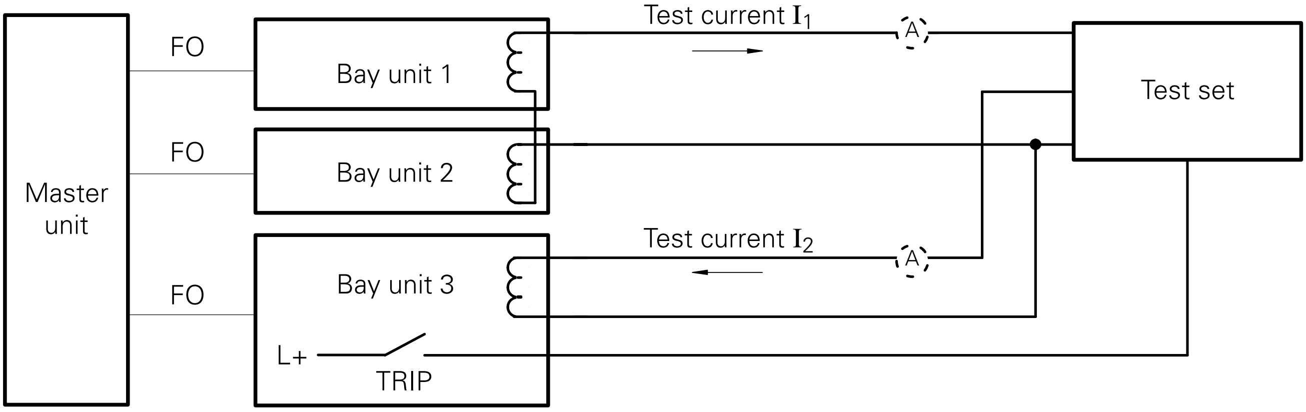


Figure 6.3 Test set–up for the check zone

Test steps:

1. The currents in bays 1 and 2 must flow in opposite directions. In order to check this, a current is injected into feeders 1 and 2.

   With correct connections, the diff–current must be almost zero and the stabilizing current 2 x test current (bays via **DA 7400, 7500 and 7600**). If the differential current is not almost zero, then all connections must be checked.

2. With I_1 = 0, current I_2 is increased until the measuring system allocated to bay 3 issues a trip command. Then current I_2 is the differential current limit (**DA 6102/ZE**).

3. Bays 1 and 2 are injected with a constant current I_1 from the test set.

   The current I_2 in bay 3 is slowly increased until the protection trips.

   I_2 is then the differential current and I_1 the stabilizing current (refer to chapter 4.4).
   Stabilizing factor is then k = I_2/I_1

4. The test is repeated with different constant currents I_1. (correct shape of the characteristic is given in Fig 6.4).

   Remark:
   The stabilizing current of the ZPS–BSZ1 shown under **DA 7400/ZE** does not consider the special treatment according to chapter 4.4.

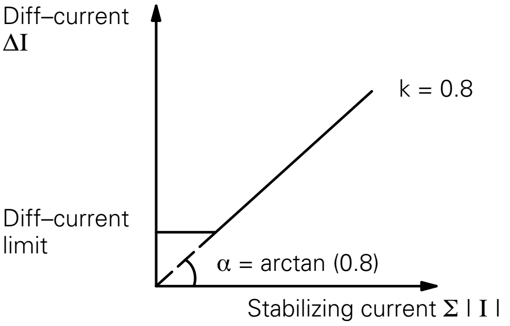


Figure 6.4 Pick–up characteristic of busbar protection

6.5.3 Checking the differential current limit for differential current supervision

6.5.3.1 Test set–up

(as in chapter 6.5.2.1)

Time measurement can be done directly with modern test sets.

6.5.3.2 Bus–section specific protection

The check zone must have a higher setting than the bus–section specific protection, so that the differential current supervision of the check zone picks up after that of the bus–section specific protection.

Example:

The supervision for the bus–section specific protection with diff–current limit $I >$ DIFsup:BZ (**DA 6305/ZE**) = 0.2 I/I_{no} is to be checked. The time T–DIFF–SUP (**DA 6304/ZE**) is to be set to 2.0 s.

The setting for the check zone $I >$ DIFsup:CZ (**DA 6306/ZE**) could then be set to 0.8 I/I_{no}.

Settings:

- In order for the diff–current supervision to block the protection, it must be operative, i.e. the parameter DIFF SUPERV (**DA 6303/ZE**) must be set to ”active”.
- The differential current limit (**DA 6305/ZE**) and the blocking time for the diff–current supervision (**DA 6304/ZE**) are set as required.
- The overcurrent limits ”I>TRIP” for the respective bays (blocks 65) must be parameterized to 0.

Test steps:

Parameter **DA 6307/ZE** set to ”blocking”

1. Bays 1 and 2 are connected to separate busbars.
2. Current I_1 in bay 1 is gradually increased until differential current supervision is indicated. The current is recorded and must correspond to the set pick–up limit (**DA 6305/ZE**).
3. A current of 4 x I_N is injected in feeder 2. With correct protection operation, the portable test set is disconnected from feeder 2.

   Test steps 2. and 3. should prove that the diff–current supervision is bus–section specific.

Parameter **DA 6307/ZE** set to ”alarm”

4. Bays 1 and 2 must be connected to the same bus section. The current I_1 in bay 1 is increased gradually until the alarm appears. Then a current 4 x I_N is switched on. With correct functioning, a trip command is given.
5. In order to measure the time delay for diff–current blocking, a current of 2 x the set diff–current limit $I >$ DIFsup: BZ (**DA 6305/ZE**) is injected by portable test set into feeder 1. Test set is disconnected by the diff–current supervision signal. The measured time corresponds to the set time T–SUPERV (**DA 6304/ZE**).

6.5.3.3 Check zone

The bus–section specific protection must have a higher setting than the check zone, so that the check zone supervision picks up before the bus–section specific protection.

Example:

The supervision for the check zone is to be checked with diff–current limit I > DIFsup : CZ (**DA 6306/ZE**) = 0.2 $I/I_{no.}$ The time T–DIFF–SUP (**DA 6304/ZE**) should be set to 2.0 s. The setting for the bus–section specific protection I > DIFsup : BZ (**DA 6305/ZE**) could then be 0.8 I/I_{no}.

Settings:

- DIFF.SUPERV set to "active"; **DA 6303/ZE**
- I > DIFsup:BZ = 0.80 I/I_{no}; **DA 6305/ZE**
- I > DIFsup:CZ = 0.20 I/I_{no}; **DA 6306/ZE**
- T–DIFF–SUP = 2 s; **DA 6304/ZE**

Test steps:

a) Checking pick–up limit and time delay

1. The current in feeder 1 is slowly increased until the supervision of the check zone picks up. The measured current must correspond to the set current (**DA 6306/ZE**).
2. Time measurement is performed as in test step 5. of chapter 6.5.3.2.

b) Checking the blocking

1. When the diff–supervision of the check zone picks up, the protection can be blocked (**DA 6308/ZE**) or an alarm can be issued DIFF SUP CZ = alarm only
2. Bays 1 and 2 are connected to the same bus.
3. The current in feeder 1 is slowly increased until the supervision of the check zone picks up.
4. In feeder 2, a current of 4 x I_N is injected. If parameter DIFF SUP CZ (**DA 6308/ZE**) was set to "block", then no trip commands are issued.

6.5.4 Testing the pick–up values for controlled tripping

6.5.4.1 Test set–up

(as in chapter 6.5.2.1)

6.5.4.2 Test steps

Settings:

The overcurrent limit for tripping should be checked for two feeders "I > TRIP".

Settings:

- In order to prevent the diff–current supervision from blocking the protection during testing, it must be turned off, DIFF SUPERV (**DA 6303/ZE**).
- The differential current limits for the bus–section specific protection I>DIFF:BZ (**DA 6102/ZE**) and for the check zone I>DIFF:CZ(**DA 6104/ZE**) are both set to 1.0 I/I_{no}.
- The overcurrent limit for bay 1 (**DA 65XX**) is set to 2.0I/I_{no} and for bay 2 (**DA 65YY**) to 0.

Test steps:

1. Bays 1 and 2 are connected to the same busbar (by simulation of isolator status).
2. The current in bay 1 is slowly increased via the test set. When reaching approximately 1 x I_N bay unit 2 must issue a trip command, because the overcurrent limit for this bay was set to 0. Bay unit 2 must issue a trip command at 2 x I_N.

6.5.5 Functional testing of circuit–breaker failure protection

6.5.5.1 Pick–up characteristic in mode of operation ”forced bus zone unbalance”

6.5.5.1.1 Test set–up

(as for chapter 6.5.2.1 with the exception that the check zone does not require special treatment, test set–up as in Fig 6.5..)

Example:

The pick–up characteristic is defined by following settings:

Differential current limit: $I >$ DIFF:BF (**DA 6203/ZE**) = 0.5 I/I_N
Stabilizing factor: STAB.FAC:BF (**DA 6202/ZE**) = 0.5

Settings:

To prevent the diff–current supervision from blocking the protection, it must be turned off, DIFF SUPERV (**DA 6303/ZE**).

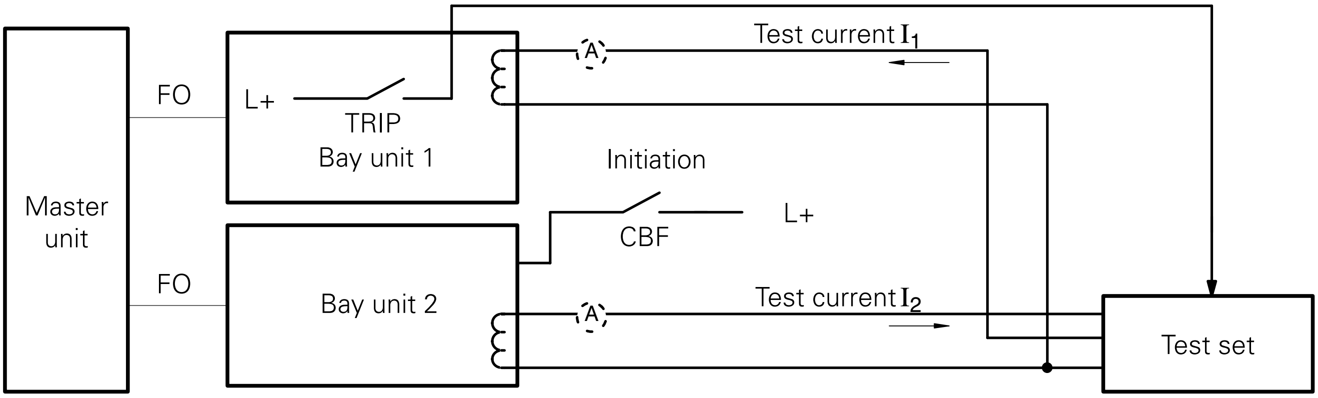


Figure 6.5 Test set–up for checking the characteristic of the circuit–breaker failure protection function

- The supervision of the CB failure protection initiation must be switched off, i.e. the parameter (**DA 6201/ZE**) (BF BI MODE) must be set to ”... no sup”.
- The breaker failure protection is parameterized bay–selective to the operation mode ”unbalance” (**DA 66XX/ZE**).
- The differential current limit $I >$ DIFF.:BF (**DA 6203/ZE**) and the stabilizing factor STAB.FAC: BF (**DA 6202/ZE**) are set to the required values.

6.5.5.1.2 Test steps

1. The test currents I_1 and I_2 must have the same phase angle. In order to check the phase angle, an identical current is sent through bay 1 and bay 2 from test set with the same normalization. With the correct phase angle and connections, the diff–current and the stabilizing current must be nearly 2 x the test current. Otherwise the polarity of the current in one feeder must be reversed. Display of the differential and stabilizing currents is requested by the corresponding address blocks 74; 75 and 76.

   It must be ensured that both bays are connected to the same busbar (confirmation by displaying the isolator replica via address block 73).

2. Bay unit 1 is injected with a constant current I_1 via the test set. After initiation by the feeder protection (trip signal) in bay 2, the measured value of bay 2 is continuously unbalanced. The current in bay 2 is slowly increased until the protection trips.
3. The differential current is then $| I_1 + I_2 |$ and the stabilizing current is $| I_1 | + | I_2 |$.

   The stabilizing factor is then differential current/ stabilizing current
   $k = | I_1 - I_2 | / | I_1 | + | I_2 |$

6.5.5.2 Checking the time delay with mode of operation ”forced bus zone unbalance”

The test set–up for the measurement of the time delay with mode of operation ”unbalance” is illustrated in Fig 6.6. This test is performed with a setting of 250 ms for T–CBF (**DA 6204/ZE**).

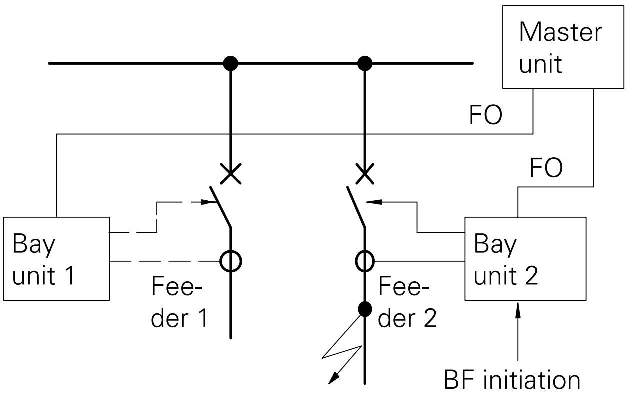


Figure 6.6 Test set–up for unbalance time measurement

- The two feeders are normalized to the same value (same CT transformation ratio).
- The polarity of the CTs is connected such that the current (approx. 2 I_N) before unbalance corresponds to an external short–circuit (through current) (Diff current approx. zero).

Time measurement is started when the feeder protection trip signal is simulated for feeder 2. The timer is stopped by the trip signal of the busbar protection.

- The measured time corresponds to the delay time for unbalance plus protection trip time.

6.5.6 General recommendations for setting the protection

6.5.6.1 Busbar protection

a) Differential current supervision (**DA 6305/ZE; DA 6306/ZE**)

   Range: 0.05 to 0.80 I_{no}
   Recommended setting for the bus–section specific protection (**DA 6305/ZE**) = 0.10 I/I_{no}
   Recommended setting for the check zone (**DA 6306/ZE**) = 0.10 I/I_{no}
   Time for protection blocking/alarm (**DA 6304/ZE**)
   Range: 1.0 to 10 s
   Recommended setting (**DA 6304**) = 2.0 s

b) Differential current pick–up for tripping (**DA 6102/ZE; DA 6104/ZE**)

   Range: 0.2 to 4.0 I_{no}
   Setting depends on short–circuit current.

   Setting value ≤ 0.6 $I_{sc\ min}$ 3–phase
   0.3 $I_{sc\ min}$ 2–phase
   1.0 $I_{sc\ min}$ 1–phase

   Firstly, the smallest fault current which can be expected in the event of a short–circuit must be determined.

   From that value and the above mentioned data, the maximum permissible setting value is calculated.

c) Stabilizing factor k (**DA 6101/ZE; DA 6103/ZE**)

The following two criteria are important for the selection of k:

1. Type of current transformer – linear or conventional..

   CTs with closed iron cores transmit the DC component with little reduction. Linearized CTs, however, reduce the DC component considerably.

2. The burden factor k_{0F} of the current transformers.

   This factor is calculated from the maximum continuous short–circuit current I_{sc} and that current I_s at which CT saturation starts:

   $k_{0F} = I_{sc}/I_s$

   The saturation current I_s is derived from the rated current I_N and the operational overcurrent number n'.

   $I_s = I_N \cdot n'$

   Operational overcurrent number results from the CT data and the actual burden of the current transformer.

   $n' = (P_n + P_i) \cdot n / (P_b + P_i)$
   P_n = rated CT burden
   P_b = connected burden (protection + leads + intermediate CT if applicable)
   P_i = internal burden of main current transformer

   The k factor to be set is then:

   $k > k_{0F} / 4 \sqrt{k_{0F}-1}$

   The basis for this formula is summarized in appendix A.1.3.

   When choosing k, the largest burden factor k_{0F} of all the CTs in the outgoing feeders from the busbar must be considered.

d) Response to diff–supervision
(**DA 6307/ZE; DA 6308/ZE**)

   Setting possibilities: "alarm only", "block with automatic release" or "block with storage"

   Recommended setting: "alarm only"

   The corresponding busbar can be selected via the bus–related differential current supervision "block". The check zone supervision should be parameterized for "alarm only", so that blocking of the complete protection is avoided.

