SIEMENS

# SIPROTEC

# Multifunction High Speed Busbar Transfer Device 7VU683

V4.60

User Manual



C53000-G1176-C369-1

**Note**

For safety purposes, please note instructions and warnings in the Preface.



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Siemens Power Automation Ltd.

Order No.: C53000-G1176-C369-1

# Preface

### Purpose of this manual

This manual describes the functions, operation, installation, and commissioning of devices 7VU683-> In particular, one will find:

- Information regarding the configuration of the scope of the device and a description of the device functions and settings > Chapter 2;
- Instructions for Installation and Commissioning > Chapter 3;
- Technical Data > Chapter 4;
- As well as a compilation of the most significant data for advanced users > Appendix A.

General information with regard to design, configuration, and operation of SIPROTEC 4 devices are set out in the SIPROTEC 4 System Description /1/.

### Target Audience

Protection engineers, commissioning engineers, personnel concerned with adjustment, checking, and service of selective protective equipment, automatic and control facilities, and personnel of electrical facilities and power plants.

### Applicability of this Manual

This manual applies to: SIPROTEC 4 Power Supply Transfer Device 7VU683; firmware version V4.6.

### Indication of Conformity

| | |
|---|---|
| CE | This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Council Directive 2004/108/EG) and concerning electrical equipment for use within specified voltage limits (Low-voltage Directive 2006/95 EG).<br><br>This conformity is proved by tests conducted by Siemens AG in accordance with the Council Directive in agreement with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the standard EN 60255-5 for the low-voltage directive.<br><br>This product is designed and manufactured for application in industrial environment.<br><br>The product conforms with the international standards of IEC 60255 and the German specification VDE 0435. |

**Additional Standards** IEEE 37.90

### Additional Support

Should further information on the System SIPROTEC 4 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 representative.

Our Customer Support Center provides a 24-hour service.

Phone: 8008289887, 4008289887

Fax: +86-025-52114978

e-mail: ea_support.cn@siemens.com

**Training Courses**

Enquiries regarding individual training courses should be addressed to our Training Center:

Energy Sector
Power Distribution Division

Energy Automation

Siemens Power Automation Ltd

Building 4, Hua Rui Industry Park,
88 Cheng Xin Avenue,
Jiangning Economic & Technological
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Nanjing 211100, P.R.China

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Internet: http://www.siemens.com.cn/ea

**Safety Information**

This manual does not constitute a complete index of all required safety measures for operation of the equipment (module, device), as special operational conditions may require additional measures. However, it comprises important information that should be noted for purposes of personal safety as well as avoiding material damage. Information that is highlighted by means of a warning triangle and according to the degree of danger, is illustrated as follows.

**DANGER!**

Danger indicates that death, severe personal injury or substantial material damage will result if proper precautions are not taken.

**WARNING!**

indicates that death, severe personal injury or substantial property damage may result if proper precautions are not taken.

**Caution!**

indicates that minor personal injury or property damage may result if proper precautions are not taken. This particularly applies to damage to or within the device itself and consequential damage thereof.

**Note**

indicates information on the device, handling of the device, or the respective part of the instruction manual which is important to be noted.

## WARNING!

**Qualified Personnel**

Commissioning and operation of the equipment (module, device) as set out in this manual may only be carried out by qualified personnel. Qualified personnel in terms of the technical safety information as set out in this manual are persons who are authorized to commission, activate, to ground and to designate devices, systems and electrical circuits in accordance with the safety standards.

**Use as prescribed**

The operational equipment (device, module) may only be used for such applications as set out in the catalogue and the technical description, and only in combination with third-party equipment recommended or approved by Siemens.

The successful and safe operation of the device is dependent on proper handling, storage, installation, operation, and maintenance.

When operating an electrical equipment, certain parts of the device are inevitably subject to dangerous voltage. Severe personal injury or property damage may result if the device is not handled properly.

Before any connections are made, the device must be grounded to the ground terminal.

All circuit components connected to the voltage supply may be subject to dangerous voltage.

Dangerous voltage may be present in the device even after the power supply voltage has been removed (capacitors can still be charged).

Operational equipment with exposed current transformer circuits may not be operated.

The limit values as specified in this manual or in the operating instructions may not be exceeded. This aspect must also be observed during testing and commissioning.

## Typographic and Symbol Conventions

The following text formats are used when literal information from the device or to the device appear in the text flow:

**Parameter Names**

Designators of configuration or function parameters which may appear word-for-word in the display of the device or on the screen of a personal computer (with operation software DIGSI), are marked in bold letters in monospace type style. The same applies to the titles of menus.

**1234A**

Parameter addresses have the same character style as parameter names. Parameter addresses contain the suffix **A** in the overview tables if the parameter can only be set in DIGSI via the option **Display additional settings**

***Parameter Options***

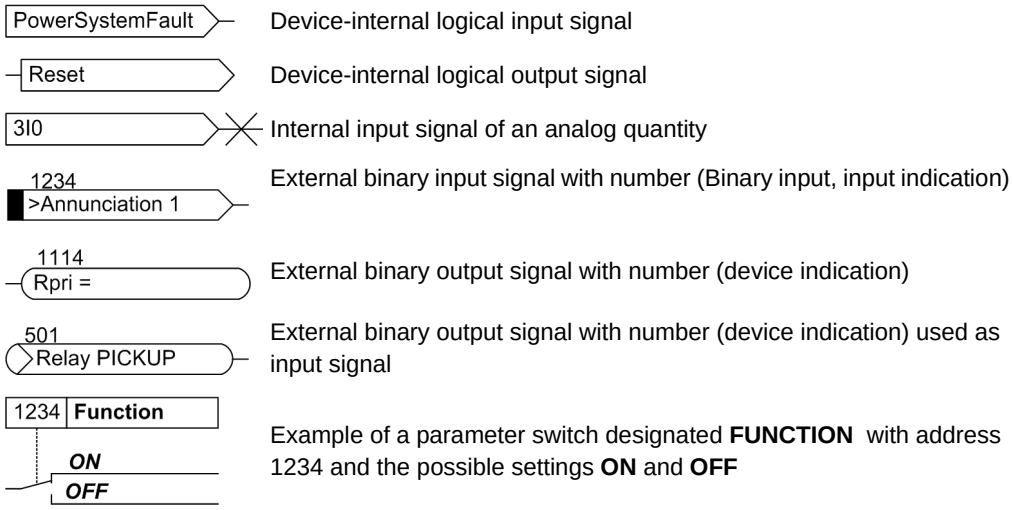
Possible settings of text parameters, which may appear word-for-word in the display of the device or on the screen of a personal computer (with operation software DIGSI), are additionally written in italics. The same applies to the options of the menus.

Message

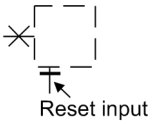
Designators for information, which may be output by the relay or required from other devices or from the switch gear, are marked in a monospace type style in quotation marks.

Deviations may be permitted in drawings and tables when the type of designator can be obviously derived from the illustration.

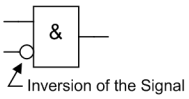
The following symbols are used in drawings:



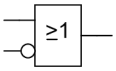

Besides these, graphical symbols are used in accordance with IEC 60617-12 and IEC 60617-13 or similar. Some of the most frequently used are listed below:



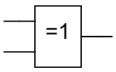

Input signal of analog quantity



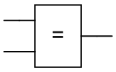

AND-gate operation of input values



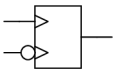

OR-gate operation of input values



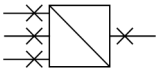

Exclusive OR-gate (antivalence): output is active, if only **one** of the inputs is active



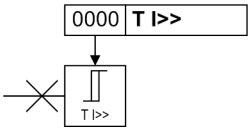

Coincidence gate (equivalence): output is active, if **both** inputs are active or inactive at the same time



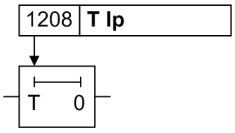
Dynamic inputs (edge-triggered) above with positive, below with negative edge



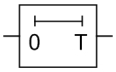
Formation of one analog output signal from a number of analog input signals



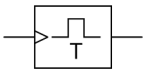

Limit stage with setting address and parameter designator (name)



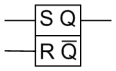

Timer (pickup delay T, example adjustable) with setting address and parameter designator (name)




Timer (dropout delay T, example non-adjustable)




Dynamic triggered pulse timer T (monoflop)




Static memory (RS-flipflop) with setting input (S), resetting input (R), output (Q) and inverted output ($\overline{Q}$)

■

# Contents

# Introduction 1

This chapter indroduces the power supply transfer devices 7VU683. It presents an overview of the scope of application, the properties ,and functional scope of the 7VU683.

# 1.1 Application Scope

In power plant, industrial plant and network substation, in order to ensure the continuity of load operation, two power supplies are provided for important loads . One power supply is working as the operating power supply, another is the backup.

When the operating power supply is shut down because of system fault or equipment maintenance or deliberate operation, the load busbar will be transferred to the standby power supply immediately by the power supply transfer devices.

# 1.2 Function Configuration

Besides power supply transfer functions, 7VU683 have the protection functions, the protected object is the tie-CB of the busbar. When the standby power supply is connected to a fault source by a power supply transfer operation, the standby power supply can be disconnected immediately. When the tie-CB is closing, if a busbar is fault, the tie-CB will be opened immediately and the power supply transfer operation will be blocked.

7VU683 have the load-shedding function to maintain the system stability after busbar transfer.

# 1.3 Characteristics

**General**

- Low power consumption, good for device long-term running.
- Powerful information recording with fault record, event log , trip log etc.
- Powerful analysis and configuration tool - DIGSI.
- Flexible to define own logic by CFC.
- Support protocols: IEC61850, Redundant T103,  T103, ModBus and ProfiBus - DP.
- High qualified Hardware, good performance of EMC.

**HSBT**

- High speed output relay, closing time is 1ms.
- Secure fast transfer.
- Real-time fast transfer, improved fast transfer.
- Support typical transfer start conditions and transfer modes.
- Protection functions for tie-CB integrated.

■

# Function 2

This chapter describes the individual functions available on the SIPROTEC 4 device 7VU683. It show the setting possibilities for each function in maximum configuration. Guidelines for establishing setting values and, where required, formular are given.

Additionally, on the basis of the following information, it may be defined which functions are to be used.

# 2.1 HSBT

## 2.1.1 General

In power plant and industry plant, the auxiliary system has at least 2 available power supplies, and the auxiliary loads are mostly induction motors. To maintain the process continuity, the motor bus has to be transferred from the normal power supply to the standby power supply when the normal power supply is not available anymore.

When the operating power supply is disconnected, the motors generates a voltage due to the energy stored in the motor fields. This induced voltage on the bus is called residual voltage. When the operating CB is opened, the busbar voltage will jump from operating source voltage to residual voltage. The magnitude and the frequency of residual voltage will decay. The decaying trend and decaying rate depend on various conditions such as the types of the motors, loads on the motors, the inertia of the motors, etc. The power supply transfer should evaluate the differential voltage between residual voltage and backup voltage. If the differential voltage is too large at motor re-energized time, large inrush current and electromagnetic torque would be generated and cause damage to the motors. If the motor dead time (the motor is not connected to any power supply) is too long, the motor restart current will increase and busbar voltage will decrease. Tt impacts the stability of the auxiliary system. To resolve these problems, the High speed busbar transfer (HSBT) device is developed.

HSBT device makes power supply transfer without causing damage to the motors and keep the motor dead time minimum.

7VU683 supports different primary diagrams:

- Segmented Single Busbar and Single Busbar
- Options of **212 Primary Diagram** in Power System Data 1

7VU683 supports different transfer schemes:

- 8805 Transfer Mode Line1 -> Line2
- 8806 Transfer Mode Line2 -> Line1
- 8807 Transfer Mode Busbar1 -> Busbar2
- 8808 Transfer Mode Busbar1 -> Line1
- 8809 Transfer Mode Busbar2 -> Busbar1
- 8810 Transfer Mode Busbar2 -> Line2

7VU683 supports different transfer start condition:

- 8821 NORMAL Condition
- 8822 FAULT Condition
- 8823Undervotlage Condition
- 8824 Underfrequency condition
- 8825 Inadvertent CB Open Condition

7VU683 supports different transfer sequence:

- PARALLEL Auto Sequence
- PARALLEL Haft-Auto Sequence
- SIMULTANEOUS Sequence
- SEQUENTIAL Sequence

7VU683 supports different transfer mode:

- 8841 FAST
- 8842 REAL-TIME FAST
- 8843 IN-PHASE

- 8844 RES-VOLT
- 8845 LONG-TIME

**Note:**

1. When **212 Primary Diagram** is set to ***Single Busbar***, only transfer schemes **8805 Transfer Mode Line1 -> Line2** and **8806 Transfer Mode Line2 -> Line1** are available. The parameters and messages of other transfer schemes will be invisible.
2. The transfer sachems and transfer modes can be set to ***ON*** or ***OFF*** separately. But when a transfer is started by any Start Condition, all other transfer schemes and transfer modes will be blocked.

CB operation logics used in HSBT are shown as followed.

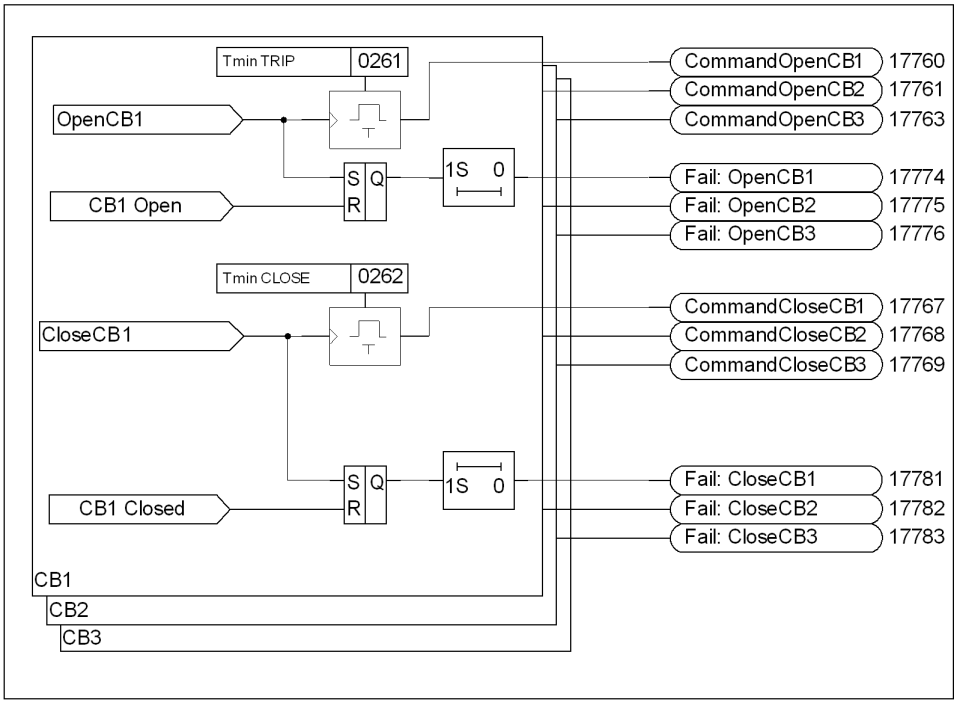



Figure 2-1 The Logic Diagram of CB Operations

**Note:**

1. The device does not support control function, it is not possible to operate the CB via front panel.
2. There is no operation on CB3 in single busbar.
3. CB positions (52a and 52b) can be routed to 2 BIs as a double point signal, or routed to one BI (H-52a , L-52b) as a normal open/close single point signal. If the default routing of CB is changed to single point signal, the default display of the device needs to be updated with the single point signal. Otherwise the display of CB position on the display panel will be incorrect. For example, CB1 position is changed to a single point signal, "17621 >CB1 52a" routed to BI1"H" and "17622 >CB1 52b "routed to BI1"L", or "17621 >CB1 52a" routed to BI1"L"and "17622 >CB1 52b" routed to BI1"H". "17621 >CB1 52a" should be linked to the CB1 on the default display.

The general logic of HSBT is shown as followed.

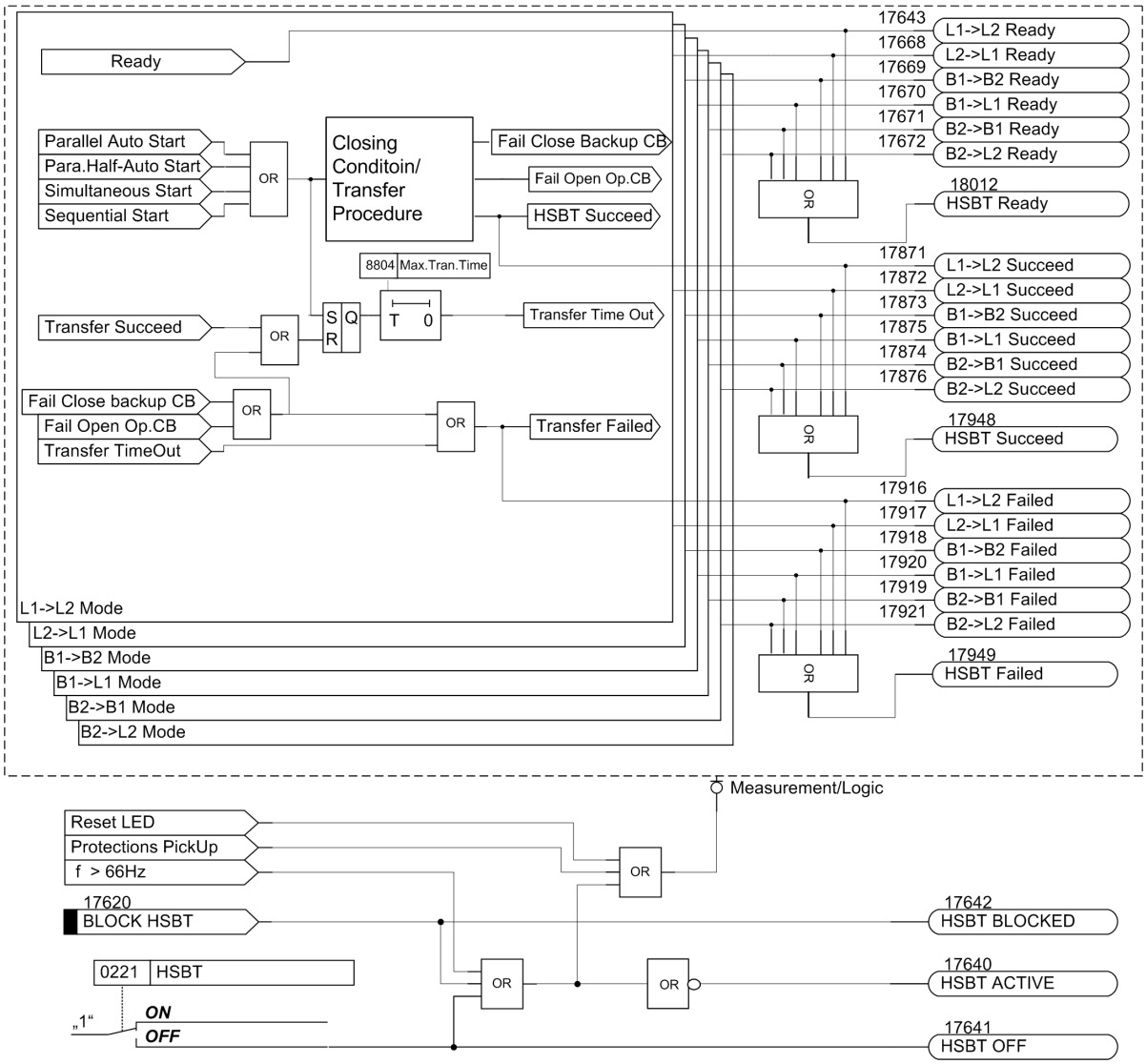



Figure 2-2 The General Logic of HSBT

**Note:**

The signals 17620 >BLOCK HSBT or the reset button "**LED**" on front panel will block HSBT function. When the blocking signals drop out, HSBT will reset and try to make ready again. The trip signals from internal protection functions also block the HSBT function.

### 2.1.1.1 Settings

| Addr. | Parameter | Range | Default Setting | Note |
|---|---|---|---|---|
| Device Configuration | | | | |
| 0158 | High Speed Busbar Transfer | Disable<br>Enable | Enable | |
| 0160 | Protection Functions | Disable<br>Enable | Disable | |
| Power System Data 1-> Power System | | | | |
| 0211 | Rated Frequency | 50Hz<br>60Hz | 50Hz | |
| 0212 | Primary Diagram | Single Bus<br>Segmented Single Bus | Segmented Single Bus | |
| 0213 | PT Connection of Line1 | UL1E transformer<br>UL2E transformer<br>UL3E transformer<br>UL12 transformer<br>UL23 transformer<br>UL31 transformer | UL12 transformer | |
| 0214 | PT Connection of Line2 | UL1E transformer<br>UL2E transformer<br>UL3E transformer<br>UL12 transformer<br>UL23 transformer<br>UL31 transformer | UL12 transformer | |
| 8900 | Busbar Live Voltage Threshold | 10.0<= .. <=150.0 | 70.0V | |
| 8901 | Busbar Dead Voltage Threshold | 10.0<= .. <=125.0 | 30.0V | |
| 8902 | Line Live Voltage Threshold | 10.0<= .. <=150.0 | 70.0V | |
| 8903 | Line Dead Voltage Threshold | 10.0<= .. <=125.0 | 30.0V | |
| 8904 | Line Dead Current Threshold | 0.02<= .. <=2.00 | 0.10I/In | |
| Power System Data 1-> Funct. | | | | |
| 0221 | High Speed Busbar Transfer | ON<br>OFF | ON | |
| 0226 | Protection Functions | ON<br>OFF | ON | |
| Power System Data 1-> VT's | | | | |
| 0231 | PT Rated Primary Voltage Line1 | 1.0<= .. <=1200.0 | 110.0kV | |
| 0232 | PT Rated Secondary Voltage Line1 | 80<= .. <=125 | 100V | |
| 0233 | PT Rated Primary Voltage Line2 | 1.0<= .. <=1200.0 | 110.0KV | |
| 0234 | PT Rated Secondary Voltage Line2 | 80<= .. <=125 | 100V | |
| 0235 | PT Rated Primary Voltage Busbar | 1.0<= .. <=1200.0 | 110.0KV | Single Bus |

| Addr. | Parameter | Range | Default Setting | Note |
|---|---|---|---|---|
| 0236 | PT Rated Secondary Voltage Busbar | 80<= .. <=125 | 100V | Single Bus |
| 0237 | PT Rated Primary Voltage Busbar1 | 1.0<= .. <=1200.0 | 110.0KV | Segmented Single Bus |
| 0238 | PT Rated Secondary Voltage Busbar1 | 80<= .. <=125 | 100V | Segmented Single Bus |
| 0239 | PT Rated Primary Voltage Busbar2 | 1.0<= .. <=1200.0 | 110.0KV | Segmented Single Bus |
| 0240 | PT Rated Secondary Voltage Busbar2 | 80<=..<=125 | 100V | Segmented Single Bus |
| Power System Data 1->CT's | | | | |
| 0251 | CT Rated Primary Current Line1 | 1<=…<=100000 | 3000A | |
| 0252 | CT Rated Secondary Current Line1 | 1A<br>5A | 5A | |
| 0253 | CT Rated Primary Current Line2 | 1<=…<=100000 | 3000A | |
| 0254 | CT Rated Secondary Current Line2 | 1A<br>5A | 5A | |
| 0255 | CT Rated Primary Current Busbar | 1<=…<=100000 | 3000A | |
| 0255 | CT Rated Primary Current Busbar | 1<=…<=100000 | 3000A | |
| 0256 | CT Rated Secondary Current Busbar | 1A<br>5A | 5A | |
| 0257A | Earth CT Rated Primary Current Busbar | 1<=…<=100000 | 3000A | |
| 0258A | Earth CT Rated Secondary Current Busbar | 1A<br>5A | 5A | |
| Power System Data 1->CB | | | | |
| 0261 | Minimum TRIP Command Duration | 0.01<=…<=10 | 0.20sec | |
| 0262 | Minimum CLOSE Command Duration | 0.01<=…<=10 | 0.20sec | |
| 0263S | CB failure detection time | 0.05<=…<=600.00 | 1.00sec | |

### 2.1.1.2 Information List

| No. | Information | Type | Fun. NO. | Inf. NO. |
|---|---|---|---|---|
| 17621 | > CB1 52a | SP | | |
| 17622 | > CB1 52b | SP | | |
| 17623 | > CB2 52a | SP | | |
| 17624 | > CB2 52b | SP | | |
| 17625 | > CB3 52a | SP | | |
| 17626 | > CB3 52b | SP | | |
| 17864 | > NonManu.Op.CB1 | SP | | |
| 17865 | > NonManu.Op.CB2 | SP | | |

| | | | | |
|---|---|---|---|---|
| 17866 | > L1 MCB Closed | SP | | |
| 17867 | > L2 MCB Closed | SP | | |
| 17868 | > B1 MCB Closed | SP | | |
| 17869 | > B2 MCB Closed | SP | | |
| 17817 | BusbarLiveVolt. | OUT | | |
| 17818 | B1 Live Volt. | OUT | | |
| 17819 | B2 Live Volt. | OUT | | |
| 17723 | B1 DeadVoltage | OUT | | |
| 17726 | B2 DeadVoltage | OUT | | |
| 17736 | BusbarDeadVolt. | OUT | | |
| 17820 | Line1 Live Volt. | OUT | | |
| 17821 | Line2 Live Volt. | OUT | | |
| 17724 | Line1 Dead Volt. | OUT | | |
| 17725 | Line1 Dead Curr. | OUT | | |
| 17727 | Line2 Dead Volt. | OUT | | |
| 17728 | Line2 Dead Curr. | OUT | | |
| 17760 | CommandOpenCB1 | OUT | 200 | |
| 17761 | CommandOpenCB2 | OUT | 200 | |
| 17762 | CommandOpenCB3 | OUT | 200 | |
| 17767 | CommandCloseCB1 | OUT | 200 | |
| 17768 | CommandCloseCB2 | OUT | 200 | |
| 17769 | CommandCloseCB3 | OUT | 200 | |
| 17774 | Fail: Open CB1 | OUT | | |
| 17775 | Fail: Open CB2 | OUT | | |
| 17776 | Fail: Open CB3 | OUT | | |
| 17781 | Fail: Close CB1 | OUT | | |
| 17782 | Fail: Close CB2 | OUT | | |
| 17783 | Fail: Close CB3 | OUT | | |
| 18005 | Warn: CB1Unavai. | OUT | | |
| 18006 | Warn: CB2Unavai. | OUT | | |
| 18007 | Warn: CB3Unavai. | OUT | | |
| 17960 | HSBT ON/OFF | IntSP | 200 | |
| 17962 | Protections ON/OFF | IntSP | 200 | 65 |

## 2.1.2 Primary Diagram

7VU683 can be applied in two primary diagrams: single busbar and segmented busbar. You can select differferent application via parameter **0212 Primary Diagram** in Power System Data 1.

### 2.1.2.1 Single Busbar

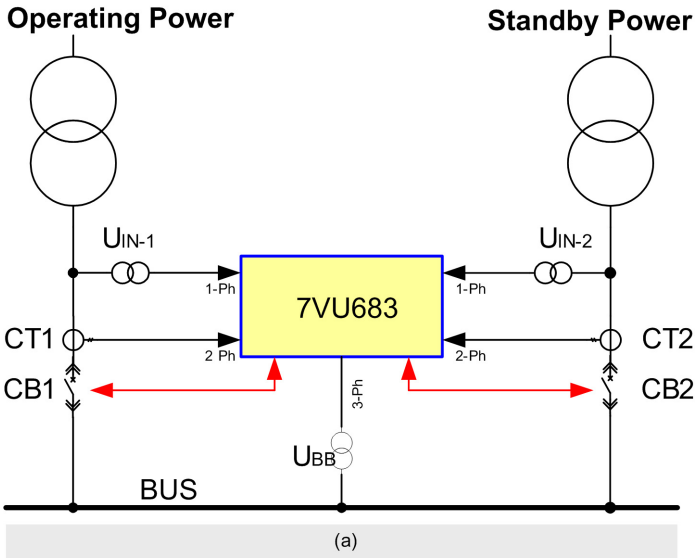



Figure 2-3 Primary Diagram of Single Busbar

Figure 2-3 shows the connections of single busbar. In single busbar, CB1 is normally closed and CB2 is open, the bus is supplied by the operating power supply. If the operating power supply is powered off by system fault or other reasons, the device will transfer the bus from the operating power supply to the standby power supply quickly.

Two transfer modes can be applied in this application: **Transfer Mode Line1** -> **Line2** (Line2 is the backup of Line1) and **Transfer Mode Line2** -> **Line1** mode (Line1 is the backup of Line2). The device connections are shown below. The setting **8831 Mono-direction Against NORMAL** affects the transfer mode.

When **8831 Mono-direction Against NORMAL** is ***YES***, it will only allow the transfer started by abnormal condition in one direction, Line1 -> Line2. In other words, except NORMAL Start, other start condition will be blocked and can not start the transfer Line2 -> Line1. Details are shown in the table below:

| CB1 Status | CB2 Status | Transfer Mode | 8831 Mono-di.Ag.NOR | Busbar Transfer Permitted? | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | NORMAL Start | FAULT Start | Under Voltage Start | Under Frequency Start | Inadvertent CB OPEN Start |
| Closed | Open | Line 1->Line 2 | YES | YES | YES | YES | YES | YES |
| | | | NO | YES | YES | YES | YES | YES |
| Open | Closed | Line 2->Line 1 | YES | YES | NO | NO | NO | NO |
| | | | NO | YES | YES | YES | YES | YES |

### 2.1.2.2 One Segmented Busbar

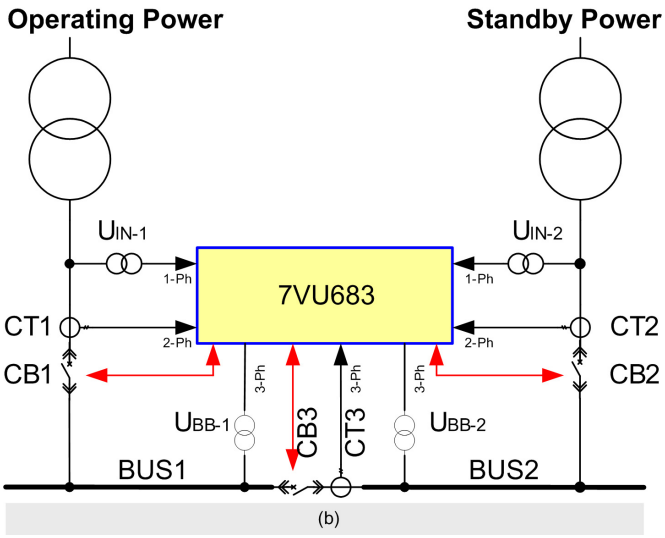



Figure 2-4 Primary Diagram of Segmented Busbar

Figure 2-4 shows the connections of a segmented busbar. In the segmented busbar, CB1 and CB3 are normally closed and CB2 is open, the Bus1 and Bus2 are supplied by the operating power supply. If the operating power supply is powered off by fault or other reasons, the device will transfer the buses from the operating power supply to the standby power supply quickly. The transfer mode will be automatically chosen according to CBs' statuses and transfer modes.