6.5.6.2 Circuit–breaker failure protection

a) Operation mode of the CBF (**DA 6201/ZE**)

Setting options:	1–channel with/without supervision 2–channel with/without supervision
Recommended setting:	”1– or 2–channel with supervision” during operation ”1– or 2–channel without supervision” during test

b) CBF–variant bay–selective (**DA 66XX/ZE**)

Setting options:	– BZ unbalance – trip by external CBF – TRIP repeat/ unbalance – TRIP repeat/ unbalance–pulse – TRIP repeat/ $I >$ sensor – $I >$ sensor
Recommended setting:	depends on CBF initialization

c) Stabilizing factor for the pick–up characteristic in the ”unbalance”mode of operation ”TRIP rep/unbal” and ”TRIP/UNB pulse”(**DA 6202/ZE**)

Range:	0 to 0.8
Recommended setting:	refer chapter 6.5.6.1

d) Diff–current limit for the pick–up characteristic in the ”unbalance” mode of operation ”TRIP–rep/unbal” and ”TRIP/UNB pulse”(**DA 6203/ZE**)

Range:	0.2 to 4.0 I/I_N
Recommended setting:	0.5 I/I_N

e) Time delay for the breaker failure protection processing (**DA 6204/ZE**)

Range:	0.05 to 1 s
Recommended setting:	2 x circuit–breaker trip time

f) Current limit for determining circuit–breaker failure in the event of busbar short–circuit and for trip signal reset bay–selective (**DA 67XX/ZE**)

Range:	0.02 to 2.0 I_N
Recommended setting:	depends on the lowest short–circuit current that can be expected.

g) Time delay for trip repetition (**DA 6208/ZE**)

Range:	0 to 1 s
Recommended setting:	0.12 s

6.5.6.3 Supervisory functions

a) Isolator running time(**DA 6301/ZE**)

Range:	1 to 180 s
Recommended setting:	depends on isolator

b) Isolator mal–function response(**DA 6302/ZE**)

Setting possibilities:	– alarm only – blocking w. autom. release – blocking with storage
Recommended setting:	alarm only

c) Cyclic test (**DA 6311/ZE**)

Setting possibilities:	active/inactive
Recommended setting:	active

d) Differential current supervision (**DA 6303/ZE**)

Setting possibilities:	active/inactive
Recommended setting:	active during normal operation; inactive during testing and commission–ing

e) Zero crossing supervision (**DA 6309/ZE**)

Setting possibilities:	active/inactive
Recommended setting:	active when using linearized CTs

f) Diff–current limit for zero crossing measurement (**DA 6310/ZE**)

Range: 0.2 to 4.0 I/I_{no}
Recommended setting: 0.5 I/I_{no}

g) Protection response during pick–up of automatic testing
(**DA 6312/ZE**)

Setting possibilities: alarm only/protection blocking
Recommended setting: alarm only

h) Supervision time of breaker failure protection release(**DA 6314/ZE**)

Range: 0.02 to 10 s
Recommended setting: 1 s

i) Delay time for supervision of the CBF release (**DA 6315/ZE**)

Range: 0.06 to 1 s
Recommended setting: 0.06 s

6.5.6.4 Overcurrent release of the bay trip command

(setting per bay; **DA 65XX/ZE**)

Range: 0 to 25 I_N (I_N = rated current of current transformers in feeder)
Recommended setting: depends on lowest short–circuit current that can be expected.

6.6 Commissioning with primary values

All secondary test sets must be removed. Measuring inputs must be connected. The installation instructions according to chapter 5.2 must have been completed. For the primary tests, the switchgear must be connected and switched on.

Warning

Primary tests may only be conducted by qualified personnel who are fully conversant with the commissioning of protection systems, the operation of the network and with the safety regulations and precautions (switching, earthing, etc.).

6.6.1 Checking the current transformer polarity with the load current.

1st step:
Read out isolator mimic by direct addressing **DA 7300/ZE**. The indications represent the station status (which isolator is connected to which busbar).

2nd step:
Take all feeders out of service with **DA 64XX/ZE; DA 4500/FE** or via the binary inputs of the bay units. Read out commissioning measured values for ZPS–BSZ1 to 3 (**DA 7400/ZE** for ZPS–BSZ1, **DA 7500/ZE** for ZPS–BSZ2 and **DA 7600/ZE** for ZPS–BSZ3). If the protection is functioning properly, the diff–current for ZPS–BSZ2 andZPS–BSZ3 should be nearly zero and under ZPS–BSZ1 the actual diff–current with the set CT polarity should be displayed, since taking the feeders out of service should have no effect on ZPS–BSZ1.

On the bay units the differential and stabilizing currents of the check zone are also displayed. This allows immediate local check of modified CT polarities via **DA 1101/FE**.

For further commissioning work, the diff–current in ZPS–BSZ1 is only read after all CTs have been set to the correct polarity.

3rd step:
One feeder at a time is released in turn and the differential and stabilizing currents are read out via **DA 7500/ZE, DA 7600/ZE**. The results must be equal to feeder current x normalizing factor (CT ratio **DA XX06/ZE**). Otherwise, the CT ratio must be checked for correctness.

This step is repeated individually for each feeder.

At the conclusion of this, all feeders are taken ”out of service”.

4th step:
The feeder with the largest current connected to busbar X is put into service and the diff–current on ZPS–BSZ2 and 3 is recorded.

5th step:
Next, the feeder connected to busbar X with the second largest current is put into service. If the load direction is the same as for the feeder in step 4, then the diff–current should be greater provided the polarity of the CT is correct. Otherwise, the polarity of the CT must be reversed by changing the setting in the correct DA (e.g. **DA YY05/ZE** for feeder YY) (see capter 6.2.3.3).

For opposite load direction, suitable measures must be adopted. The stabilizing current is the average value of the sum of the magnitudes of the connected currents. For sinusoidal currents, the r.m.s. values are calculated by applying the factor 1.11.

6th step:
Step 5.) is repeated until all feeders of BZ X have been taken into service.

7th step:
Steps 4.), 5.) und 6.) are repeated for all other busbars. At the end of these measurements, the diff–current should amount to almost zero.

8th step:
Diff–current and stabilizing current of ZPS–BSZ1 are read out via **DA 7400/ZE**. The diff–current must be almost zero and the stabilizing current must correspond to the average value of the sum of the magnitudes.

9th step:
If the station conditions permit, busbar coupling via isolators and bus tie bay the above described tests should be repeated in order to check the bus preference and the current transformer polarity in the bus tie bay.

The protection software includes a measurement preference with solid (isolator) bus coupling.

10th step:
Create current conditions such that the polarity of the CTs including summation circuit (I_E) can be determined for each feeder.

Remarks:
For checking the polarity, a service feeder current of at least 0.1/CT normalizing factor is required, e.g. with n_{ct}= 1, 10% of the rated current is required and with n_{ct} = 0.5, 20% of rated current is required.

If insufficient current is available for the test, then testing of such feeders must be performed with a primary test set.

6.6.2 Checking the connections of the circuit–breaker failure protection initiation inputs

Subsequent to chapter 6.6.1, the tests below can be performed:

1st step:
The supervision for the CB failure protection initiation (**DA 6201/ZE**) must be switched off and mode of operation ”unbalance” bay–selective (**DA 66XX/ZE**) must be selected.

2nd step:
The CB failure protection for one feeder is initiated.

The differential and stabilizing currents are displayed under **DA 7400/ZE**. The differential current must be equal to the feeder current with CB failure protection initiation x normalizing factor. The stabilizing current should be the same before and after the initiation.

This step is repeated for each feeder.

3rd step:
Following the conclusion of the test, the supervision for the CB failure protection initiation is released (**DA 6201/ZE**).

6.6.3 Checking the alarms and trip signals

The circuit–breaker test can be performed by current injection or by a manual trip command , which generates a protection trip command or a trip command via **DA 8200/ZE** – see chapter 6.2.5.3 or **DA 4400/FE** – see chapter 6.4.3).

Before starting the test, the corresponding feeder has to be taken out of service. Following this step the circuit breaker test may be performed.

The test of the alarm relays and LEDs of the master unit is supported by the DIGSI software. Energization and deenergization is carried out automatically after selection of the corresponding alarm relay number. Optical and acoustical indicators should be used to check the alarm relays.

6.6.4 Switching the protection into service

All setting values should be checked again, in case they were altered during the tests. Switching the miniature circuit breakers of the DC supply OFF and ON cancels all alarms (including operations alarms) and the fault record memory of the master unit.

The ”ready for operation” LED (green) at the ZE must be on. The failure indication (red) must be off.

All trip signals can now be switched through. If a test switch is available, it must be in the ”service” position.

No alarm may be present (on the EAZ1 and EAZ2 module) .

7 Maintenance

The 7SS52 does not require any special maintenance. All circuits processing measured values and signals are designed in static technique.

As the protection is almost completely self–monitored, from the measuring inputs through the measuring systems up to the coils of the trip relays, device faults are automatically annunciated. This yields an enhanced availability of the protection system. Maintenance tests at short intervals therefore become superfluous.

7.1 Maintenance recommendation

Functional tests of the protection system are recommended in intervals of 5 years.

Before executing tests or maintenance works it has to be ensured that there arises no danger for personnel and that the tests do not influence station components which are in service.

The warnings given in chapter 6.5.1 have to be observed!

1. Check of all measuring circuits with regard to the accuracy requirements. For this purpose test currents have to be injected into each bay unit, their magnitude lying in the nominal current range (selected between 0.8 and 1.2 I_N) as well as in the fault current range (I_{test} > 6.3 I_N). In order to avoid a protection trip, an external fault has to be simulated.

   When testing with fault current, attention has to be paid to eventual thermal overloading of the input current transformers. Currents up to 30 x I_N are permissible for a duration of 10s. After this a cooling down period should be allowed.

   The magnitude of the injected current value is monitored by means of reading the bay current at the master unit (**DA 7800/ZE**). A tolerance of up to 5 % is permissible.

2. Functional test of the trip circuits per bay unit. They are checked using the integrated supplementary function circuit breaker test (refer to chapters 6.2.5.3 and 6.4.3).
3. Check the function of the binary inputs in the bay units and the master unit. Both states of the binary inputs are simulated. The reaction of the protection to the selected input signal can be analysed via the LED indications or by means of the contents in the operations or fault event memories.
4. Check the alarm outputs
   Apart from the alarm relay M1 in the bay units the function of KR5 ("transfer trip") has to be tested. This can be achieved by

   a) simulating the marshalled function or

   b) if this causes difficulties, then configuration to the function circuit breaker test is recommended. Then the function can be started by integrated operation.

      After completion of the test, the original configuration has to be re–established.

The functional check of the alarm relays is supported by software (refer to chapter 6.2.6.2 "6.Test alarm relays" on page 6 – 24).

7.2 Fault analysis

Disturbances of digital protection devices are in most cases caused by component failures. Practical experience also shows that ambiental conditions (e.g. short electromagnetic interference beyond the values guaranteed by the manufacturer) may in few cases initiate failure alarm.

Continuous failures in the protection system or its components are indicated at the master unit by changing the operations indication from LED green, to the red LED ”failure” and reset of the alarm relay ”device failure”. Additionally the protection system is blocked in order to avoid overfunction.

The disturbance can be caused by:

1. Failures in the master unit
   (Failure or defect in the auxiliary voltage supply, module failure)
2. Failures in one of the connected bay units (interruption of power supply, defective measuring circuit, module failure)
3. Interruption of the communication link to one of the bay units
   (defective transmission or reception modules, interrupted FO link, increased number of transmission errors)

Guided by the various failure causes, a systematical analysis has to be carried out. The user is herewith supported by the protection system’s diagnostic information:

1. Master unit
   - operational event buffer
   - fault event buffer
   - operational events marshalled to LEDs (refer to chapter 6.2.7)
   - LED indications on the modules
2. Bay unit
   - operational events marshalled to LEDs (refer to chapter 6.4.2.4)

7.2.1 Analysis of operational events

The master unit’s operational events provide first hand information about the cause of a registered device failure. If operational events which have been marshalled to LEDs are missing, then the operational event buffer in the master unit has to be interrogated (**DA7100/ZE**). The user gets information about

- auxiliary voltage failure,
- pick–up of the differential current supervision,
- errors in the measured value supervision of the bay units and
- failure detection by the cyclic test.

Detected failures in the bay unit are indicated with their bay number in order to locate the failure.

Thus the failure can further be located locally in the bay. Operational events which support identification of a failure are e.g.:

- Disturbance of the power supply
- Failure detection by the measured value supervision.

7.2.2 Checking the auxiliary voltage supply

The alarm of auxiliary voltage failure in the protection device can be caused by a device failure as well as by disturbances in the external wiring. It should be checked whether

- auxiliary voltage can be measured with adaquate magnitude and correct polarity,
- the ON/OFF switch for the integrated converter on the front plate of the FE or behind the front plate of the ZE is in ON position,
- the modules are correctly fitted and locked and
- the fuses in the power supply section of the FE (module SAF) or ZE (module SV) have not blown.

The explanation of the LED indication of the power supply module in the master unit is given in chapter 7.2.4.

7.2.3 Replacement of fuses

The power supply modules SV in the master unit and SAF in the bay units are protected against short–circuit by fine–wire fuses.

For checking or replacement of these fuses, the units' front plates has to be opened after loosening the fixing screws.

The SV is located at the extreme right mounting place in the subrack of the ZE (refer to Fig 2.2). This module can be withdrawn from the subrack after switching off the auxiliary voltage and loosening the module lock).

The module SAF of the bay unit (refer to Fig 2.3) can be withdrawn from the casing after removing the front ribbon cable.

For easy removal of the modules the extraction tool, which is part of the delivery, may be used.

Attention

Electrostatic discharges across the modules' connectors, printed conductors and connection pins have to be avoided by previously contacting earthed metal parts.

Note

Even after disconnection of the power supply or removal of modules dangerous voltages may be present in the device (capacitor storage)!

The withdrawn modules shall be placed vertically on the laboratory table. The use of a conductive surface (e.g. EMC–mat) is recommended for the modules in order to avoid electromagnetic discharging via components.

The location of the fuse element can be seen in Fig 7.1 and 7.2.

After checking the fine–wire fuses, the module is inserted into the casing. Care must be taken that the module is fixed correctly and firmly contacted with the rear–side plug connector.

Then the removed electrical connections have to be re–established and the front cover closed. Please note that the switch for the power supply SV in the master unit is not accessible with closed front plate.

The device is switched ON. If the auxiliary voltage failure continues to be indicated, then there must be a failure or short–circuit in the internal power supply. The power supply module should be sent to the factory.

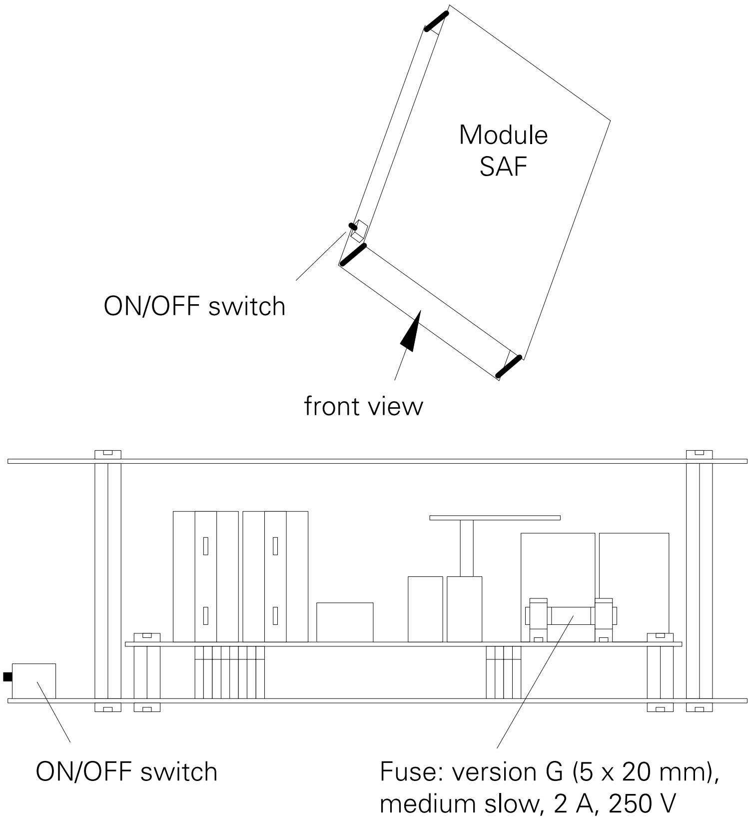


Figure 7.1 Location of the fine–wire fuse in the power supply module SAF of the bay unit

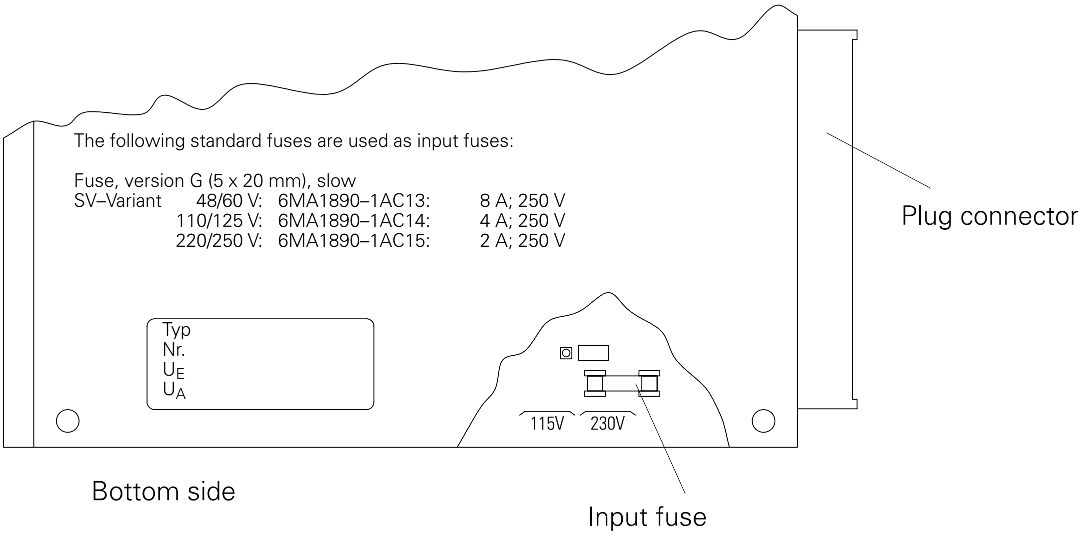


Figure 7.2 Location of the fine–wire fuse in the power supply module SV of the master unit

7.2.4 Check of the LEDs on the modules

The modules ZPS–SBK, ZPS–BSZ, ZPS–SK and SV are equipped with LED indications which are visible after opening the front plate of the master unit.

Warning

For testing and commissioning, the ruling safety regulations for working in high–voltage installations have to be obeyed.

The following test steps are performed partly in the presence of dangerous voltages. They must only be executed by qualified personnel, who are familiar with the safety regulations and precautions and follow these.

5 LEDs are located vertically on the modules ZPS. The functions of their indiactions are described below.

1. ZPS–SBK

Table 7.1 ZPS–SBK

LED status	RED H1	GRN H1	YELL1 H2	YELL2 H3	YELL3 H4	Status
1	–	x	–	+	⊗	Normal operation status
2	x				+	Failure status (diagnosis by means of fault buffer required)

Detected system failures cause reset of the protection device. If such a failure cannot be eliminated by a restart, a second restart is attempted. After three unsuccessful restart attempts the protection is automatically taken out of service and the failure is indicated by the alarm relay ”device failure”.

This is indicated on the ZPS–SBK by flashing of the 3rd yellow LED (H4). The cause for the failure which blocked the protection is read from the fault buffer.

Depressing keys ”F2” and ”1” indicates at the LC–display the latest status information in the fault record buffer. When communicating via the software DIGSI, the contents of the fault record buffer are directly displayed after depressing the protection device. The further analysis is described in chapter 7.2.5.

2. ZPS–BSZ

Table 7.2 ZPS–BSZ

LED status	RED H1	GRN H1	YELL1 H2	YELL2 H3	YELL3 H4	Status
1	–	x	–	+	–	Normal operation status
2	x				+	Failure status
3	x	–	x	–	–	Start–up not completed succesfully (diagnosis by means of fault buffer required)

3. ZPS–SK

Table 7.3 ZPS–SK

LED status	RED H1	GRN H1	YELL1 H2	YELL2 H3	YELL3 H4	Status
5	–	x	–	–	–	Fault–free cyclic process
6	x	+	–	–	+	Failure of one bay unit or one channel
7	x	–	–	–	+	Failure of the SK module

x bright
– dark
+ flashing
⊗ dim

Fault–free processing is indicated by the green LED. In the event of a module failure, the red LED lights up. In the event of failure of a configured bay, but normal function of the module, additionally the green LED flashes.

Depressing the pushbutton S5 which is located under the LEDs, causes a module reset with the ZPS–BSZ and ZPS–SK. Depressing the pushbutton on the ZPS–SBK causes a system reset, the ZE is started up. In addition the setting parameters related to the bay units are updated without restart

Table 7.4 Power supply module of the master unit

LED designation	Colour	Function
+5 V	GREEN	Auxiliary voltage for supply of the processor boards and for the alarm relay ”device failure”
+15 V	GREEN	Auxiliary voltage not used for the master unit
–15 V	GREEN	Auxiliary voltage exclusively for contrast control of the LC display
+15 V	GREEN	Alarm relay voltage
–15 V	GREEN	Auxiliary voltage not used for the master unit
+24 V	GREEN	Alarm relay voltage

LED ON means that the corresponding auxiliary voltage is available.

If the LED indication fails completely, then the auxiliary voltage supply must be checked (chapter 7.2.2) or the fine–wire fuse has to be replaced (chapter 7.2.3). Defective power supplies must be replaced.

7.2.5 Fault indication and analysis of the fault buffer

System faults are recorded in a fault record buffer for posterior analysis and in most cases indicated directly at the 4–line LC–display (plain text).

The display characterizes a more detailed specification of the failure (eventually indication of the faulty processor board or bay unit) and an operating instruction (e.g. faulty bay unit can be taken out of service, if the failure cannot be eliminated immediately).

```
Fault BU No 04
no reception
Bay 04 o.service → go on
exit Monitor <ESC>
```

Display in case of auxiliary voltage failure of bay unit no 4

```
No. of cards wrong
act: 05 must: 06
Error Buffer <F2>
exit Monitor <ESC>
```

Display in case of missing ZPS–SK–no 2 (e.g. with 9 existing bays)

Read–out of the fault record buffer contents can only be executed from the ”monitor function”. This function is entered by a triple system reset or by entering the specific password ”321”.

The fault buffer contains only information in the hexadecimal format.

The detailed meaning of the displayed information can be interpreted only by the manufacturer’s specialists. Therefore in the event of detected disturbances the manufacturer should be contacted.

The status events in the fault buffer can be read out either by using the integrated keypad of the master unit or supported by the communication program DIGSI (”emulation keypad”).

After entering the password ”321”, followed by the ”ENTER”–key, start of the monitor–function is confirmed after depressing key ”F2”. Depressing key ”1” starts read out of the fault buffer. Consecutive depressing of key ”1” indicates always the next of the up to 20 status events.

Display

```
02.00   0000   0000   0000
00   000000000
```

Operation via DIGSI displays all 20 status events on the screen after entering the key sequence XFO.

Meaning of the display:

```
aa.bb   cccc   dddd   eeee
ff   ggggggggg
```

a	b	c	d	e	f	g
SNR	FNR	TNR	FI1	FI2	FI3	RELZ

SNR	Number of the status event
FNR	Type of failure
TNR	Task number
FI1	Failure information 1
FI2	Failure information 2
FI3	Failure information 3
RELZ	Relative time in milliseconds

The first event which will be read out, is the most recent system event. In most cases this is the information that the protection has attempted the third restart. The cause for this event can be found in the following events which are read out.

These events were written previously as can be seen from the relative time tag.

Leaving the fault buffer is possible by the combination of keys ”CTRL + Z” in DIGSI (”emulation keypad”) or on the keypad itself by depressing the ”ESC”–key twice.

In most cases, disturbances occuring out of an operational situation, can be eliminated by replacing modules.

Table 7.5 shows a list of some typical status events from the fault buffer, which help the operation personnel in locating the fault cause.

If the fault cannot be clearly identified, then the contents of the fault buffer should be sent to the manufacturer. After saving the status events, a new restart may be attempted by switching OFF and ON the master unit. This cancels all information in the fault buffer. (The no–voltage status should last >30 s in order to guarantee erasure of the fault record buffer contents.)

Table 7.5 Status events

Cons. no	FNR (HEX)	TNR (HEX)	FI1	FI2	FI3	Description of fault (countermeasures)	plain text indication
1.	03				1	slave module (ZPS–BSZ or ZPS–SK) cannot be addressed (substitution of module recommended)	yes
2.	04	102 600			1	More than one ZPS module with identical coding (change jumper allocation or states of the switches (refer to chapter 5.2.5)	yes
3.	07	1	100		1	Overflow of the event buffer (events are lost!)	
4.	0D	601	1000	0	1	More than 24 sectionalizers configured	
			1001	0	1	T–TRIP–REP (**DA 6208/ZE**) > T–SVS (**DA 6204/ZE**)	
5.	0F	600		0C 10	1	Protection system failure after three unsuccessful restart attempts (Analysis of the following buffer events)	
6.	0F	600		0 0D 0E 0F 20 21 22	1	Failure on the ZPS–SBK module (replace module)	
7.	0F 13	600 10D	xxyy	 0	1 1	Module failure detected (requires replacement) The affected module is marked by FI1: YY = 02; ZPS–BSZ1 03; ZPS–BSZ2 04; ZPS–BSZ3 05; ZPS–SK1 . . . etc 0A ZPS–SK6	
8.	0F	601 602	1002 1004 1007 1008 1004	 1 2 3 4		Error in the station configuration (Check the configured number of bays and isolators; check number and location of the bus couplers and sectionalizers; verify sequence of configuration (bus coupler before outgoing feeder before sectionalizer)	
9.	13	200	0	0	1	Module ZPS–SBK defective (replace module)	yes
10.	15	10E			2 3 4	equivalent to fault no 3 (verify number of configured outgoing feeders, bus sections and bus coupler sections)	yes
11.	15	200 600		0 2 3	2 3 4	ZPS–BSZ1 defective (replace module) ZPS–BSZ2 defective (replace module) ZPS–BSZ3 defective (replace module)	yes
12.	16	200 600		0 1	1 2 3 4	ZPS–SBK defective (replace module) ZPS–BSZ1 defective (replace module) ZPS–BSZ2 defective (replace module) ZPS–BSZ3 defective (replace module)	yes

<table>
<tr><th>Cons. no</th><th>FNR (HEX)</th><th>TNR (HEX)</th><th>FI1</th><th>FI2</th><th>FI3</th><th>Description of fault (countermeasures)</th><th>plain text indication</th></tr>
<tr><td>13.</td><td>16</td><td>2200
2220
2235
2236
2239
223A
6200
6235
6236
6239
623A</td><td>xxyy</td><td></td><td>1</td><td>ZPS/FE defective (substitution of module/FE)
The affected module is marked by FI1:

02 ZPS–BSZ1
03 ZPS–BSZ2
04 ZPS–BSZ3
05 ZPS–SK1
.
.
.
0A ZPS–SK6
101 FE1
.
.
.
148 FE 48</td><td>yes</td></tr>
<tr><td>14.</td><td>19</td><td>600
201</td><td>
xxyy</td><td>
zzvv</td><td></td><td>Auxiliary voltage failure detected
Failure detected by cyclic test routine
xx ZPS–BSZ–No
yy Bay–No
zz Test result
<table>
<tr><th>Test results (ZZ)</th><th>Meaning</th></tr>
<tr><td>F0; F5
F2; F6
F3; F7
F4; F9; FF</td><td>missing release from ZPS–BSZ1 failure on ZPS–BSZ 1
missing TRIP from ZPS–BSZ2 failure on ZPS–BSZ 2
missing TRIP from ZPS–BSZ3 failure on ZPS–BSZ 3
no check–back signal from ZPS–SK–modules</td></tr>
</table></td><td></td></tr>
<tr><td>15.</td><td>1A</td><td>102
600
123</td><td>0</td><td>0
1</td><td>1
2
3
4</td><td>ZPS–SBK defective (replace module)
ZPS–BSZ1 defective (replace module)
ZPS–BSZ2 defective (replace module)
ZPS–BSZ3 defective (replace module)</td><td>yes</td></tr>
<tr><td>16.</td><td>1D</td><td>102
600</td><td></td><td></td><td>1</td><td>5 V auxiliary voltage failure for ZPS modules detected</td><td></td></tr>
<tr><td>17.</td><td>1F</td><td>600</td><td>xxyy</td><td>zzvv</td><td>1</td><td>The number of the modules fitted in the master unit (xxyy) differs from the configured station design (zzvv). (requires verification of the configuration; eventually also verification of the coding of the modules according to chapter 5.2.5.)
If the programmed configuration data are unknown, then the data must be programmed by means of an ”initial start–up” (system boot).
If configuration data and design match, then the first module indicated to be missing must be replaced.</td><td>yes</td></tr>
<tr><td>18.</td><td>20</td><td></td><td></td><td></td><td>0005
.
.
.
000A</td><td>Failure on a ZPS–SK module (module replacement)
FI3 indicates the number of the affected module
5 Hex ≙ ZPS–SK1; 0 A Hex ≙ ZPS–SK6</td><td>yes</td></tr>
<tr><td>19.</td><td>21</td><td></td><td></td><td></td><td>00xx</td><td>Failure of a bay unit communication
Causes may lie in a defective LMZ module, in a defective FO cable, in a defective bay unit or a defective connection plug. The affected transmission channel is marked by FI3: 64Hex + Chan. No. Hex. f.i. Channel 1 ≙ (100 + 1) Dec ≙ 64 Hex + 1</td><td>yes</td></tr>
</table>

Note to Table 7.5:
The information fields not occupied in the table are of minor importance for fault analysis or can only be interpreted by the manufacturer.

7.2.6 Analysis of failures in the communication ZE–FE

Following components of the protection participate in the protection–internal fast data transmission:

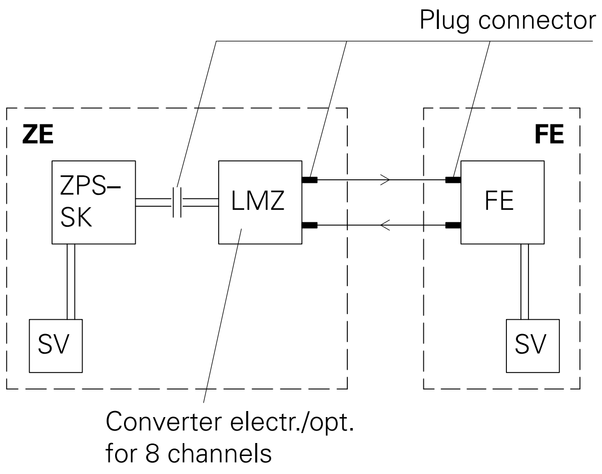


Figure 7.3 Components for data transmission

Start–up of the master unit can be completed successfully only if the data links to all configured bay units can be established without failures.

If only one FE fails, then the protection system is blocked and a failure alarm is generated.

In the event of failed start–up, indicated by the red LED ”failure”, the faulty data link has to be located.

The protection system may continue in service after the faulty bay was taken out of service. Configuration ”bay out of service” can be done by **DA 64xx/ZE**.

During the commissioning period or if failures were detected, the data transmission links have to be tested individually. For this procedure a station configuration with less bays (e.g. 4) is initially selected.

For this purpose, the 5th bay is configured ”non–existent” by parameter **DA 0503/ZE**. If start–up is completed correctly after switching on the master unit, then further bays can be configured as ”existent”, until the original configuration of the station is reached.

It should be noted that the first bay configured as ”non–existent” defines the design of the station.

Failures in data transmission can be located by a specific test run.

a) Test run of the ZPS–SK

The FO connection of the concerned channel is linked by a fibre–optical cable from transmitter to receiver. Test run can be set by fitting a jumper at loaction X34 on the ZPS–SK.

The parameter ”cyclic protection test” **DA 6311/ZE** must be switched off for the test run.

The red LED H1 flashes and thus indicates the test run. The configured bays are checked.

At least one channel must be faulty, if the green LED H1 (refer to Fig 5.5) flashes. Then the yellow LEDs indicate the channel with the highest number, which is faulty.

Table 7.6 ZPS–SK

RED H1	GRN H1	YELL1 H2	YELL2 H3	YELL3 H4	Status
					Test run ZPS–SK
x	+	–	–	–	Failure in channel 1
x	+	–	–	x	Failure in channel 2
x	+	–	x	–	Failure in channel 3
x	+	–	x	x	Failure in channel 4
x	+	x	–	–	Failure in channel 5
x	+	x	–	x	Failure in channel 6
x	+	x	x	–	Failure in channel 7
x	+	x	x	x	Failure in channel 8

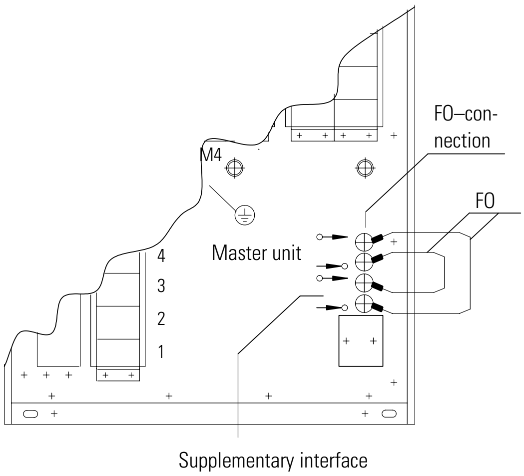


Figure 7.4 Connection of the interface points for the test run

Connection of the two FO–terminals allows to check the transmission channel for interruptions (for max. FO–cable lengths of 700m).