6 transfer modes can be applied in segmented busbar: **8805 Transfer Mode Line1** -> **Line2** (Line2 is the backup of Line1), **8806 Transfer Mode Line2** -> **Line1** (Line1 is the backup of Line2), **8807 Transfer Mode Busbar1** -> **Busbar2** (Bus2 is the backup of Bus1)，**8808 Transfer Mode Busbar1** -> **Line1** (Bus1 is the backup of Line1),**8809 Transfer Mode Busbar2** -> **Busbar1** (Bus1 is the backup of Bus2)， **8810 Transfer Mode Busbar2** -> **Line2** (Bus2 is the backup of Line2), the device connections are shown below. The transfer modes can be affected by the setting of **8831 Mono-direction Against NORMAL**, details are shown in the table below:

| CB1 Status | CB2 Status | CB3 Status | Transfer Mode | 8831 Mono-di.Ag. NOR | Busbar Transfer Permitted? | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | NORMAL Start | FAULT Start | Under Voltage Start | Under Frequency Start | Inadvertent CB Open Start |
| Closed | Open | Closed | Line 1->Line 2 | YES | YES | YES | YES | YES | YES |
| | | | | NO | YES | YES | YES | YES | YES |
| Closed | Open | Closed | Bus 2->Line 2 | YES | YES | NOT APPLIED | NOT APPLIED | NOT APPLIED | NOT APPLIED |
| | | | | NO | | | | | |
| Open | Closed | Closed | Line 2->Line 1 | YES | YES | NO | NO | NO | NO |
| | | | | NO | YES | YES | YES | YES | YES |
| Open | Closed | Closed | Bus 1->Line 1 | YES | YES | NOT APPLIED | NOT APPLIED | NOT APPLIED | NOT APPLIED |
| | | | | NO | | | | | |
| Closed | Closed | Open | Bus 1->Bus 2 | YES | YES | YES | YES | YES | YES |
| | | | | NO | YES | YES | YES | YES | YES |
| Closed | Closed | Open | Bus 2->Bus 1 | YES | YES | NO | NO | NO | NO |
| | | | | NO | YES | YES | YES | YES | YES |

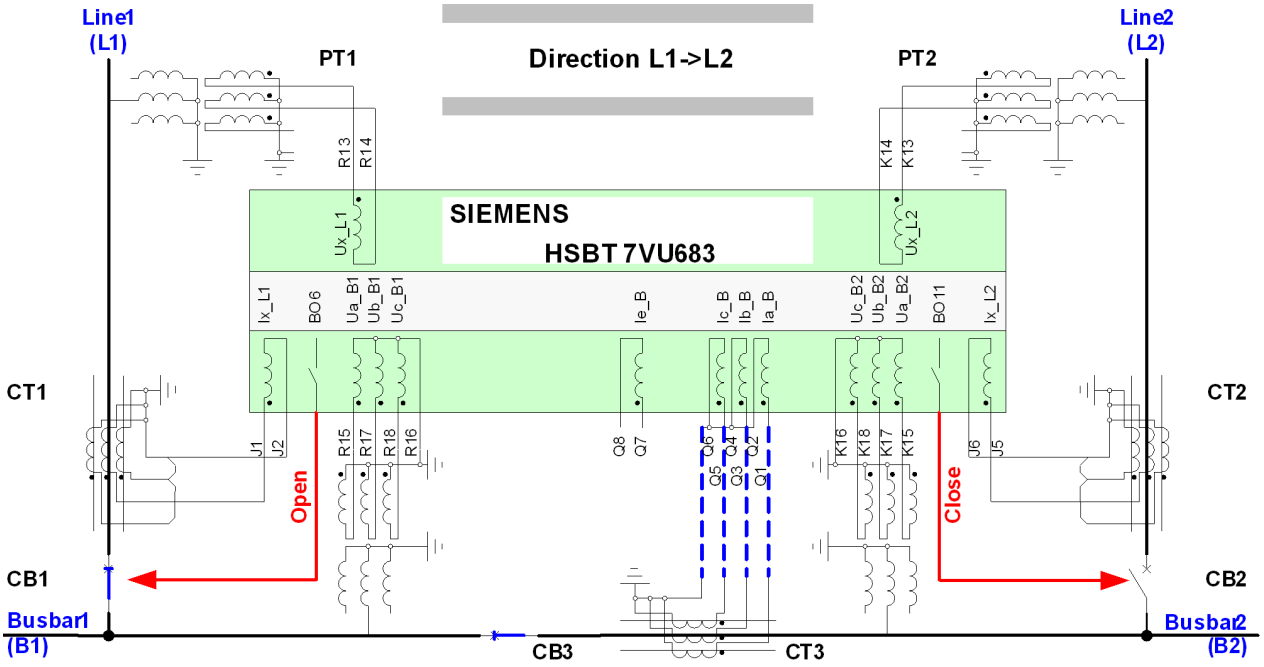



Figure 2-5 Device Connections of Transfer Mode L1->L2

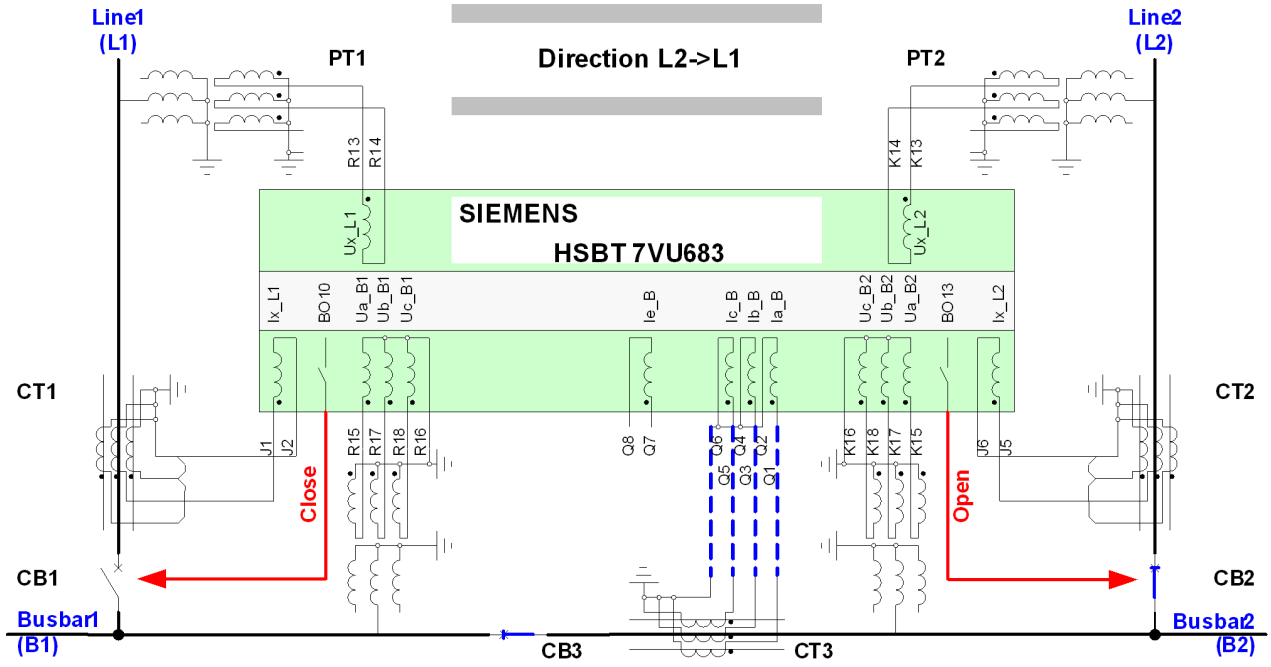



Figure 2-6 Device Connections of Transfer Mode L2->L1

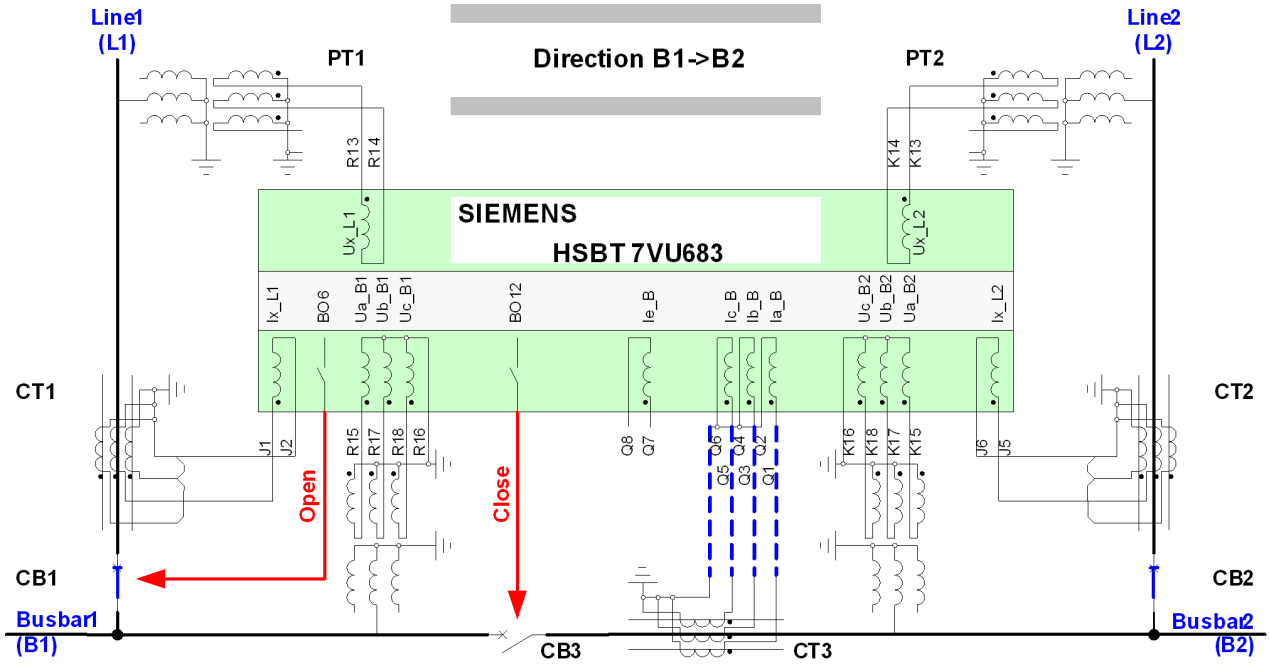



Figure 2-7 Device Connections of Transfer Mode B1->B2

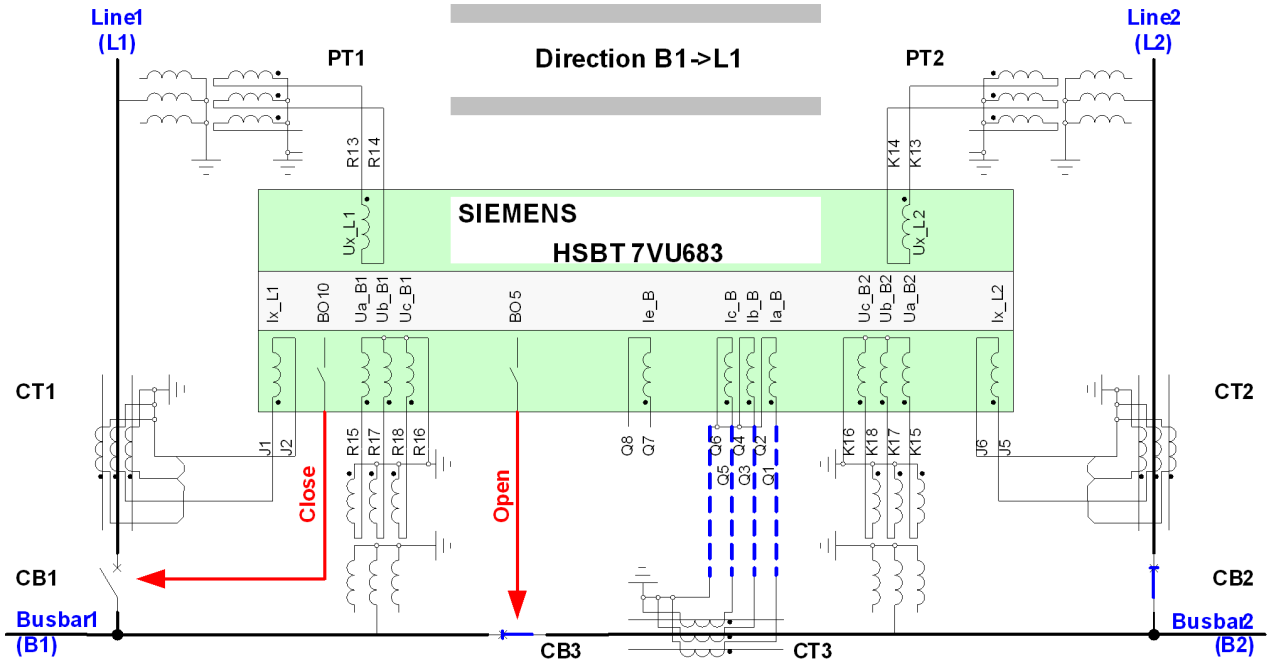



Figure 2-8 Device Connections of Transfer Mode B1->L1

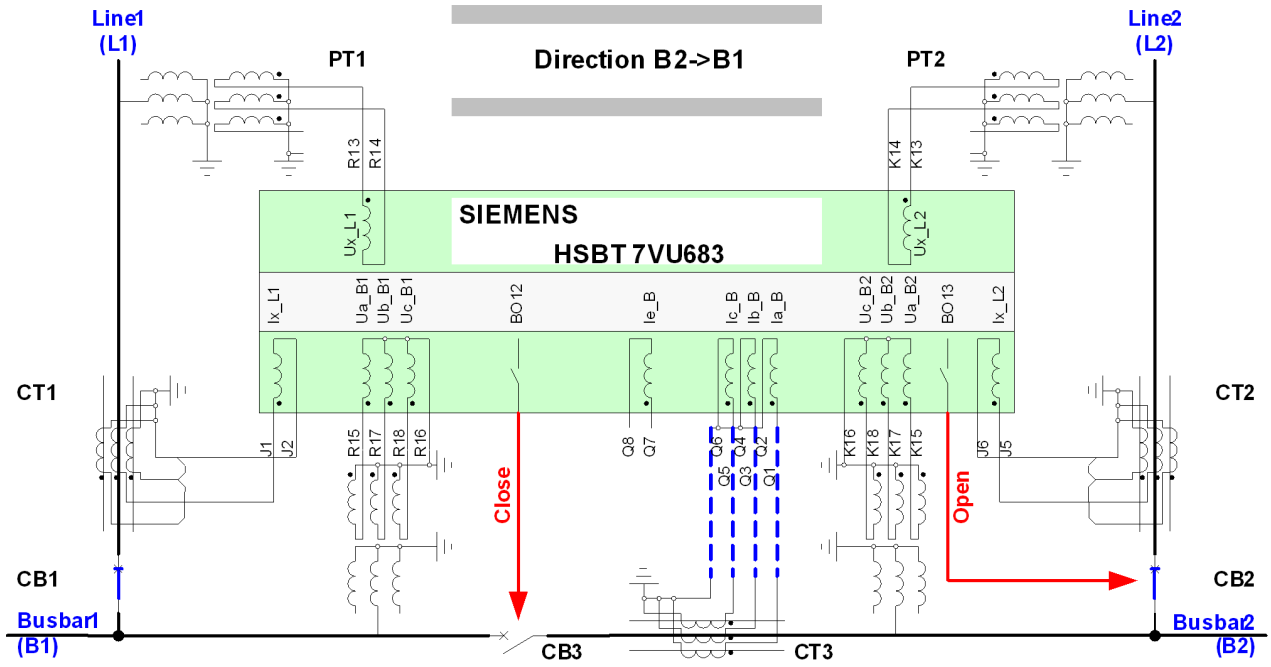



Figure 2-9 Device Connections of Transfer Mode B2->B1

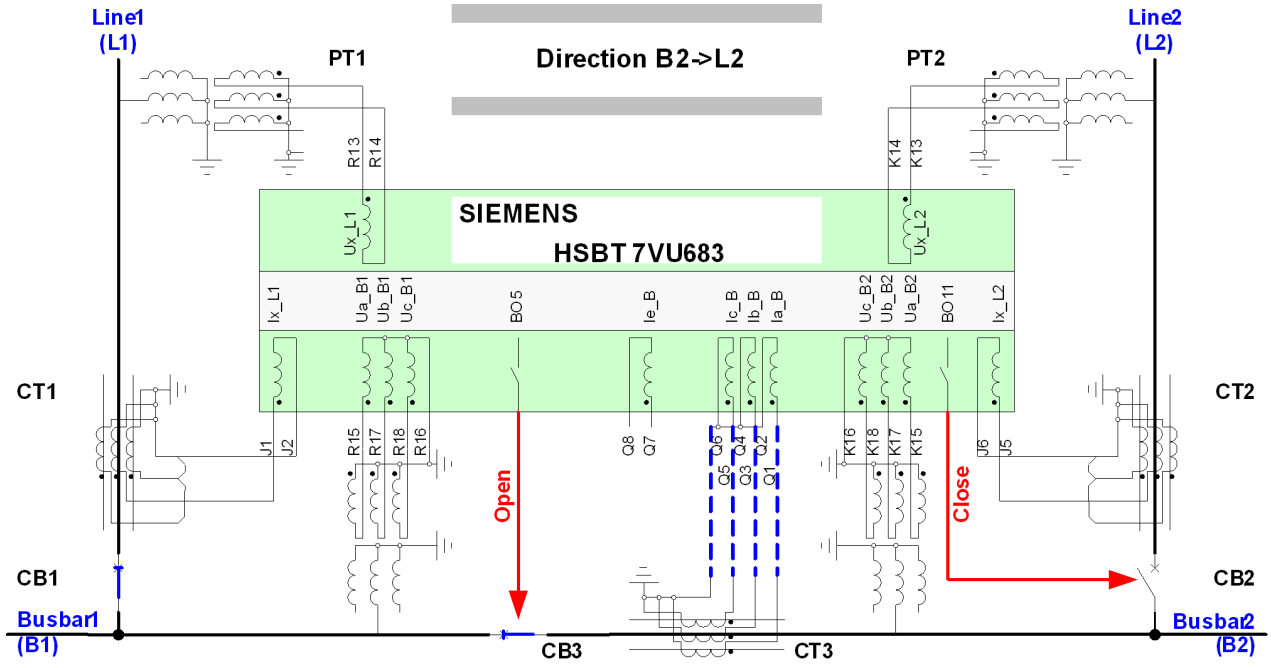



Figure 2-10 Device Connections of Transfer Mode B2->L2

## 2.1.3 Transfer Modes

Transfer modes can be switched to ***ON*** or ***OFF*** via setting the parameters **8805 Transfer Mode Line1** -> **Line2**, **8806 Transfer Mode Line2 -> Line1**, **8807 Transfer Mode Busbar1** -> **Busbar2**, **8808 Transfer Mode Busbar1** -> **Line1**, **8809 Transfer Mode Busbar2** -> **Busbar1**, **8810 Transfer Mode Busbar2** -> **Line2** and **8831 Mono-direction Against NORMAL**.

Transfer modes **8805 Transfer Mode Line1** -> **Line2**, **8806 Transfer Mode Line2 -> Line1**, **8807 Transfer Mode Busbar1** -> **Busbar2** and **8809 Transfer Mode Busbar2** -> **Busbar1** can be started by NORMAL condition and abnormal conditions (including Fault Condition, Undervoltage Condition, Underfrequency Condition or Inadvertent CB Open Condition). But if **8831 Mono-direction Against NORMAL** is set to ***YES*** , **8806 Transfer Mode Line2 -> Line1** and **8809 Transfer Mode Busbar2** -> **Busbar1** can only be started by NORMAL conditions.

The transfer modes **8808 Transfer Mode Busbar1** -> **Line1** and **8810 Transfer Mode Busbar2** -> **Line2** can only be started by NORMAL conditions.

When a transfer is finished (failed or succeeded), HSBT will reset and make Ready for next transfer. The reset mode is defined by parameter **8817 Manual Restart**. If it is set to ***YES***, HSBT will wait for the reset command from external signal 17863 >Manually Restart or reset button "**LED**" on front panel. If it is set to ***NO***, HSBT will automatically reset after a successful transfer. But if it is a failed transfer, manual reset is always required and ignoring the parameter **8817 Manual Restart**. Reset logic is shown below.

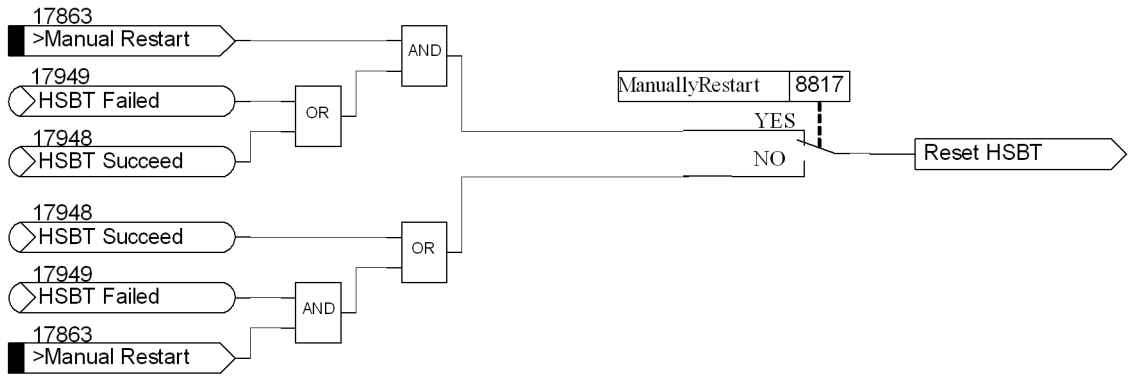



Figure 2-11 Logic of HSBT Reset

Parameter **8804 Max.Tran.Time** is used to limit the duration of a transfer procedure. The time will begin to count from the transfer start. If the time exceeds the setting value and the transfer does not succeed, the transfer will fail and wait for the reset command.

Before a transfer is started by a start condition, the HSBT has to be Ready. The Ready and Un-Ready conditions and logics are detailed below.

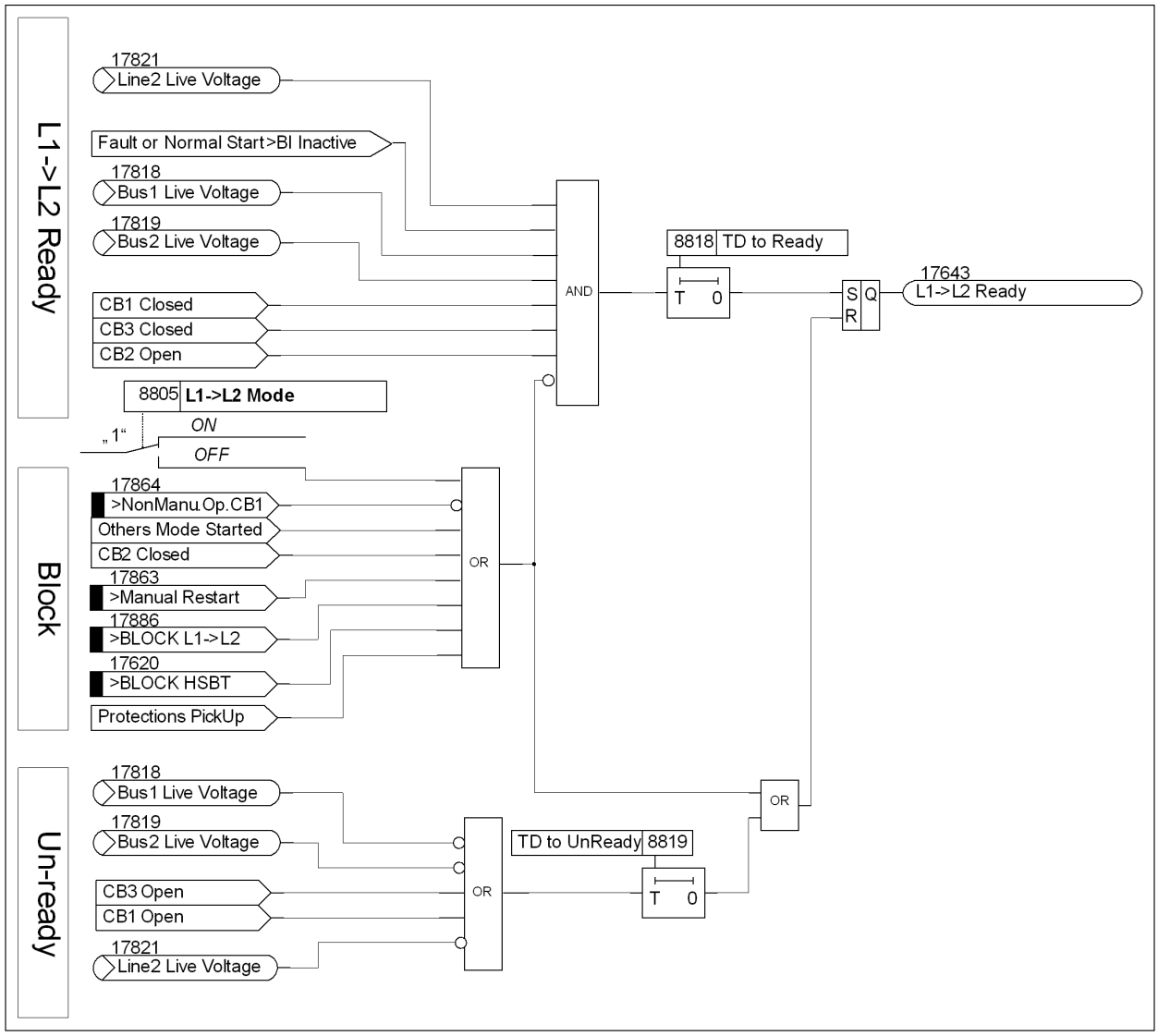



Figure 2-12 Ready and Unready Logic of Line1 -> Line2 Mode

**Note:**

1. When it's single busbar, the conditions of CB3 and Bus2 will be ignored in the logic.

2. The signal "Others Mode Started" means there is another transfer mode is already started, the same below.

3. If "17864 >Non.Manu.Op.CB1" is not routed to a BI, it's value will be 1 and will not taken as a block condition, the same below.

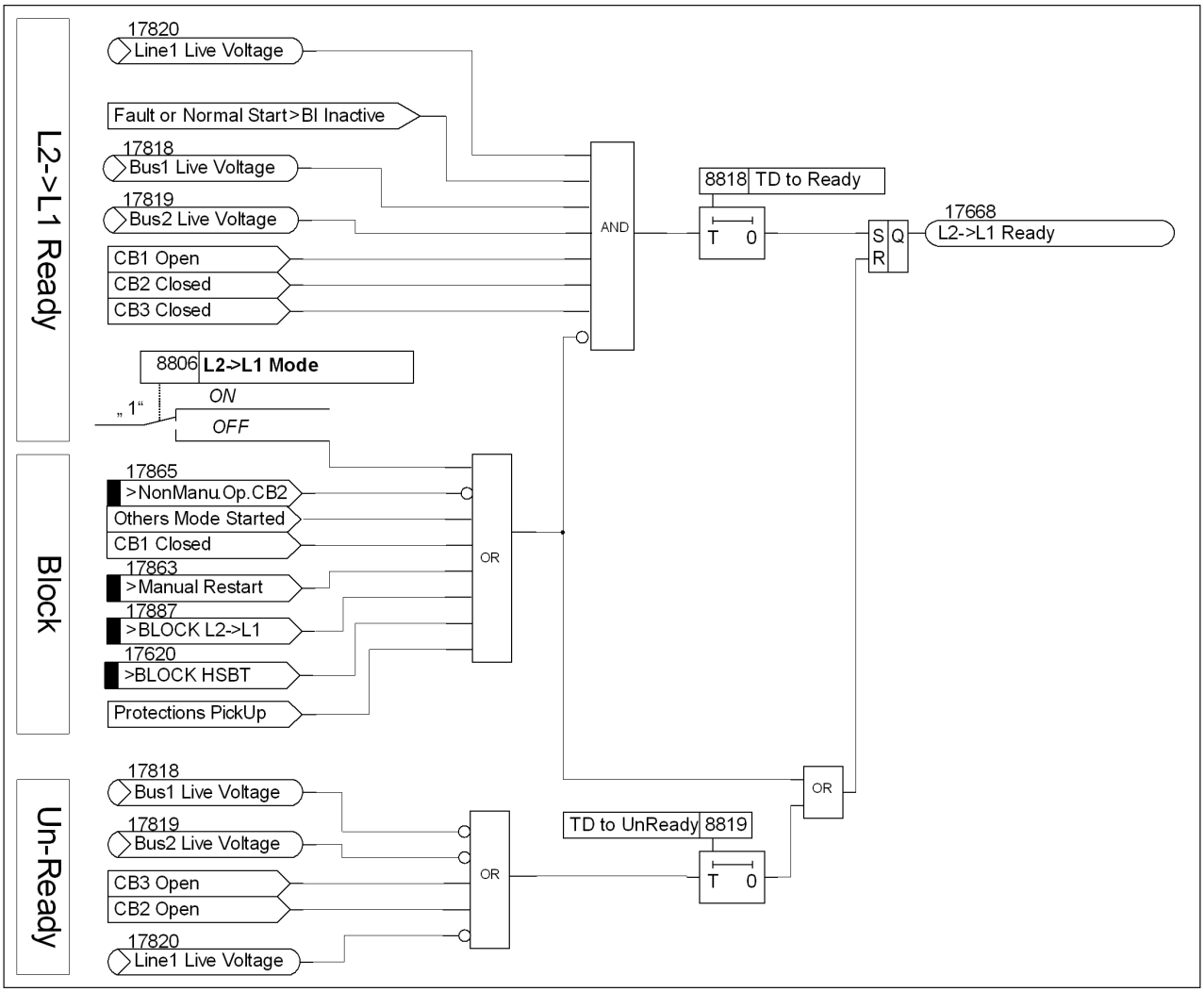



Figure 2-13 Ready and Unready Logic of Line2 -> Line1 Mode

**Note:**

When it is single busbar, the conditions of CB3 and Bus2 will be ignored in the logic.

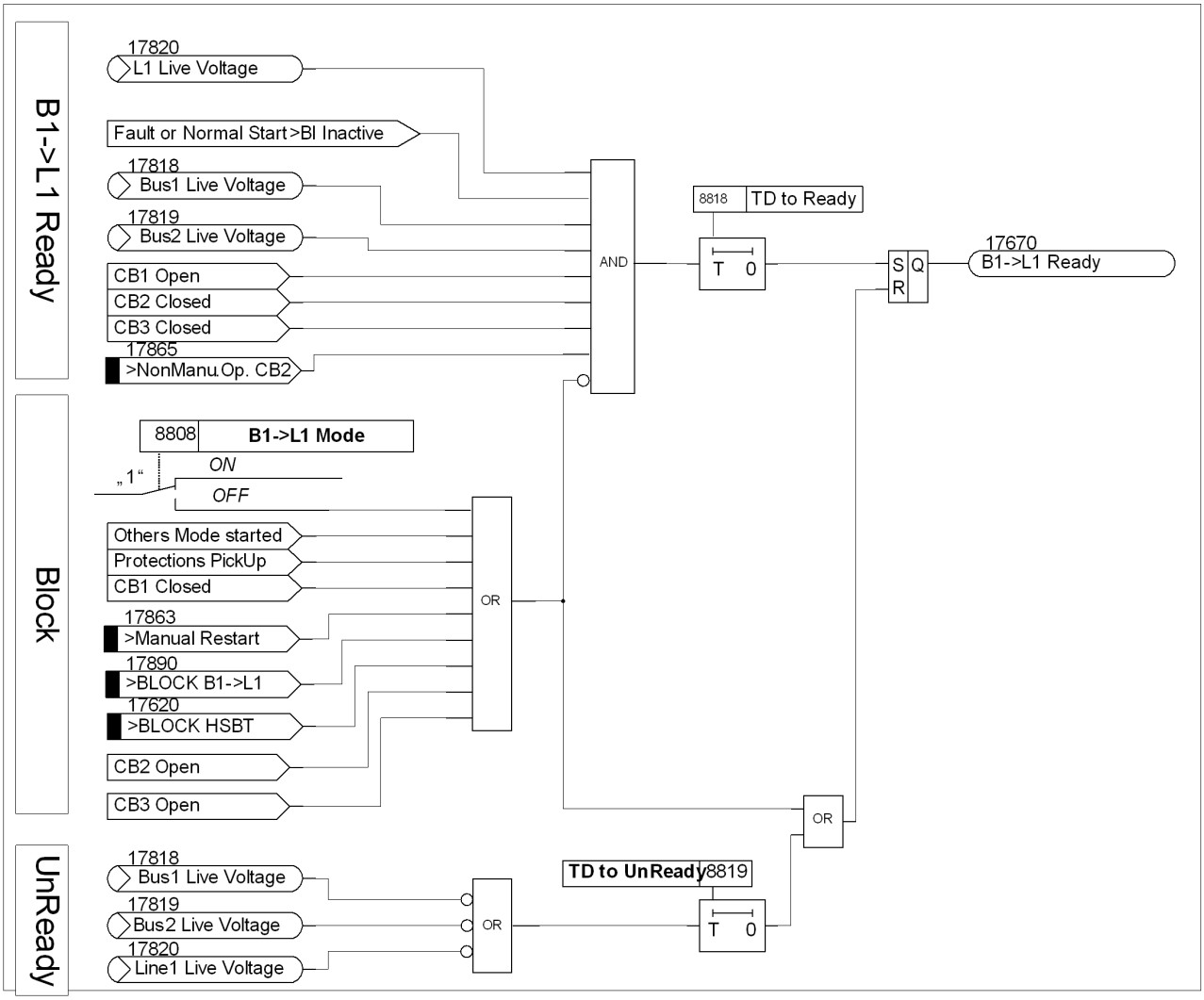



Figure 2-14 Ready and Unready Logic of Bus1 -> Line1 Mode

**Note:**

The transfer mode is just for segmented bus. When it is set to single busbar, the parameters and messages of this mode will be invisible.

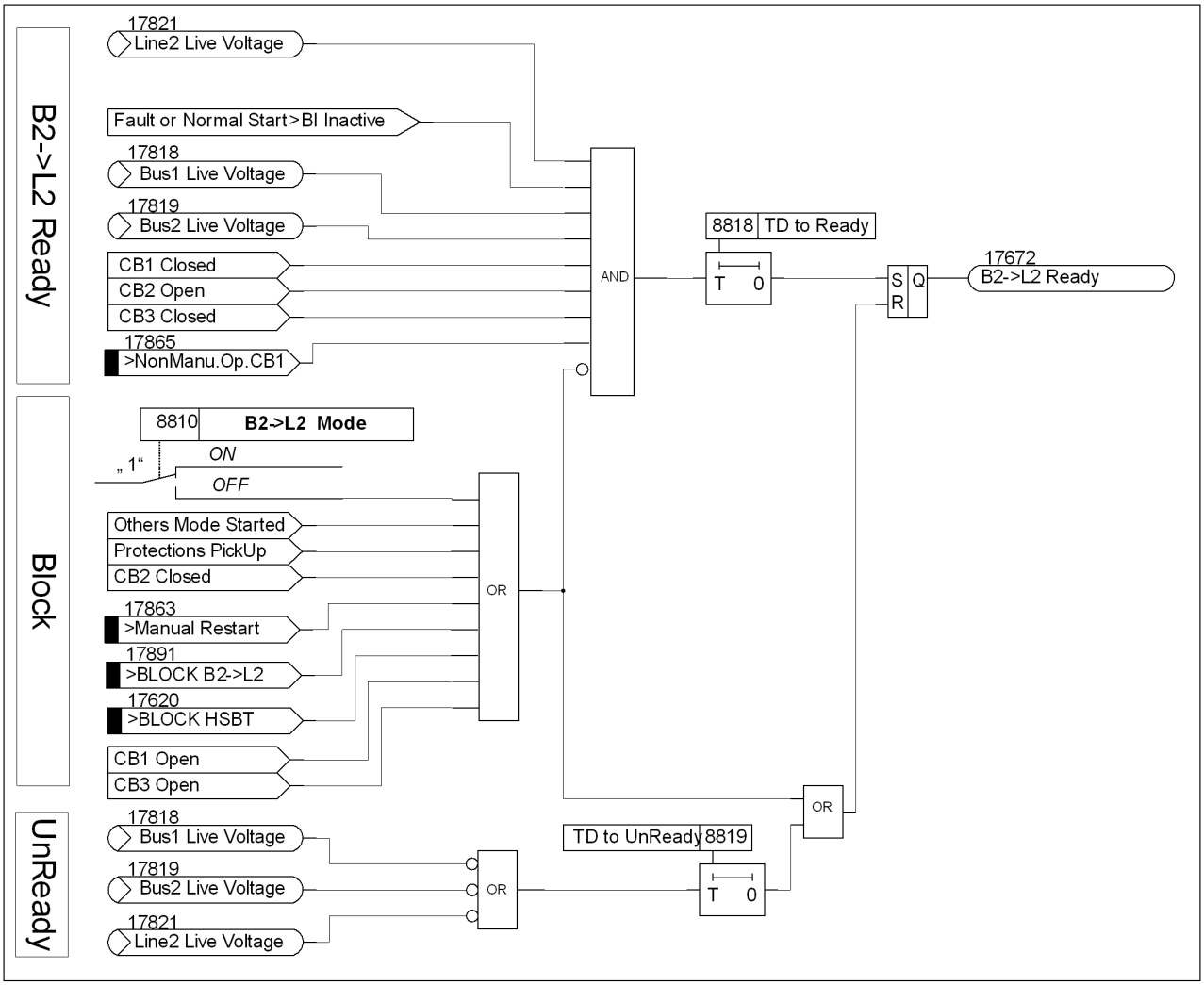



Figure 2-15 Ready and Unready Logic of Bus2 -> Line2 Mode

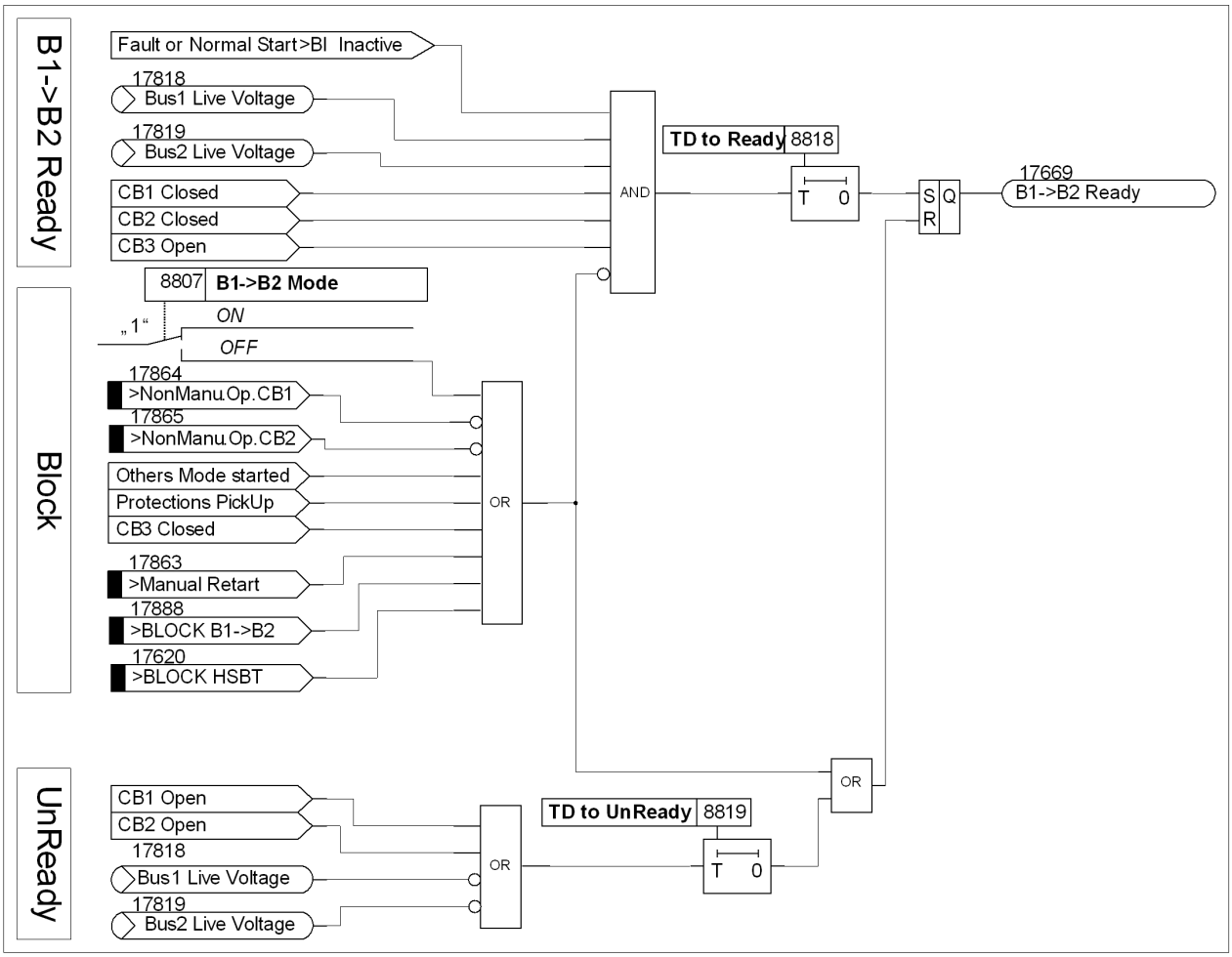



Figure 2-16 Ready and Unready Logic of Bus1 -> Bus2 Mode

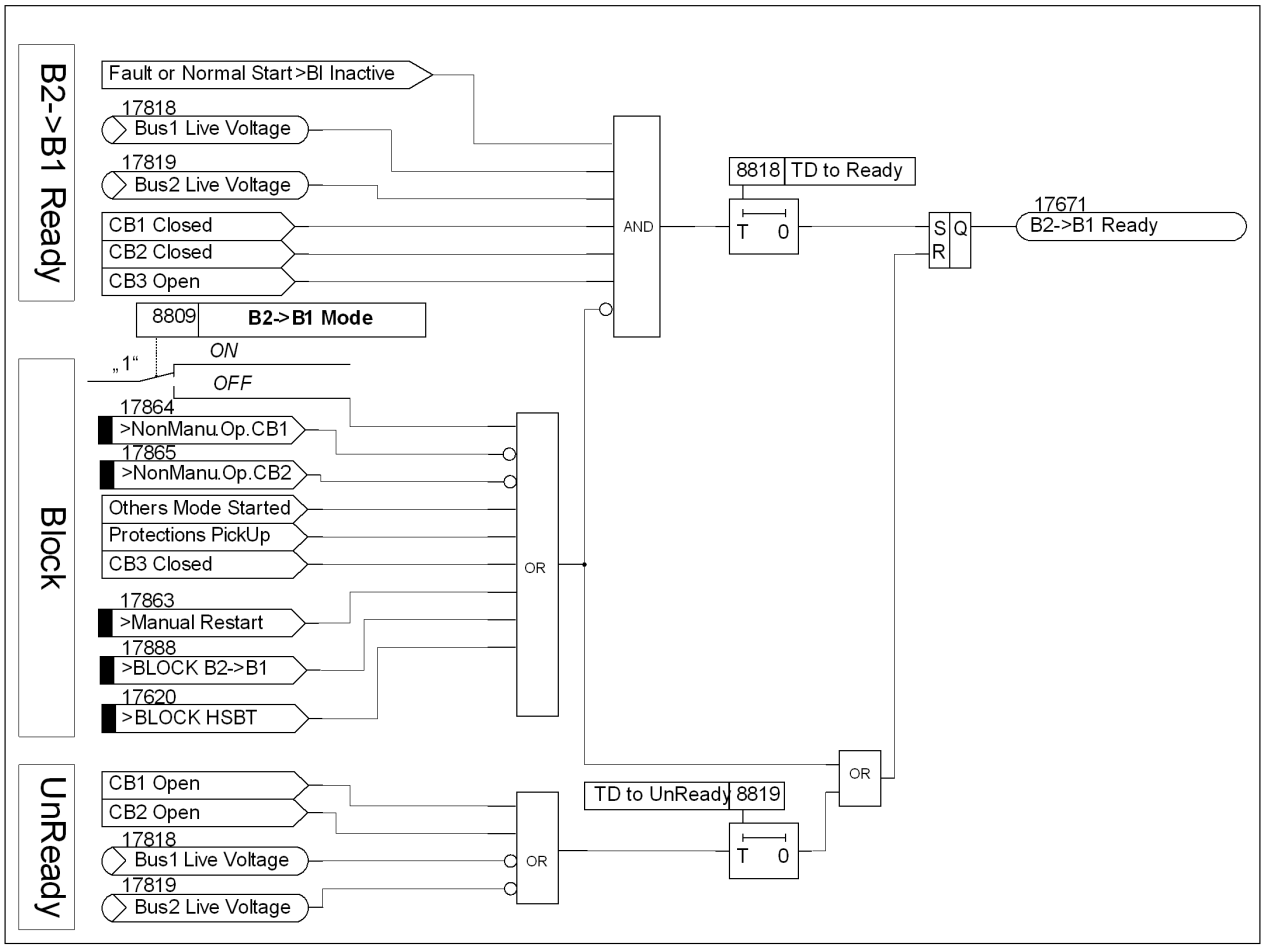



Figure 2-17 Ready and Unready Logic of Bus2 -> Bus1 Mode

## 2.1.4 Start Conditions

There are 5 start conditions : **8821 NORMAL Condition**, **8822 FAULT Condition**, **8823 Undervoltage Condition**, **8824 Underfreuqency Condition** and **8825 Inadvertent CB Open Condition**, each start condition can be set to ***ON*** or ***OFF*** separately.

At the same time, only one transfer mode can be started by one start condition. When a transfer is started by a start condition, all other transfer modes and start conditions will be blocked. When the transfer is finished (failed or succeeded), manual reset or automatic reset will reset all transfer modes to make ready for next transfer.

### 2.1.4.1 NORMAL Condition

Under the NORMAL Condition start, the power system is fault free and the starting command must be manually issued. This start command could come from remote control center or local controller.

NORMAL start supports bi-direction transfer, i.e. the power supply of busbar can be switched from Operating power supply to Standby power supply, it could also be from Standby power supply to Operating power supply.

7VU683 supports 6 normal start BIs, each BI is used for each transfer mode. NORMAL Start logic is shown below.

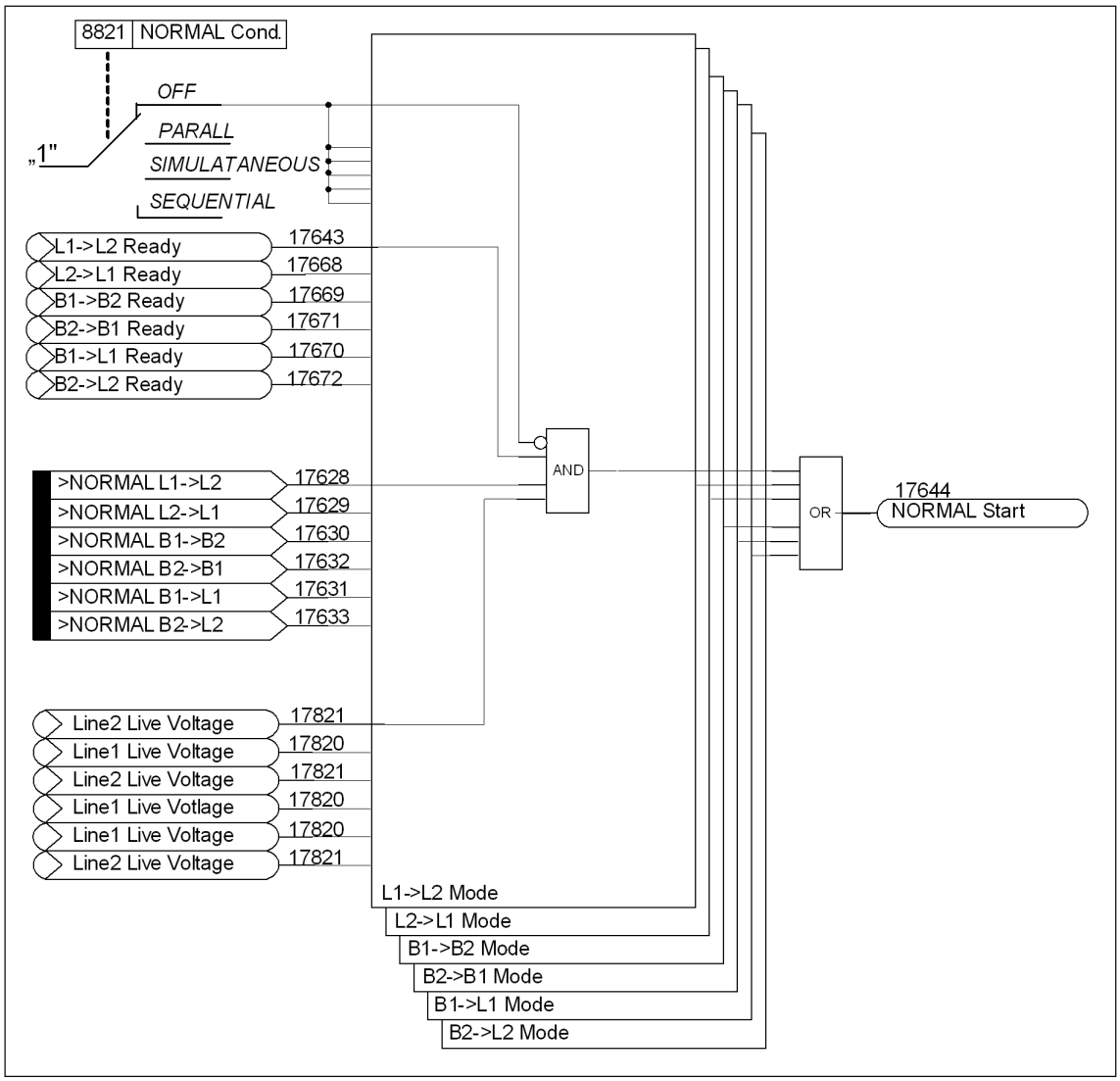



Figure 2-18 Logic of NORMAL Start

### 2.1.4.2 FAULT Condition

When the system is fault, the protection device will trip the operating circuit breaker. At the same time, the trip signal will start the HSBT, it is known as FAULT Start.

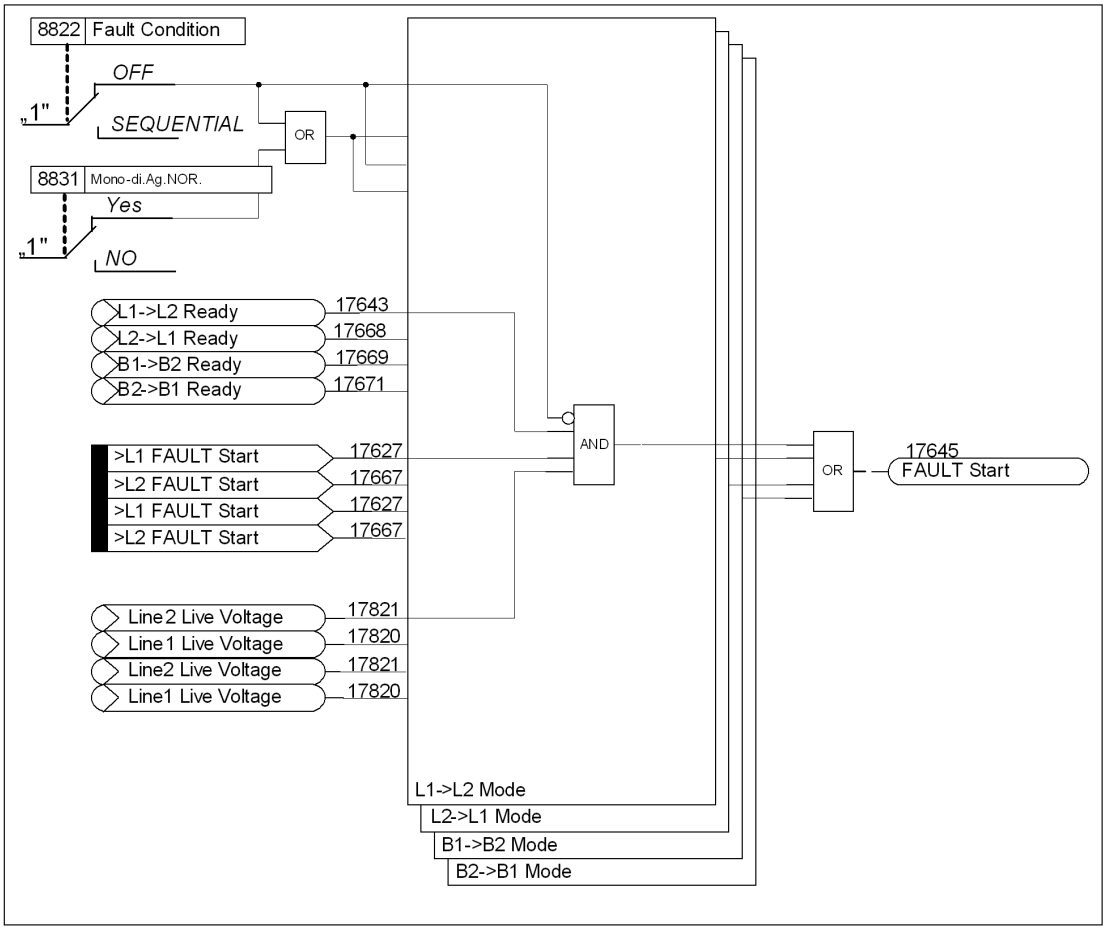



Figure 2-19 Logic of FAULT Start

### 2.1.4.3 Undervoltage Condition

Undervoltage Condition is an internal start condition. When the Bus 3 phase voltages are lower than the **8826 Undervoltage Threshold** and no current on operating source line, Undervotlage Condition will start with a time delay.

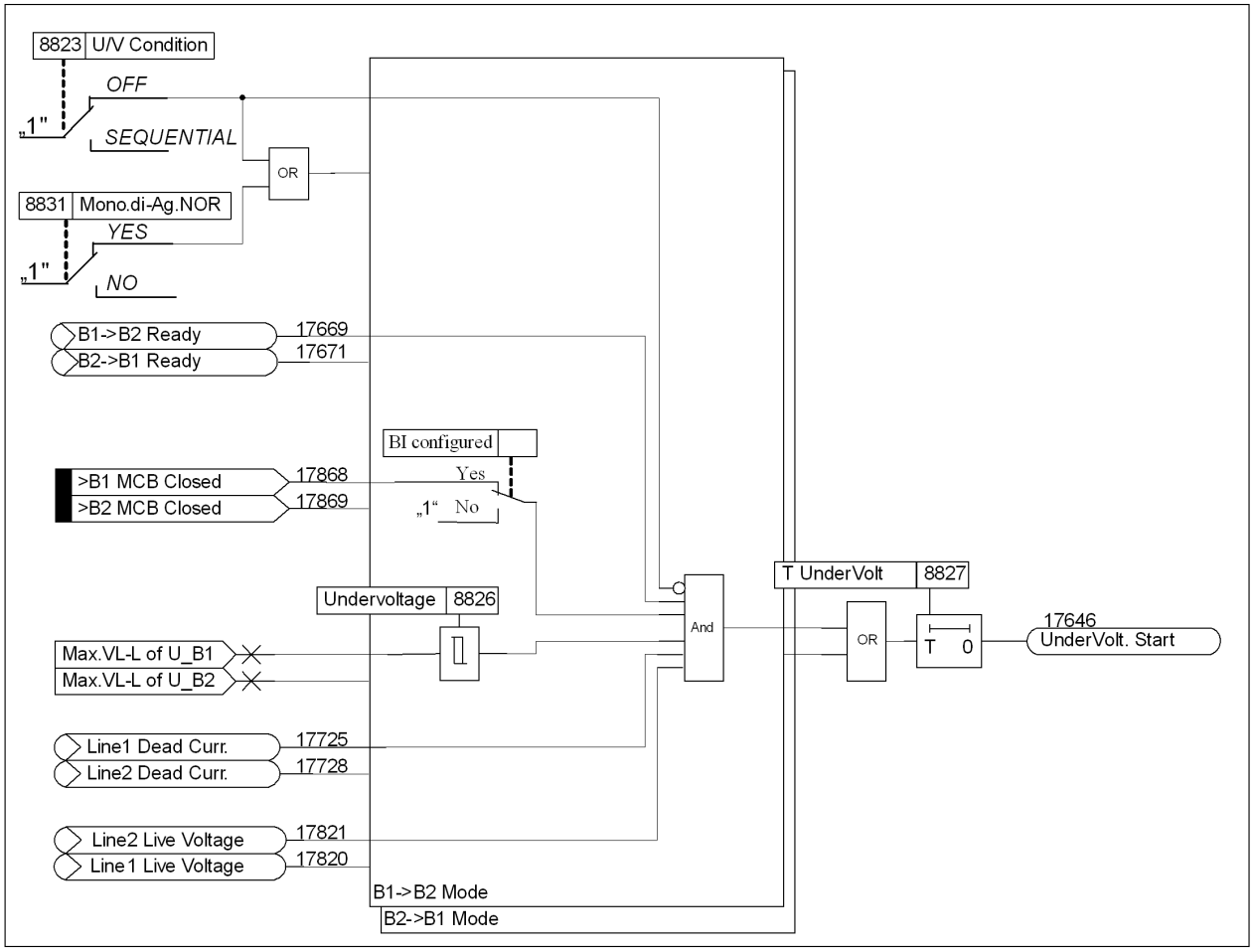



Figure 2-20 The logic of Undervoltage start Between Bus

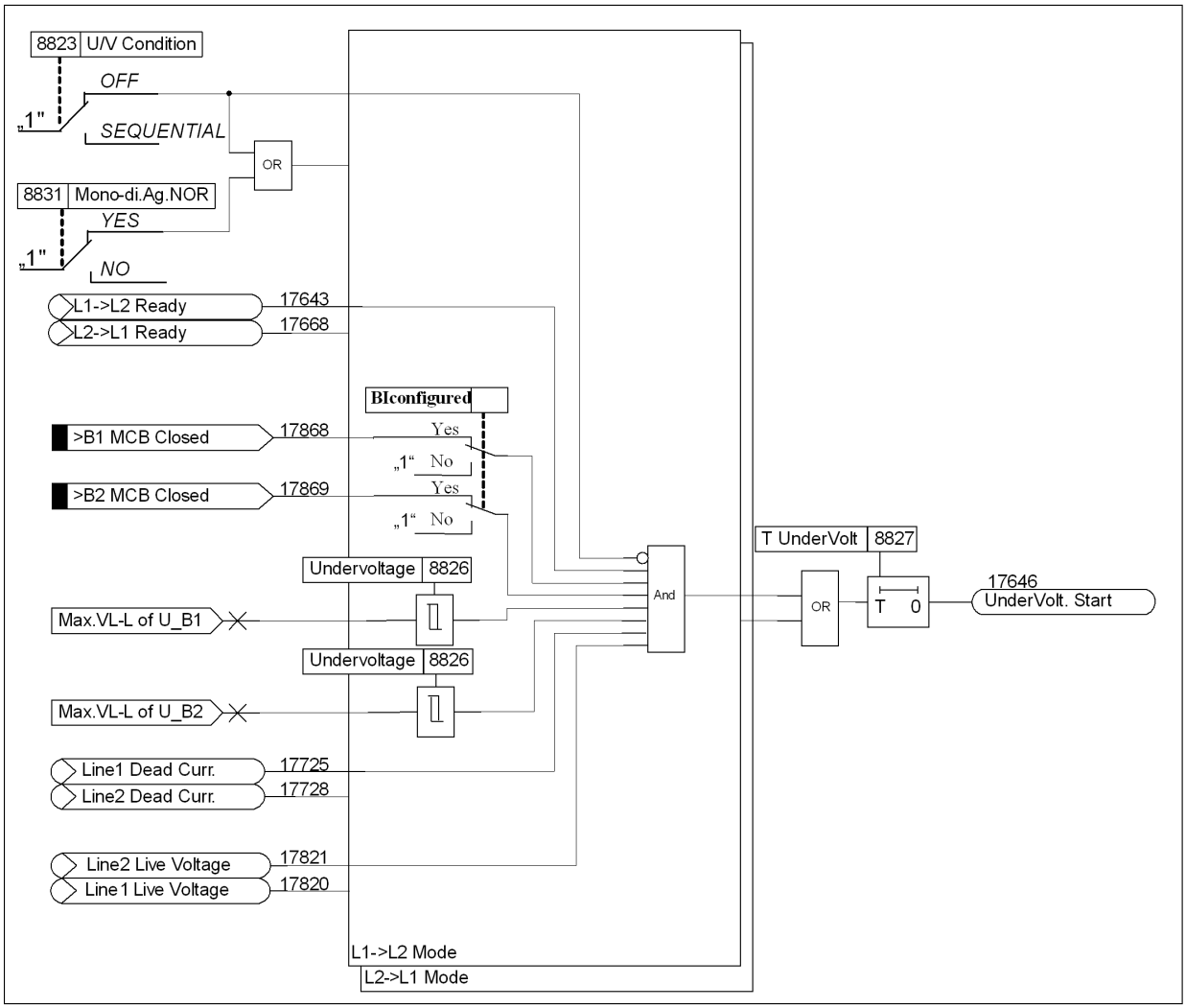



Figure 2-21 Logic of Undervoltage Start Between Line

**Note:**

When it is set to single busbar, the signals of Bus2 are not considered.

### 2.1.4.4 Underfrequency Condition

Underfrequency Condition is an internal start condition. When the busbar voltage frequency is lower than **8829 Underfrequency Threshold** and no current on operating source line, Underfrequency Condition will start with a time delay. This start condition is mainly applied in the situation that the trip signal of power supply can not be connected to HSBT. When the operating power supply is tripped by a protection relay, the frequency on the bus will drop.

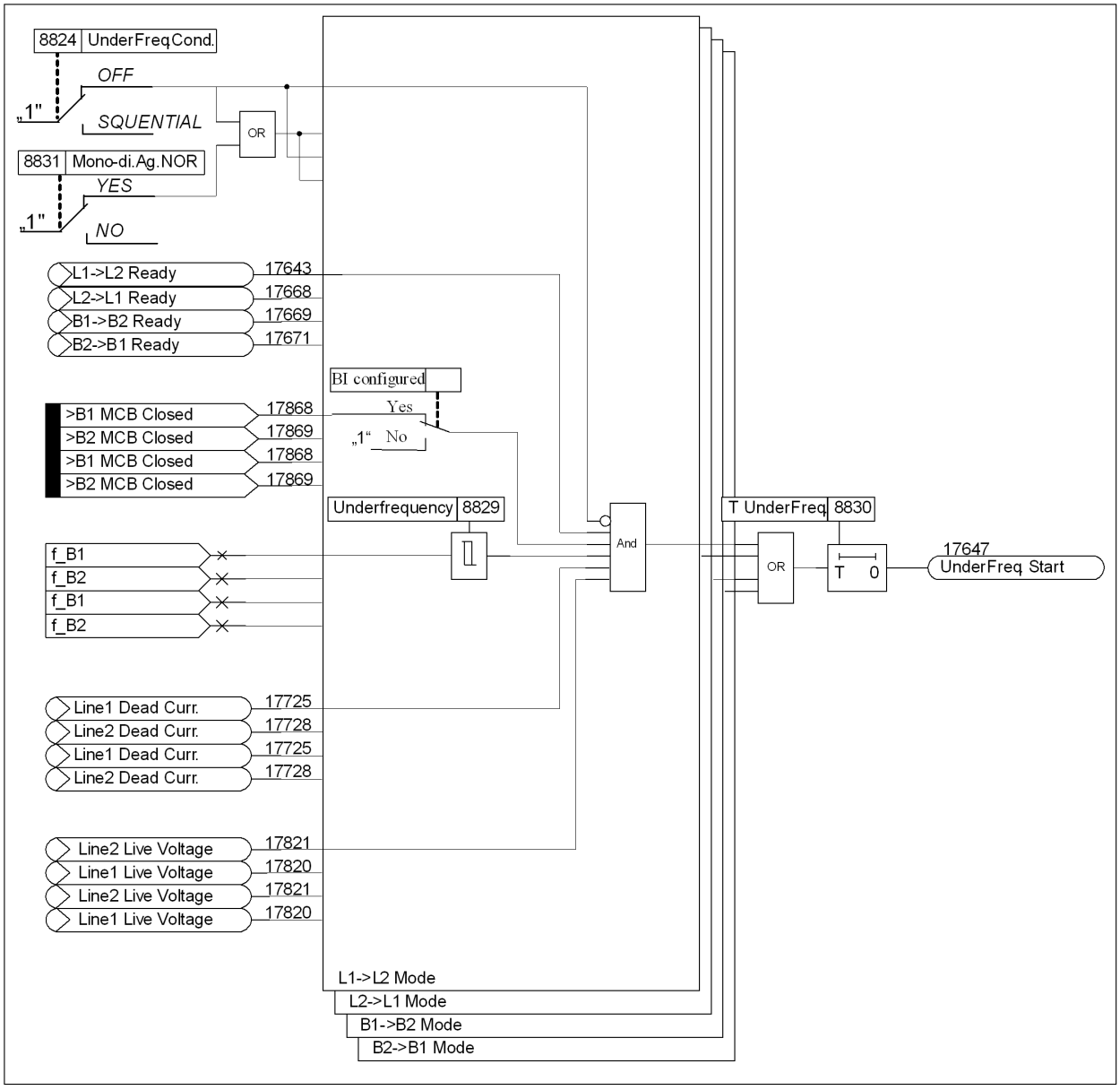



Figure 2-22 Logic of Under Frequency Start

**Note:**

When it is set to single busbar, the signals of Bus2 are not considered.

### 2.1.4.5 Inadvertent CB Open Condition

Inadvertent CB Open Condition is an internal start condition. When the CB of the operating power supply is opened and the operating power supply is out of current, Transfer will be started to close the CB of the standby power supply. But the start should be blocked if the operating CB is opened manually by the operator. 17864 >Non Manually Open CB1 and 17865 >Non Manually Open CB2 are provided as the block signal of manual operation.

When 17864 >Non Manually Open CB1 and 17865 >Non Manually Open CB2 are routed to the BIs in the DIGSI matrix, their default values are 1, if the CB is opened manually, the signal value will become 0, Ready status will drop out and become Unready immediately, the transfer will be blocked.