A FO–coupler (part of the delivery) is used to connect the FSMA plugs.

After finishing the test, the jumper must be removed and the cyclic protection test must be switched on again.

b) Test run of the bay unit

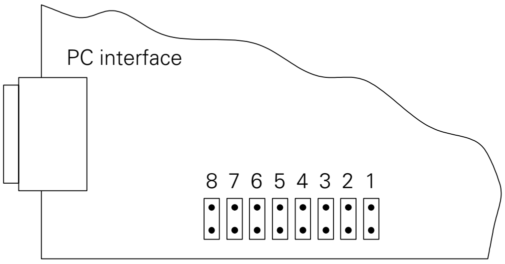
If the test described in a) was run successfully, then it is very likely that a failure in the bay unit caused the channel disturbance.

Fitting jumper no 5 on the PFE module activates a test function (refer to Fig 7.5). The jumper is delivered together with the master unit.

The supplementary interface at the bay unit (refer to Fig 2.5 and 7.4) simulates the master unit for the test run.

To run the test, the transmitter of the interface to the master unit is connected to the receiver of the supplementary interface and the receiver of the interface to the master unit is connected to the transmitter of the supplementary interface by a FO cable (FO cables are delivered together with the master unit).

In the event of a transmission error in control or alarm direction, the alarm ”Fail com CU” **FNo190/FE** is issued. This alarm can be allocated to an LED. After about 0.5 s service without failure, the alarm is cancelled.



Test function ”service without master unit”
Fit jumper to location 5

Figure 7.5 Location of jumpers on the module PFE of the bay unit

Start–up can be completed successfully even with a failed bay (FE or FO–link defective).

To achieve this, the faulty bay must be taken out of service. This is done by parameterizing (**DA 64XY/ZE**).

The corresponding bay must be excluded from the protection zone by ”isolating”.

The protection system allows service of the fault–free bays until the defective bay unit or FO–cable is replaced.

8 Repair

It is recommended to refrain strictly from repairing units or modules, because they contain especially selected components, which must be handled according to the regulations for electrostatic endangered devices (EED). In the first place, special techniques are required for working with the printed circuit boards, so that the flow–soldered boards and sensitive components are not damaged.

Therefore, if a defect cannot be eliminated by the operations described in chapter 7, then it is recommended to send the complete unit or defective module back to the manufacturer.

Suitable transportation packing has to be used. Mechanical impact protection according to IEC 255–21–1 class 2 and IEC 255–21–2 class 1 must be ensured.

In case it is unavoidable to replace single modules, then the EED–regulations have to be followed (handling of electrostatic endangered devices).

Warning

Even after switching off the auxiliary voltage or withdrawing the module, dangerous voltages may be present (capacitor storage)!

Attention

Electrostatic discharges via the components, printed conductors and connection pins must under all circumstances be avoided by previous contact with earthed metal parts. This applies in the same way for replacing components in sockets, such as EPROMs or EEPROMs. Suitable electrostatic protecting packing has to be used for mailing.

Modules fitted in the unit are not endangered.

After replacement of devices or modules, complete parameterizing is required. Details are given in chapter 6.

9 Storage

The devices should be stored in dry and clean rooms. For storage of devices or related spare modules the applicable temperature range is –25 °C to +70 °C (refer to chapter 3.1, technical data).

The relative humidity must not cause condensation or ice.

It is recommended to limit the temperature range for storage to values between +10 °C and +35 °C in order to avoid early ageing of the electrolytic capacitors in the power supplies.

Furthermore it is recommended to connect the devices every two years to auxiliary voltage, so that the electrolytic capacitors in the power supplies are formatted. The same procedure should be followed before installing these devices. In case of extreme climatic conditions (tropical), this pre–heats the device and avoids condensation.

A.1 Appendix

A.1.1 Event records – Block 71 to 76 and 78/ZE – Examples

```
7000 READOUT     ANNUNCIATIONS ?

7100 ANNUNC:   Operational ?

7101  COM t =   13 Setting
7102  GO  t =   13 out of serv. :A04
7103  COM t =   13 Setting
7104  COM t =    0 VOLTAGE FAIL
7105      t =    0 Annunc Buf empty
7106      t =    0 Annunc Buf empty
7107      t =    0 Annunc Buf empty

                .
                .
                .

7138      t =    0 Annunc Buf empty
7139      t =    0 Annunc Buf empty
7140      t =    0 Annunc Buf empty


7200 ANNUNC:   Fault indicat. ?

7201  COM t =   10 TrpBZ01 =   1
7202  COM t =   10 Transf. Trip:A05
7203  COM t =    2 VOLTAGE FAIL
7204      t =    0 Annunc Buf empty
7205      t =    0 Annunc Buf empty

                .
                .
                .

7298      t =    0 Annunc Buf empty
7299      t =    0 Annunc Buf empty
```

```
7300 . ANNUNC:   Isolator replic ?

7301  Bay      1   =on BZ1               1)
7302  Bay      2   =on BZ2
7303  Bay      3   =not connected
7304  Bay      4   =out of service
7305  Bay      5   =on BZ2

                .
                .
                .

7344  Bay      44   =not connected
7345  Bay      45   =not connected
7346  Bay      46   =not connected
7347  Bay      47   =not connected
7348  Bay      48   =not connected
7349  Sect. isol.   =not connected      2)
7350  Sect. isol.   =not connected
7351  Sect. isol.   =not connected
7352  Sect. isol.   =not connected

                .
                .
                .

7369  Sect. isol.   =not connected
7370  Sect. isol.   =not connected
7371  Sect. isol.   =not connected
7372  Sect. isol.   =not connected
```

Note:
The bays or sectionalizers are allocated to the preferred BZ/CS sections.

---

1) Only the configured bays are listed (max. 48: DA 7301 to 7348/ZE)

2) Listed are the isolators of bay types ”bus–coupler” or ”feeder”, which are configured as sectionalizers and the sectionalizers of bays which are configured as type ”sectionalizer” (max. 24: DA 7349 to 7372/ZE).
For listing, the bays are scrolled through for sectionalizers, whereby the bays are counted forward, beginning with bay no 1 / isolator 1.

7400 ANNUNC: DI/ST curr CZ ?

```
7401  Id   Ckz L1 =    0  % I/Ino   3)
7402  Is   Ckz L1 =    0  % I/Ino   3)
7403  Id   Ckz L2 =    0  % I/Ino   3)
7404  Is   Ckz L2 =    0  % I/Ino   3)
7405  Id   Ckz L3 =    0  % I/Ino   3)
7406  Is   Ckz L3 =    0  % I/Ino   3)
```

7500 ANNUNC: DI/ST curr BSZ2 ?

```
7501  Id BZ01L1-2 =    0  % I/Ino   3)
7502  Is BZ01L1-2 =    0  % I/Ino   3)
7503  Id BZ01L2-2 =    0  % I/Ino   3)
7504  Is BZ01L2-2 =    0  % I/Ino   3)
7505  Id BZ01L3-2 =    0  % I/Ino   3)
7506  Is BZ01L3-2 =    0  % I/Ino   3)

                .
                .
                .

7567  Id BZ12L1-2 =    0  % I/Ino   3)
7568  Is BZ12L1-2 =    0  % I/Ino   3)
7569  Id BZ12L2-2 =    0  % I/Ino   3)
7570  Is BZ12L2-2 =    0  % I/Ino   3)
7571  Id BZ12L3-2 =    0  % I/Ino   3)
7572  Is BZ12L3-2 =    0  % I/Ino   3)
```

7600 ANNUNC: DI/ST curr BSZ3 ?

```
7601  Id BZ01L1-3 =    0  % I/Ino   3)
7602  Is BZ01L1-3 =    0  % I/Ino   3)
7603  Id BZ01L2-3 =    0  % I/Ino   3)
7604  Is BZ01L2-3 =    0  % I/Ino   3)
7605  Id BZ01L3-3 =    0  % I/Ino   3)
7606  Is BZ01L3-3 =    0  % I/Ino   3)

                .
                .
                .

7667  Id BZ12L1-3 =    0  % I/Ino   3)
7668  Is BZ12L1-3 =    0  % I/Ino   3)
7669  Id BZ12L2-3 =    0  % I/Ino   3)
7670  Is BZ12L2-3 =    0  % I/Ino   3)
7671  Id BZ12L3-3 =    0  % I/Ino   3)
7672  Is BZ12L3-3 =    0  % I/Ino   3)
```

7800 ANNUNC: I Bay ? (Input J)

```
I Bay No ?            (Input 4)
                 = 4  (Input E)

I Bay No 04 = 310  0  0 % I/IN   4)
```

---

3) I_{no}:
Normalized nominal current, related to base current transformer
(current transformer with highest transformation ratio)

4) Annunciation phase–selective in the sequence: L1, L2, L3

A.1.2 Available operational and fault events

Explanations for the following event list of the master unit (see table A.9.1):

1)	Events can not be marshalled (rel./LED–allocation not possible)
2)	0/1 depending on setting DA 6302/ZE
3)	0/1 depending on setting DA 6307/ZE
4)	0/1 depending on setting DA 6308/ZE
5)	0/1 depending on setting DA 6312/ZE
BAY	Bay number
Axx	Bay number 01 to 48
BI	Binary input
OE	Operational event
BSZ	ZPS–BSZ–module
FE	Bay unit
FNo	Function No
I–SUM	Summation current
C	Coming–event
C/G	Coming/going–event
LED	Light emitting diode
L1, L2, L3	Phases
CB	Circuit breaker
LZ	Isolator run time fault
M	LED indication is stored ”memorized”
MW	Measured value
ISOL flt	Isolator fault
FE	Fault event
FLT–No	Fault number
SM	Group alarm (designates the allocation of the single alarm to the corresponding group alarm)
SM–No	Group alarm No
BZ 01 ... 12	Busbar zone 01 ... 12
CBF	Circuit breaker failure protection
ISOi	Isolator i (i = 1 to 5)
zzz	Fault–no in short text

Table A.9.1 Alarms from the master unit for PC, LC display and binary inputs and outputs

FNo	Event buffer	Logical function	Short text (text on LC display)	SM–No	Relay/ LED– no.	Alarm characte- ristic
0	OE	Failure with protection blocking	Err. PROT BLOCK	–	1, M	C/G
1	OE	Failure without protection blocking	Err. PROT ACTIVE	–	2, M	C/G
2						
3	OE	System initialise	R E B O O T	–	1)	C
4	OE	Reset of system processors	DEVICE RESTART	–	1)	C
5	OE	Voltage failure	VOLTAGE FAIL	–	1)	C
6	OE	Reset after configuration	RESTART AFT CONF	–	1)	C
7	OE	Settings being set	Setting	–	1)	C/G
8	OE	Configuration being set	Configuration	–	1)	C/G
9	OE	Fault: CBF–BI L1 time exceeded or Fault: CBF–BI release outside time window	BF BI err:L1:BXY	–	12, M	C/G+BN
10	OE	Fault: CBF–BI L2 time exceeded or Fault: CBF–BI release outside time window	BF BI err:L2:BXY	–	12, M	C/G+BN
11	OE	Fault: CBF–BI L3 time exceeded or Fault: CBF–BI release outside time window	BF BI err:L3:BXY	–	12, M	C/G+BN
12	OE	Fault: CBF–BI release time exceeded	BF COM BIN MON T	–	12, M	C/G
13	OE	LED–reset	LED–reset	–	–	C
14	FE	Missing TRIP–command release	no TripReleas:BXY	–	30, M	C+BN
15	OE	Bay out of service	out of serv.:BXY	–	11	C/G+BN
16	FE	Trip command for bus zone 01 L1	TRP BZ01 L1= zzz	30	17, M	C + FN
17	FE	Trip command for bus zone 02 L1	TRP BZ02 L1= zzz	30	18, M	C + FN
18	FE	Trip command for bus zone 03 L1	TRP BZ03 L1= zzz	30	19, M	C + FN
19	FE	Trip command for bus zone 04 L1	TRP BZ04 L1= zzz	30	20, M	C + FN
20	FE	Trip command for bus zone 05 L1	TRP BZ05 L1= zzz	30	21, M	C + FN
21	FE	Trip command for bus zone 06 L1	TRP BZ06 L1= zzz	30	22, M	C + FN
22	FE	Trip command for bus zone 07 L1	TRP BZ07 L1= zzz	30	23, M	C + FN
23	FE	Trip command for bus zone 08 L1	TRP BZ08 L1= zzz	30	24, M	C + FN
24	FE	Trip command for bus zone 09 L1	TRP BZ09 L1= zzz	30	25, M	C + FN
25	FE	Trip command for bus zone 10 L1	TRP BZ10 L1= zzz	30	26, M	C + FN
26	FE	Trip command for bus zone 11 L1	TRP BZ11 L1= zzz	30	27, M	C + FN
27	FE	Trip command for bus zone 12 L1	TRP BZ12 L1= zzz	30	28, M	C + FN
28	FE	Trip Repetition L1	Trip Rep.L1:BXY	–	14, M	C + BN
29	FE	Breaker failure/transfer trip	transf Trp:BXY	–	15, M	C + BN
30	FE	Trip Group alarm ”fast trip–command”	no alarm text	–	16, M	
31						

FNo	Event buffer	Logical function	Short text (text on LC display)	SM–No	Relay/ LED– no.	Alarm characte- ristic
32	FE	Trip command for bus zone 01 L2	TRP BZ01 L2= zzz	30	17, M	C + FN
33	FE	Trip command for bus zone 02 L2	TRP BZ02 L2= zzz	30	18, M	C + FN
34	FE	Trip command for bus zone 03 L2	TRP BZ03 L2= zzz	30	19, M	C + FN
35	FE	Trip command for bus zone 04 L2	TRP BZ04 L2= zzz	30	20, M	C + FN
36	FE	Trip command for bus zone 05 L2	TRP BZ05 L2= zzz	30	21, M	C + FN
37	FE	Trip command for bus zone 06 L2	TRP BZ06 L2= zzz	30	22, M	C + FN
38	FE	Trip command for bus zone 07 L2	TRP BZ07 L2= zzz	30	23, M	C + FN
39	FE	Trip command for bus zone 08 L2	TRP BZ08 L2= zzz	30	24, M	C + FN
40	FE	Trip command for bus zone 09 L2	TRP BZ09 L2= zzz	30	25, M	C + FN
41	FE	Trip command for bus zone 10 L2	TRP BZ10 L2= zzz	30	26, M	C + FN
42	FE	Trip command for bus zone 11 L2	TRP BZ11 L2= zzz	30	27, M	C + FN
43	FE	Trip command for bus zone 12 L2	TRP BZ12 L2= zzz	30	28, M	C + FN
44	FE	Trip repetition L2	Trip Rep.L2:BXY	–	14, M	C + BN
45						
46						
47						
48	FE	Trip command for bus zone 01 L3	TRP BZ01 L3= zzz	30	17, M	C + FN
49	FE	Trip command for bus zone 02 L3	TRP BZ02 L3= zzz	30	18, M	C + FN
50	FE	Trip command for bus zone 03 L3	TRP BZ03 L3= zzz	30	19, M	C + FN
51	FE	Trip command for bus zone 04 L3	TRP BZ04 L3= zzz	30	20, M	C + FN
52	FE	Trip command for bus zone 05 L3	TRP BZ05 L3= zzz	30	21, M	C + FN
53	FE	Trip command for bus zone 06 L3	TRP BZ06 L3= zzz	30	22, M	C + FN
54	FE	Trip command for bus zone 07 L3	TRP BZ07 L3= zzz	30	23, M	C + FN
55	FE	Trip command for bus zone 08 L3	TRP BZ08 L3= zzz	30	24, M	C + FN
56	FE	Trip command for bus zone 09 L3	TRP BZ09 L3= zzz	30	25, M	C + FN
57	FE	Trip command for bus zone 10 L3	TRP BZ10 L3= zzz	30	26, M	C + FN
58	FE	Trip command for bus zone 11 L3	TRP BZ11 L3= zzz	30	27, M	C + FN
59	FE	Trip command for bus zone 12 L3	TRP BZ12 L3= zzz	30	28, M	C + FN
60	FE	Trip repetition L3	Trip Rep.L3:BXY	–	14, M	C + BN
61						
62						
63						