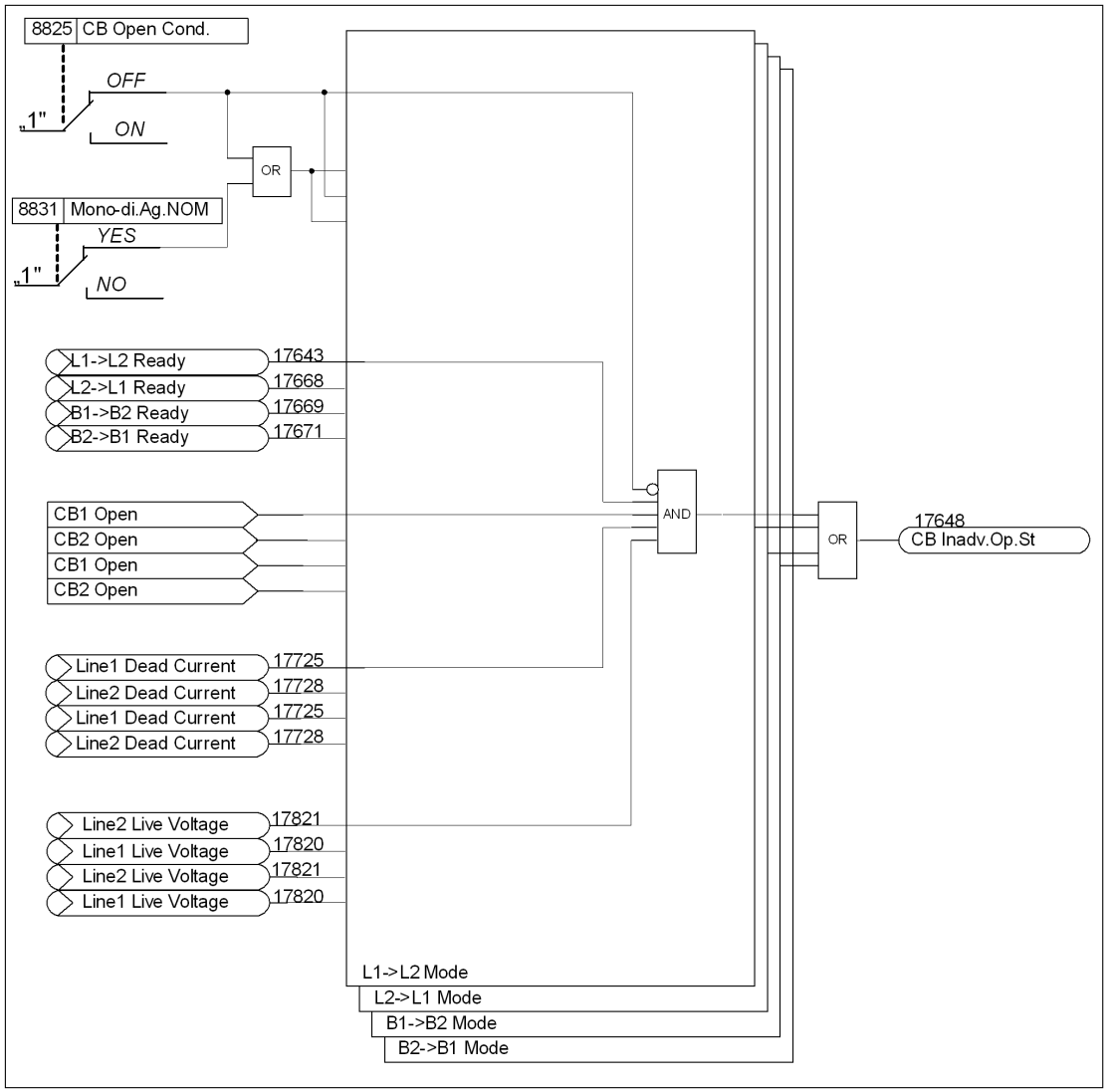



Figure 2-23 Logic of Inadvertent CB Open Start

## 2.1.5 Transfer Sequence

When transfer is started, it will operate in a sequence to open the CB of the operating power supply and to close the CB of standby power supply. There are 4 kinds of transfer sequence: parallel, parallel half-auto, sequential and simultaneous sequences.

The parallel and simultaneous sequence transfer can only be started by NORMAL condition. The relationship between transfer sequence and transfer start conditions are shown below.

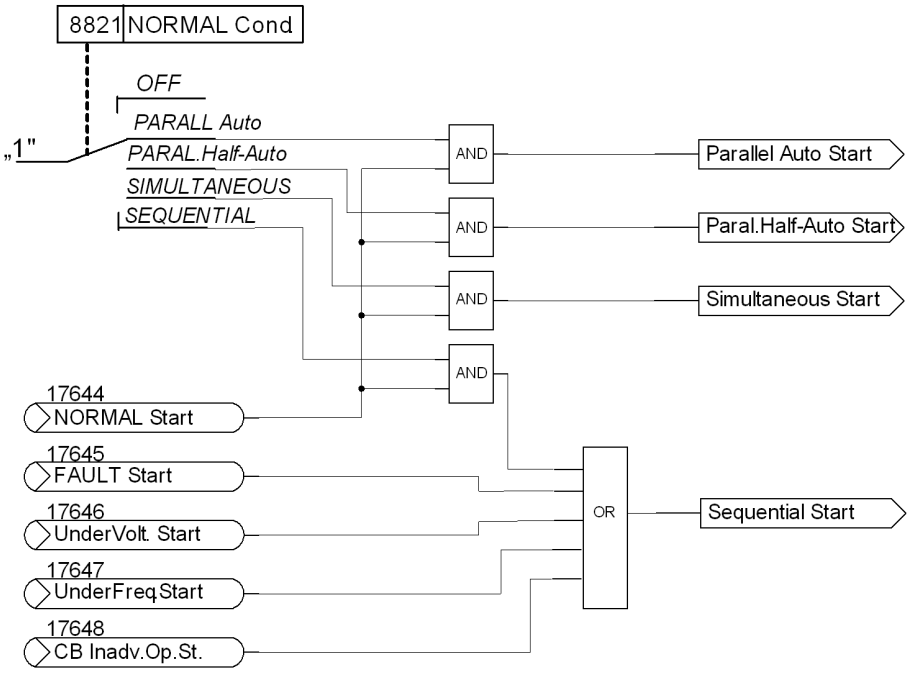



Figure 2-24 Relationship Between Transfer Sequences and Sart Conditions

**PRALLEL Sequence**

PARALLEL Sequence transfer can be started by NORMAL condition. It includes **PARALLEL Auto Sequence** and **PARALLEL Half-auto Sequence**.

**PARALLE Auto sequence**:

- HSBT firstly releases the close command to the backup circuit breaker with synchronization between two power supplies, when the backup CB is closed, two power supplies are operating in parallel. And HSBT will release the open command to the operating circuit breaker with a time delay ( **8854 PARALLEL Auto**: **CB Open Time Delay** ). To avoid a long time parallel operation of the operating power supply and the standby power supply, which is caused by the failure of opening operating CB, HSBT provides the decoupling function. When the backup CB is closed, if the operating CB is not opened in 1 second, HSBT will release the open command to the backup CB to decouple the operating power supply and the standby power supply.

**PARALLEL Half-auto Sequence**:

tHSBT firstly releases the close command to the backup circuit breaker with synchronization between two power supplies, when the backup CB is closed, two power supplies are operating in parallel. And HSBT will wait for the external signal of manual command to release the open command to the operating circuit breaker. If the manual command does not come within max transfer time (**8804 Maximum Permitted HSBT Operating Time**), the transfer operation will be time-out and failed. Then HSBT will open the backup CB to decouple 2 power supplies.

Because of this switching sequence (make before break), a dead interval at the busbar is not possible and the connected processes will not be influenced.

The time when both CBs are closed is called overlapping time. For optimizing this overlapping time, the HSBT 7VU683 offers the possibility to adjust the internal time delay in Auto mode for opening the CB over the parameter setting **8854 PARALLEL Auto**: **CB Open Time Delay.**

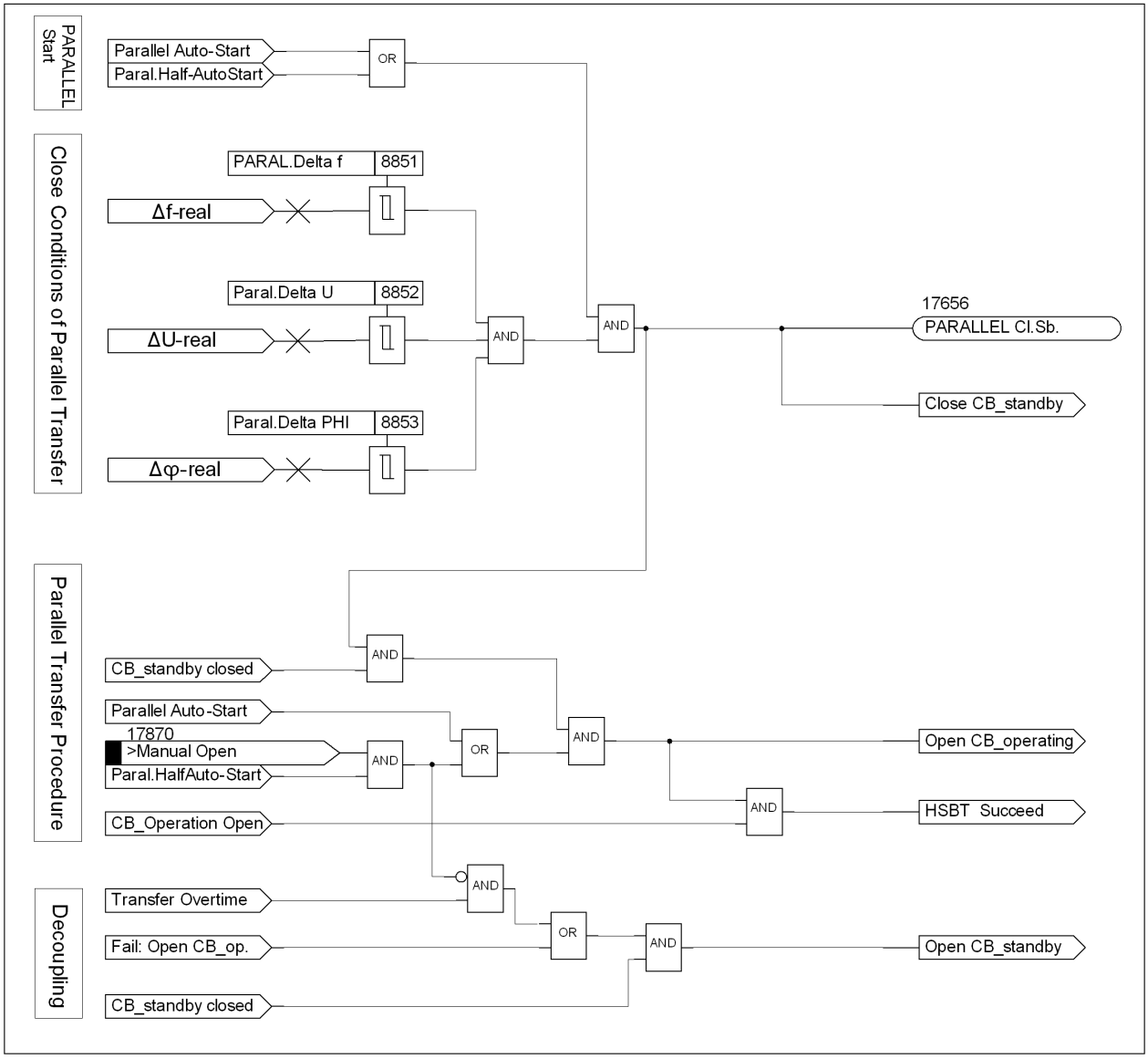



Figure 2-25 Logic of PARALLEL Sequence Transfer

**Note:**

1.Df-real,DU-real and Dφ -real are real-time values of differential frequency, differential voltage and differential angle between residual voltage and backup voltage.

2.DU-real value is the differential amplitude value of voltages.

### SEQUENTIAL Sequence

In **SEQUENTIAL Sequence**, when transfer is started by any start condition, HSBT releases trip command to open the operating CB first. When operating CB is opened, HSBT evaluates the transfer criteria of different transfer modes. If a transfer mode is suitable, HSBT will release the close command to the backup CB.

The close criteria of SEQUENTIAL Sequence transfer is based on the residual voltage characteristics. When the bus is disconnected with the power supply, A induced voltage by induction motors will appear on the bus, which is called residual voltage. In other words, when the operating CB is opened, the busbar voltage will change from the source voltage to the residual voltage. Before close the backup CB, a differential voltage is across the backup CB that depends on the phase and magnitude of the residual voltage. Followed figure shows the curve of residual voltage characteristic. The amplitude and frequency of the residual voltage will decay after the circuit breaker is opened. The decaying rate depends on the motor parameters and the connected loads.

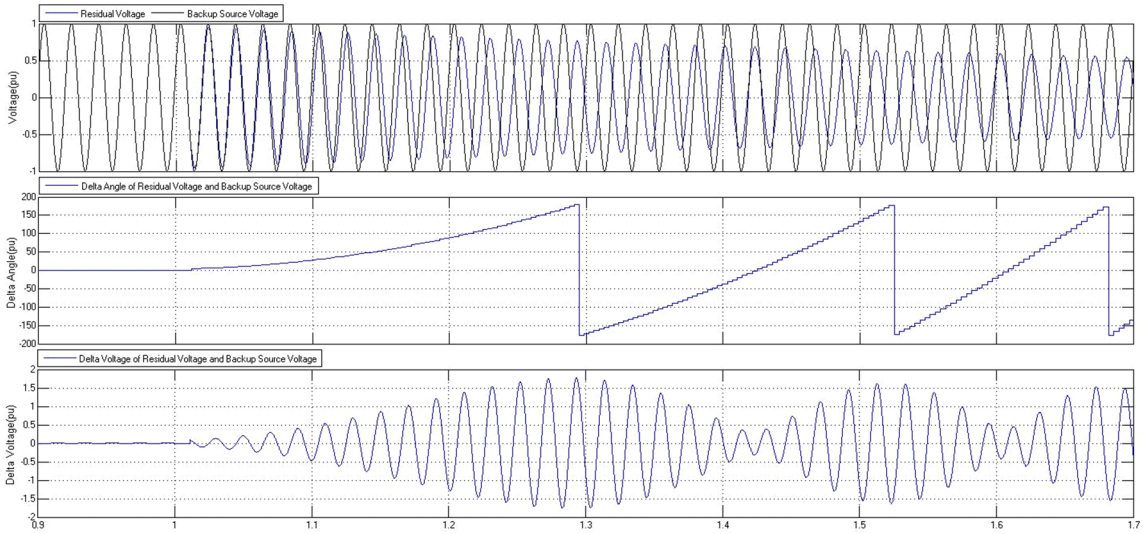



Figure 2-26 Curves of Residual Voltage and Delta Voltage

At the bus re-energized time, the DU across backup CB is distributed to the system side(For example, power transformer) and the motors. See the following equivalent circuit when motors are restarted.

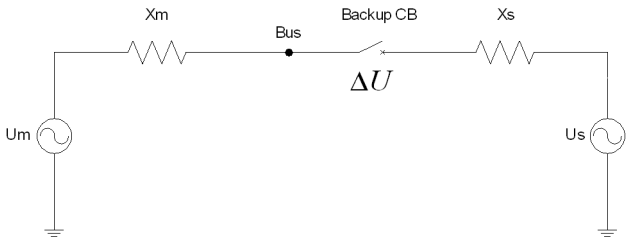



Figure 2-27 Equivalent Circuit of Bus Transfer

The voltage over the motor can not exceed the up-limit ko/v*Un (For example 1.1Un) of the motor.Here parameter setting ko/v is the overvoltage factor of the motor.

In the equivalent circuit, DU across backup CB is the vector of the differential voltage between the vector of residual voltage and the vector of backup source voltage. Xs and Xm are the reactance of system and motors respectively. So the voltage over the motor can be calculated by the following equation.

Um = |DU |*Xm/(Xs+Xm)
Set factor K = Xm/(Xs+Xm), then

Um = K*|DU |

Because Um can not exceed the permissible motor voltage ko/v *Un, For example 1.1Un, then

K*|DU |< ko/v  Un

|DU |< ko/v/K * Un

Assume ko/v=1.1 and K=0.67, the calculated safety |DU | should be less than 1.64*Un. If ko/v=1.1 and K=0.95 assumed, the calculated safe |DU | should be less than 1.15*Un.

Note this permissible differential voltage is the value when backup CB is closed.

Based on this basic requirement of |DU |, five different transfer modes are derived: **FAST Transfer Mode**, **REAL-TIME FAST Transfer Mode**, **IN-PHASE Transfer Mode**, **RES-VOLT Transfer Mode** and **LONG-TIME Transfer Mode**. Following figure shows the vector of residual voltage and transfer area of different transfer modes. Assume that the safe differential voltage is 1.0Un, the right side of curve B-B' is the safe filed to re-energize. The different transfer zones are also shown according to the transfer criteria. The transfer criteria of different transfer modes are detailed in following description.

In the figure, the differential phase less than 90 degrees is also taken into account for Fast Transfer and Real-time Fast transfer. The differential phase limit is helpful to decrease the influence to the motors.

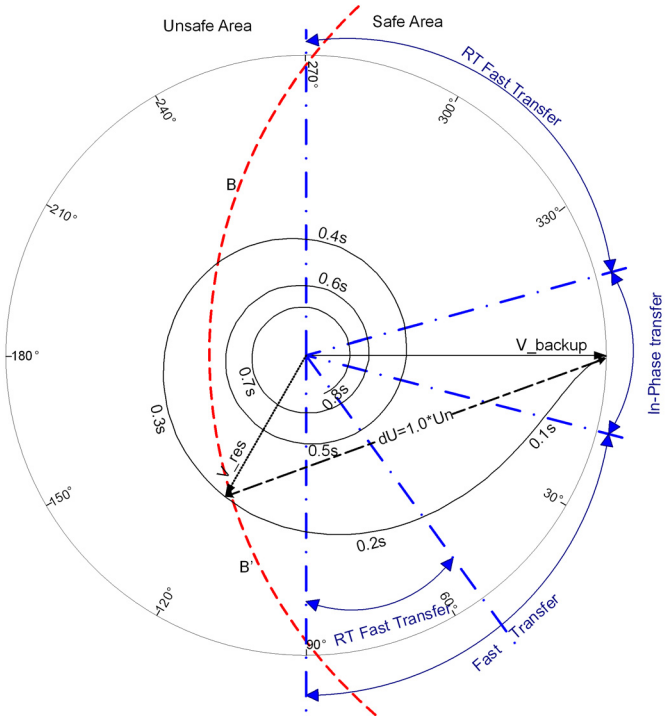



Figure 2-28 Curve of a Typical Residual Voltage and Transfer modes

Based on the estimated values of the magnitude, frequency and phase angle of the decaying voltage vector, and the backup CB closing time, the bus transfer device will determine whether **FAST Transfer**, **REAL-TIME FAST Transfer**, **IN-PHASE Transfer**, **RES-VOLT Transfer** or **LONG-TIME Transfer** is suited for a particular plant condition.

### FAST Transfer

The **FAST Transfer** is preferred because in theory it keeps the power interruption on the motor bus to a minimum. And this transfer operation ensures that motors and the loads are not subjected to excessive or accumulated stresses. Normally, the phase angle difference allowed in a a fast transfer is less than 20 degree

and residual voltage not less than 85% of motor normal voltage. Normally the fast transfer time is short enough(For example, <100ms), then the voltage drop and frequency drop are small and the motors on the bus can be easily restarted, to avoid subjecting motors to high inrush currents and transient shaft torques. The influence to the connected processes is slight.

The criteria of **FAST Transfer** are below,

Df-real < **8858 FAST Transfer: Delta Frequency**

Dφ-real < **8859 FAST Transfer: Delta Phase Angle**

ULL > **8860 FAST Transfer: Undervoltage Block**

where

Df-real = differential frequency between decaying busbar voltage and backup source voltage

Dφ-real = differential phase angle between decaying busbar voltage and backup source voltage

ULL = phase to phase voltages of the residual voltage

Df-real , Dφ-real and ULL are calculated real-time values.

The values of parameters **8858 FAST Transfer**: **Delta Frequency** and **8859 FAST Transfer**: **Delta Phase Angle** are instant values when the operating CB is opened. The customer has to set these two parameters based on the estimated values of the magnitude, frequency and phase angle of the decaying residual voltage, and the backup CB closing time to make the decision whether it locates in the permissible range when the backup CB is closed.

Here is an example to set the **FAST Transfer** parameters. The customer ensures that the safe transfer area is the differential phase angle less than 60 degrees, the close duration of backup CB is 100ms, and the customer estimates the average slip frequency during breaker close is 1Hz. Then the increased differential phase during closing the breaker is 36 degrees, to make sure the re-energized point will not be beyond the safe transfer area, the close command can be issued if the measured real-time value of Dφ-real is less than 24 degrees. Otherwise the **FAST Transfer** will fail and other transfer modes will be active. So **8859 FAST Transfer**: **Delta Phase Angle** can be set to 20 degrees and **8858 FAST Transfer**: **Delta Frequency** can be set to 1 Hz.

**FAST Transfer** is available in 120ms when the operating CB is opened. If the **FAST Transfer** criteria can not be fulfilled in 120ms, **FAST Transfer** will quit and evaluate other transfer criteria.

**REAL-TIME FAST Transfer**

**REAL-TIME FAST Transfer** is applied on the busbar connected with asynchronous motors. It needs additional two system periods to estimate the decaying trend and decaying rate of residual voltage frequency and amplitude. It's a backup of the **FAST Transfer**.

The criteria of **REAL-TIME FAST Transfer** are below:

DU - forecast < **8862 REAL-TIME FAST Transfer: Delta U**

Dφ - forecast < **8863 REAL-TIME FAST Transfer: DeltaPhaseAngle**

Df - real < **8861 REAL-TIME FAST Transfer: Delta Frequency**

ULL > **8864 REAL-TIME FAST Transfer: Undervolt.Block**

where

DU - forecast = magnitude of differential voltage vector between busbar voltage and backup source voltage

Dφ - forecast = differential phase angle between busbar voltage and backup source voltage

Df - real = differential frequency between busbar voltage and backup source voltage

ULL = phase to phase voltages of the bus voltage

DU - forecast and Dφ -forecast are forecasted values at the instant backup breaker is closed, which are calculated based on the characteristic of residual voltage and the CB closing time (CB's closing time is set via

parameters **8801 CB1 Closing Time**, **8802 CB2 Closing Time** and **8803 CB3 Closing Time**). When the operating CB is opened, HSBT calculates the differential phase, differential frequency and amplitude and the decaying trend of residual voltage, when getting the decaying trend and decaying rate of amplitude and frequency, HSBT can get to know the amplitude and phase of residual voltage at next time. E.g. the next time when backup CB is closed.

Df -real and ULL are calculated real-time values.

**8862 REAL-TIME FAST Transfer**: **Delta U** and **8863 REAL-TIME FAST Transfer**: **DeltaPhaseAngle** are the permissible values at the instant backup CB is closed.

**IN-PHASE Transfer**

**IN-PHASE Transfer** works as a backup of **FAST Transfer** and **REAL-TIME FAST Transfer.**

If the HSBT missed FAST Transfer and REAL-TIME FAST Transfer, it will automatically turn to the IN-PHASE Transfer. In-phase instance is that the phase angle difference is zero. In practice the phase angle limit is usually 10 degree.

The criteria of **IN-PHASE Transfer** are below.

Dφ-forecast < **8869 IN-PHASE Transfer: Delta Phase Angle**

Df -real < **8868 IN-PHASE Transfer: Delta Frequency**

ULL > **8870 IN-PHASE Transfer: Undervoltage Block**

where

Dφ-forecast = differential phase angle between busbar voltage and backup source voltage

Df -real = differential frequency between busbar voltage and backup source voltage

ULL = phase to phase voltages of the bus voltage

Dφ-forecast is the forecasted values at the instant backup breaker is closed, which is calculated based on the characteristic of residual voltage and the CB closing time (CB's closing time is set via parameters **8801 CB1 Closing Time**, **8802 CB2 Closing Time** and **8803 CB3 Closing Time**).

Df-real and ULL are calculated real-time values.

**8869 IN-PHASE Transfer**: **Delta Phase Angle** is the permissible value at the instant backup CB is closed.

**RES-VOLT Transfer**

The residual voltage transfer is to wait until the busbar voltage drops below a predetermined point, e.g. 30% of rated voltage, before closing the backup source breaker. This transfer is the slowest of the transfer modes. The criterion is

ULL < **8871 RES-VOLT Transfer: Threshold**

where

ULL = phase to phase voltages of the bus voltage

ULL are calculated real-time values

Under this condition, the motors reacceleration will draw huge currents. For this type of transfer, the auxiliary system components, as well as the protection settings, need to take into account the large motor restarting currents.

**LONG-TIME Transfer**

It is the backup of **RES-VOLT Transfer**. The criterion is to wait until the setting time (**8872 Long-Time Transfer: Threshold**) elapses. When the operating CB is opened, the time begins to count.

The logic of SEQUENTIAL Sequence transfer is below.

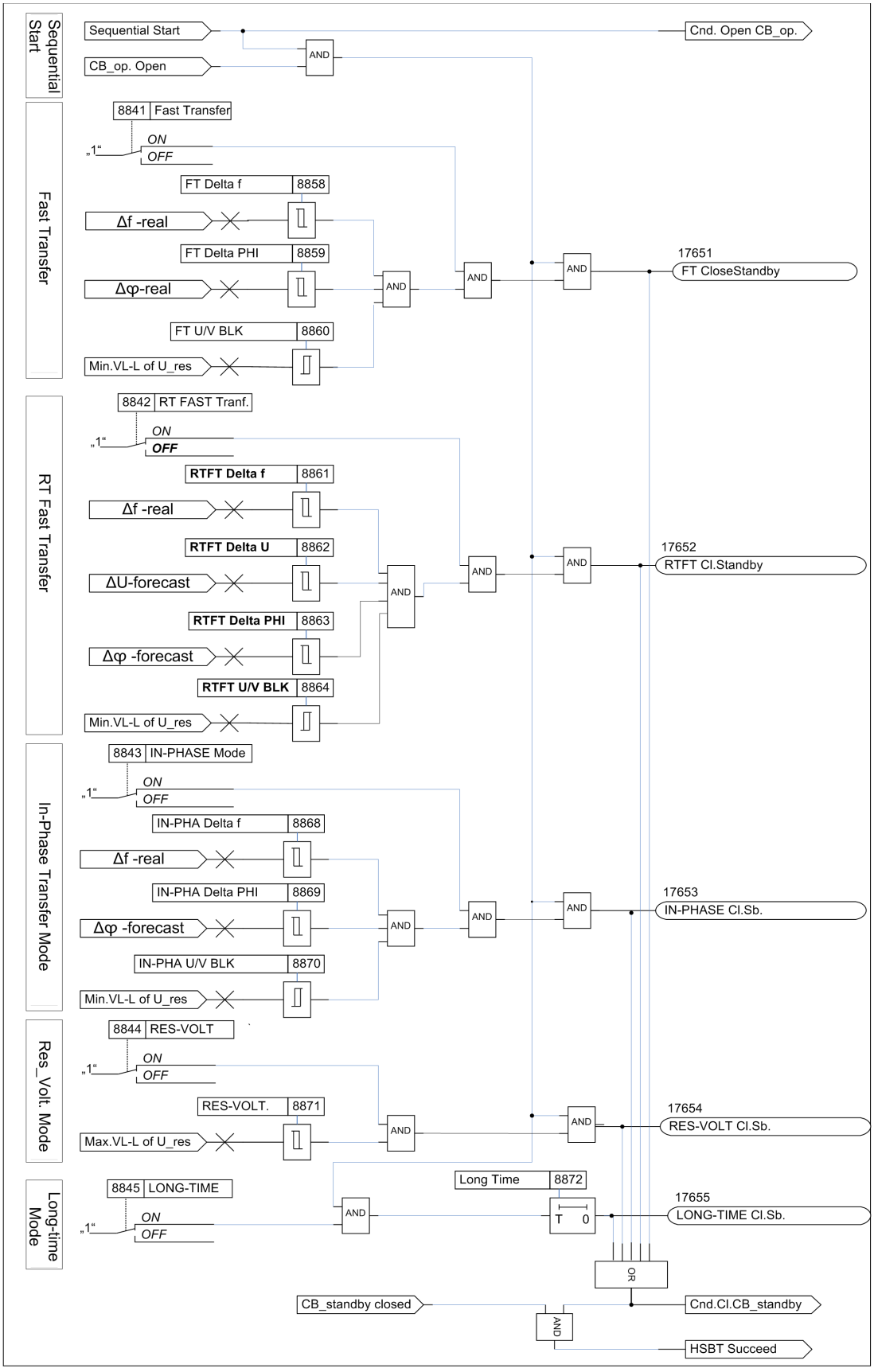



Figure 2-29 Logic of SEQUENTIAL Sequence Transfer

**SIMULTANEOUS Sequence**

When HSBT is started, it will release the trip command to the operating CB. Meanwhile, if the SIMULTANEOUS transfer criteria are fulfilled, it will release the close command to the backup CB.

The difference between SIMULTANEOUS transfer and SEQUENTIAL transfer is the calculation start point. For the SIMULTANEOUS transfer, when HSBT is started, it starts to calculate the differential phase and differential frequency. For the SEQUENTIONAL transfer, when HSBT is started, it will not start to calculate until the operating CB is opened. In other words, SIMULTANEOUS transfer deals with the busbar voltage before operating CB is opened, that's operating source voltage. SEQUENTIONAL transfer deals with the busbar voltage after operating CB is opened, that's residual voltage.

Because of the different operating times of the CBs (a CB normally opens faster than it closes), the power supply of the busbar will be interrupted for a few milliseconds. The length of this dead interval depends on the difference of the CB operating time and the device acting time. But to ensure no parallel of two power supplies, **8857 SIMULTANEOUS Sequence: CB Close T-Delay** is used to delay closing the backup CB. If this parameter value is more than the operating CB opening time, the transfer sequence will change to sequential sequence automatically.

When the CB of standby power supply is closed and the CB of operating power supply does not open within 1s after CB opening command is sent out, HSBT will recognize it as a failure to open the CB. Decoupling will work to open the CB of backup to avoid long time parallel operating.

The details of SIMULTANEOUS Sequence transfer are shown below.

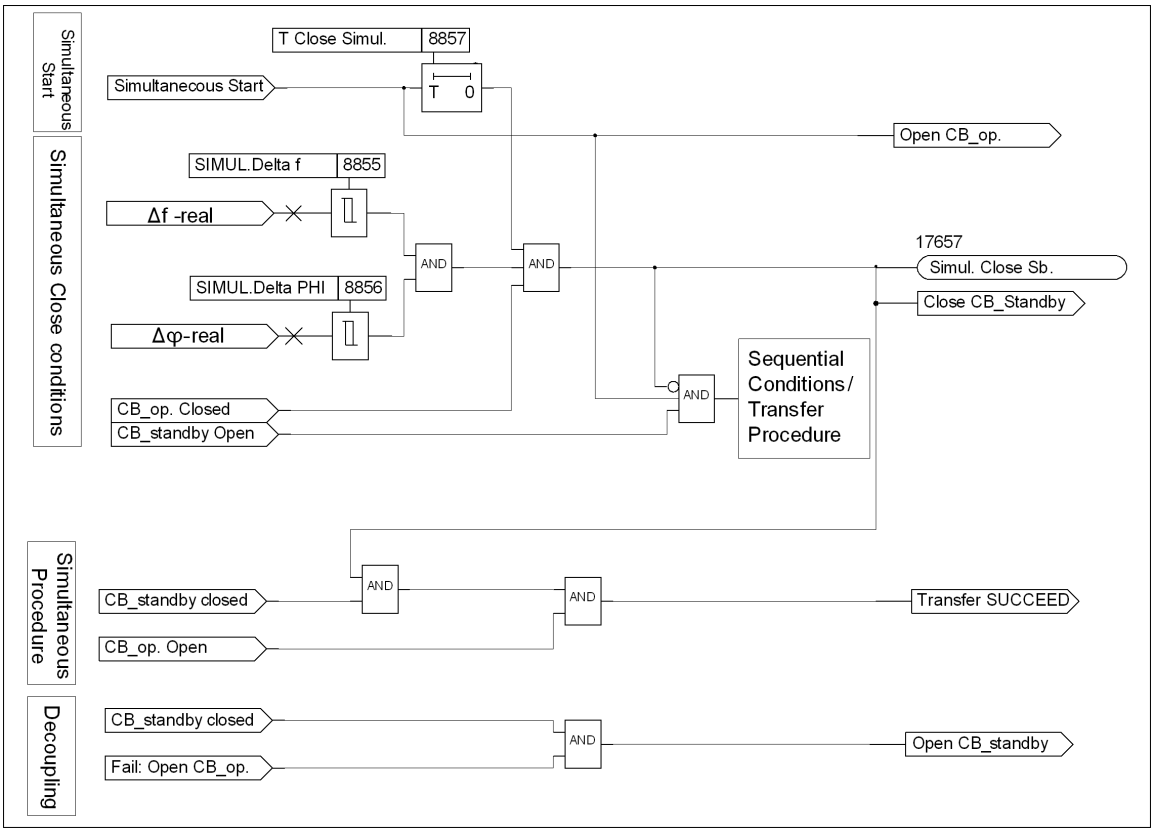



Figure 2-30 Logic of SIMULTANEOUS Sequence Transfer

If it is failed to open the operating CB, de-coupling function will work and open the backup CB, which is closed before, to avoid the long time parallel operation of the two power supplies.

When the operating CB is opened and SIMULTANEOUS Transfer does not success yet, it will automatically change to SEQUENTIAL Sequence. It is necessary to make sure that SEQUENTIAL Sequence is enabled.

## 2.1.6 Low Voltage Load Shedding

HSBT supports low voltage load shedding function with 2 stages. In SEQUENTIAL Sequence, when the parameters **8811 Line1->Line2 LVLSH**, **8812 Line2->Line1 LVLSH**, **8813 Bus1->Bus2 LVLSH**, **8814Bus2->Bus1 LVLSH**, **8815 Bus1->Line1 LVLSH**, **8816 Bus2->Line2 LVLSH** are set to ***ON*,** Low voltage shedding function will be enabled when **FAST Transfer**, **REAL-TIME FAST Transfer** and **IN-PHASE Transfer** failed.

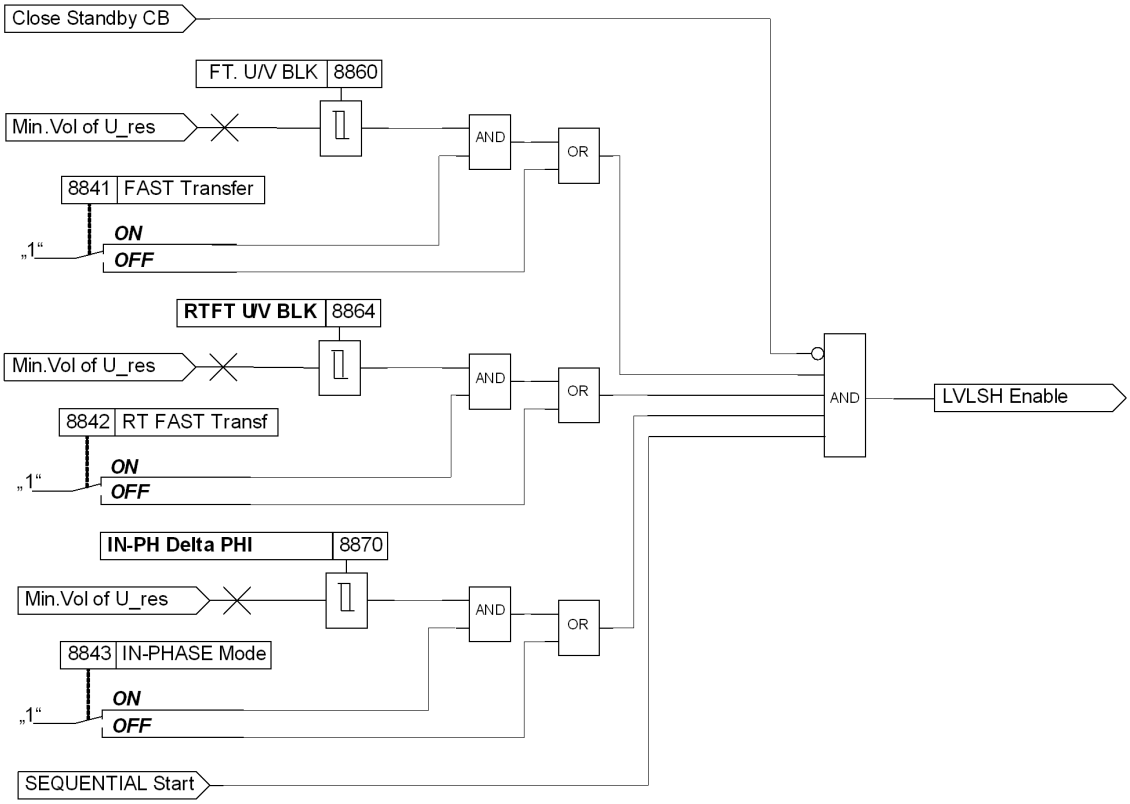



Figure 2-31 Enable Logic of LVLSH

If the LVLSH is enabled, it will send out the trip command with a time delay, according to the transfer mode, to open the unimportant load when the residual voltage on the bus is lower than the setting value of LVLSH. The trip command to open the unimportant loads can be divided into two classed according the two stages of LVLSH. The two stages of LVLSH are decided by the setting of **Low Voltage Load-Shedding Pickup** and **Low Voltage Load-Shedding Time Delay**. The stages can be used to distinguish less important loads and unimportant loads.

LVLSH logic in segmented busbar:

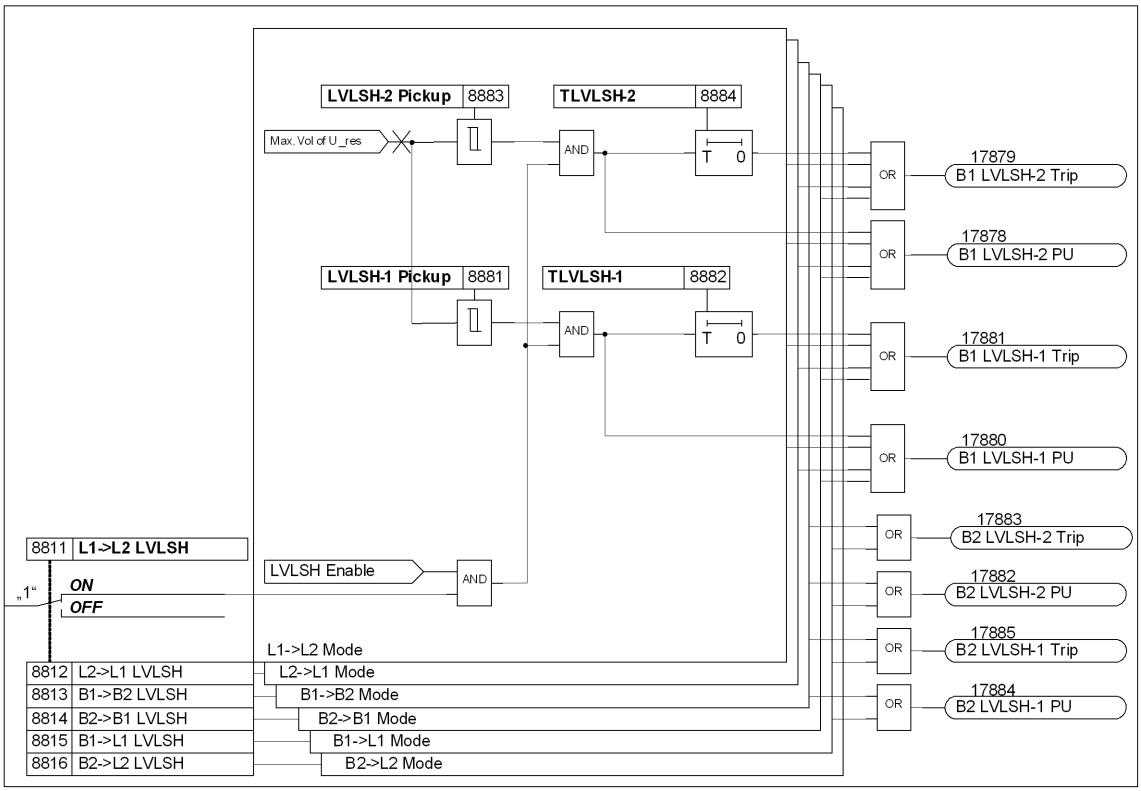



Figure 2-32 Logic of LVLSH in Segmented Busbar

**Note:**

LVLSH for bus2 can only be used in Bus2->Bus1 mode and Bus2->Line2 mode. Other LVLSH of the transfer mode is for bus1. The threshold setting value of LVLSH must be lower than the under voltage block of the three close criterion (FT, RTFT and In-Phase) and bigger than the threshold of Residual-Voltage criterion.

LVLSH logic in single busbar:

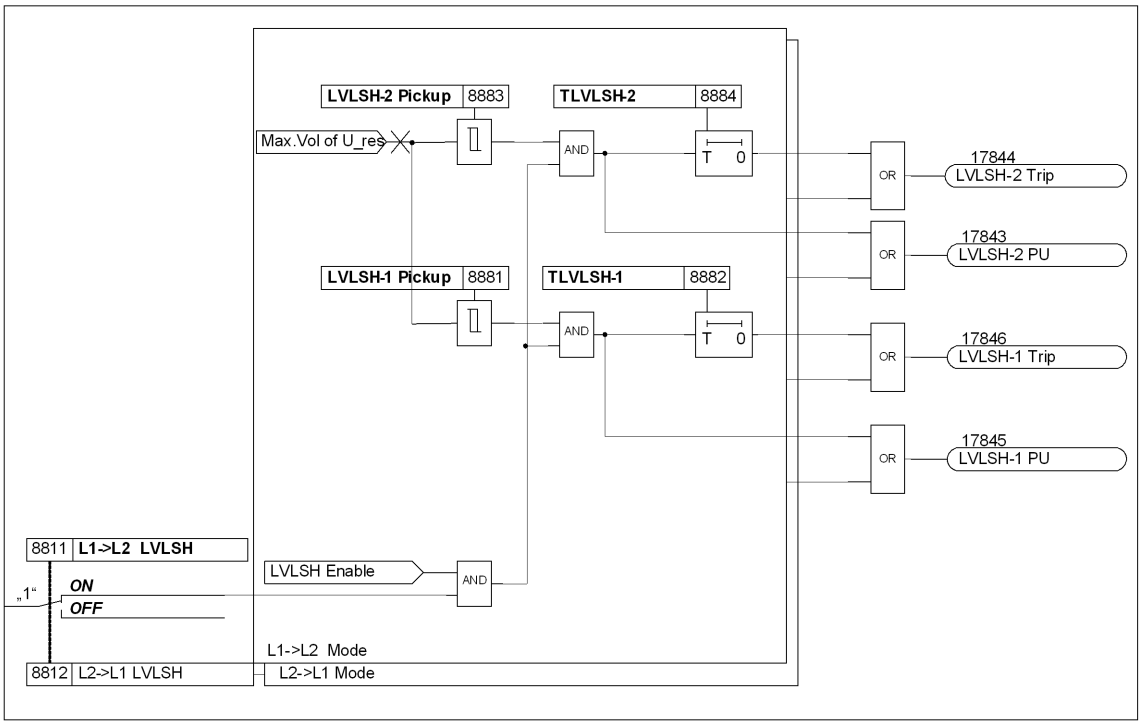



Figure 2-33 Logic of LVLSH in Single Busbar

If **Low voltage load shedding** is enabled, its threshold of low voltage shedding must be bigger than the threshold of **Residual voltage criterion** and lower than threshold of undervoltage blocking criteria of **FAST Transfer, RT Fast Transfer** and **In-phase Transfer**.

## 2.1.7 Test Mode

7VU683 supports the test mode function to test the transfer logic or commissioning. The function can be enabled by setting the parameter **8820 HSBT TestMode** to ***ON*** or setting external signal `18020 >Test Mode`.

When test mode is enabled, nothing is changed except the CB close commands. In test mode, HSBT will release virtual close command 18021 Command: Close CB1(Test), 18022 Command: Close CB2(Test), 18023 Command: Close CB3(Test) instead of 17767 Command: Close CB1, 17768 Command: Close CB2 and 17769 Command: Close CB3.

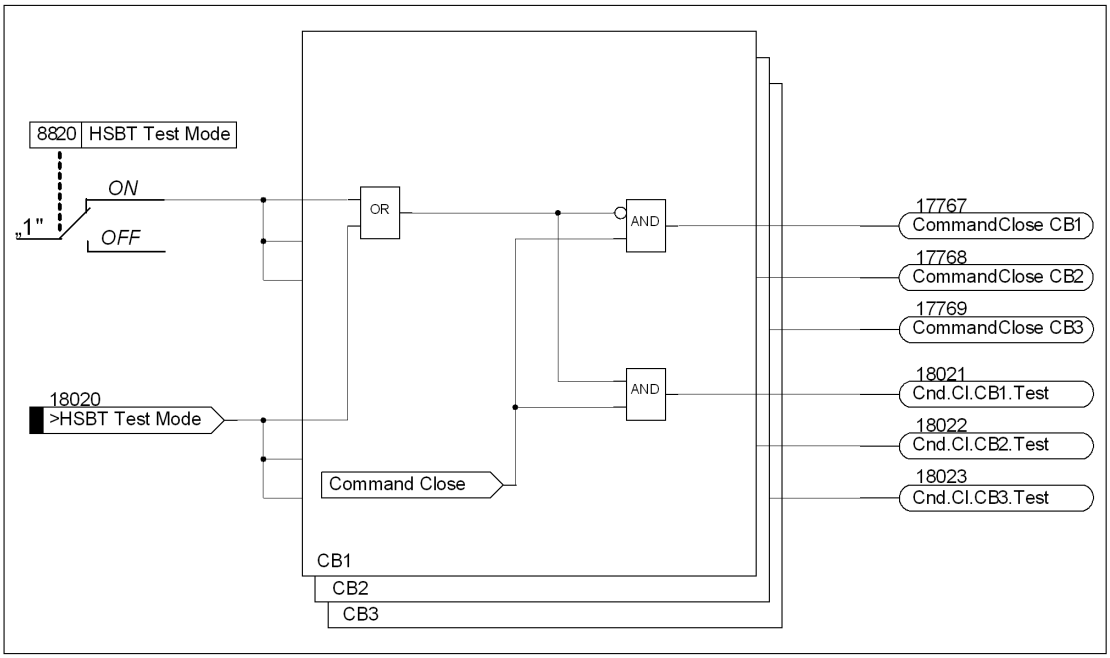



Figure 2-34 Logic of Test Mode

## 2.1.8 HSBT Local/Remote Start

HSBT can be started by remote operator through DCS or by local button. There are 2 solutions.

Solution 1: Creating a single control (SC) signal on DIGSI matrix, connecting its Source to the system port, connecting its Destination to a BO, which is connected with external "Remote" switch, and connecting local start button to "Local" switch. When remote operator gives a command by protocol communication, the SC signal will be turned ON, connected BO will be outputted and start HSBT.

The reference logic is shown below:

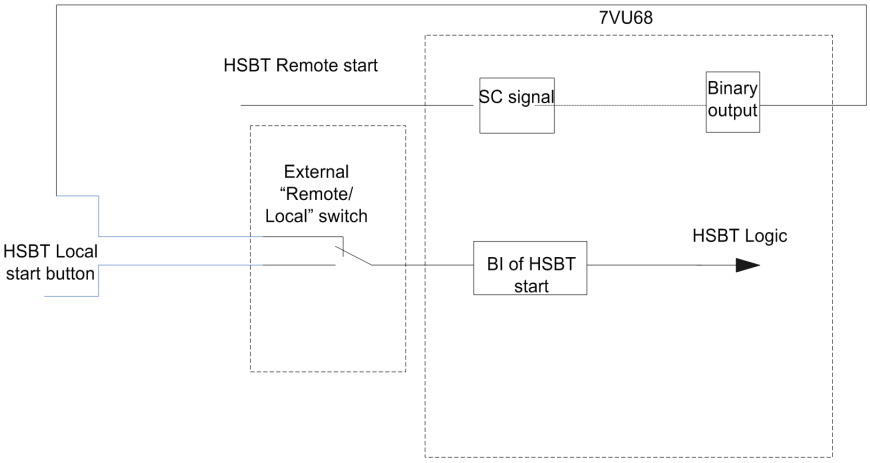



Figure 2-35 Solution 1: reference diagram of HSBT remote start

Solution 2: Using "Remote/local" key on the front panel of device and CFC

**Note:**
FW is V4.60 and P-SET is V4.60
Configuration of the products shall be subject to any changes without additional notices. Please check the new version of 7VU683 manual for further information.

The reference logic is shown below:

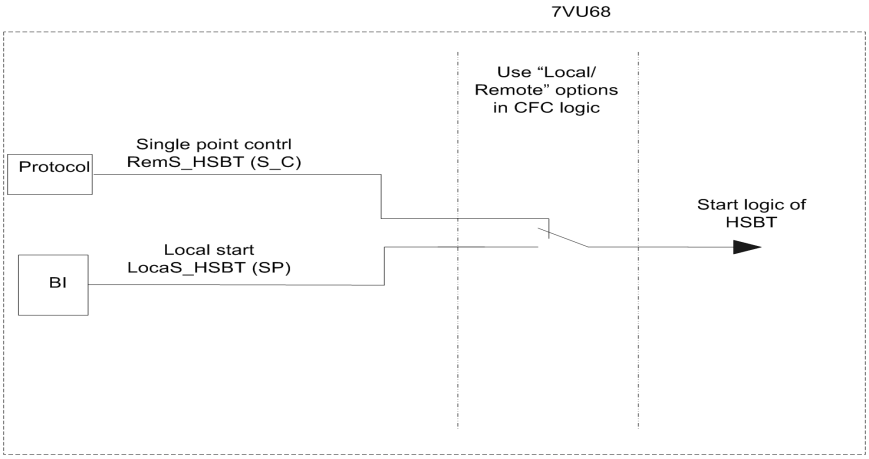



Figure 2-36 Solution 2: reference diagram of HSBT remote start

7VU683 provides a default CFC logic block for HSBT Local/Remote start. In the default CFC chart, the power supply transfer between lines can be started by remote or local. The details of the default CFC are introduced below.

1.Intermediate signals are created on DIGSI matrix. "ReStL1->L2" and "ReStL2->L1" are for HSBT remote start, "Local St.L1->L2" and "Local St.L2->L1" are for HSBT local start.

| | Information | | | | Source | | | | Destination | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Display text | L | Type | BI | F | S | C | BO | LEDs | B | | S | C | D | CM |
| | | | | | | | | | | | O | T | | | C D | |
| Remote start | | ReStL1->L2 | | C_S | | | X | | | | IO | | | X | | |
| Local start | | Local St.L1->L2 | | SP | H5 | | | | | | IO | | | X | | |
| Remote start | | ReStL2->L1 | | C_S | | | X | | | | IO | | | X | | |
| Local start | | Local St.L2->L1 | | SP | H12 | | | | | | IO | | | X | | |

Figure 2-37 Information routing to CFC in DIGSI

The type of HSBT remote start signals are single control (SC); Their properties are: pulse output, 1 second length; Their Sources are System Interface, their Destinations are CFC. The type of HSBT local start signals are Single Point (SP); theire filter times are 1 second, configured in fault record; their Sources are binary inputs, and their Destinations are CFC.

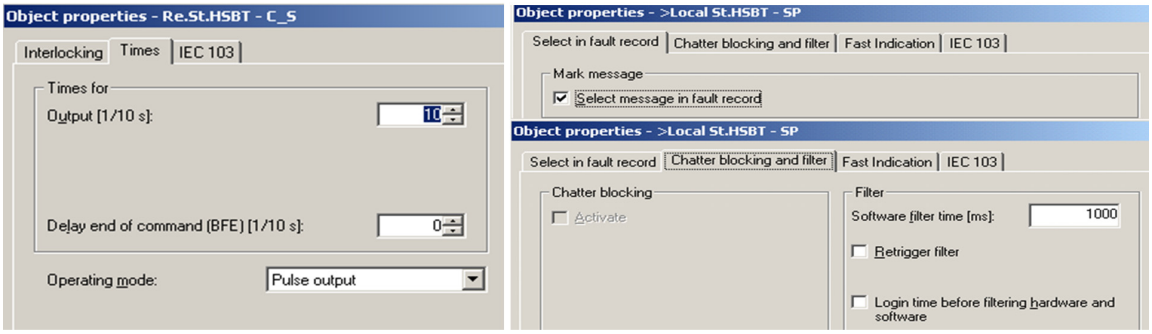



Figure 2-38 Object properties

2. Route "CntrlAuth" to CFC in "CntrlAuthority" block.

| | Information | | | | Source | | | | Destination | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Display text | L | Type | BI | F | S | C | BO | LEDs | B | | S | C | D | CM |
| | | | | | | | | | | | O | T | | | C D | |
| Cntrl Authority | | Cntrl Auth | | DP | | | | | | | IO | | | X | | |
| | | ModeREMOTE | | IntSP | | | | | | | IO | | | | | |
| | | ModeLOCAL | | DP | | | | | | | IO | | | | | |

Figure 2-39 CFC Control Authority

3. Make CFC the source of "17628 >NORMAL L1->L2" and "17629 >NORMAL L2->L1"

| Information | | | | Source | | | | Destination | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | Display text | L | Type | BI | F | S | C | BO | LEDs | B | | S | C | D | CM |
| | | | | | | | | | | O | T | | | C D | |
| 17628 | >NORMAL L1->L2 | | SP | | | | X | | | IO | | | | | |
| 17629 | >NORMAL L2->L1 | | SP | | | | X | | | IO | | | | | |

Figure 2-40 CFC normal startup

4. CFC logic of HSBT remote start is shown below

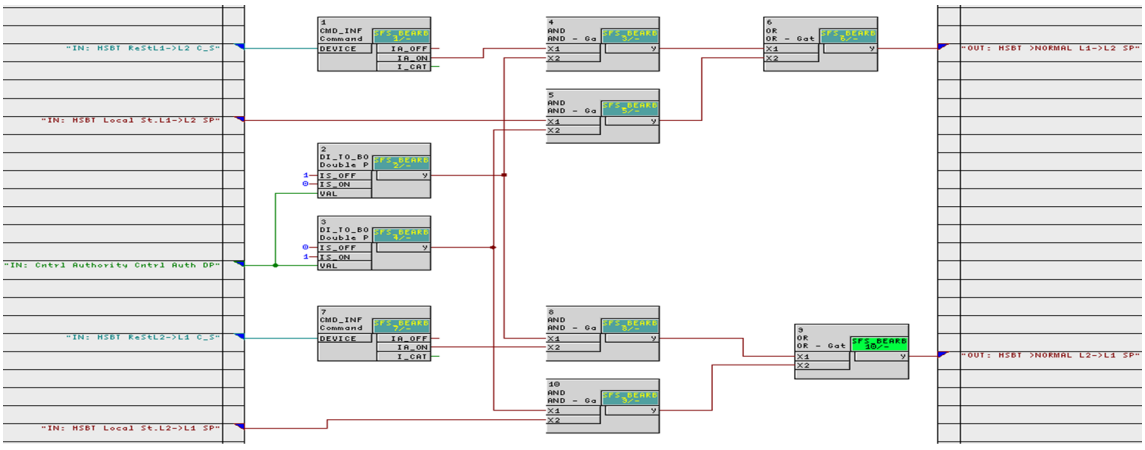


Figure 2-41 CFC interlocking

**Note:**
This CFC logic block can only be configured with the priority of Interlocking (SFS_BEARB / INTERLOCK).

If the customer needs other logics, please refer to the default CFC chart and make own CFC blocks, then delete the default CFC chart.

## 2.1.9 CB Closing Time

Parameters **8801 CB1 Closing time**, **8802 CB2 Closing time** and **8803 CB3 Closing time** are real close times.

Transfer criteria of **REAL-TIME FAST Transfer** and **IN-PHASE Transfer** will forecast the differential voltage and differential phase when instant backup CB is closed according to the **CB closing time**. So these parameters should be set as accuracy as possible. HSBT will record the CB close time in fault logs after transfer operation. At most 8 fault logs can be recorded. The average of recorded CB close times is a reference for the customers to set the parameters.

It is better to use the high speed BOs on the device to reduce transfer time of HSBT. It is suggested to use the default configurations of BOs.

## 2.1.10 Settings

| Addr. | Parameter | Range | Default Setting | Note |
|---|---|---|---|---|
| HSBT->General | | | | |
| 8801 | CB1 Closing Time | 1 ..150 ms | 70 ms | |
| 8802 | CB2 Closing Time | 1 ..150 ms | 70 ms | |
| 8803 | CB3 Closing Time | 1 ..150 ms | 70 ms | |
| 8804 | Max. Tran. Time | 1 ..600 sec | 30 sec | |
| 8805 | Transfer Mode L1->L2 | ON<br>OFF | OFF | |
| 8806 | Transfer Mode L2->L1 | ON<br>OFF | OFF | |
| 8807 | Transfer Mode B1->B2 | ON<br>OFF | OFF | |
| 8808 | Transfer Mode B1->L1 | ON<br>OFF | OFF | |
| 8809 | Transfer Mode B2->B1 | ON<br>OFF | OFF | |
| 8810 | Transfer Mode B2->L2 | ON<br>OFF | OFF | |
| 8811 | L1->L2 LVLSH | YES<br>NO | NO | |
| 8812 | L2->L1 LVLSH | YES<br>NO | NO | |
| 8813 | B1->B2 LVLSH | YES<br>NO | NO | |
| 8814 | B2->B1 LVLSH | YES<br>NO | NO | |

| Addr. | Parameter | Range | Default Setting | Note |
|---|---|---|---|---|
| 8815 | B1->L2 LVLSH | YES<br>NO | NO | |
| 8816 | B2->L2 LVLSH | YES<br>NO | NO | |
| 8817 | ManuallyRestart | YES<br>NO | NO | |
| 8818 | Time Delay to Ready Status | 0.05 ..600.00 sec | 10.00 sec | |
| 8819 | TD to Un-ready | 0.05 ..600.00 sec | 10.00 sec | |
| 8820 | HSBT Test Mode | ON<br>OFF | OFF | |
| HSBT->Start Condition | | | | |
| 8821 | NORMAL Condition | OFF<br>PARALLEL Auto<br>PARAL. Half-Auto<br>SIMULTANEOUS<br>SEQUENTIAL | PARALLEL Auto | |
| 8822 | FAULT Condition | OFF<br>SEQUENTIAL | SEQUENTIAL | |
| 8823 | Undervoltage Condition | OFF<br>SEQUENTIAL | SEQUENTIAL | |
| 8826 | Undervoltage Threshold | 1.0 ..125.0 V | 70.0 V | |
| 8827 | Undervoltage Time Delay | 0.00 ..60.00 sec | 1.00 sec | |
| 8824 | Underfrequency Condition | OFF<br>SEQUENTIAL | OFF<br>SEQUENTIAL | |
| 8829 | Underfrequency Threshold | 45.00 ..49.90 Hz | 49.50 Hz | Fn=50Hz |
| 8829 | Underfrequency Threshold | 55.00 ..59.90 Hz | 59.50 Hz | Fn=60Hz |
| 8830 | Underfrequency Time Delay | 0.00 ..60.00 sec | 1.00 sec | |
| 8825 | Inadvertent CB Open Condition | OFF<br>ON | ON | |
| 8831 | Mono-direction Against NORMAL | YES<br>NO | YES | |
| HSBT->ransfer Mode | | | | |
| 8841 | FAST Transfer Mode | OFF<br>ON | OFF | |
| 8842 | REAL-TIME FAST Transfer Mode | OFF<br>ON | OFF | |
| 8843. | IN-PHASE Transfer Mode | OFF<br>ON | OFF | |
| 8844 | RES-VOLT Transfer Mode | OFF<br>ON | OFF | |
| 8845 | LONG-TIME Transfer Mode | OFF<br>ON | OFF | |
| HSBT-->ransfer Set | | | | |
| 8851 | PARAL. Delta f | 0.02 ..2.00 Hz | 0.50 Hz | |
| 8852 | PARAL. Delta U | 1.0 ..50.0, 0 V | 20.0 V | |

| Addr. | Parameter | Range | Default Setting | Note |
|---|---|---|---|---|
| 8853 | PARAL. Delta PHI | 0.5 ..40.0° | 15.0 ° | |
| 8854 | T Op.PARAL.Auto | 0.00 ..60.00 sec | 0.50 sec | |
| 8855 | SIMUL.Delta f | 0.02 ..2.00 Hz | 0.50 Hz | |
| 8856 | SIMUL.Delta PHI | 0.5 ..60.0° | 15.0° | |
| 8857 | T Close SIMUL. | 0.00 ..60.00 sec | 0.50 sec | |
| 8858 | FT Delta f | 0.10 ..10.00 Hz | 1.00 Hz | |
| 8859 | FT Delta PHI | 0.5 ..60.0 ° | 20.0 ° | |
| 8860 | FT U/V BLK | 50.0 ..150.0 V | 60.0 V | |
| 8861 | RTFT Delta f | 0.50 ..15.00 Hz | 2.00 Hz | |
| 8862 | RTFT Delta U | 50.0 ..150.0 V | 110.0 V | |
| 8863 | RTFT Delta PHI | 0.5 ..120.0 ° | 90.0 ° | |
| 8864 | RTFT U/V BLK | 50.0 ..150.0 V | 60.0 V | |
| 8868 | IN-PHA Delta f | 0.50 ..15.00 Hz | 6.00 Hz | |
| 8869 | IN-PHA Delta PHI | 0.5 ..90.0 ° | 10.0 ° | |
| 8870 | IN-PHA U/V BLK | 50.0 ..150.0 V | 40.0 V | |
| 8871 | RES-VOLT | 20.0 ..60.0 V | 25.0 V | |
| 8872 | LONG-TIME | 0.50 ..10.00 sec | 9.00 sec | |
| HSBT-->VLSH | | | | |
| 8881 | LVLSH-1 Pickup | 10.0 ..80.0 V | 45.0 V | |
| 8882 | T LVLSH-1 | 0.00 ..60.00, oo sec | 0.50 sec | |
| 8883 | LVLSH-2 Pickup | 10.0 ..80.0 V | 35.0 V | |
| 8884 | T LVLSH-2 | 0.00 ..60.00, oo sec | 0.10 sec | |

## 2.1.11 Information List

| No. | Information | Type | Fun. NO. | Inf. NO. |
|---|---|---|---|---|
| 17620 | >BLOCK HSBT | SP | | |
| 17863 | >Manually Restart | SP | | |
| 17627 | >Line1 FAULT Start | SP | | |
| 17667 | >Line2 FAULT Start | SP | | |
| 17628 | >NORMAL Start Line1->Line2 | SP | | |
| 17629 | >NORMAL Start Line2->Line1 | SP | | |
| 17630 | >NORMAL Start Busbar1->Busbar2 | SP | | |
| 17631 | >NORMAL Start Busbar1->Line1 | SP | | |
| 17632 | >NORMAL Start Busbar2->Busbar1 | SP | | |
| 17633 | >NORMAL Start Busbar2->Line2 | SP | | |
| 17870 | >Manual Open Command in PARALL.Half-Auto | SP | | |
| 18020 | >HSBT Test Mode | SP | | |
| 17640 | HSBT is Active | OUT | | |

| No. | Information | Type | Fun. NO. | Inf. NO. |
|---|---|---|---|---|
| 17641 | HSBT switched OFF | OUT | | |
| 17642 | HSBT is Blocked | OUT | | |
| 17644 | NORMAL Start | OUT | | |
| 17645 | FAULT Start | OUT | | |
| 17646 | Undervoltage Start | OUT | | |
| 17647 | Underfrequency Start | OUT | | |
| 17648 | Inadvertent CB Open Start | OUT | | |
| 17651 | FAST Transfer Close Standby Supply | OUT | | |
| 17652 | REAL-TIME FAST Transfer Cl.StandbySupply | OUT | | |
| 17653 | IN-PHASE Transfer Close Standby Supply | OUT | | |
| 17654 | RES-VOLT Transfer Close Standby Supply | OUT | | |
| 17655 | LONG-TIME Transfer Close Standby Supply | OUT | | |
| 17656 | PARALLEL Sequence Close Standby Supply | OUT | | |
| 17657 | SIMULTANEOUS Sequence Cl. Standby Supply | OUT | | |
| 18014 | dU = | VI | | |
| 18015 | df = | VI | | |
| 18016 | dphi = | VI | | |
| 18017 | CB1 Closing Time = | VI | | |
| 18018 | CB2 Closing Time = | VI | | |
| 18019 | CB3 Closing Time = | VI | | |
| 18021 | Command:Close CB1(Test) | OUT | | |
| 18022 | Command:Close CB2(Test) | OUT | | |
| 18023 | Command:Close CB3(Test) | OUT | | |
| 17886 | >BLOCK Line1 -> Line2 | SP | | |
| 17950 | Line1 -> Line2 is Blocked | OUT | | |
| 17643 | Line1 -> Line2 is Ready | OUT | | |
| 17871 | Line1 -> Line2 Succeeded | OUT | 200 | 15 |
| 17922 | Line1 -> Line2 TimeOut | OUT | | |
| 17916 | Line1 -> Line2 Failed | OUT | 200 | 21 |
| 17887 | >BLOCK Line2 -> Line1 | SP | | |
| 17951 | Line2 -> Line1 is Blocked | OUT | | |
| 17668 | Line2 -> Line1 is Ready | OUT | | |
| 17872 | Line2 -> Line1 Succeeded | OUT | 200 | 16 |
| 17923 | Line2 -> Line1 TimeOut | OUT | | |
| 17917 | Line2 -> Line1 Failed | OUT | 200 | 22 |
| 17888 | >BLOCK Busbar1 -> Busbar2 | SP | | |
| 17952 | Busbar1 -> Busbar2 is Blocked | OUT | | |
| 17669 | Busbar1 -> Busbar2 is Ready | OUT | | |
| 17873 | Busbar1 -> Busbar2 Succeeded | OUT | 200 | 17 |
| 17924 | Busbar1 -> Busbar2 TimeOut | OUT | | |
| 17918 | Busbar1 -> Busbar2 Failed | OUT | 200 | 23 |
| 17889 | >BLOCK Busbar2 -> Busbar1 | SP | | |

| No. | Information | Type | Fun. NO. | Inf. NO. |
|---|---|---|---|---|
| 17953 | Busbar2 -> Busbar1 is Blocked | OUT | | |
| 17671 | Busbar2 -> Busbar1 is Ready | OUT | | |
| 17874 | Busbar2 -> Busbar1 Succeeded | OUT | 200 | 18 |
| 17925 | Busbar2 -> Busbar1 TimeOut | OUT | | |
| 17919 | Busbar2 -> Busbar1 Failed | OUT | 200 | 24 |
| 17890 | >BLOCK Busbar1 -> Line1 | SP | | |
| 17954 | Busbar1 -> Line1 is Blocked | OUT | | |
| 17670 | Busbar1 -> Line1 is Ready | OUT | | |
| 17875 | Busbar1 -> Line1 Succeeded | OUT | 200 | 19 |
| 17926 | Busbar1 -> Line1 TimeOut | OUT | | |
| 17920 | Busbar1 -> Line1 Failed | OUT | 200 | 25 |
| 17891 | >BLOCK Busbar2 -> Line2 | SP | | |
| 17955 | Busbar2 -> Line2 is Blocked | OUT | | |
| 17672 | Busbar2 -> Line2 is Ready | OUT | | |
| 17876 | Busbar2 -> Line2 Succeeded | OUT | 200 | 20 |
| 17927 | Busbar2 -> Line2 TimeOut | OUT | | |
| 17921 | Busbar2 -> Line2 Failed | OUT | 200 | 26 |
| 18012 | HSBT is Ready | OUT | 200 | 93 |
| 17948 | HSBT Succeed | OUT | 200 | 91 |
| 17949 | HSBT Failed | OUT | 200 | 92 |
| 17878 | B1 Low Voltage Load-Shedding2 Pickup | OUT | | |
| 17879 | B1 Low Voltage Load-Shedding2 Trip | OUT | | |
| 17880 | B1 Low Voltage Load-Shedding1 Pickup | OUT | | |
| 17881 | B1 Low Voltage Load-Shedding1 Trip | OUT | | |
| 17882 | B2 Low Voltage Load-Shedding2 Pickup | OUT | | |
| 17883 | B2 Low Voltage Load-Shedding2 Trip | OUT | | |
| 17884 | B2 Low Voltage Load-Shedding1 Pickup | OUT | | |
| 17885 | B2 Low Voltage Load-Shedding1 Trip | OUT | | |
| 17843 | Low Voltage Load-Shedding2 Pickup | OUT | | |
| 17844 | Low Voltage Load-Shedding2 Trip | OUT | | |
| 17845 | Low Voltage Load-Shedding1 Pickup | OUT | | |
| 17846 | Low Voltage Load-Shedding1 Trip | OUT | | |
| 17963 | Line1 -> Line2 ON/OFF | IntSP | 200 | 66 |
| 17964 | Line2 -> Line1 ON/OFF | IntSP | 200 | 67 |
| 17965 | Busbar1 -> Busbar2 ON/OFF | IntSP | 200 | 68 |
| 17966 | Busbar1 -> Line1 ON/OFF | IntSP | 200 | 69 |
| 17967 | Busbar2 -> Busbar1 ON/OFF | IntSP | 200 | 70 |
| 17968 | Busbar2 -> Line2 ON/OFF | IntSP | 200 | 71 |
| 17969 | Fast Transfer Mode ON/OFF | IntSP | | |
| 17970 | Real Time Fast Transfer Mode ON/OFF | IntSP | | |
| 17971 | IN-PHASE Transfer Mode ON/OFF | IntSP | | |
| 17972 | RES-VOLT Transfer Mode ON/OFF | IntSP | | |
| 17973 | LONG-TIME Transfer Mode ON/OFF | IntSP | | |

| No. | Information | Type | Fun. NO. | Inf. NO. |
|---|---|---|---|---|
| 17670 | Busbar1 -> Line1 is Ready | OUT | | |
| 17875 | Busbar1 -> Line1 Succeeded | OUT | 200 | 19 |

## 2.2 Protection

Protection functions can be set on or set off by the parameter **226 Protection Functions.**

For device 7VU683 the protection functions are available on the condition that the parameter **212 Primary Diagram** is set to **Segmented Single Busbar**.