FNo	Event buffer	Logical function	Short text (text on LC display)	SM–No	Relay/ LED– no.	Alarm characte- ristic
64	OE	Isolator 1 position CLOSED	Isol1 ON: BXY	–	1)	C + BN
65	OE	Isolator 1 position OPEN	Isol1 OFF: BXY	–	1)	C + BN
66	OE	Isolator 1 status fault:	Isol1 Flt pla: BXY	84	1)	C + BN
67	OE	Isolator 1 fault: run time	Isol1 Flt run: BXY	85	1)	C + BN
68	OE	Isolator 2 position CLOSED	Isol2 ON: BXY	–	1)	C + BN
69	OE	Isolator 2 position OPEN	Isol2 OFF: BXY	–	1)	C + BN
70	OE	Isolator 2 status fault:	Isol2 Flt pla: BXY	84	1)	C + BN
71	OE	Isolator 2 fault: run time	Isol2 Flt run: BXY	85	1)	C + BN
72	OE	Isolator 3 position CLOSED	Isol3 ON: BXY	–	1)	C + BN
73	OE	Isolator 3 position OPEN	Isol3 OFF: BXY	–	1)	C + BN
74	OE	Isolator 3 status fault:	Isol3 Flt pla: BXY	84	1)	C + BN
75	OE	Isolator 3 fault: run time	Isol3 Flt run: BXY	85	1)	C + BN
76	OE	Isolator 4 position CLOSED	Isol4 ON: BXY	–	1)	C + BN
77	OE	Isolator 4 position OPEN	Isol4 OFF: BXY	–	1)	C + BN
78	OE	Isolator 4 status fault:	Isol4 Flt pla: BXY	84	1)	C + BN
79	OE	Isolator 4 fault: run time	Isol4 Flt run: BXY	85	1)	C + BN
80	OE	Isolator 5: position CLOSED	Isol5 ON: BXY	–	1)	C + BN
81	OE	Isolator 5: position OPEN	Isol5 OFF: BXY	–	1)	C + BN
82	OE	Isolator 5: status fault:	Isol5 Flt pla: BXY	84	1)	C + BN
83	OE	Isolator 5: fault: run time	Isol5 Flt run: BXY	85	1)	C + BN
84	OE	Isol. status flt: both on (com. alarm)	no alarm text	0/1 2)	6, M	
85	OE	Isol. status flt: run time (com. alarm)	no alarm text	0/1 2)	6, M	
86	OE	Auxiliary voltage not present	Bay DC fail:BXY	0/1 2)	7, M	C/G+BN
87	OE	Circuit breaker fault	CB fail:BXY	–	8, M	C/G+BN
88	OE	Freeze fault record	flt rec freezed	–	1)	C/G
89	OE	Block fault record	flt rec blocked	–	13, M	C/G
90						
91						
92	OE	Diff.curr. superv.bus zone1 SM	no alarm text	0/1 3)	3, M	
93	OE	Diff.–current–superv: Check zone L1	Diff. sup CKZ L1	0/1 4)	4, M	C/G
94	OE	Diff.–current–superv: Check zone L2	Diff. sup CKZ L2	0/1 4)	4, M	C/G
95	OE	Diff.–current–superv: Check zone L3	Diff. sup CKZ L3	0/1 4)	4, M	C/G

FNo	Event buffer	Logical function	Short text (text on LC display)	SM–No	Relay/ LED– no.	Alarm characte- ristic
96	OE	Diff.curr. superv.bus z. 01 L1 on BSZ2	Id–sup BZ01 L1 –2	92	M	C/G
97	OE	Diff.curr. superv.bus z. 02 L1 on BSZ2	Id–sup BZ02 L1 –2	92	M	C/G
98	OE	Diff.curr. superv.bus z. 03 L1 on BSZ2	Id–sup BZ03 L1 –2	92	M	C/G
99	OE	Diff.curr. superv.bus z. 04 L1 on BSZ2	Id–sup BZ04 L1 –2	92	M	C/G
100	OE	Diff.curr. superv.bus z. 05 L1 on BSZ2	Id–sup BZ05 L1 –2	92	M	C/G
101	OE	Diff.curr. superv.bus z. 06 L1 on BSZ2	Id–sup BZ06 L1 –2	92	M	C/G
102	OE	Diff.curr. superv.bus z. 07 L1 on BSZ2	Id–sup BZ07 L1 –2	92	M	C/G
103	OE	Diff.curr. superv.bus z. 08 L1 on BSZ2	Id–sup BZ08 L1 –2	92	M	C/G
104	OE	Diff.curr. superv.bus z. 09 L1 on BSZ2	Id–sup BZ09 L1 –2	92	M	C/G
105	OE	Diff.curr. superv.bus z. 10 L1 on BSZ2	Id–sup BZ10 L1 –2	92	M	C/G
106	OE	Diff.curr. superv.bus z. 11 L1 on BSZ2	Id–sup BZ11 L1 –2	92	M	C/G
107	OE	Diff.curr. superv.bus z. 12 L1 on BSZ2	Id–sup BZ12 L1 –2	92	M	C/G
108						
109						
110						
111						
112	OE	Diff.curr. superv.bus z. 01 L2 on BSZ2	Id–sup BZ01 L2 –2	92	M	C/G
113	OE	Diff.curr. superv.bus z. 02 L2 on BSZ2	Id–sup BZ02 L2 –2	92	M	C/G
114	OE	Diff.curr. superv.bus z. 03 L2 on BSZ2	Id–sup BZ03 L2 –2	92	M	C/G
115	OE	Diff.curr. superv.bus z. 04 L2 on BSZ2	Id–sup BZ04 L2 –2	92	M	C/G
116	OE	Diff.curr. superv.bus z. 05 L2 on BSZ2	Id–sup BZ05 L2 –2	92	M	C/G
117	OE	Diff.curr. superv.bus z. 06 L2 on BSZ2	Id–sup BZ06 L2 –2	92	M	C/G
118	OE	Diff.curr. superv.bus z. 07 L2 on BSZ2	Id–sup BZ07 L2 –2	92	M	C/G
119	OE	Diff.curr. superv.bus z. 08 L2 on BSZ2	Id–sup BZ08 L2 –2	92	M	C/G
120	OE	Diff.curr. superv.bus z. 09 L2 on BSZ2	Id–sup BZ09 L2 –2	92	M	C/G
121	OE	Diff.curr. superv.bus z. 10 L2 on BSZ2	Id–sup BZ10 L2 –2	92	M	C/G
122	OE	Diff.curr. superv.bus z. 11 L2 on BSZ2	Id–sup BZ11 L2 –2	92	M	C/G
123	OE	Diff.curr. superv.bus z. 12 L2 on BSZ2	Id–sup BZ12 L2 –2	92	M	C/G
124						
125						
126						
127						

FNo	Event buffer	Logical function	Short text (text on LC display)	SM–No	Relay/ LED– no.	Alarm characte- ristic
128	OE	Diff.curr. superv.bus z. 01 L3 on BSZ2	Id–sup BZ01 L3 –2	92	M	C/G
129	OE	Diff.curr. superv.bus z. 02 L3 on BSZ2	Id–sup BZ02 L3 –2	92	M	C/G
130	OE	Diff.curr. superv.bus z. 03 L3 on BSZ2	Id–sup BZ03 L3 –2	92	M	C/G
131	OE	Diff.curr. superv.bus z. 04 L3 on BSZ2	Id–sup BZ04 L3 –2	92	M	C/G
132	OE	Diff.curr. superv.bus z. 05 L3 on BSZ2	Id–sup BZ05 L3 –2	92	M	C/G
133	OE	Diff.curr. superv.bus z. 06 L3 on BSZ2	Id–sup BZ06 L3 –2	92	M	C/G
134	OE	Diff.curr. superv.bus z. 07 L3 on BSZ2	Id–sup BZ07 L3 –2	92	M	C/G
135	OE	Diff.curr. superv.bus z. 08 L3 on BSZ2	Id–sup BZ08 L3 –2	92	M	C/G
136	OE	Diff.curr. superv.bus z. 09 L3 on BSZ2	Id–sup BZ09 L3 –2	92	M	C/G
137	OE	Diff.curr. superv.bus z. 10 L3 on BSZ2	Id–sup BZ10 L3 –2	92	M	C/G
138	OE	Diff.curr. superv.bus z. 11 L3 on BSZ2	Id–sup BZ11 L3 –2	92	M	C/G
139	OE	Diff.curr. superv.bus z. 12 L3 on BSZ2	Id–sup BZ12 L3 –2	92	M	C/G
140						
141						
142						
143						
144	OE	Diff.curr. superv.bus z. 01 L1 on BSZ3	Id–sup BZ01 L1 –3	92	M	C/G
145	OE	Diff.curr. superv.bus z. 02 L1 on BSZ3	Id–sup BZ02 L1 –3	92	M	C/G
146	OE	Diff.curr. superv.bus z. 03 L1 on BSZ3	Id–sup BZ03 L1 –3	92	M	C/G
147	OE	Diff.curr. superv.bus z. 04 L1 on BSZ3	Id–sup BZ04 L1 –3	92	M	C/G
148	OE	Diff.curr. superv.bus z. 05 L1 on BSZ3	Id–sup BZ05 L1 –3	92	M	C/G
149	OE	Diff.curr. superv.bus z. 06 L1 on BSZ3	Id–sup BZ06 L1 –3	92	M	C/G
150	OE	Diff.curr. superv.bus z. 07 L1 on BSZ3	Id–sup BZ07 L1 –3	92	M	C/G
151	OE	Diff.curr. superv.bus z. 08 L1 on BSZ3	Id–sup BZ08 L1 –3	92	M	C/G
152	OE	Diff.curr. superv.bus z. 09 L1 on BSZ3	Id–sup BZ09 L1 –3	92	M	C/G
153	OE	Diff.curr. superv.bus z. 10 L1 on BSZ3	Id–sup BZ10 L1 –3	92	M	C/G
154	OE	Diff.curr. superv.bus z. 11 L1 on BSZ3	Id–sup BZ11 L1 –3	92	M	C/G
155	OE	Diff.curr. superv.bus z. 12 L1 on BSZ3	Id–sup BZ12 L1 –3	92	M	C/G
156						
157						
158						
159						

FNo	Event buffer	Logical function	Short text (text on LC display)	SM–No	Relay/ LED– no.	Alarm characte- ristic
160	OE	Diff.curr. superv.bus z. 01 L2 on BSZ3	Id–sup BZ01 L2 –3	92	M	C/G
161	OE	Diff.curr. superv.bus z. 02 L2 on BSZ3	Id–sup BZ02 L2 –3	92	M	C/G
162	OE	Diff.curr. superv.bus z. 03 L2 on BSZ3	Id–sup BZ03 L2 –3	92	M	C/G
163	OE	Diff.curr. superv.bus z. 04 L2 on BSZ3	Id–sup BZ04 L2 –3	92	M	C/G
164	OE	Diff.curr. superv.bus z. 05 L2 on BSZ3	Id–sup BZ05 L2 –3	92	M	C/G
165	OE	Diff.curr. superv.bus z. 06 L2 on BSZ3	Id–sup BZ06 L2 –3	92	M	C/G
166	OE	Diff.curr. superv.bus z. 07 L2 on BSZ3	Id–sup BZ07 L2 –3	92	M	C/G
167	OE	Diff.curr. superv.bus z. 08 L2 on BSZ3	Id–sup BZ08 L2 –3	92	M	C/G
168	OE	Diff.curr. superv.bus z. 09 L2 on BSZ3	Id–sup BZ09 L2 –3	92	M	C/G
169	OE	Diff.curr. superv.bus z. 10 L2 on BSZ3	Id–sup BZ10 L2 –3	92	M	C/G
170	OE	Diff.curr. superv.bus z. 11 L2 on BSZ3	Id–sup BZ11 L2 –3	92	M	C/G
171	OE	Diff.curr. superv.bus z. 12 L2 on BSZ3	Id–sup BZ12 L2 –3	92	M	C/G
172						
173						
174						
175						
176	OE	Diff.curr. superv.bus z. 01 L3 on BSZ3	Id–sup BZ01 L3 –3	92	M	C/G
177	OE	Diff.curr. superv.bus z. 02 L3 on BSZ3	Id–sup BZ02 L3 –3	92	M	C/G
178	OE	Diff.curr. superv.bus z. 03 L3 on BSZ3	Id–sup BZ03 L3 –3	92	M	C/G
179	OE	Diff.curr. superv.bus z. 04 L3 on BSZ3	Id–sup BZ04 L3 –3	92	M	C/G
180	OE	Diff.curr. superv.bus z. 05 L3 on BSZ3	Id–sup BZ05 L3 –3	92	M	C/G
181	OE	Diff.curr. superv.bus z. 06 L3 on BSZ3	Id–sup BZ06 L3 –3	92	M	C/G
182	OE	Diff.curr. superv.bus z. 07 L3 on BSZ3	Id–sup BZ07 L3 –3	92	M	C/G
183	OE	Diff.curr. superv.bus z. 08 L3 on BSZ3	Id–sup BZ08 L3 –3	92	M	C/G
184	OE	Diff.curr. superv.bus z. 09 L3 on BSZ3	Id–sup BZ09 L3 –3	92	M	C/G
185	OE	Diff.curr. superv.bus z. 10 L3 on BSZ3	Id–sup BZ10 L3 –3	92	M	C/G
186	OE	Diff.curr. superv.bus z. 11 L3 on BSZ3	Id–sup BZ11 L3 –3	92	M	C/G
187	OE	Diff.curr. superv.bus z. 12 L3 on BSZ3	Id–sup BZ12 L3 –3	92	M	C/G
188						
189						
190						
191						

FNo	Event buffer	Logical function	Short text (text on LC display)	SM–No	Relay/ LED– no.	Alarm characte- ristic
192	OE	Measured value supv. I–SUM	MEAS in sup:BXY	1	M	C/G+BN
193	OE	15V supply supervision FE	15V–superv.:BXY	1	10, M	C/G+BN
195	OE	0V supply supervision FE	0V–superv.:BXY	1	10, M	C/G+BN
196	OE	Failure in auto. testing: BSZ 1 L1	FLT AUT L1 –1:BXY	0/1 5)	1)	C+BN
197	OE	Failure in auto. testing: BSZ 2 L1	FLT AUT L1 –2:BXY	0/1 5)	1)	C+BN
198	OE	Failure in auto. testing: BSZ 3 L1	FLT AUT L1 –3:BXY	0/1 5)	1)	C+BN
199	OE	Failure in auto. testing: BSZ 1 L2	FLT AUT L2 –1:BXY	0/1 5)	1)	C+BN
200	OE	Failure in auto. testing: BSZ 2 L2	FLT AUT L2 –2:BXY	0/1 5)	1)	C+BN
201	OE	Failure in auto. testing: BSZ 3 L2	FLT AUT L2 –3:BXY	0/1 5)	1)	C+BN
202	OE	Failure in auto. testing: BSZ 1 L3	FLT AUT L3 –1:BXY	0/1 5)	1)	C+BN
203	OE	Failure in auto. testing: BSZ 2 L3	FLT AUT L3 –2:BXY	0/1 5)	1)	C+BN
204	OE	Failure in auto. testing: BSZ 3 L3	FLT AUT L3 –3:BXY	0/1 5)	1)	C+BN
205	OE	Failure in auto. testing: (com. alarm)	no alarm text	0/1 5)	5, M	–
206	OE	15V–supervision CU	15V–superv. CU	1	10, M	C/G
207	OE	24V–supervision CU	24V–superv. CU	1	10, M	C/G
208	OE	Request restart	req restart	215	1)	C+BN
209	OE	Request change CT Polarity	RqChangCTPol: BXY	215	1)	C+BN
210	OE	Request bay out of service	request BOS: BXY	215	1)	C/G+BN
211	OE	Request manual trip L1	req man Trp L1:BXY	215	1)	C+BN
212	OE	Request manual trip L2	req man Trp L2:BXY	215	1)	C+BN
213	OE	Request manual trip L3	req man Trp L3:BXY	215	1)	C+BN
214	OE	Request manual trip L1 L2 L3	req man T L123:BXY	215	1)	C+BN
215	OE	Request bay (Group alarm for rel.)	no alarm text	–	29, M	–
216						
217						
218						
219						
220						
221						
222						
223						

A.1.3 Basis for selection of the stabilization factor k

Step 1:
The relationship between the point (in time) at which saturation occurs and the stabilisation factor is established.