When the rated frequency is 50Hz, the operation range of frequency of protection functions is 20Hz to 66Hz. When the rated frequency is 60Hz, the operation range of frequency of protection functions is 25Hz to 66Hz. Protection functions will be unavailable beyond the frequency rang.

The setting values and their default values of current related parameters in flowing are under a rating of 1A rated secondary current. When the rated secondary current is 5A, the values should be multiplied by 5.

## 2.2.1 Phase Overcurrent Protection

This device supplies 2 stages of definite time phase overcurrent protection.

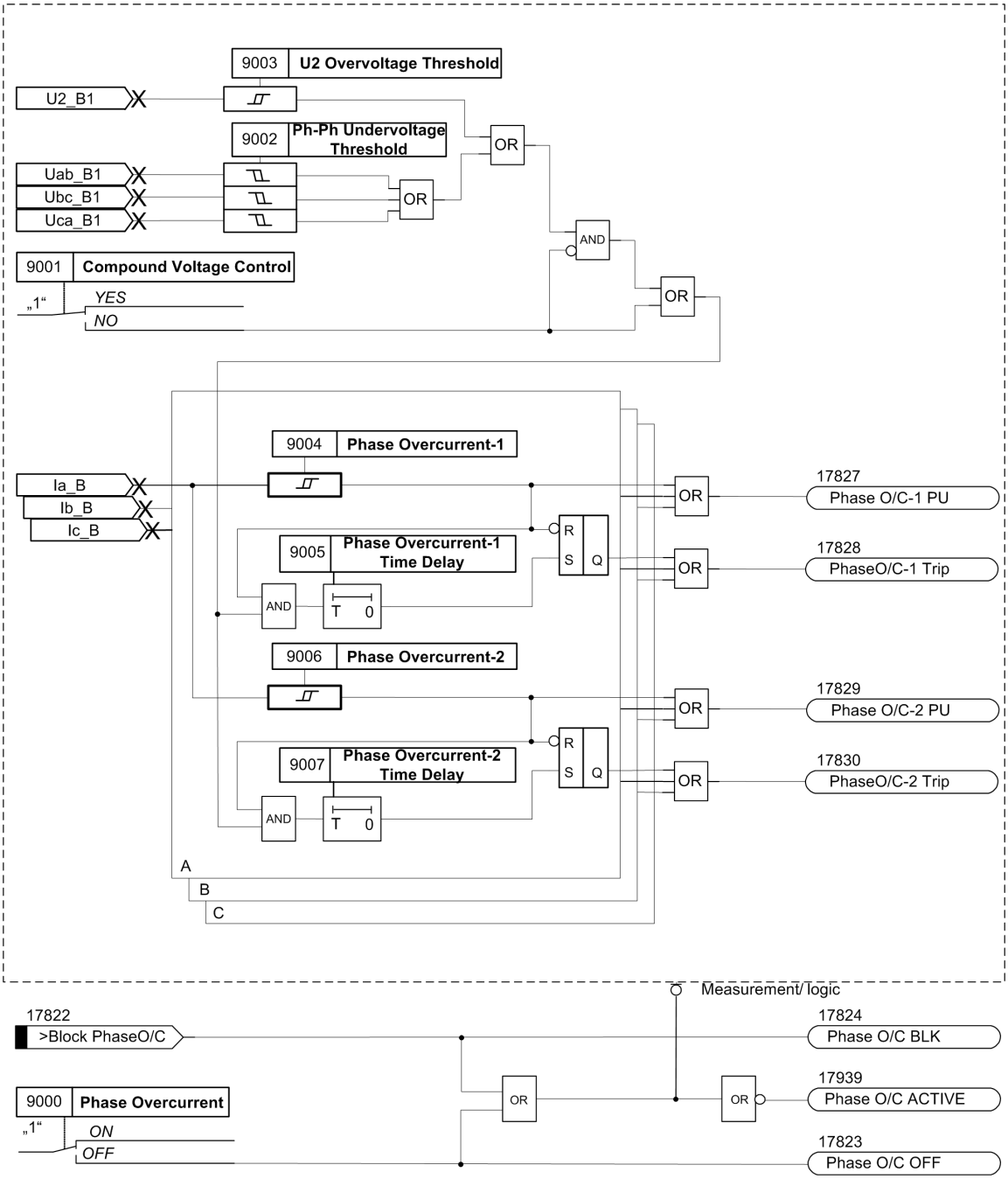



Figure 2-42 Logic diagram of the phase overcurrent protection

1. Compound voltage control can be enabled or disabled by setting the parameter **9001 Compound Voltage Control** to ***YES*** or ***NO***.
2. PT broken wire can not block the phase overcurrent protection.
3. After the trip signal is released, the dropout of the voltage signal cannot reset the trip signal, only current dropout can reset the trip signal.

### 2.2.1.1 Settings

| Addr. | Parameter | Setting Options | Default Setting | Comments |
|---|---|---|---|---|
| Protection Functions->General | | | | |
| 9000 | Phase Overcurrent | ON<br>OFF | OFF | |
| Protection Functions -> Voltage Control | | | | |
| 9002 | Ph-Ph Undervoltage Threshold | 1V..125V, 0V | 70 V | |
| 9003 | U2 Overvoltage Threshold | 1V..125V, ∞ | 8 V | |
| Protection Functions -> Phase O/C | | | | |
| 9001 | Compound Voltage Control | YES<br>NO | YES | |
| 9004 | Phase Overcurrent-1 | 0.1A..35 A | 3 A | |
| 9005 | Phase Overcurrent-1 Time Delay | 0s..60s, ∞ | 0.5s | |
| 9006 | Phase Overcurrent-2 | 0.1A..35 A | 5 A | |
| 9007 | Phase Overcurrent-2 Time Delay | 0s..60s, ∞ | 0.1s | |

### 2.2.1.2 Information List

| No. | Information | Type | Function No. | Inf.NO. |
|---|---|---|---|---|
| 17822 | >Block PhaseO/C | SP | | |
| 17939 | PhaseO/C ACTIVE | OUT | | |
| 17823 | PhaseO/C OFF | OUT | | |
| 17824 | PhaseO/C BLK | OUT | | |
| 17827 | PhaseO/C-1 PU | OUT | | |
| 17828 | PhaseO/C-1 Trip | OUT | 200 | 44 |
| 17829 | PhaseO/C-2 PU | OUT | | |
| 17830 | PhaseO/C-2 Trip | OUT | 200 | 46 |
| 17981 | Ph.O/C ON/OFF | IntSP | 200 | 85 |

## 2.2.2 Zero Sequence Overcurrent Protection

This device supplies 2 stages of definite time zero sequence overcurrent protection.

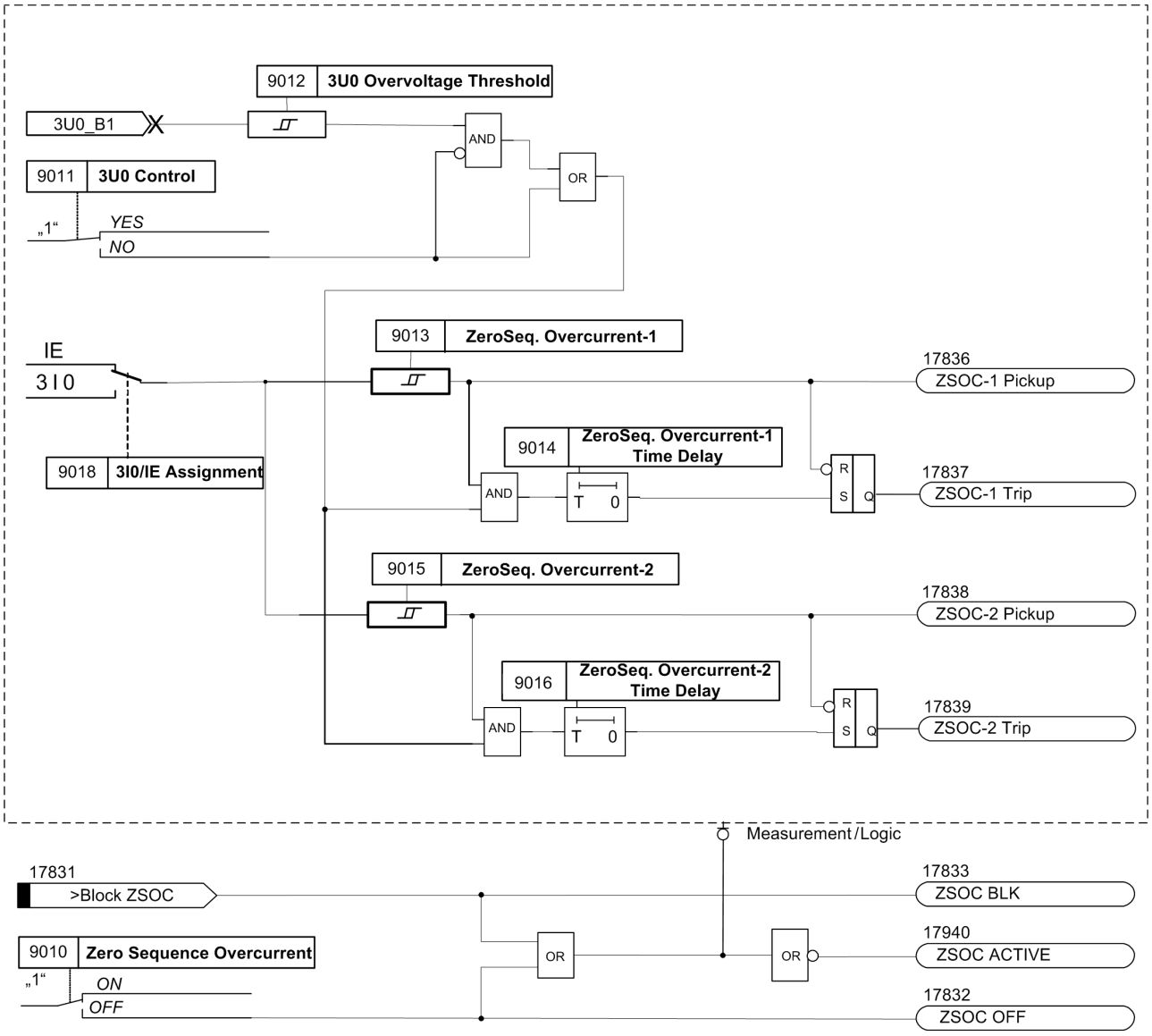



Figure 2-43 Logic diagram of the zero sequence overcurrent protection

1. Zero sequence voltage function can be enabled or disabled by setting the parameter **9011 3U0 Control** to ***YES*** or ***NO***.

2.PT broken wire cannot block zero sequence overcurrent protection.

3.After the trip signal is released, the dropout of the voltage signal cannot reset the trip signal, only current dropout can reset the trip signal.

### 2.2.2.1 Settings

| Addr. | Parameter | Setting Options | Default Setting | Comments |
|---|---|---|---|---|
| Protection Functions-> General | | | | |
| 9010 | Zero Sequence Overcurrent | ON<br>OFF | OFF | |
| 9018 | 3I0/IE Assignment | IE<br>3I0 | 3I0 | |
| Protection Functions -> Voltage Control | | | | |
| 9012 | 3U0 Overvoltage Threshold | 1V..200V | 30V | |
| Protection Functions -> Zero Sequ. O/C | | | | |
| 9011 | 3U0 Control | Yes<br>No | Yes | |
| 9013 | Zerosequ. Overcurrent-1 | 0.1A..35A | 3A | |
| 9014 | Zerosequ. Overcurrent-1 Time Delay | 0s..60s, ∞ | 0.5s | |
| 9015 | Zerosequ. Overcurrent-2 | 0.1A..35A | 5A | |
| 9016 | Zerosequ. Overcurrent-1 Time Delay | 0s..60s, ∞ | 0.1s | |

### 2.2.2.2 Information List

| No. | Information | Type | Function No. | Inf.No. |
|---|---|---|---|---|
| 17831 | >Block ZSOC | SP | | |
| 17940 | ZSOC ACTIVE | OUT | | |
| 17832 | ZSOC OFF | OUT | | |
| 17833 | ZSOC BLK | OUT | | |
| 17836 | ZSOC-1 PU | OUT | | |
| 17837 | ZSOC-1 Trip | OUT | 200 | 48 |
| 17838 | ZSOC-2 PU | OUT | | |
| 17839 | ZSOC-2 Trip | OUT | 200 | 50 |
| 17982 | ZSOC ON/OFF | IntSP | 200 | 86 |

## 2.2.3 Phase O/C for Busbar Energization Protection

This device supplies 2 stages of definite time phase overcurrent protection for busbar energization.

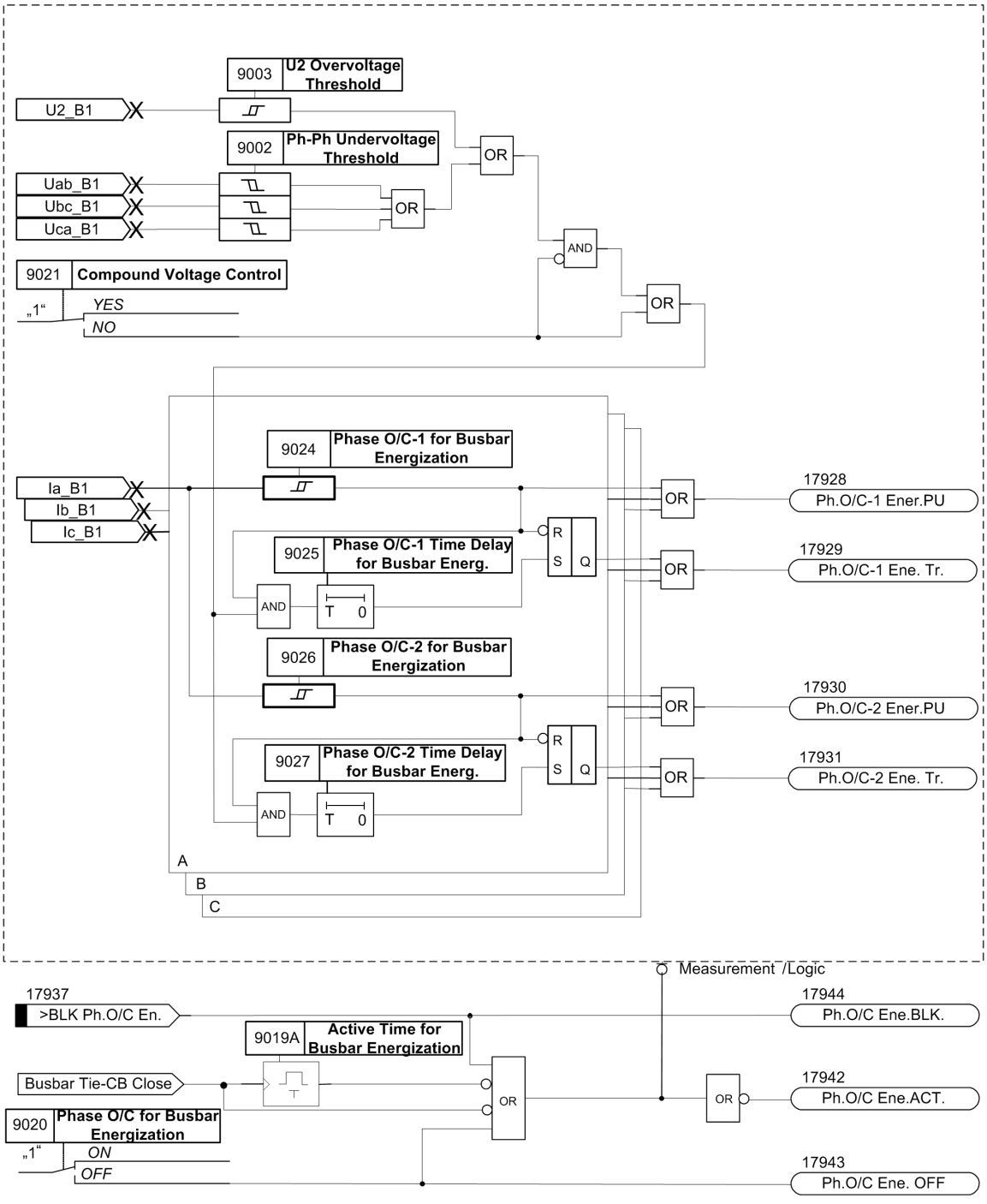



Figure 2-44 Logic Diagram of the Phase Overcurrent for Busbar Energization Protection

1. When the parameter **9020 Phase O/C** for Busbar Energization is set to ***ON*** and bus-tie CB is closed, Phase overcurrent for busbar energization protection will start to run. The running time is set by the parameter **9019A Active Time** for Busbar Energization.
2. Compound voltage control can be enabled or disabled by setting the parameter **9021 Compound Voltage** Control to ***YES*** or ***NO***.
3. PT broken wire cannot block phase overcurrent for busbar energization protection.
4. After the trip signal is released, the dropout of the voltage signal cannot reset the trip signal, only current dropout can reset the trip signal.

### 2.2.3.1 Settings

| Addr. | Settings | Setting Options | Default Setting | Comments |
|---|---|---|---|---|
| Protection Functions -> General | | | | |
| 9020 | Phase O/C for Busbar Energization | ON<br>OFF | OFF | |
| 9019A | Active time for Busbar Energization | 0.01s..600.00s | 5.00s | |
| Protection Functions -> Voltage Control | | | | |
| 9002 | Ph-Ph Undervoltage Threshold | 1V..125V, 0V | 70V | |
| 9003 | U2 Overvoltage Threshold | 1V..125V, ∞ | 8V | |
| Protection Functions -> Ph. O/C Energiz. | | | | |
| 9021 | Compound Voltage Control | Yes<br>No | No | |
| 9024 | Phase O/C-1 for Busbar Energ. | 0.1A..35A | 2A | |
| 9025 | Phase O/C-1 Time Delay for Busbar Energization | 0s..60s, ∞ | 0.5s | |
| 9026 | Phase O/C -2 for Busbar Energization | 0.1A..35A | 4A | |
| 9027 | Phase O/C -2 Time Delay for Busbar Energ. | 0s..60s, ∞ | 0.1s | |

### 2.2.3.2 Information List

| No. | Information | Type | Funcion No. | Inf. No. |
|---|---|---|---|---|
| 17942 | Ph.O/C Ene.ACT. | OUT | | |
| 17943 | Ph.O/C Ene. OFF | OUT | | |
| 17944 | Ph.O/C Ene. BLK | OUT | | |
| 17928 | Ph.O/C-1Ener.PU | OUT | | |
| 17929 | Ph.O/C-1Ene.Tr. | OUT | 200 | 54 |
| 17930 | Ph.O/C-2Ener.PU | OUT | | |
| 17937 | >BLK Ph. O/C En | SP | 200 | 56 |
| 17983 | Ph.O/CEn.ON/OFF | IntSP | 200 | 87 |

## 2.2.4 Earth O/C for Busbar Energization Protection

This device supplies 2 stages of definite time earth overcurrent for busbar energization.

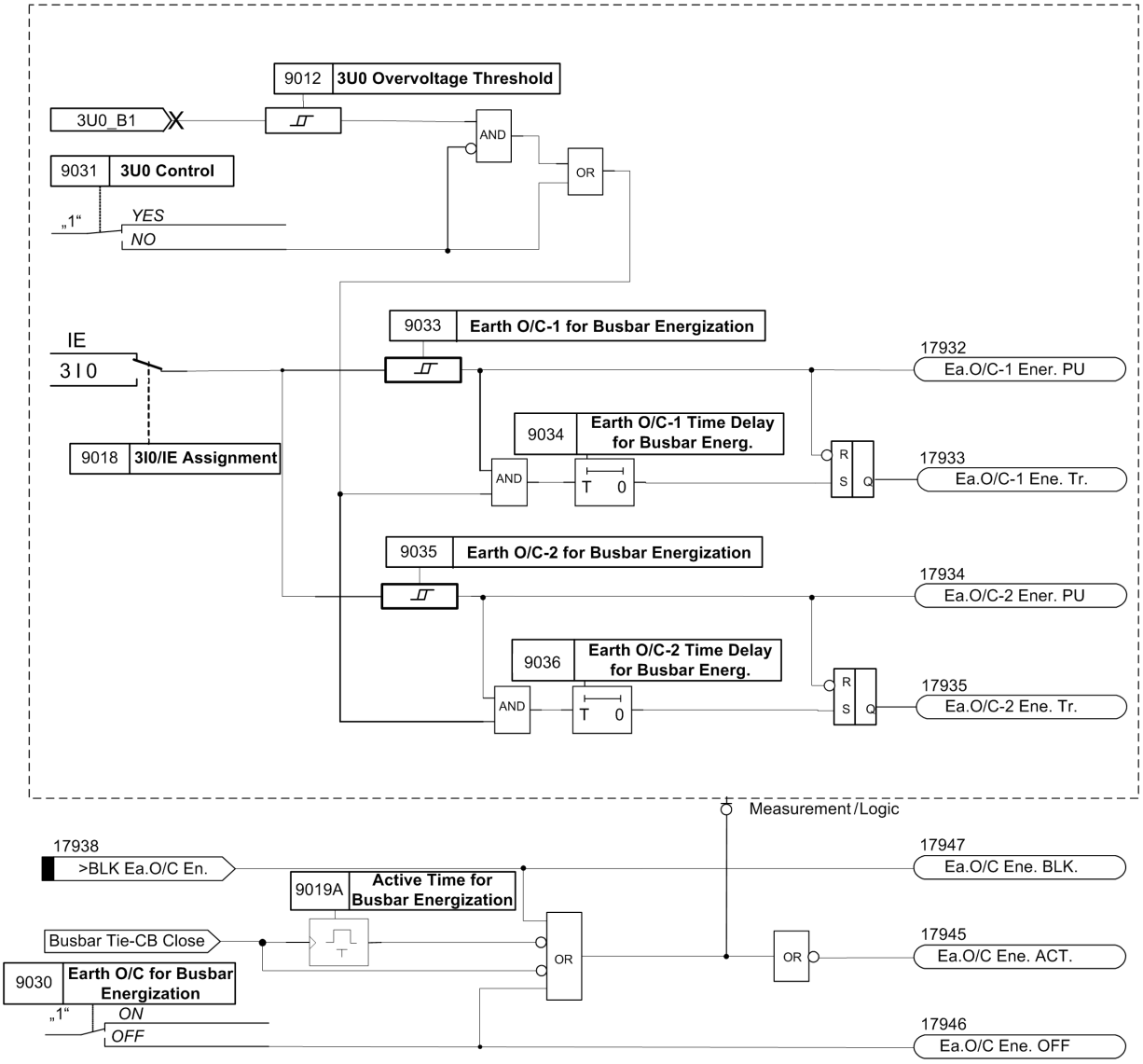



Figure 2-45 Logic Diagram of the Earth Overcurrent for Busbar Energization Protection

1. When the parameter **9030 Earth O/C** for Busbar Energization is set to ***ON*** and bus coupler circuit-breaker is closed, Ground overcurrent for busbar energization protection will start to run. The running time is set by the parameter **9019A Active Time** for Busbar Energization.
2. Ground voltage control can be enabled or disabled by setting the parameter **9031 3U0 Control** to ***YES*** or ***NO***.
3. PT broken wire cannot block ground overcurrent for busbar energization protection.
4. After the trip signal is released, the dropout of the voltage signal cannot reset the trip signal, only current dropout can reset the trip signal.

### 2.2.4.1 Settings

| Addr. | Settings | Setting Options | Default Setting | Comments |
|---|---|---|---|---|
| Protection Functions -> General | | | | |
| 9030 | Earth O/C for Busbar Energization | ON<br>OFF | OFF | |
| 9018 | 3I0/IE Assignment | IE<br>3I0 | 3I0 | |
| 9019A | Active time for Busbar Energization | 0.01s..600.00s | 5.00s | |
| Protection Functions -> Voltage Control | | | | |
| 9012 | 3U0 Overvoltage Threshold | 1V..200V | 30V | |
| Protection Functions -> Ea. O/C Energiz | | | | |
| 9031 | 3U0 Control | Yes<br>No | Yes | |
| 9033 | Earth O/C-1 for Busbar Energ. | 0.1A..35A | 2A | |
| 9034 | Earth O/C-1 Time Delay for Busbar Energization | 0s..60s, ∞ | 0.5s | |
| 9035 | Earth O/C -2 for Busbar Energization | 0.1A..35A | 4A | |
| 9036 | Earth O/C -2 Time Delay for Busbar Energ. | 0s..60s, ∞ | 0.1s | |

### 2.2.4.2 Information List

| No. | Information | Type | Funcion No. | Inf. No. |
|---|---|---|---|---|
| 17938 | >>BLK Ea.O/C En. | SP | | |
| 17945 | Ea.O/C Ene.ACT. | OUT | | |
| 17946 | Ea.O/C Ene. OFF | OUT | | |
| 17947 | Ea.O/C Ene. BLK | OUT | | |
| 17932 | Ea.O/C-1Ener.PU | OUT | | |
| 17933 | Ea.O/C-1Ene.Tr. | OUT | 200 | 58 |
| 17934 | Ea.O/C-2Ener.PU | OUT | | |
| 17935 | Ea.O/C-2Ene.Tr. | OUT | 200 | 60 |
| 17984 | Ea.O/CEn.ON/OFF | IntSP | 200 | 88 |

# 2.3 Monitor Function

When the rated frequency is 50Hz, the frequency operation range of supervision functions is 45Hz to 66Hz.

When the rated frequency is 60Hz, the frequency operation range of supervision functions is 55Hz to 66Hz.

## 2.3.1 PT Broken Wire Supervision

PT broken wire supervision contains busbar PT broken wire supervision and line PT broken wire supervision.

For device 7VU683, busbar PT broken wire will be available when the parameter **212 Primary Diagram** is set to ***Single Busbar***; Busbar1 PT broken wire and busbar2 PT broken wire will be available when the parameter **212 Primary Diagram** is set to ***Segmented Single Busbar***.

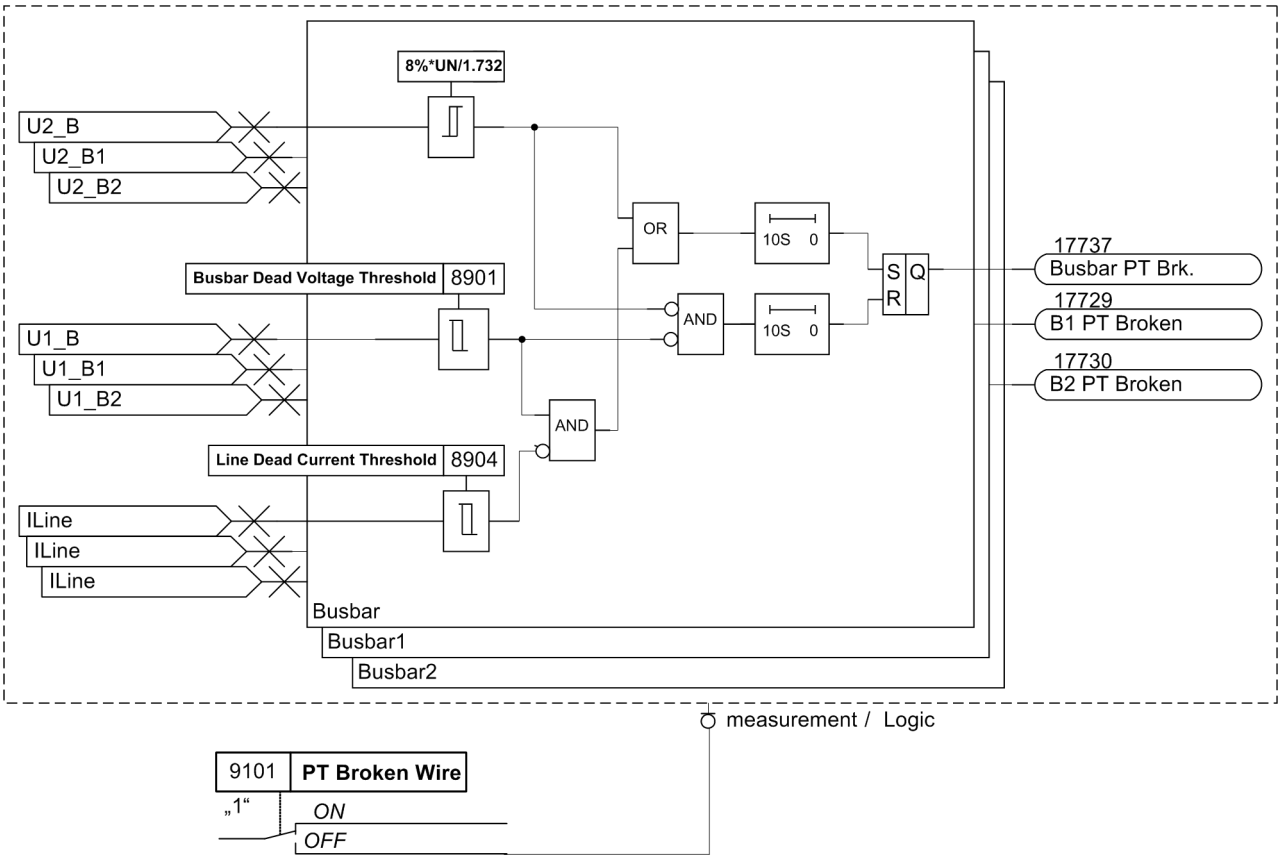



Figure 2-46 Logic Diagram of Busbar PT Broken Wire Supervision

Logic of busbar PT broken wire supervision:

1. UN is the secondary rated busbar voltage. That is **236 PT Rated Secondary Voltage Busbar**.
2. If Segment Single Busbar primary diagram is selected, then ***U1N*** and ***U2N*** will replace UN in the figure above.
3. If the busbar is supplied by line1, ILine is ***IL1***; if busbar is supplied by line2,ILine is ***IL2***.

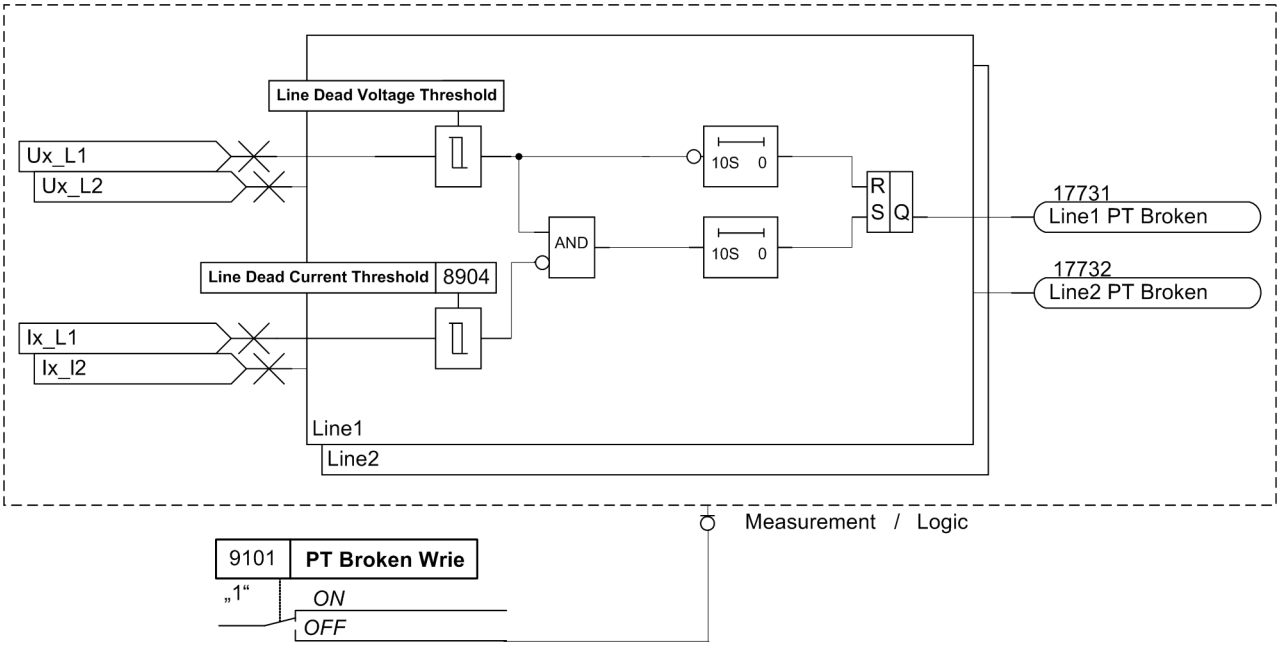



Figure 2-47 Logic Diagram of line PT Broken Wire Supervision

Logic of line PT broken wire supervision:

1. Line2 PT broken wire will be unavailable if the parameter **214 PT Connection of Line2** is set to ***Not Connected***.
2. If the parameter **213 PT Connection of Line1** is set to ***Va-b transformer, Vb-c transformer*** or ***Vc-a transformer***, the value of dead line equals the value of **8903 Line Dead Voltage Threshold**; if the parameter **213 PT Connection of Line1** is set to ***Va transformer, Vb transformer*** or ***Vc transformer***, the value of dead line equals the value of **8903 Line Dead Voltage Threshold**/1.732. It is same with Line2.

### 2.3.1.1 Settings

| Addr. | Settings | Setting Options | Default Setting | Comments |
|---|---|---|---|---|
| Supervision | | | | |
| 9101 | PTBroken Wire | ON<br>OFF | ON | |

### 2.3.1.2 Information List

| No. | Information | Type | Function No. | Inf. No. |
|---|---|---|---|---|
| 17737 | Busbar PT Brk. | OUT | | |
| 17729 | Busbar1 PT Broken | OUT | | |
| 17730 | Busbar2 PT Broken | OUT | | |
| 17731 | Line1 PT Broken | OUT | | |
| 17732 | Line2 PT Broken | OUT | | |

## 2.3.2 Busbar Voltage Sequence Supervision

For device 7VU683, busbar voltage sequence supervision will be available if the parameter **212 Primary Diagram** is set to ***Single Busbar***. Busbar1 voltage sequence supervision and busbar2 voltage sequence supervision will be available only if the parameter **212 Primary Diagram** is set to ***Segmented Single Busbar***.

Busbar, busbar1 and busbar2 have the same voltage sequence supervision logic. the logic is shown in next .

Take busbar for sample, If phase angle of Va-b is ahead of Vb-c and Vb-c is ahead of Vc-a, the phase sequence is right, otherwise warning message **17993 Failure: Phase Sequence Busbar Voltage** will be released in 5 seconds. The precondition of this logic is the phase-phase voltages are > 80%**UN. UN** is the value of **236 PT Rated Secondary Voltage Busbar**.

### 2.3.2.1 Settings

| Addr. | Settings | Setting Options | Default Setting | Comments |
|---|---|---|---|---|
| Supervision | | | | |
| 9102 | Busbar Voltage Sequence Supervision | ON<br>OFF | ON | |

Please reference Power System Data 1 to get other settings.

### 2.3.2.2 Information List

| No. | Information | Type | Function No. | Inf. No. |
|---|---|---|---|---|
| 17993 | Fail Ph.Seq.V.B. | OUT | | |
| 17994 | FailPh.Seq.V.B1 | OUT | | |
| 17995 | FailPh.Seq.V.B2 | OUT | | |

■

# Mounting And Commissioning 3

This chapter is intended for experienced commissioning staff. They should be familiar with the commissioning of protection and control equipment, with operation of the power system network and with the safety rules and regulations. Certain adaptations of the hardware to the power system specifications may be necessary.

# 3.1 Mounting And Connections

**WARNING!**

**Warning of improper transport, storage, installation, and application of the device.**

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

Trouble free and safe use of this device depends on proper transport, storage, installation, and application of the device according to the warnings in this instruction manual.

Of particular importance are the general installation and safety regulations for work in a high-voltage environment (for example, ANSI, IEC, EN, DIN, or other national and international regulations). These regulations must be observed.

## 3.1.1 Configuration Information

**Prerequisites**

For mounting and connection the following requirements and conditions must be met: The rated device data has been tested as recommended in the SIPROTEC 4 System Description /1/ and their compliance with these data is verified with the Power System Data.

**Connection Variants**

Overview diagrams are shown in Appendix A.2. Connection examples for current and voltage transformer circuits are given in Appendix A.3. It must be checked that the setting configuration of the Power System Data 1, Section 2.5, corresponds with the connections.

**Currents/Voltages**

Connection diagrams are shown in the chapter 2 Function.

**Binary Inputs and Outputs**

Allocation possibilities of binary inputs and outputs, i.e. the individual matching to the system are described in the SIPROTEC 4 System Description /1/. The presettings of the device are listed in Appendix A, Section A.3. Check also whether the labelling corresponds to the allocated message functions.

**Changing Setting Groups**

If binary inputs are used to switch setting groups, please observe the following:

- Two binary inputs must be dedicated to the purpose of changing setting groups when four groups are to be switched. One binary input must be set for ">Set Group Bit0", the other input for ">Set Group Bit1".
- If either of these input functions is not assigned, then it is considered as not controlled.For the control of 2 setting groups one binary input is sufficient, namely ">Set Group Bit0", since the non-assigned binary input ">Set Group Bit1" is then regarded as not connected.
- The control signals must be permanently active so that the selected setting group is and remains active.

Where:

no = not energized or not connected, yes = energized If binary inputs are used to change setting groups, please observe the following:

Table 3-1 Changing setting groups using binary inputs

| **Binary Input** | | >**Active Group** |
|---|---|---|
| >**Set Group Bit 0** | >**Set Group Bit 1** | |
| No | No | Goup A |
| Yes | No | Goup B |
| No | Yes | Goup C |
| Yes | Yes | Goup D |

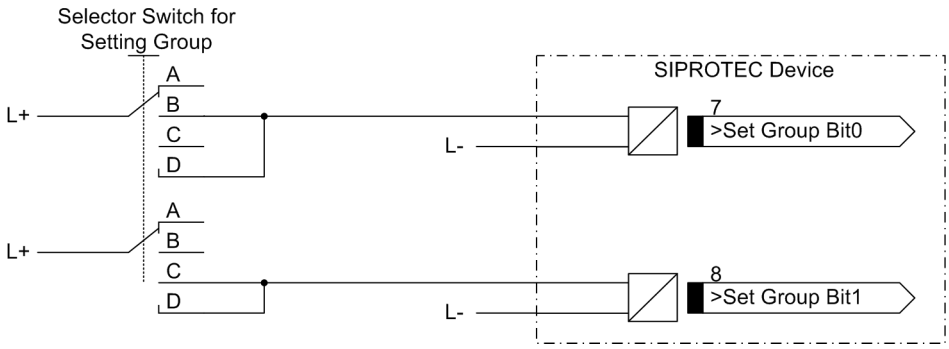



Figure 3-1 Changing setting groups using binary inputs

## 3.1.2 Hardware Modifications

### 3.1.2.1 General

Subsequent adaptation of hardware to the power system conditions may be necessary for example with regard to the control voltage for binary inputs or termination of bus-capable interfaces. The hints given in this section should be observed in all cases whenever hardware modifications are made.

**Power Supply Voltage**

There are different power supply voltage ranges for the auxiliary voltage (refer to the Ordering Information in the Appendix). The power supplies with the ratings 60/110/125 VDC and 110/125/220/250 VDC / 115/230 VAC are interconvertible. Jumper settings determine the rating. Jumper setting allocation to the rated voltage ranges, and their location on the PCB are described in this Section under the margin title "Processor Board C-CPU-2". When the device is delivered, these jumpers are set according to the name-plate sticker. Generally, they need not be altered.

**Life Contact**

The life contact of the device is a changeover contact, from which either the opener or closer can be connected to the device terminals F3 and F4 via a jumper (X40). Assignments of the jumpers to the contact type and the spatial layout of the jumpers are described in Section at margin heading "Processor Board C-CPU-2".

**Nominal Currents**

The input transformers of the devices are set to a rated current of 1 A or 5 A by burden switching. Jumpers are set according to the name-plate sticker. Location layout of these jumpers and their current rating allocation are described in this Section under "C-I/O-11 Input/Output Board ",All the relevant jumpers of one side must be set

uniformly for a rated current, i.e. one jumper each (X61 through X63) for each of the input transformers and additionally the common jumper X60.

If nominal current ratings are to be changed exceptionally, then the new change must be notified to the device at addresses **252 CT Rated Secondary Current Line1**; **254 CT Rated Secondary Current Line2**;**256 CT Rated Secondary Current Busbar** ;**258A Earth CT Rated Secondary Current Busbar** in the Power System Data.

---

**Note**

The jumper settings must correspond to the secondary device currents configured . Otherwise the device is blocked and outputs an alarm.

The rated secondary current Line1 and Line2 must set same, because there is a common jumper X60.

---

### Pickup Voltage for Binary Inputs

When the device is delivered the binary inputs are set to operate with a voltage that corresponds to the rated voltage of the power supply. If the rated values differ from the power system control voltage, it may be necessary to change the switching threshold of the binary inputs.

To change the switching threshold of a binary input, one jumper must be changed for each input. The allocation of the plug-in jumpers to the binary inputs and their actual positioning are described in this Section.

### Contact Mode for Binary Outputs

Input/output modules can have relays that are equipped with changeover contacts. For this it is necessary to rearrange a jumper. For which relay on which board this applies is described in this Section under "Input/Output Board C-I/O -1" , "Input/Output Board C-I/O -10" and "Input/Output Board C-I/O -11".

### Replacing Interface

The serial interfaces can only be exchanged in the versions for panel flush mounting and cubicle mounting. Which interfaces can be exchanged, and how this is done, is described in this Section under the margin title "Replacing Interface Modules".

### Terminating Resistors for RS485 and Profibus DP (Electrical)

For reliable data transmission the RS485 bus or the electrical Profibus DP must be terminated with resistors at the respective last device on the bus. For this purpose termination resistors are provided on the PCB of the C-CPU-2 processor board and on the RS485 or PROFIBUS interface module which can be connected via jumpers. Only one of the three options may be used. The physical location of the jumpers on the PCB is described in this Section under the margin title "Processor Board C-CPU-2", and under the margin title "Bus-Capable Serial Interfaces" for the interface modules. Both jumpers must always be plugged in the same way.

The terminating resistors are disabled on unit delivery.

### Spare Parts

Spare parts may be the backup battery that maintains the data in the battery-buffered RAM when the voltage supply fails, and the miniature fuse of the internal power supply. Their physical location is shown in Figure 3-3. The ratings of the fuse are printed on the board next to the fuse itself. When replacing the fuse, please observe the guidelines given in the SIPROTEC 4 System Manual /1/ in the chapter "Maintenance" and "Corrective Action / Repairs".

### 3.1.2.2 Disassembly

**Disassembly of the Device**

**Note**

It is assumed for the following steps that the device is not in operation.

**Caution !**

**Caution when changing jumper settings that affect nominal values of the device**

As a consequence, the ordering number (MLFB) and the ratings that are stated on the nameplate do no longer match the actual device properties.

If such changes are necessary, the changes should be clearly and fully noted on the device. Self adhesive stickers are available that can be used as replacement nameplates.

To perform work on the printed circuit boards, such as checking or moving switching elements or exchanging modules, proceed as follows:

- Prepare area of work: Preparing a surface appropriate to electrostatic sensitive devices (EGB). In addition to this, the following tools are required:
  - screwdriver with a 5 to 6 mm wide tip
  - a Philips screwdriver size 1
  - 5 mm socket or nut driver
- Unfasten the screw-posts of the D-subminiature connectors on the back panel at location "A" and "C". This activity does not apply if the device is for surface mounting.
- If the device has additional communication interfaces at locations "A", "C" and/or "B" "D" on the rear, the screws located diagonally to the interfaces must be removed. This activity does not apply if the device is for surface mounting.
- Remove the caps on the front cover and loosen the screws that become accessible.
- Remove the front panel and tilt it to the side.

**Work on the Plug Connectors**

**Caution!**

**Mind electrostatic discharges**

Non-observance can result in minor personal injury or material damage.

When handling with plug connectors, electrostatic discharges may emerge by previously touching an earthed metal surface must be avoided.

Do not plug or withdraw interface connections under power!

The following must be observed:

- Disconnect the ribbon cable between the front cover and the C-CPU-2 board (in Figures Figure 3-2) at the front cover side. To disconnect the cable, push up the top latch of the plug connector and push down the bottom latch of the plug connector. Carefully set aside the front cover.
- Disconnect the ribbon cables between the C-CPU-2 board (1) and the I/O boards (2) to (4), depending on the variant ordered).
- Remove the boards and set them on the grounded mat to protect them from ESD damage. In the case of the device variant for panel surface mounting, please be aware of the fact a certain amount of force is required in order to remove the C-CPU-2 module due to the existing plug connectors.
- Check the jumpers in accordance with Figures 3-2 to 3-9 and the following information, and as the case may be change or remove them.

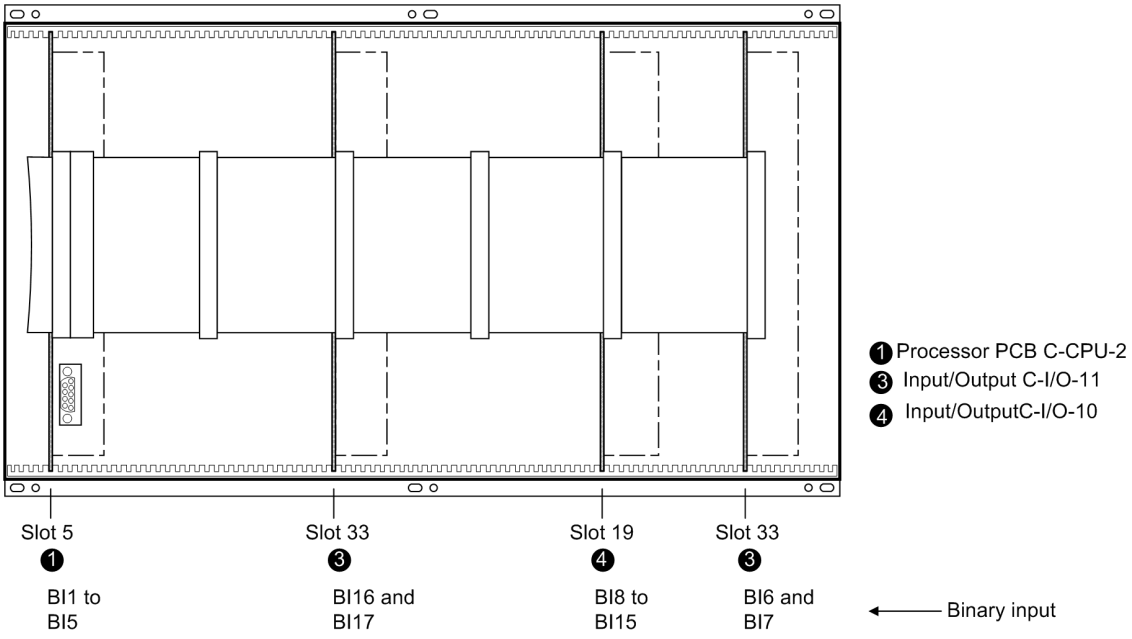



Figure 3-2 Front view of a 7VU683 (housing size 1/1) after removal of the front cover (simplified and scaled down)

## 3.1.2.3 Switching Elements on the Printed Circuit Boards

**Processor Module C-CPU-2**

The PCB layout of the processor board C-CPU-2 is illustrated in the following Figure. The set nominal voltage of the integrated power supply is checked according to Table 3-1, the quiescent state of the life contact according to Table 3-2, the selected operating voltages of binary inputs BI1 to BI5 according to Table 3-3 and the integrated interface RS232 / RS485 according to Tables 3-4 to 3-2. The location and ratings of the miniature fuse (F1) and of the buffer battery (G1) are shown in the following Figure.

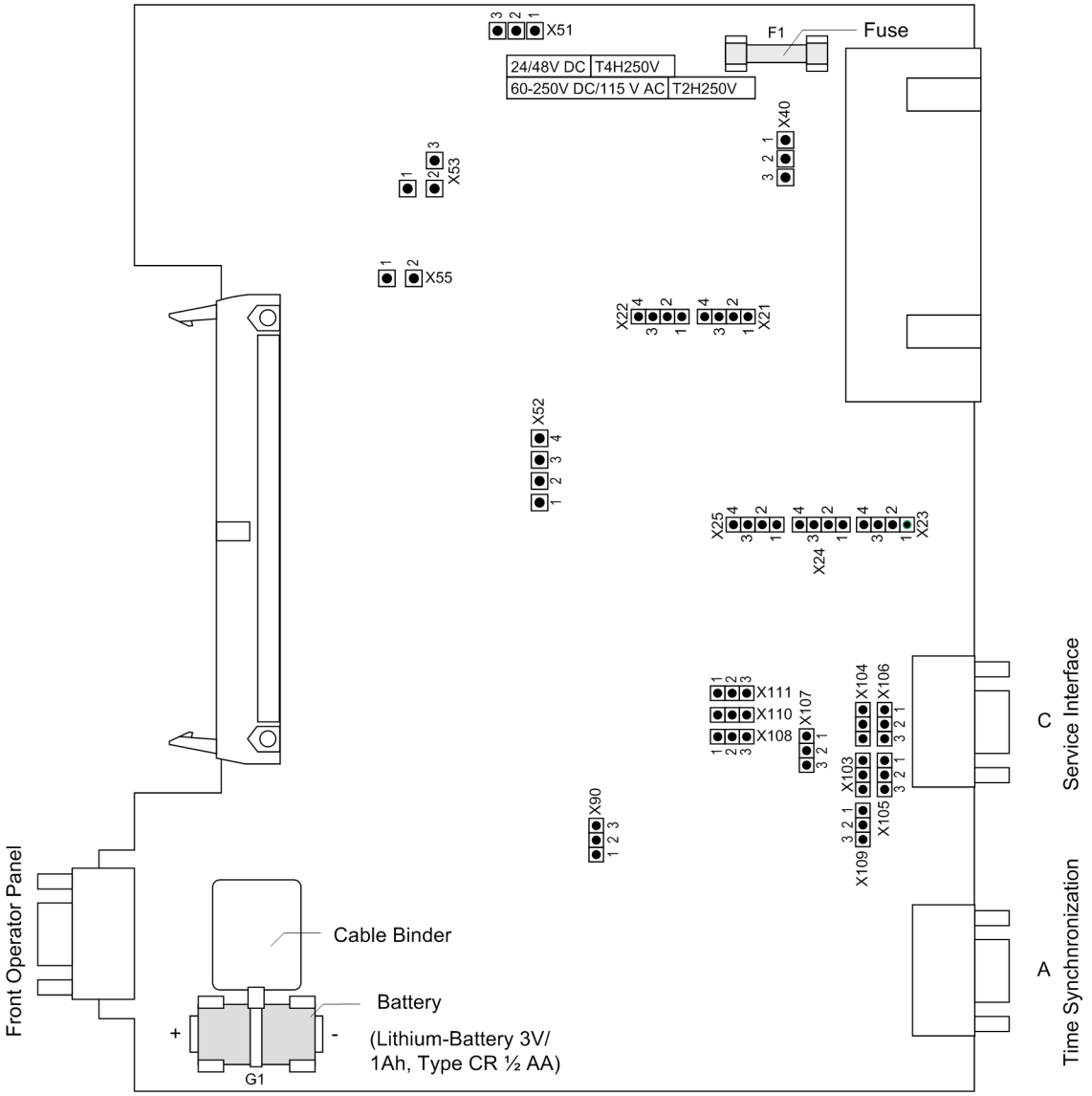



Figure 3-3 Processor Board C-CPU with Jumper Settings Required for the Board Configuration, of the Battery and Miniature Fuse

Table 3-2 Table 3-2Jumper setting of the rated voltage of the integrated **Power Supply** on the C-CPU-2 processor module

| **Jumper** | **Nominal Voltage** | | |
|---|---|---|---|
| | **24 to 48 VDC** | **60 to 125 VDC** | **110 to 250 VDC, 115 to 230 VAC** |
| X51 | not used | 1-2 | 2-3 |
| X52 | not used | 1-2 and 3-4 | 2-3 |
| X53 | not used | 1-2 | 2-3 |
| X55 | not used | not used | 1-2 |
| | cannot be changed | interchangeable | |
| Fuse | T4H250V | T2H250V | |

Table 3-3 Jumper position of the quiescent state of the Life contact on the C-CPU-2 processor module

| Jumper | Nominal Voltage | | |
|---|---|---|---|
| | Open in the quiescent state (NO contact) | Closed in the quiescent state (NC contact) | Presetting |
| X40 | 1-2 | 2-3 | 2-3 |

Table 3-4 Jumper setting of the control voltages of binary inputs BI1 to BI5 on the C-CPU-2 processor module

| Binary inputs | Jumper | 17 V Threshold[1)] | 73V Threshold[2)] | 154V Threshold [3)] |
|---|---|---|---|---|
| BI1 | X21 | 1-2 | 2-3 | 3-4 |
| BI2 | X22 | 1-2 | 2-3 | 3-4 |
| BI3 | X23 | 1-2 | 2-3 | 3-4 |
| BI4 | X24 | 1-2 | 2-3 | 3-4 |
| BI5 | X25 | 1-2 | 2-3 | 3-4 |

1) Factory settings for devices with rated power supply voltages of 24 VDC to 125 VDC
2) Factory settings for devices with power supply voltages of 110 VDC to 250 VDC and 115/230 VAC
3) Use only with pickup voltages 220 or 250 VDC

The R485 interface can be converted into an RS232 interface by modifying the jumpers.
Jumpers X105 to X110 must be set to the same position !

Table 3-5 Jumper Settings of the Integrated RS232/RS485 Interface on the C-CPU-2 Board

| Jumper | /CTS from interface RS232 | /CTS triggered by /RTS |
|---|---|---|
| X103 to X104 | 1-2 | 1-2 |
| X105 to X110 | 1-2 | 2-3 |

The jumpers are preset at the factory according to the configuration ordered.

With interface RS232 jumper X111 is needed to activate CTS which enables the communication with the modem.

Table 3-6 Jumper setting for CTS (flow control) on the C-CPU-2 processor module

| Jumper | /CTS from interface RS232 | /CTS triggered by /RTS |
|---|---|---|
| X111 | 1-2 | 2-3[1)] |

1) Default setting of releases 7VU68.../BB

**Jumper setting 2-3:** The connection to the modem is usually established with a star coupler or fibre-optic converter. Therefore the modem control signals according to RS232 standard DIN 66020 are not available. Modem signals are not required since the connection to the SIPROTEC? 4 devices is always operated in the half-duplex mode. Please use the connection cable with order number 7XV5100-4.

**Jumper setting 1-2:**This setting makes the modem signals available, i. e. for a direct RS232-connection between the SIPROTEC 4 device and the modem this setting can be selected optionally. We recommend use of a standard RS232 modem connection cable (converter 9-pole on 25-pole).

**Note**

For a direct connection to DIGSI with interface RS232 jumper X111 must be plugged in position 2-3.

If there are no external terminating resistors in the system, the last devices on a RS485 bus must be configured via jumpers X103 and X104.

Table 3-7 Jumper settings of the Terminating Resistors of interface RS485 on the C-CPU-2 processor

| Jumper | Terminating Resistor Connected | Terminating Resistor Dis-connected | Presetting |
|---|---|---|---|
| X103 | 2-3 | 1-2 | 1-2 |
| X104 | 2-3 | 1-2 | 1-2 |

**Note**

Both jumpers must always be plugged in the same way!

Jumper X90 has currently no function. The factory setting is 1-2.

The terminating resistors can also be connected externally (e.g. to the connection module). In this case, the terminating resistors located on the RS485 or PROFIBUS interface module or directly on the PCB of the processor board C-CPU-2 must be de-energized.

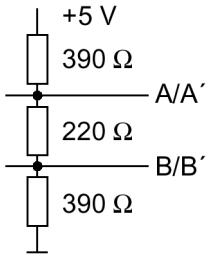



Figure 3-4 Termination of the RS485 interface (external)

**Input/Output Board C-I/O-10 (Only 7VU683)**

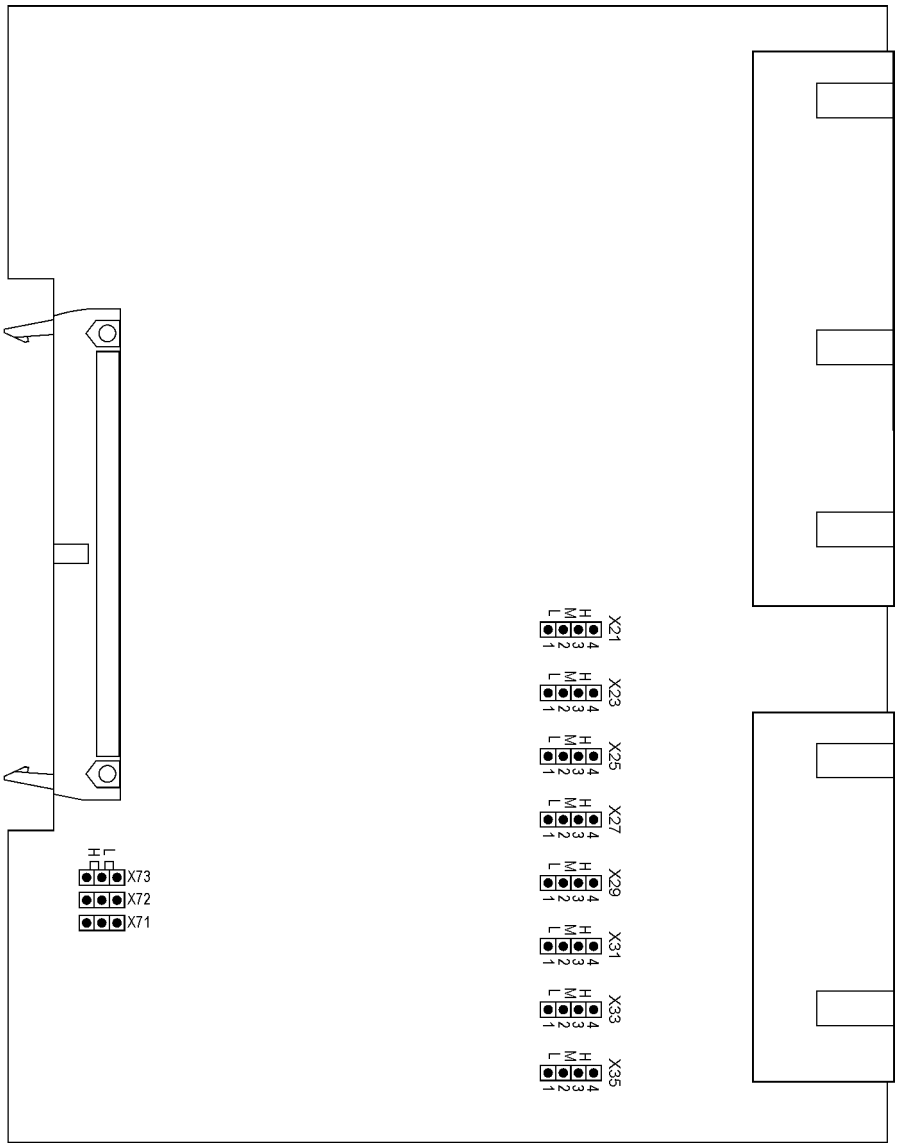



Figure 3-5 Input/output board C-I/O-10 with representation of jumper settings required for checking configuration settings

Table 3-8 Jumper setting of pickup voltages of binary inputs BI8 to BI15 on Input/Output module module C- I/O-10 in the 7VU683

| Binary inputs | Jumper | 17 VDC Threshold [1] | 73 VDC Threshold [2] | 154 VDC Threshold [3] |
|---|---|---|---|---|
| BI8 | X21 | L | M | H |
| BI9 | X23 | L | M | H |
| BI10 | X25 | L | M | H |
| BI11 | X27 | L | M | H |
| BI12 | X29 | L | M | H |
| BI13 | X31 | L | M | H |
| BI14 | X33 | L | M | H |
| BI15 | X35 | L | M | H |

1) Factory settings for devices with rated power supply voltages of 24 VDC to 125 VDC

2) Factory settings for devices with power supply voltages of 110 VDC to 250 VDC and 115/230 VAC

3) Use only with control voltages 220 to 250 VDC

Jumpers X71, X72 and X73 on the input/output board C-I/O-10 are used to set the bus address and must not be changed. The following Table lists the jumper presettings.

Table 3-9 Jumper settings of PCB Address of the input/output board C-I/O-10

| Jumper | Presetting |
|---|---|
| X71 | 2-3(L) |
| X72 | 2-3(L) |
| X73 | 1-2(H) |

**Input/Output Board C-I/O-11**

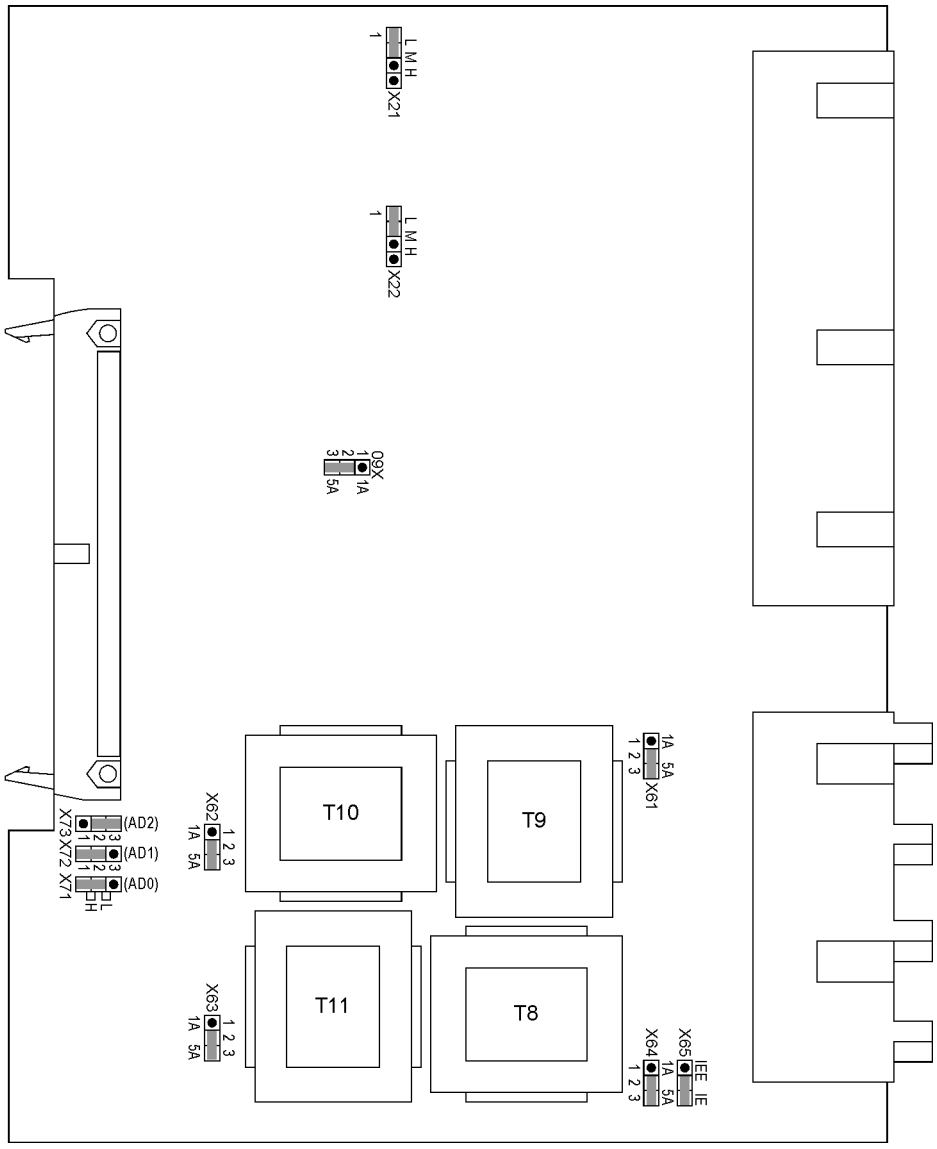



Figure 3-6 C-I/O-11 input/output board with representation of jumper settings required for checking configuration settings

The set nominal currents of the current input transformers are to be checked on the input/output board C-I/O-11. All jumpers must be set for one nominal current, i.e. respectively one jumper (X61 to X63) for each input transformer and additionally the common jumper X60.