The following condition must be fulfilled in order to prevent bus zone tripping for an external fault (refer fig A.9.1)

$2\ I_K \sin \omega T_S \cdot K > I_K$ (c1)
$2 \sin \omega T_S \cdot K > 1$ (c2)

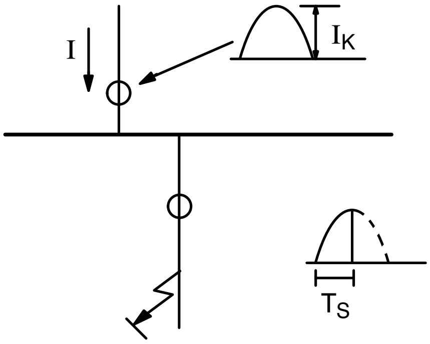


Figure A.9.1 Short–circuit on a feeder with CT saturation

To determine the point in time T_s at which saturation occurs, the burden factor u must be considered.

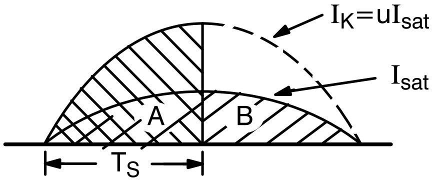


Figure A.9.2 Current/time characteristic

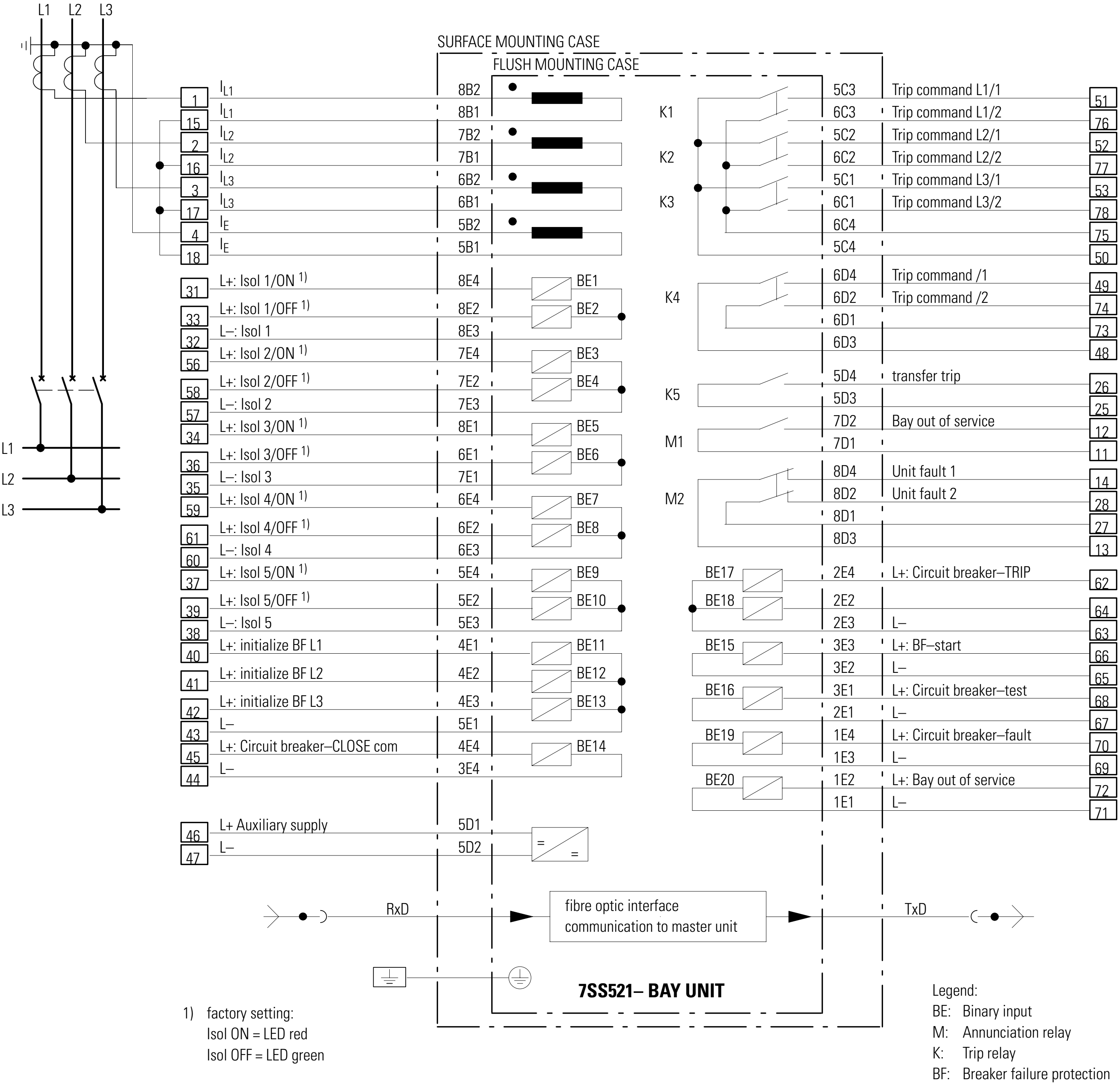
If the CT is burdened with $I_K=uI_{sat}$, then it will saturate after time T_S whereby area A ▧ = area B ▨

$$\text{i. e.} \quad \int_0^{\omega Ts} I_K \sin \omega t = \int_0^{\pi} I_{sat} \sin \omega t \qquad \text{(c3)}$$

$u\ (1 - \cos \omega T_S) = 2$ (c4)

If equations c2 and c4 are combined, then:
$K > U/4\ \sqrt{U-1}$ (c5),
The stabilization factor must be chosen according to condition c5.

A.1.4 Connection diagrams



1) factory setting:
Isol ON = LED red
Isol OFF = LED green

Legend:
BE: Binary input
M: Annunciation relay
K: Trip relay
BF: Breaker failure protection

Figure A.9.3 Connection diagram bay unit

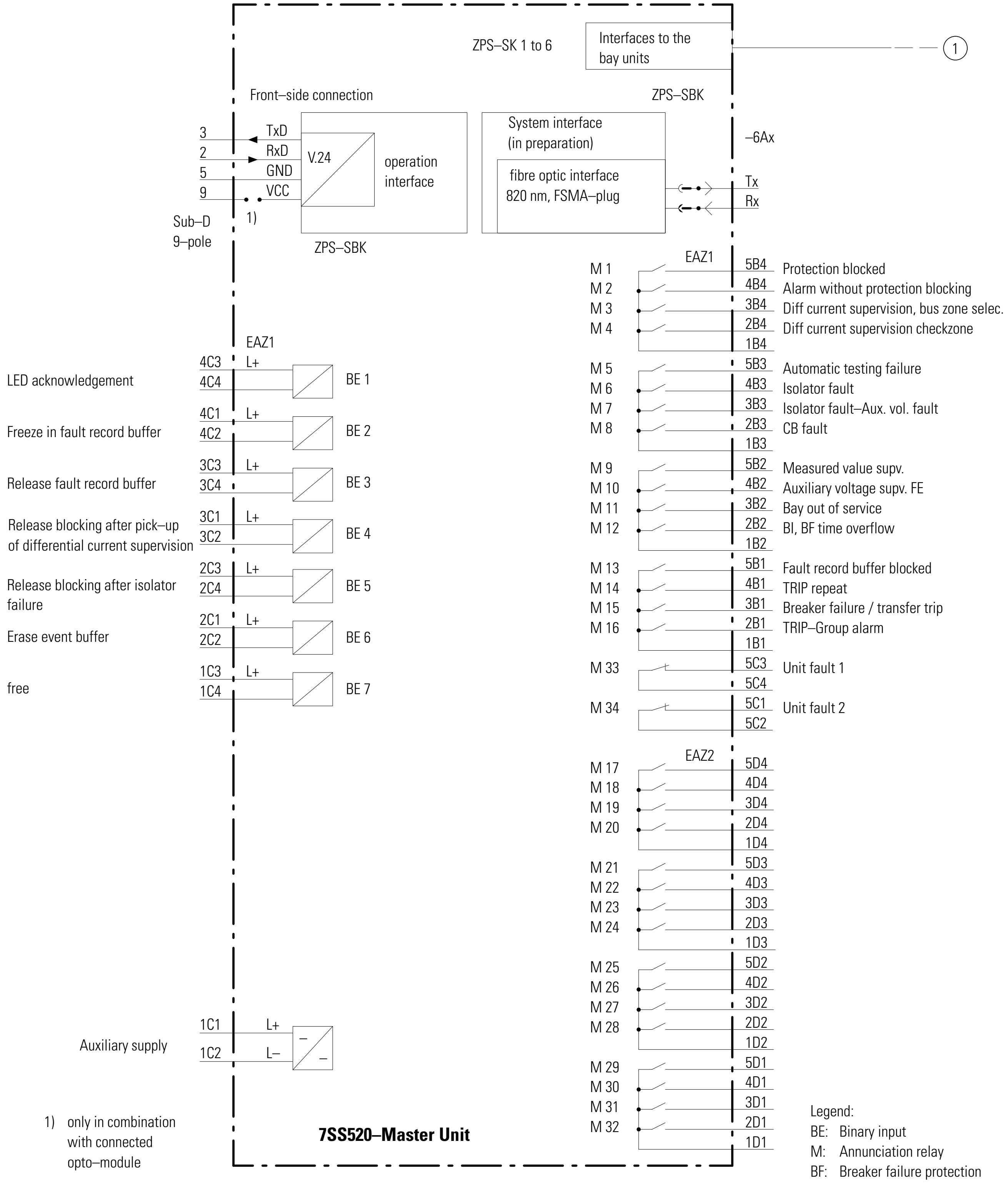


Figure A.9.4 Connection diagram Master Unit

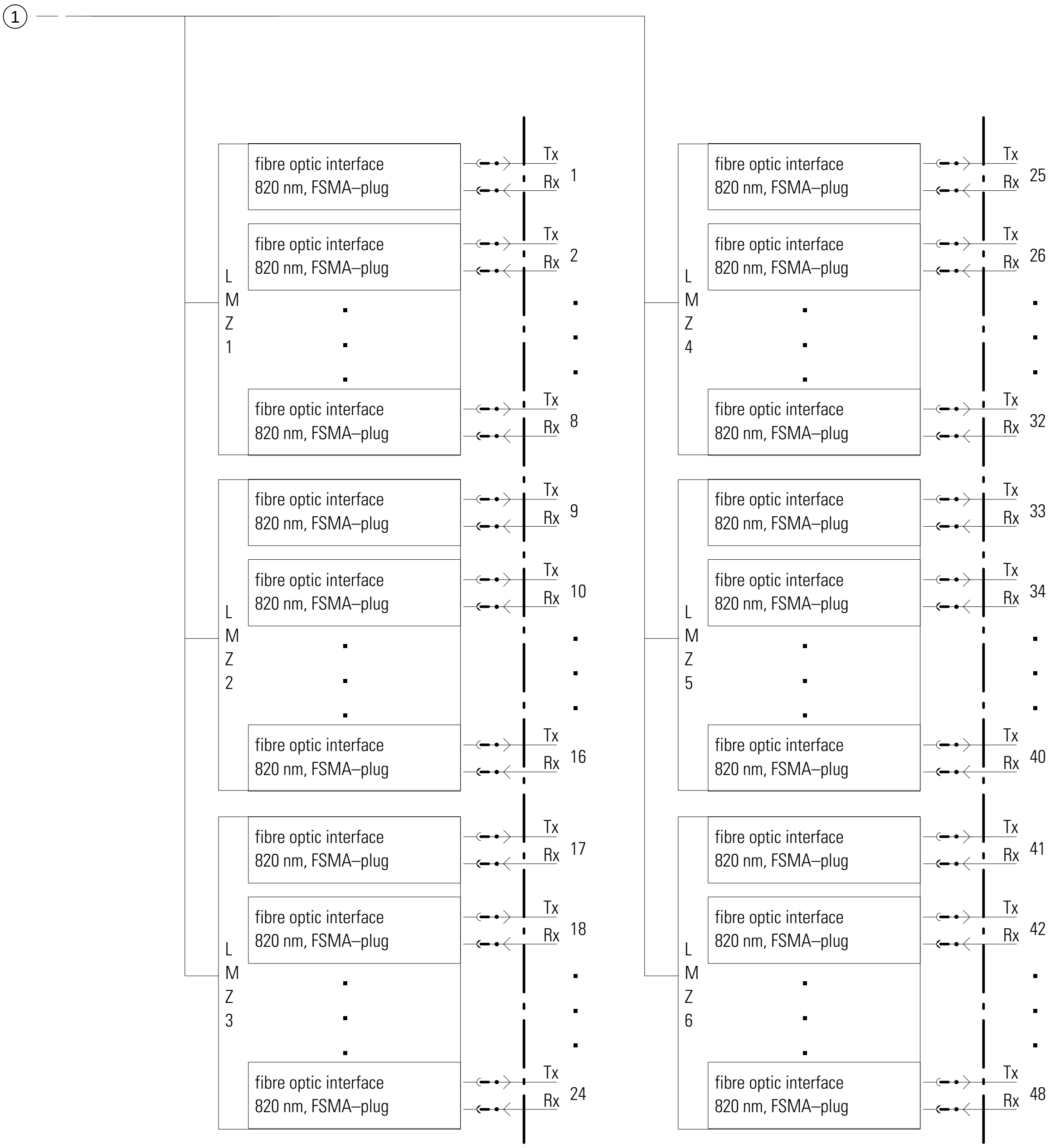


Figure A.9.5 Connection diagram Master Unit (Cont.)

Table A.9.2 Basic position of jumpers on ZPS–module (master unit)

	ZPS–module									
Jumper	SBK	BSZ 1	BSZ 2	BSZ 3	SK 1	SK 2	SK 3	SK 4	SK 5	SK 6
X20	off	off	off	off	off	off	off	off	off	off
X22	off	off	off	off	off	off	off	off	off	off
X23	on	on	on	on	on	on	on	on	on	on
X24	off	off	off	off	off	off	off	off	off	off
X25	5 – 6	off	off	off	off	off	off	off	off	off
X26	off	5 – 6	5 – 6	5 – 6	5 – 6	5 – 6	5 – 6	5 – 6	5 – 6	5 – 6
X27	on	on	on	on	on	on	on	on	on	on
X29	on	off	off	off	off	off	off	off	off	off
X30	off	on	off	off	off	off	off	off	off	off
X31	off	off	off	off	off	off	off	off	off	off
X32	on	on	on	on	on	on	on	on	on	on
X33	off	off	off	off	off	off	off	off	off	off
X34	on	off	off	off	off	off	off	off	off	off

Table A.9.3 Basic position of switches on ZPS–module (master unit)

	ZPS–function									
Switch	SBK [1]	BSZ 1	BSZ 2	BSZ 3	SK 1	SK 2	SK 3	SK 4	SK 5	SK 6
S2										
S2.1	off	off	off	off	off	off	off	off	off	off
S2.2	off	off	off	off	off	off	off	off	off	off
S2.3	off	off	off	off	off	off	off	off	off	off
S2.4	off	on	on	on	on	on	on	on	on	on
S2.5	off	off	off	off	off	off	off	off	off	off
S2.6	off	off	off	off	off	off	off	off	off	off
S3										
S3.1	off	on	on	on	on	on	on	on	on	on
S3.2	off	off	on	off	on	off	on	off	on	off
S3.3	off	on	on	off	off	on	on	off	off	on
S3.4	off	off	off	on	on	on	on	off	off	off
S3.5	off	off	off	off	off	off	off	on	on	on
S3.6	off	on	on	on	on	on	on	on	on	on

1) position not relevant

	ZPS–function									
Switch	SBK [1]	BSZ 1	BSZ 2	BSZ 3	SK 1	SK 2	SK 3	SK 4	SK 5	SK 6
S4										
S4.1	off	off	off	off	off	off	off	off	off	off
S4.2	off	off	on	off	on	off	on	off	on	off
S4.3	off	on	on	off	off	on	on	off	off	on
S4.4	off	off	off	on	on	on	on	off	off	off
S4.5	off	off	off	off	off	off	off	on	on	on
S4.6	off	off	off	off	off	off	off	off	off	off

1) position not relevant

Table A.9.4 Basic position of switches on EAZ–modules

Switch S1	EAZ 1	EAZ 2
1	off	off
2	off	off
3	off	on
4	off	off

A.1.5 Pre–setting of binary inputs and outputs

Table A.9.5 Pre–setting of annunciation relays and LED's of master unit

LED– and alarm relay–No	Logical function	FNo	Short text (text on LC display)
1	Failure with protection blocking	000	Err. PROT BLOCK
2	Failure without protection blocking	001	Err. PROT ACTIVE
3	Diff current supervision selective [1]	92	Id–sup BZ01 L1 –2 to Id–sup BZ12 L1 –2 Id–sup BZ01 L2 –2 to Id–sup BZ12 L2 –2 Id–sup BZ01 L3 –2 to Id–sup BZ12 L3 –2 Id–sup BZ01 L1 –3 to Id–sup BZ12 L1 –3 Id–sup BZ01 L2 –3 to Id–sup BZ12 L2 –3 Id–sup BZ01 L3 –3 to Id–sup BZ12 L3 –3
4	Diff current supervision check zone	093 – 095	diff sup CKZ L1; 2; 3
5	Cyclic test failure identified [2]	205	Flt aut L1 –1; 2; 3:BXY Flt aut L2 –1; 2; 3:BXY Flt aut L3 –1; 2; 3:BXY
6	Isolator failure (plausibility check CLOSED, OPEN simultaneously, running time supervision)	084 085	Isoly Flt pla:BXY Isoly Flt run:BXY (y = 1 ... 5)
7	Isolator failure–auxiliary voltage failure	086	Bay DC Fail:BXY
8	Circuit breaker failure	087	CB fail:BXY
9	Measured value supervision	192	Meas in sup:BXY
10	Supply voltage supervision FE	193 195 206 207	15V–superv.:BXY 0V–superv.:BXY 15V–superv.CU 24V–superv.CU
11	Bay out of service	015	out of serv.:BXY
12	Binary input breaker failure, time exceeded	009 – 012	BF BI err:L1; 2; 3:BXY
13	Fault record buffer blocked	089	Flt rec blocked
14	TRIP repeat	028 044 060	TripRepL1; 2; 3:BXY
15	Breaker failure / transfer trip	029	transf Trp:BXY
16	TRIP busbar "high–speed TRIP" [3]	030	TRPBZ01 L1 = zzz – TRPBZ12 L1 = zzz TRPBZ01 L2 = zzz – TRPBZ12 L2 = zzz TRPBZ01 L3 = zzz – TRPBZ12 L3 = zzz zzz = Fault–No.
17	Busbar protection TRIP command BZ1	016 032 048	TRPBZ01 L1; 2; 3 = zzz
18	Busbar protection TRIP command BZ2	017 033 049	TRPBZ02 L1; 2; 3 = zzz
19	Busbar protection TRIP command BZ3	018 034 050	TRPBZ03 L1; 2; 3 = zzz
20	Busbar protection TRIP command BZ4	019 035 051	TRPBZ04 L1; 2; 3 = zzz
21	Busbar protection TRIP command BZ5	020 036 052	TRPBZ05 L1; 2; 3 = zzz
22	Busbar protection TRIP command BZ6	021 037 053	TRPBZ06 L1; 2; 3 = zzz
23	Busbar protection TRIP command BZ7	022 038 054	TRPBZ07 L1; 2; 3 = zzz
24	Busbar protection TRIP command BZ8	023 039 055	TRPBZ08 L1; 2; 3 = zzz
25	Busbar protection TRIP command BZ9	024 040 056	TRPBZ09 L1; 2; 3 = zzz
26	Busbar protection TRIP command BZ10	025 041 057	TRPBZ10 L1; 2; 3 = zzz
27	Busbar protection TRIP command BZ11	026 042 058	TRPBZ11 L1; 2; 3 = zzz
28	Busbar protection TRIP command BZ12	027 043 059	TRPBZ12 L1; 2; 3 = zzz

1) FNo. 92: Diff. current supervision selective
Collective alarm comprises the single alarms according to table 6.2 on page 6–24.

2) FNo. 205: Periodical test alarm
Collective alarm comprises all single alarms according to table 6.2 on page 6–24.

3) FNo. 30: "high–speed TRIP"
common alarm for TRIP command alarm FNo. 16 – 27; 32–43 and 48–59. Recognition of the alarm "high–speed TRIP" runs with a resolution of 1 ms. Marshalling of this function to alarm relays is possible.

LED– and alarm relay–No	Logical function	FNo	Short text (text on LC display)
29	Request bay [4]	215	req restart RqChangCTPol:BXY request BOS:BXY req man Trp L1; L2; L3:BXY
30	no TRIP command release [5]	014	no Trip Releas:BXY
31	not marshalled		
32	not marshalled		

[4] FNo. 215: ”request bay” Collective alarm comprises all single alarms according to table 6.2 on page 6–24.

[5] FNo. 14: ”no TRIP command release” This alarm indicates the missing TRIP release via binary input at a bay unit. The supervision is active only if **DA 6107/ZE** was set to ”existent”.

Table A.9.6 Pre–settings of binary inputs of master unit

Binary inputs	Short text	Logical function
1	>LED acknowl	LED acknowledgement
2	>Flt rec freeze	Freeze in fault record buffer (generate fault record)
3	>Flt rec rel	Release fault record buffer (erase the stored fault records)
4	>BloDifSup rel	Release blocking after pick–up of differential current supervision
5	>BloISO Flt rel	Release blocking after isolator failure
6	>Eventbuf erase	Erase contents of the operations and fault record buffer
7	free	

Table A.9.7 Pre–settings of output relays of bay unit

Direct address	1st display line	2nd display line	FNo	Note
6201	ALARM RELAY 1	Bay o.of serv	7080	Bay out of service
6400	MARSHALLING	COMMAND RELAY		
6401	COMMAND RELAY 1	CBF Trip L1	7051	Breaker failure protection TRIP L1
		BB Trip L123	7040	Busbar protection TRIP L123
		CBF Trip L123	7050	Breaker failure protection TRIP L123
		CB Test L1	7060	Circuit breaker test phase L1
6402	COMMAND RELAY 2	CBF Trip L2	7052	Breaker failure protection TRIP L2
		BB Trip L123	7040	Busbar protection TRIP L123
		CBF Trip L123	7050	Breaker failure protection TRIP L123
		CB Test L2	7061	Circuit breaker test phase L2
6403	COMMAND RELAY 3	CBF Trip L3	7053	Breaker failure protection TRIP L3
		BB Trip L123	7040	Busbar protection TRIP L123
		CBF Trip L123	7050	Breaker failure protection TRIP L123
		CB Test L3	7062	Circuit breaker test phase L3
6404	COMMAND RELAY 4	BB trip L123	7040	Busbar protection TRIP L123
		CBF Trip L123	7050	Breaker failure protection TRIP L123
		CBF Trip L1	7051	Breaker failure protection TRIP L1
		CBF Trip L2	7052	Breaker failure protection TRIP L2
		CBF Trip L3	7053	Breaker failure protection TRIP L3
		CB Test L1	7060	Circuit breaker test phase L1
		CB Test L2	7061	Circuit breaker test phase L2
		CB Test L3	7062	Circuit breaker test phase L3
6405	COMMAND RELAY 5	BB intertrip	7070	Busbar protection transfer trip

Table A.9.8 Pre–set LED indications

Dir. addr.	1st display line	2nd display line		FNo	Note
6300	MARSHALLING	>LEDs			
6301	LED 1	>Isol1–Closed	nm	7000	Isolator status signal Closed for isolator 1
6302	LED 2	>Isol1–Open	nm	7001	Isolator status signal Open for isolator 1
6303	LED 3	>Isol2–Closed	nm	7002	Isolator status signal Closed for isolator 2
6304	LED 4	>Isol2–Open	nm	7003	Isolator status signal Open for isolator 2
6305	LED 5	>Isol3–Closed	nm	7004	Isolator status signal Closed for isolator 3
6306	LED 6	>Isol3–Open	nm	7005	Isolator status signal Open for isolator 3
6307	LED 7	>Isol4–Closed	nm	7006	Isolator status signal Closed for isolator 4
6308	LED 8	>Isol4–Open	nm	7007	Isolator status signal Open for isolator 4
6309	LED 9	>Isol5–Closed	nm	7008	Isolator status signal Closed for isolator 5
6310	LED 10	>Isol5–Open	nm	7009	Isolator status signal Open for isolator 5
6311	LED 11	not marsh		1	No function is allocated to output
6312	LED 12	not marsh		1	No function is allocated to output
6313	LED 13	Fail com.CU	nm	190	Data communication link to master unit disturbed
6314	LED 14	BB Trip L123	m	7040	Busbar protection trip command L123
		CBF Trip L123	m	7050	Breaker failure protection trip command L123
		CBF Trip L1	m	7051	Breaker failure protection trip command L1
		CBF Trip L2	m	7052	Breaker failure protection trip command L2
		CBF Trip L3	m	7053	Breaker failure protection trip command L3
		CB Test L1	m	7060	Circuit breaker test phase L1
		CB Test L2	m	7061	Circuit breaker test phase L2
		CB Test L3	m	7062	Circuit breaker test phase L3
6315	LED 15	BB intertrip	m	7070	Busbar protection transfer trip command
6316	LED 16	Bay o.of ser	nm	7080	Bay out of service

nm: not memorized
m: memorized

Table A.9.9 Pre–set binary inputs

Dir. addr.	1st display line	2nd display line		FNo	Note
6100	MARSHALLING	>BINARY INPUTS			
6101	BINARY INPUT 1	>Isol1–Closed	A	7000	Isolator status signal Closed for isolator 1
6102	BINARY INPUT 2	>Isol1–Open	A	7001	Isolator status signal Open for isolator 1
6103	BINARY INPUT 3	>Isol2–Closed	A	7002	Isolator status signal Closed for isolator 2
6104	BINARY INPUT 4	>Isol2–Open	A	7003	Isolator status signal Open for isolator 2
6105	BINARY INPUT 5	>Isol3–Closed	A	7004	Isolator status signal Closed for isolator 3
6106	BINARY INPUT 6	>Isol3–Open	A	7005	Isolator status signal Open for isolator 3
6107	BINARY INPUT 7	>Isol4–Closed	A	7006	Isolator status signal Closed for isolator 4
6108	BINARY INPUT 8	>Isol4–Open	A	7007	Isolator status signal Open for isolator 4
6109	BINARY INPUT 9	>Isol5–Closed	A	7008	Isolator status signal Closed for isolator 5
6110	BINARY INPUT 10	>Isol5–Open	A	7009	Isolator status signal Open for isolator 5
6111	BINARY INPUT 11	>CBF L1	A	7020	Circuit breaker failure initiation for phase L1
6112	BINARY INPUT 12	>CBF L2	A	7021	Circuit breaker failure initiation for phase L2
6113	BINARY INPUT 13	>CBF L3	A	7022	Circuit breaker failure initiation for phase L3
6114	BINARY INPUT 14	>CB–CLOSE com	A	356	Close command for bus coupler circuit breaker
6115	BINARY INPUT 15	>CBF rel	A	7024	Circuit breaker failure protection release signal
6116	BINARY INPUT 16	>CB test	A	1156	start three–pole circuit breaker test
6117	BINARY INPUT 17	>CB Open	A	7026	Bus coupler circuit breaker in Open status
6118	BINARY INPUT 18	not marshalled	A	1	No function is allocated to input
6119	BINARY INPUT 19	>CB fail	A	7028	Circuit breaker disturbed
6120	BINARY INPUT 20	>Bay o.of ser	A	7029	Control: bay out of service

A: working–contact
R: quiescent–contact

```
Alarms from the bay unit for LC display and binary inputs and outputs
-------------------------------------------------------------------------------------------

FNo  – Function number of the alarm
MW   – measured value
EA   – E: marshallable to binary input
       A: marshallable to binary output (LED, alarm relay, command relay)
```

Table A.9.10 Marshallable output functions

FNo	Short text	Logical functions	
5	>LED–ackn	>Reset LED indications	EA
56	REBOOT	Initial start–up	
60	LED–ackn	Reset LED indications	
143	15V–superv.	Failure supply voltage 15 V	A
145	0V–superv.	Failure offset monitoring 0 V	A
161	Meas in supI	Measured value supervision I	A
190	Fail Com.CU	Data communication to master unit disturbed	A
511	Com Trip	Protection common trip	A
601	IL1 [%] =	Actual current of phase L1 [%]	MW
602	IL2 [%] =	Actual current of phase L2 [%]	MW
603	IL3 [%] =	Actual current of phase L3 [%]	MW
604	IE [%] =	Actual earth current [%]	MW
608	IDL1 [%]=	Operational measured value diff current phase L1 in %	MW
609	IDL2 [%]=	Operational measured value diff current phase L2 in %	MW
610	IDL3 [%]=	Operational measured value diff current phase L3 in %	MW
611	ISL1 [%]=	Operational measured value stab current phase L1 in %	MW
612	ISL2 [%]=	Operational measured value stab current phase L2 in %	MW
613	ISL3 [%]=	Operational measured value stab current phase L3 in %	MW
644	f [%]=	Actual frequency f [%]	MW
651	IL1 =	Actual current in phase L1	MW
652	IL2 =	Actual current in phase L2	MW
653	IL3 =	Actual current in phase L3	MW
654	IE =	Actual earth current	MW
1156	>CB test	>Start three–pole circuit breaker test	EA
1174	CB test	Circuit breaker test running	
7000	>Isol1–Closed	>Isolator status signal Closed for isolator 1	EA
7001	>Isol1–Open	>Isolator status signal Open for isolator 1	EA
7002	>Isol2–Closed	>Isolator status signal Closed for isolator 2	EA
7003	>Isol2–Open	>Isolator status signal Open for isolator 2	EA
7004	>Isol3–Closed	>Isolator status signal Closed for isolator 3	EA
7005	>Isol3–Open	>Isolator status signal Open for isolator 3	EA
7006	>Isol4–Closed	>Isolator status signal Closed for isolator 4	EA
7007	>Isol4–Open	>Isolator status signal Open for isolator 4	EA
7008	>Isol5–Closed	>Isolator status signal Closed for isolator 5	EA
7009	>Isol5–Open	>Isolator status signal Open for isolator 5	EA
7020	>CBF L1	Circuit breaker test phase L1	EA
7021	>CBF L2	Circuit breaker test phase L2	EA
7022	>CBF L3	Circuit breaker test phase L3	EA

FNo	Short text	Logical functions	
7023	>CBF pulse	>Breaker failure pulse	EA
7024	>CBF release	>Breaker failure release	EA
7025	>TRIP release	>TRIP–command release	EA
7026	>CB OPEN	>Bus coupler circuit breaker in Open status	EA
7027	>CB CLOSE com	>Circuit breaker status closed	EA
7028	>CB fail	>Circuit breaker disturbed	EA
7029	>Bay o.of ser	>Control: bay out of service	EA
7030	BB Start	Busbar protection common start	A
7040	BB Trip L123	Busbar protection trip command L123	A
7050	CBF Trip L123	Breaker failure protection Trip command L123	A
7051	CBF Trip L1	Breaker failure protection Trip command L1	A
7052	CBF Trip L2	Breaker failure protection Trip command L2	A
7053	CBF Trip L2	Breaker failure protection Trip command L3	A
7070	BB intertrip	Busbar protection transfer trip command	A
7080	Bay o.of ser	Bay out of service	A

A.1.6 Table of direct addresses – master unit (overview)

A.1.6.1 System and configuration data

```
Common configuration data
------------------------------------------------------------------------------------------------
0000 7SS52 V1.00

4900 CONFIGURAT: BB–Configurat. ?     *)
4901 BB/BZorAuxZ =BZ01/BZ01           (min. 0 – max. 4.24) 2)
                                       0        ≙ not existent,
                                      1–4.01–12 ≙ BB01..BB04/BZ01..BZ12,
                                      1–4.13–24 ≙ BZ01..BZ04/AB01..AB12)

4902 BB/BZorAuxZ =non existent        (like DA 4901)
                 .
                 .
                 .
4924 BB/BZorAuxZ =non existent        (like DA 4901)
```

---

1) DA 4901 – 4924 are only supported by DIGSI

2) BB = main busbar no 01 – 04
BZ = bus zone no 01 – 12
CS = bus coupler section no 13 – 24

```
Bay–related configuration data
-----------------------------------------------------------------------------------
0100 DESIGN DATA: Config. Bay 01 ?
0101 TYPE   :B01 =feeder bay         (section–isolat, bus–coupler, feeder bay)
0102 DESIGNA:B01 =1.0                (min. 0.0 – max. 99.9)
0103 BAY STA:B01 =existent           (existent, non existent)
0104 CT LOC :B01 =line side          (bus side, line side, non existent)
0105 CT POL :B01 =line side          (bus side, line side)
0106 CT NORM:B01 =0.001              (min. 0.001 – max. 1.000)
0107 BZ–ISO1:B01 =on BZ01            (min. 000.00 – max. 123.24)
                                     0           ≙ non existent,
                                     1 ... 12    ≙ on BZ01 ... BZ12,
                                     13 ...24    ≙ on AB01 ... AB12,
                                     1.2...23.24 ≙
                                     on BZ01/BZ02...AB11/AB12
                                     101...124   ≙ on BZ01 ON...
                                     ....AB12 ON
                                     101.2 ...   ≙ on BZ01/BZ02ON ...
                                     123.24      ≙ on AB11/AB12ON
0108 BZ–ISO2:B01 =non existent       (like BZ–ISO1)
0109 BZ–ISO3:B01 =non existent       (like BZ–ISO1)
0110 BZ–ISO4:B01 =non existent       (like BZ–ISO1) 1)
0111 BZ–ISO5:B01 =non existent       (non existent, existent)
-----------------------------------------------------------------------------------
0200 DESIGN DATA: Config. Bay 02 ?
-----------------------------------------------------------------------------------
                 .
                 .
                 .
-----------------------------------------------------------------------------------
4800 CONFIGURAT: Config. Bay 48 ?
-----------------------------------------------------------------------------------
```

---

1) Function of isolator 4 depends an DA 5404/ZE

```
System data
-------------------------------------------------------------------------------------
5000 CHANGE   SYST./DESIGN DATA?
5100 SYST:DATA.: System state  ?
5101 REBOOT      =blocked            (blocked, released)
5102 LED COL ISO =red for CLOSED     (green f. CLOSED, red f. CLOSED)
5103 FAULT RESPO =released           (blocked, released)
5104 AUT LED ACK =blocked            (blocked, released)
5105 FRECUENCY   =50    Hz           (50 Hz, 60 Hz)
5106 I>SUM  SUPV =.50   I/IN   *)    (min.  0.20 – max.   1.00)
5107 OFFSET SUPV =.10   V            (min.  0.10 – max.    .50)
5108 15 V   SUPV =1.50  V            (min.  0.50 – max.   2.50)
-------------------------------------------------------------------------------------
5200 SYST:DATA: Serial link ?
5201 TERMBAUD CU =19200  Baud        (min.  1.200 – max.   38400)
-------------------------------------------------------------------------------------
5400 DESGN DATA: Common configur?
5401 PROT TR BUS   =blocked          (blocked, released)
5402 BAY DC FAIL   =OLD isol status  (OLD isol status, isol CLOSED)
5403 ISOL ST 1/1   =OLD isol status  (OLD isol status, isol CLOSED)
5404 BB–ISOLAT 4   =BB–isolator      (TR–isolator, BB–isolator)
```

---

1) IN – Nominal current of the bay current transformer

A.1.6.2 Parameters

```
Common parameters
-------------------------------------------------------------------------------
6000 CHANGE    SETTINGS   ?
6100 SETTINGS:  BB–Diff.Protec ?
6101 STAB FAC:BZ =.65                (min.  0.10 – max.    0.80)
6102 I>DIFF. :BZ =1.00     I/Ino  1) (min.  0.20 – max.    4.00)
6103 STAB FAC:CZ =.50                (min.  0.00 – max.    0.80)
6104 I>DIFF. :CZ =1.00     I/Ino     (min.  0.20 – max.    4.00)
6105 NORM BAS IN =1000.0    A     2) (min. 20.00 – max. 3000.00)
6106 TRIP EXTEND =.10      s         (min.  0.02 – max.    1.00)
6107 BI TRIPENAB =not existent       (non existent, existent)
6108 T–CB   OPEN =0        s         (min.  0.00 – max.    1.00)
-------------------------------------------------------------------------------
6200 SETTINGS:  Bkr.Fail Protec?
6201 BF BI MODE  =1–chanelWithSup    (1–chanel no sup, 1–chanelWithSup,
                                      2–chanel no Sup, 2–chanelWithSup)
6202 STAB FAC:BF =.50                (min.  0.00 – max.    0.80)
6203 I>DIFF. :BF =2*I>BF (DA 6700) 3)
6204 TIME UNB BF =.25      s         (min.  0.05 – max.    1.00)
6205 T–BF IMPULS =.50      s         (min.  0.05 – max.    1.00)
6206 T–CB FAULT  =.10      s         (min.  0.00 – max.    1.00)
6207 TR REPOPMOD =single–phase       (single–phase, three–phase)
6208 T–TRIP  REP =.12      s         (min.  0.00 – max.    1.00)
-------------------------------------------------------------------------------
```

---

1) Ino – Normalized nominal current related to base current transformer (current transformer with highest transformation ratio)

2) Nominal current of the base current transformer

3) DA 67XY with XY = bay number 01 to 48

6300 SETTINGS: Supervision ?

```
6301 ISO TRA TIM =7.00     s          (min.  1.00 – max.  180.00)
6302 ISO MAL RES =alarm only       1)  (alarm only, blockAutoReleas,
                                       block storage)
6303 DIFF SUPERV =active               (inactive, active)
6304 T-DIFF SUPV =2        s           (min.  1    – max.   10   )
6305 I>SUPERV:BZ =.10      I/Ino  2)   (min.  0.05 – max.    0.80)
6306 I>SUPERV:CZ =.10      I/Ino  2)   (min.  0.05 – max.    0.80)
6307 DIFF SUP BZ =alarm only           (alarm only, blockAutoReleas,
                                       block storage)
6308 DIFF SUP CZ =alarm only           (alarm only, blockAutoReleas,
                                       block storage)
6309 ZERO CR SUP =active               (inactive, active)
6310 I> ZERO  CR =.50      I/Ino  2)   (min.  0.20 – max.    4.00)
6311 AUTO   TEST =active               (inactive, active)
6312 TEST  FAULT =alarm only           (alarm only, block protect.)
6313 I< MAN TRIP =.05      I/IN   3)   (min.  0.00 – max.    0.50)
6314 MON T BF CI =1.00     s           (min.  0.02 – max.  10.00)
6315 FLT T BF CI =.06      s           (min.  0.06 – max.   1.00)
6316 FLTREC RELE =automatic            (automatic, manual) 4)
6317 RELE BOS BU =released             (blocked,released)
```

---

1) For supervision of run time, breaker fault and auxiliary voltage

2) Ino – Normalized nominal current related to base current transformer (current transformer with highest transformation ratio)

3) IN – Nominal current of bay current transformer

4) Two fault record buffers, each 300 ms(200 ms before and 100 ms after the fault) are available.
Release auto: The fault record is automatically switched over to the other memory after each end of a fault. A previous fault record, still existing there, is overwritten.
Release manual: After storing two fault records, the fault recording function remains blocked until released via operation in DA 8300. If released, then both buffers are erased, independent of their contents.

```
Bay–related parameters
---------------------------------------------------------------------------------
6400 SETTINGS:  StatusBay 01–48?
6401 STATUS B 01 =active              (inactive, active)
6402 STATUS B 02 =active              (inactive, active)
                 .
                 .
                 .
6448 STATUS B 48 =active              (inactive, active)
---------------------------------------------------------------------------------
6500 SETTINGS:  I>TripBay 01–48?
6501 I>TRIP BAY01 =.00      I/IN  1)  (min.  0.00 – max.  25.00)
6502 I>TRIP BAY02 =.00      I/IN  1)  (min.  0.00 – max.  25.00)
                 .
                 .
                 .
6548 I>TRIP BAY48 =.00      I/IN  1)  (min.  0.00 – max.  25.00)
---------------------------------------------------------------------------------
6600 SETTINGS:  BF OpMode 01–48?
6601 BF OPMD B01 =BZ unbalance        (not existent, external,
                                      BZ unbalance, trip rep/unbal, I>query,
                                      trip rep/I>quer, trip rep/unb imp)
6602 BF OPMD B02 =BZ unbalance        (like DA 6601)
                 .
                 .
                 .
6648 BF OPMD B48 =BZ unbalance        (like DA 6601)
---------------------------------------------------------------------------------
6700 SETTINGS:  I>BF  Bay 1–48?
6701 I>BF BAY 01 =.50      I/IN  1)   (min.  0.10 – max.  2.00)
6702 I>BF BAY 02 =.50      I/IN  1)   (min.  0.10 – max.  2.00)
                 .
                 .
                 .
6748 I>BF BAY 48 =.50      I/IN  1)   (min.  0.10 – max.  2.00)
```

---

1) I_N – Nominal current of the bay current transformer

A.1.6.3 Commands/tests

```
8000 CONTROL     / TEST      ?

8100 TEST:        Auto testing  ?     1)  (Input J)

8200 TEST:        Manual trip ?       2)  (Input J)

8300 CONTROL:     ReleasFltRecBuf  ?  3)  (Input J)

8400 CONTROL:     FreezeFltRecBuf ?       (Input J)

8500 CONTROL:     ReleasBloDifSup ?       (Input J)(Release blocking by pick-up
                                          diff current supervision ?)

8600 CONTROL:     ReleasBloIsoMal ?       (Input J)(Release blocking by pick-up
                                          isolator failure (run time, status,
                                          auxiliary voltage failure) or test
                                          failure  ?)

8700 CONTROL:     Reset annun buf  ?  4)  (Input J) (related to fault events
                                                       and operational events)
```

---

1) Test start requires ”switched off” setting DA 6311/ZE.

2) CB test possible only if bay is out of service and I-bay < I-limit value DA 6313

3) If two fault record buffers are frozen, then both will be released simultaneously

4) Applies for operational events and fault events

A.1.7 Table of direct addresses – bay unit (overview)

```
1000 PARAMETERS
---------------------------------------------------------------------------------
1100 POWER SYSTEM DATA
1101 CT STARPNT                       Current transformer polarity
     TOWARDS LINE                     Towards line
     TOWARDS BUSBAR                   Towards busbar

Any change of this parameter is indicated to the master unit
---------------------------------------------------------------------------------


Test and Commissioning Aids 7SS521
---------------------------------------------------------------------------------
4000 TESTS
---------------------------------------------------------------------------------
4400 CB TEST LIVE TRIP
4401 CB TRIP L1                       Circuit breaker trip test poleL1
4402 CB TRIP L2                       Circuit breaker trip test poleL2
4403 CB TRIP L3                       Circuit breaker trip test poleL3
4404 CB TRIP L123                     Circuit breaker trip test 3–pole
---------------------------------------------------------------------------------
4500 COMMUNICATION MASTER UNIT
4501 Com. CU                          Bay out of service
4502 Com. CU                          Bay in sevice
---------------------------------------------------------------------------------


Addresses for alarms, measured values etc. 7SS521
---------------------------------------------------------------------------------
5000 CHANGE
---------------------------------------------------------------------------------
5700 OPERATIONAL MEASURED VALUES
5701 IL1[%]        = XXXX.X           Actual current in phase L1 [%]=
5702 IL2[%]        = XXXX.X           Actual current in phase L2 [%]=
5703 IL3[%]        = XXXX.X           Actual current in phase L3 [%]=
5704 IE[%]         = XXXX.X           Actual earth current [%]
5705 IDL1[%]       = XXXX.X           Oper meas value diff current phase L1 in %
5706 IDL2[%]       = XXXX.X           Oper meas value diff current phase L2 in %
5707 IDL3[%]       = XXXX.X           Oper meas value diff current phase L3 in %
5708 ISL1[%]       = XXXX.X           Oper meas value stab current phase L1 in %
5709 ISL2[%]       = XXXX.X           Oper meas value stab current phase L2 in %
5710 ISL3[%]       = XXXX.X           Oper meas value stab current phase L3 in %
5711 f[Hz]         = XXXX.X           Frequency f[Hz]=
```

A.1.8 Reference table for configuration parameters – bay unit

```
6000 MARSHALLING
-------------------------------------------------------------------------------

6100 MARSHALLING BINARY INPUTS
                         pre–settings:
6101 BINARY INPUT 1     >isolator 1 closed    A 1)
6102 BINARY INPUT 2     >isolator 1 open      A
6103 BINARY INPUT 3     >isolator 2 closed    A
6104 BINARY INPUT 4     >isolator 2 open      A
6105 BINARY INPUT 5     >isolator 3 closed    A
6106 BINARY INPUT 6     >isolator 3 open      A
6107 BINARY INPUT 7     >isolator 4 closed    A
6108 BINARY INPUT 8     >isolator 4 open      A
6109 BINARY INPUT 9     >isolator 5 closed    A
6110 BINARY INPUT 10    >isolator 5 open      A
6111 BINARY INPUT 11    >CBF L1               A
6112 BINARY INPUT 12    >CBF L2               A
6113 BINARY INPUT 13    >CBF L3               A
6114 BINARY INPUT 14    >CB CLOSE com         A
6115 BINARY INPUT 15    >CBF rel              A
6116 BINARY INPUT 16    >CB test              A
6117 BINARY INPUT 17    >CB open              A
6118 BINARY INPUT 18    not marshalled
6119 BINARY INPUT 19    >CB fail              A
6120 BINARY INPUT 20    >Bay o.of ser         A
-------------------------------------------------------------------------------

6200 MARSHALLING SIGNAL RELAYS
6201 SIGNAL RELAY 1       pre–setting: Bay o.of ser   nm 2)
-------------------------------------------------------------------------------

6300 MARSHALLING LED INDICATORS
                         pre–setting:
6301 LED 1  (red)        >Isolator 1 closed   nm  2)
6302 LED 2  (green)      >Isolator 1 open     nm
6303 LED 3  (red)        >Isolator 2 closed   nm
6304 LED 4  (green)      >Isolator 2 open     nm
6305 LED 5  (red)        >Isolator 3 closed   nm
6306 LED 6  (green)      >Isolator 3 open     nm
6307 LED 7  (red)        >Isolator 4 closed   nm
6308 LED 8  (green)      >Isolator 4 open     nm
6309 LED 9  (red)        >Isolator 5 closed   nm
6310 LED 10 (green)      >Isolator 5 open     nm
6311 LED 11 (red)        not marshalled
6312 LED 12 (red)        not marshalled
```

---

1) A: working–contact, R: quiescent–contact

2) nm: not memorized, m: memorized

```
                        pre–setting:
6313 LED 13  (red)      Fail com.CU    nm
6314 LED 14  (red)      BB Trip L123    m
                        BF Trip L123    m
                        BF Trip L1      m
                        BF Trip L2      m
                        BF Trip L3      m
                        CB Test L1      m
                        CB Test L2      m
                        CB Test L3      m
6315 LED 15  (red)      BB intertrip    m
6316 LED 16  (red)      Bay o.of ser   nm

---------------------------------------------------------------------------------
6400 MARSHALLING TRIP RELAYS
                        pre–setting:
6401 TRIP RELAY 1       BF Trip L1
                        BB Trip L123
                        BF Trip L123
                        CB Test L1
6402 TRIP RELAY 2       BF Trip L2
                        BB Trip L123
                        BF Trip L123
                        CB Test L2
6403 TRIP RELAY 3       BF Trip L3
                        BB Trip L123
                        BF Trip L123
                        CB Test L3
6404 TRIP RELAY 4       BB Trip L123
                        BF Trip L123
                        BF Trip L1
                        BF Trip L2
                        BF Trip L3
                        CB Test L1
                        CB Test L2
                        CB Test L3
6405 TRIP RELAY 5       BB intertrip
---------------------------------------------------------------------------------
7000 OP.SYSTEM CONFIGURATION

---------------------------------------------------------------------------------
7100 INTEGRATED OPERATION
7120 OPER 1st line      Operational measured value line 1
7121 OPER 1st line      Operational measured value line 1 primary/secondary
7122 OPER 2nd line      Operational measured value line 2
7123 OPER 2nd line      Operational measured value line 2 primary/secondary
7124 OPER 3rd line      Operational measured value line 3
7125 OPER 3rd line      Operational measured value line 3 primary/secondary
7126 OPER 4th line      Operational measured value line 4
7127 OPER 4th line      Operational measured value line 4 primary/secondary
```

A.1.9 Abbreviations

BSZ	Protection module
IBS	Commissioning
CS	Bus coupler section (sections which serve exclusively for longitudinal connection of bus zones and to which no outgoing feeders are connected)
LED	Light emitting diode
CB	Circuit breaker
SEC	Sectionalizer
MLFB	Coded ordering number
PC	Personal computer
SBK	Control–operation–interface module
BZ	Bus zone
BF	Circuit breaker failure
CBF	Circuit breaker failure protection
TB	Transfer busbar
ZPS	Central processor module protection

To
Siemens Aktiengesellschaft
EV S E 14
Postfach 4806
90026 Nürnberg
Germany

Fax: (49) 911/433–7365

Dear reader, printing errors can never be entirely eliminated: therefore, should you come across any when reading this manual, kindly enter them in this form together with any comments or suggestions for improvement that you may have.

From
Name
Company/Dept.
Address
Telephone no./Fax no.

Suggestions	**Corrctions**	
for manual	**Order–no.**	**Edition**
7SS52 DistributedBusbar/Circuit Breaker Failure Protection SIPROTEC 7SS52 Operation Manual	E50410–A0012–U501–A1–7691	May 1998

Branch
Power Transmission and Distribution
Business segment Protection and Substation Control Systems
Postfach 48 06
D-90026 Nürnberg
Germany

Siemens Aktiengesellschaft

Order–no.: **E50410–A0012–U501–A1–7691**
File no.: 7SS52 V1.0
Printed in Germany