Jumper X64 is set to the required rated current for IE current input: "1A" or "5A", jumper X65 set "IE"

There are 2 measuring inputs for the single phase measuring location Ix_Line 1 and Ix_Line2. The jumpers

X61,, X63 and common jumper X60 belonging to this measuring location must be plugged all to the rated secondary current of the connected current transformers: "1A "or "5A".

Table 3-10 Jumper setting of pickup voltages of binary inputs BI6、BI7 and BI16、BI17 on Input/Output module C- I/O-11

| Binary Input | Jumper | 17 VDC Threshold [1] | 73 VDC Threshold [2] | 154 VDC Threshold[3] |
|---|---|---|---|---|
| BI6 | X21 | L | M | H |
| BI7 | X22 | L | M | H |
| BI16 | X21 | L | M | H |
| BI17 | X22 | L | M | H |

[1] Factory settings for devices with rated power supply voltages of 24 VDC to 125 VDC

[2] Factory settings for devices with power supply voltages of 110 VDC to 250 VDC and 115/230 VAC

[3] Use only with control voltages 220 to 250 VDC

The jumpers X71, X72 through X73 serve for setting the bus address. Their position may not be changed. The following table shows the preset jumper positions.

**Installation Place**

Table 3-11 Jumper settings of module addresses of the input/output module C-I/O-11 (Left Slot 33 No.4)

| Jumper | Factory Setting |
|---|---|
| X71 | 1-2(H) |
| X72 | 2-3(L) |
| X73 | 1-2(H) |

Table 3-12 Jumper settings of module addresses of the input/output module C-I/O-11 (right Slot 33 No.3)

| Jumper | Factory Setting |
|---|---|
| X71 | 1-2(H) |
| X72 | 1-2(H) |
| X73 | 2-3(L) |

## 3.1.2.4 Interface Module

**Replacing Interface Modules**

The interface modules are located on the C-CPU-2 board. The following figure shows the PCB with location of the modules.

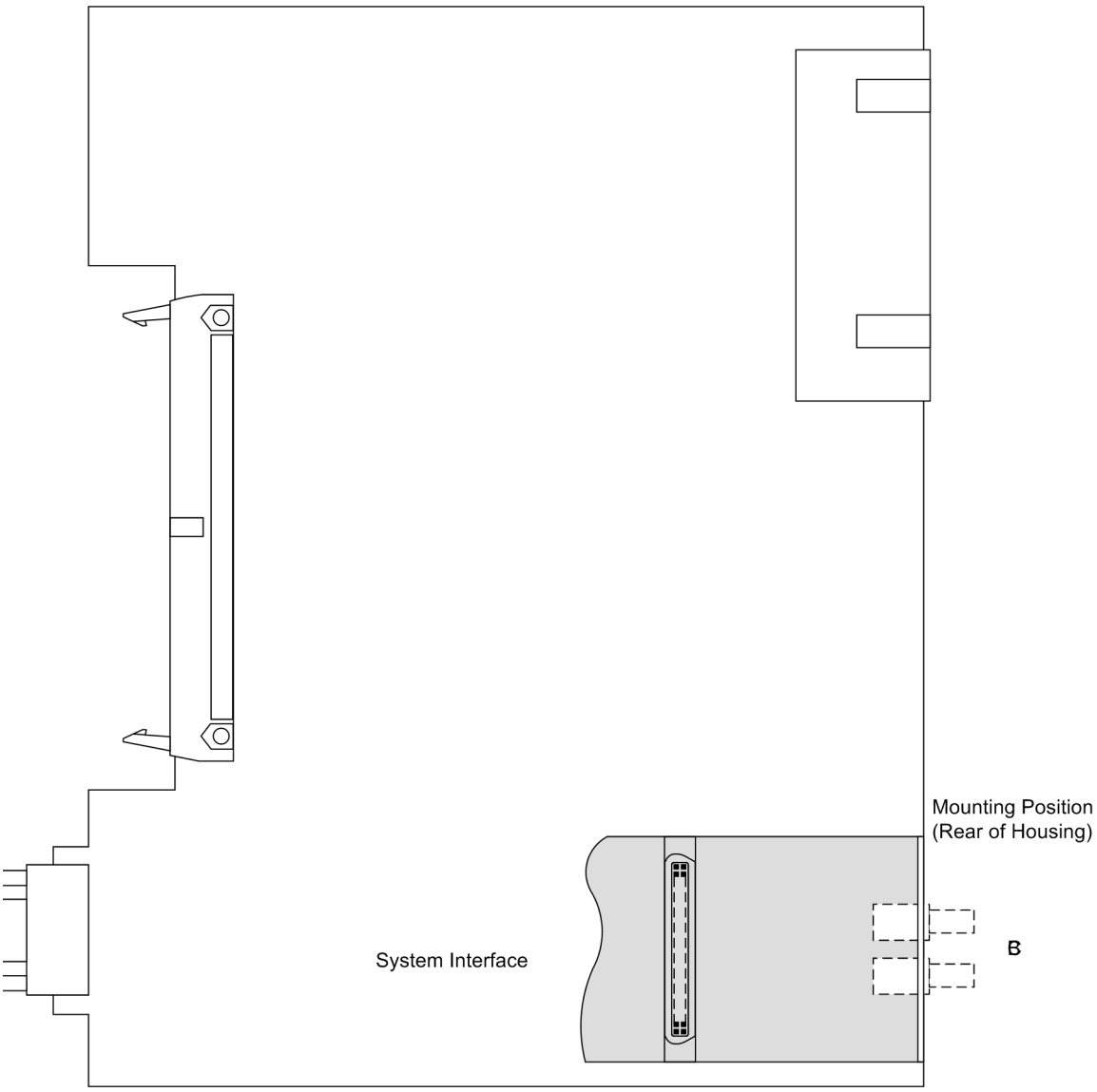



Figure 3-7 C-CPU-2 board with interface modules

Please note the following:

- The interface modules can only be replaced in devices for panel flush mounting and cubicle mounting.
- Only interface modules can be used with which the device can be ordered from the factory also in accordance with the order number .

Table 3-13 Replacing interface modules

| Interface | Mounting Location/Interface | Replacement Module |
|---|---|---|
| System Interface | B | Only interface modules that can be ordered in our facilities via the order key |

### EN100 Ethernet Module (IEC 61850)

The Ethernet interface module has no jumpers. No hardware modifications are required to use it.

### Interface Termination

For bus-capable interfaces a termination is necessary at the bus for each last device, i.e. terminating resistors must be connected. With the 7VU683 device, this concerns the variants with RS485 or PROFIBUS interfaces.

The terminating resistors are located on the RS485 or Profibus interface module, which is on the C-CPU-2 board ((1) in Figures 3-2), or directly on the PCB of the C-CPU-2 board (see margin title "C-CPU-2 Processor Board", Table 3-3).

The module for the RS485 interface is shown in Figure 3-9, the module for the Profibus interface in Figure 3-10.

On delivery the jumpers are set so that the terminating resistor are disconnected. Both jumpers of a module must always be plugged in the same way.

| Jumper | Terminating Resistors | |
|---|---|---|
| | Connected | Disconnected |
| X3 | 2-3 | 1-2 *) |
| X4 | 2-3 | 1-2 *) |

*) Default setting

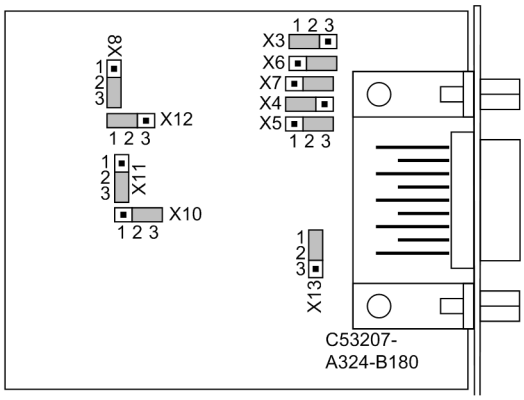



Figure 3-8 Position of Terminating Resistors and the Plug-in Jumpers for Configuration of the RS485 Interface

| Jumper | Terminating Resistors | |
|---|---|---|
| | Connected | Disconnected |
| X3 | 1-2 | 2-3 *) |
| X4 | 1-2 | 2-3 *) |
| | | |

*) Default setting

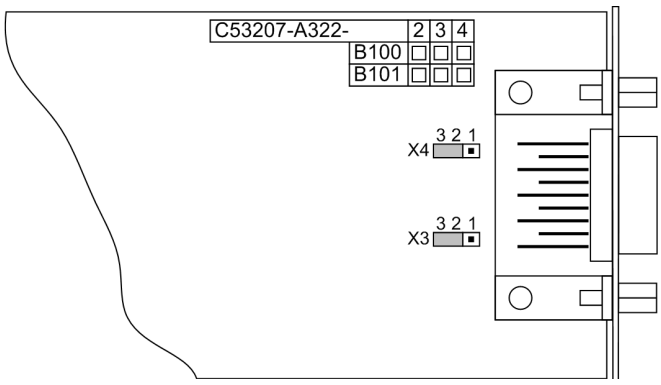



Figure 3-9 Position of the Plug-in Jumpers for the Configuration of the Terminating Resistors at the Profibus (FMS and DP), and Modbus Interfaces

The terminating resistors can also be connected externally (e.g. to the terminal block), see Figure 3-5. In this case, the matching resistors located on the RS485 or PROFIBUS interface module or directly on the PCB of the C-CPU-2 board of must be disabled.

It is possible to convert the R485 interface to a RS232 interface by changing the jumper positions and vice-versa.

The jumper positions for the alternatives RS232 or RS485 (as in Figure 3-10) are derived from the following Table.

Table 3-14 Configuration for RS232 or RS485 on the interface module

| Jumper | X5 | X6 | X7 | X8 | X10 | X11 | X12 | X13 |
|---|---|---|---|---|---|---|---|---|
| RS232 | 1-2 | 1-2 | 1-2 | 1-2 | 1-2 | 2-3 | 1-2 | 1-2 |
| RS485 | 2-3 | 2-3 | 2-3 | 2-3 | 2-3 | 2-3 | 1-2 | 1-2 |

The jumpers X5 to X10 must be plugged in the same way!

The jumpers are preset at the factory according to the configuration ordered.

### 3.1.2.5 Reassembly

The device is assembled in the following steps:

- Insert the boards carefully in the housing. The mounting locations are shown in Figures 3-2.
- Plug in the plug connectors of the ribbon cable onto the input/output modules I/O and then onto the processor module C-CPU-2. Be careful not to bend any connector pins! Do not apply force!
- Connect the plug connectors of the ribbon cable between the C-CPU-2 board and the front panel to the front panel plug connector.
- Press the plug connector interlocks together.
- Replace the front panel and screw it tightly to the housing
- Replace the covers again.
- Screw the interfaces on the rear panel of the device tight again.

This activity does not apply if the device is for surface mounting.

## 3.1.3 Mounting

### 3.1.3.1 Panel Flush Mounting

For the 1/1 housing size (Figure 3-14) there are six covers and six holes.

- Remove the 4 covers at the corners of the front cover, for size 1/1 the two covers located centrally at the top and bottom also have to be removed. The 6 elongated holes in the mounting bracket are revealed and can be accessed.
- Insert the device into the panel cut-out and fasten it with four or six screws. For dimensions refer to Appendix A.4
- Mount the six covers.
- Connect the ground on the rear plate of the device to the protective ground of the panel. Using at least one M4 screw. The cross-sectional area of the ground wire must be equal to the cross-sectional area of any other control conductor connected to the device. The cross-section of the ground wire must be at least 2.5 mm 2.

- Connections use the screw terminals on the rear side of the device in accordance the wiring diagram. For screw connections with forked lugs or direct connection, before inserting wires the screws must be tightened so that the screw heads are flush with the outer edge of the connection block. A ring lug must be centred in the connection chamber, in such a way that the screw thread fits in the hole of the lug. The SIPROTEC 4 System Description has pertinent information regarding wire size, lugs, bending radii, etc.

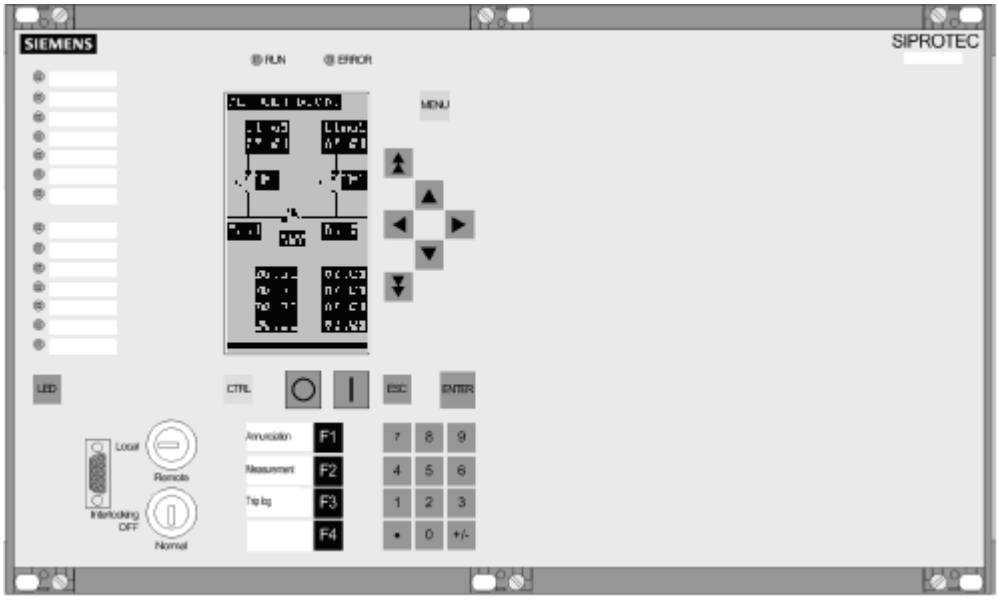



Figure 3-10 Example of panel flush mounting of a device (housing size 1/1)

### 3.1.3.2 Rack and Cubicle Mounting

For the 1/1 housing size (Figure 3-16) there are six covers and six holes.

To install the device in a frame or cubicle, two mounting brackets are required.

- Loosely screw the two mounting brackets in the rack or cubicle with six screws.
- Remove the 4 covers at the corners of the front cover, for size 1/1 the two covers located centrally at the top and bottom also have to be removed. Thus the 4 respectively 6 slots in the mounting flange are revealed and can be accessed.
- Fasten the device to the mounting brackets with four or six screws.
- Mount the six covers.
- Tighten fast the eight screws of the angle brackets in the rack or cubicle.
- Connect the ground on the rear plate of the device to the protective ground of the panel. Using at least one M4 screw. The cross-sectional area of the ground wire must be equal to the cross-sectional area of any other control conductor connected to the device. The cross-section of the ground wire must be at least 2.5 mm 2.
- Connections use the screw terminals on the rear side of the device in accordance the wiring diagram. For screw connections with forked lugs or direct connection, before inserting wires the screws must be tightened so that the screw heads are flush with the outer edge of the connection block. A ring lug must be centred in the connection chamber, in such a way that the screw thread fits in the hole of the lug. The SIPROTEC 4 System Description /1/ has pertinent information regarding wire size, lugs, bending radii, etc.

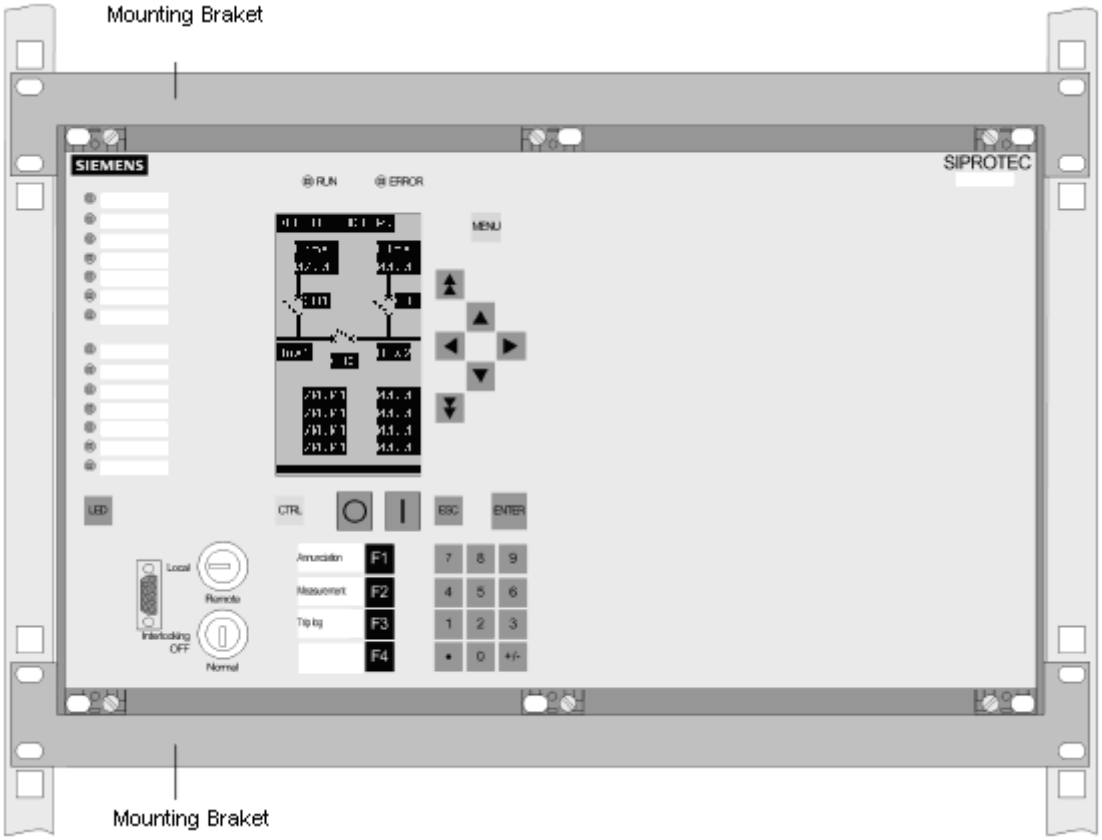



Figure 3-11 Example of rack or cubicle mounting of a device (housing size 1/1)

# 3.2 Checking Connection

## 3.2.1 Checking Data Connections of Serial Interfaces

**Pin-Assignment**

The tables of the following margin headings list the pin assignments for the different serial interfaces, the time synchronization interface and the Ethernet interface of the device. The position of the connections can be seen in the following figures.

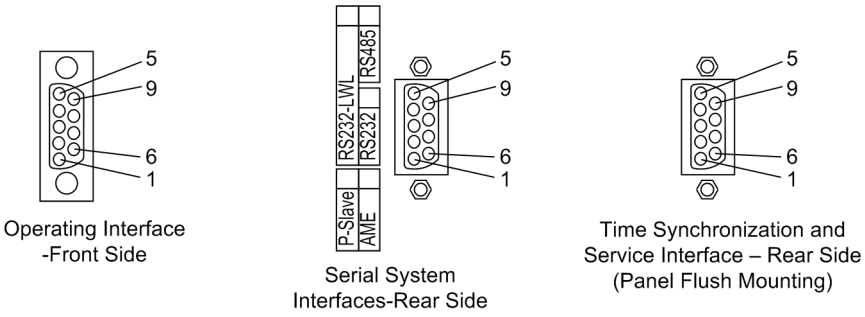



Figure 3-12 9-pin D-subminiature female connectors

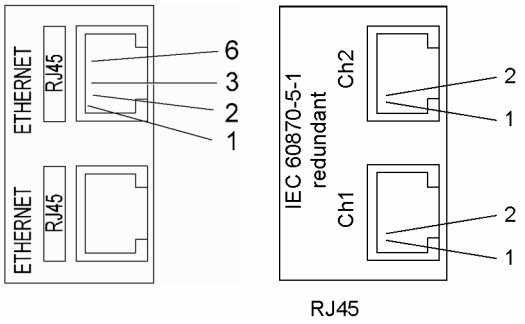



Figure 3-13 Ethernet connector and IEC 60870-5-1 redundant interface

## 3.2.2 System Interface

For versions equipped with a serial interface to a control center, the user must check the data connection. The visual check of the assignment of the transmission and reception channels is of particular importance. With RS232 and fibre optic interfaces, each connection is dedicated to one transmission direction. Therefore the output of one device must be connected to the input of the other device and vice versa.

With data cables, the connections are designated according to DIN 66020 and ISO 2110:

- TxD = Data Output
- RxD = Data Input
- $\overline{\text{RTS}}$ = Request to Send
- $\overline{\text{CTS}}$ = Clear to Send
- GND = Signal / Chassis Ground

The cable shield is to be grounded at both ends. For extremely EMC-loaded environments the GND may be integrated into a separate individually shielded wire pair to improve the immunity to interference.

Table 3-15 The assignments of the D-subminiature and RJ45 connector for the various interfaces

| Pin No. | RS232 | RS 485 | Profibus DP Slave, RS 485 | Modbus, RS485 | Ethernet EN100 | Redundant T103 |
|---|---|---|---|---|---|---|
| 1 | Shield (with shield ends electrically connected) | | | | Tx+ | B/B' (RxD/TxD-P) |
| 2 | RxD | – | – | – | Tx- | A/A' (RxD/TxD-N) |
| 3 | TxD | A/A' (RxD/TxD-N) | B/B' (RxD/TxD-P) | A | Rx+ | |
| 4 | – | – | CNTRA-(TTL) | RTS (TTL level) | – | |
| 5 | EARTH | C/C' (EARTH) | C/C' (EARTH) | EARTH1 | – | |
| 6 | – | – | +5 V (max. load < 100 mA) | VCC1 | Rx- | |
| 7 | RTS | – [1)] | – | – | – | |
| 8 | CTS | B/B' (RxD/TxD-P) | A/A' (RxD/TxD-N) | B | – | |
| 9 | – | – | – | – | Disabled | |

1) Pin 7 also carries the RTS signal with RS232 level when operated as RS485 Interface. Pin 7 may therefore not be connected!

## 3.2.3 Termination

The RS485 interface is capable of half-duplex service with the signals A/A' and B/B' with a common relative potential C/C' (GND). Verify that only the last device on the bus has the terminating resistors connected, and that the other devices on the bus do not. The jumpers for the terminating resistors are located on the interface module RS485 (see Figure 3-9) or on the PROFIBUS module RS485 (see Figure 3-10). The terminating resistors can also be connected externally. In this case, the terminating resistors located on the module must be disabled.

If the bus is extended, make sure again that only the last device on the bus has the terminating resistors switched-in, and that all other devices on the bus do not.

## 3.2.4 Time Synchronization Interface

Either 5 VDC, 12 VDC or 24 VDC time synchronization signals can be processed if the connections are made as indicated in the table below.

Table 3-16 D-subminiature connector assignment of the time synchronization interface

| Pin No. | Designation | Signal Meaning |
|---|---|---|
| 1 | P24_TSIG | Input 24 V |
| 2 | P5_TSIG | Input 5 V |
| 3 | M_TSIG | Return Line |
| 4 | M_TSYNC[1)] | Return Line [1)] |
| 5 | Shield | Shield Potential |
| 6 | – | – |
| 7 | P12_TSIG | Input 12 V |
| 8 | P_TSYNC [1)] | Input 24 V [1)] |
| 9 | SHIELD | Shield Potential |

[1)] Assigned, but not used

## 3.2.5 Optical Fibres

**WARNING!**

Do not look directly into the fibre-optic elements!

The transmission via fibre optics is particularly insensitive to electromagnetic interference and thus ensures galvanic isolation of the connection. Transmit and receive connections are shown with the symbols for transmit and for receive.

The character idle state for the optical fibre interface is "Light off". If the character idle state is to be changed, use the operating program DIGSI, as described in the SIPROTEC 4 System Description.

## 3.2.6 Checking Device Connection

### General

By checking the device connections the correct installation of the protection device e.g. in the cubicle must be tested and ensured. This includes wiring check and functionality as per drawings, visual assessment of the protection system, and a simplified functional check of the protection device.

### Auxiliary Voltage Supply

Before the device is connected for the first time to voltage, it should be have been at least 2 hours in its operating room, in order to attain temperature equilibrium and to avoid dampness and condensation.

**Note**

If a redundant supply is used, there must be a permanent, i.e. uninterruptible connection between the minus polarity connectors of system 1 and system 2 of the DC voltage supply (no switching device, no fuse), because otherwise there is a risk of voltage doubling in case of a double earth fault.

Switch on the auxiliary voltage circuit breaker (supply protection), check voltage polarity and amplitude at the device terminals or at the connection modules.

### Visual Check

Check the cubicle and the devices for damage, condition of the connections etc., and device earthing.

### Secondary Check

This test does not undertake to check the individual protection functions for the accuracy of their pick-up values and characteristic curves. Unlike analog electronic or electromechanical protective devices, no protection function test is required within the framework of the device test, since this is ensured by the factory tests. Protection functions are only used to check the device connections.

A plausibility check of the analog-digital converter with the operational measured values is sufficient since the subsequent processing of the measured values is numerical and thus internal failures of protection functions can be ruled out.

Where secondary tests are to be performed, a three-phase test equipment providing test currents and voltages is recommended (e.g. Omicron CMC 56 for manual and automatic testing). The phase angle between currents and voltages should be continuously controllable.

The accuracy which can be achieved during testing depends on the accuracy of the testing equipment. The accuracy values specified in the Technical data can only be reproduced under the reference conditions set down in IEC 60 255 resp. VDE 0435/part 303 and with the use of precision measuring instruments.

Tests can be performed using the currently set values or the default values.

If unsymmetrical currents and voltages occur during the tests it is likely that the asymmetry monitoring will frequently pickup. This is of no concern because the condition of steady-state measured values is monitored which, under normal operating conditions, are symmetrical; under short circuit conditions these monitorings are not effective.

**Note**

If during dynamic testing, measured values are connected from or reduced to zero, a sufficiently high value should be present at least one other measuring circuit (in general a voltage), to permit frequency adaptation.

Measured values in earth paths of voltage or current (IEE, UE) can not adapt the scanning frequency. To check them a sufficiently high value measured value should be present in one of the phases.

### Wiring

It is particularly important to check the correct wiring and allocation of all device interfaces. The margin heading titled"Test function for checking the binary inputs and outputs" provides additional information to this end.

For analog inputs a plausibility check can be controlled as described above under the margin title "Secondary Testing".

### Function Check

The only functional test required for protective relays is a plausibility check of the operational measured values by means of some secondary test equipment; this is to ensure that no damage has occurred during transit (see also side title "Secondary Testing").

### LEDs

After tests where the displays appear on the LEDs, these should be reset in order that they present information only on the currently executed test. This should be done at least once each using the reset button on the front panel and via the binary input for remote reset (if allocated). Observe that an independent reset occurs also on the arrival of a new fault and that setting of new indications can be optionally made dependent on the pickup or a trip command (parameter **201 FltDisp.LED/LCD**).

**Test Switch**

Check the functions of all test switches that are installed for the purposes of secondary testing and isolation of the device. Of particular importance are "test switches " in current transformer circuits. Be sure these switches short-circuit the current transformers when they are in the test mode.

## 3.2.7 Checking System Incorporation

**General Information**

**WARNING!**

**Warning of dangerous voltages**

Non-observance of the following measures can result in death, personal injury or substantial property damage.

Therefore, only qualified people who are familiar with and adhere to the safety procedures and precautionary measures shall perform the inspection steps.

With this check of the protection, the correct incorporation of the device into the power system is tested and ensured.

Checking of protection parametrization (allocations and settings) in accordance with the power system requirements, is an important test step here.

The interface-wide incorporation check in the power system results on the one hand in testing of cubicle wiring and drawing record in accordance with functionality, and on the other hand the correctness of cabling between transducer or transformer and protection device.

**Auxiliary Voltage Supply**

Check the voltage magnitude and polarity at the input terminals.

**Note**

If a redundant supply is used, there must be a permanent, i.e. uninterruptible connection between the minus polarity connectors of system 1 and system 2 of the DC voltage supply (no switching device, no fuse), because otherwise there is a risk of voltage doubling in case of a double earth fault.

**Caution!**

**Be careful when operating the device on a battery charger without a battery**

Non-observance of the following measure can lead to unusually high voltages and consequently, the destruction of the device.

Do not operate the device on a battery charger without a connected battery. (Limit values can be found in the technical data).

**Visual Check**

During the visual check the following must be considered:

- Check of the cubicle and the devices for damage;
- Check of earthing of the cabinet and the device;
- Check the external cabling for condition and completeness.

**Acquisition of Technical Power System Data**

For checking protection parameterization (allocation and settings) in accordance with power system requirements, recording of technical data of the individual components is necessary in the primary system. This includes,the voltage and current transformers.

Where deviations from the planning data are found, the settings of the protection must be modified accordingly.

**Analog Inputs**

The check of the current and voltage transformer circuits includes:

- Acquisition of technical data
- Visual check of transformers, e.g. for damage, assembly position, connections
- Check of transformer earthing, especially earthing of the broken delta winding in only one phase
- Check cabling in accordance with circuit diagram
- Check of the short circuiters of the plug connectors for current circuits

Further tests are under certain circumstances necessary in accordance with contract:

- Insulation measurement of cable
- Measurement of transformation ratio and polarity
- Burden measurement
- Checking the functions of test switches, if used for secondary testing.
- Measuring transducers/ Measuring transducer connection

**Binary Inputs and Outputs**

For more information see also Section 3.3.

- Setting of binary inputs:
  - Check and match jumper allocation for pickup thresholds (see Section 3.1)
  - Check the pickup threshold - if possible - with a variable DC voltage source
- Check the tripping circuits from the command relays and the tripping lines down to the various components (circuit breakers, excitation circuit, emergency tripping, switchover devices etc.)
- Check the signal processing from the signal relays and the signal lines down to the station control and protection system; to do so, energize the signal contacts of the protective device and check the texts in the station control and protection system
- Check the control circuits from the output relays and the control lines down to the circuit breakers and disconnectors etc.
- Check the binary input signals from the signal lines down to the protective device by activating the external contacts.

**Voltage Trans-former Miniature Circuit Breaker (VT mcb)**

Since it is very important for the undervoltage protection, that this functions are blocked automatically if the circuit breaker for the voltage transformers has tripped, the blocking should be checked along with the voltage circuits. Switch off voltage transformer protection switches.

One should check in the operational annunciations that the VT mcb trip was detected. A requirement for this is that the auxiliary contact of the VT mcb is connected and correspondingly allocated.

Close the VT mcb again: The above annunciations appear under the "going" operational annunciations, i.e. with the comment "OFF" (e.g. ">L1 MCB Closed" " "OFF").

If one of the indications does not appear, check the connection and allocation of these signals.

If the "ON" and "OFF" messages are exchanged, then the breaker auxiliary contact type should be checked and corrected if necessary.

# 3.3 Commissioning

**WARNING!**

**Warning of dangerous voltages when operating an electrical device.**

Non-observance of the following measures can result in death, personal injury or substantial property damage.

Only qualified people shall work on and around this device. They must be thoroughly familiar with all warnings and safety notices in this instruction manual as well as with the applicable safety steps, safety regulations, and precautionary measures.

The device is to be grounded to the substation ground before any other connections are made.

Hazardous voltages can exist in the power supply and at the connections to current transformers, voltage transformers, and test circuits.

Hazardous voltages can be present in the device even after the power supply voltage has been removed (capacitors can still be charged).

After removing voltage from the power supply, wait a minimum of 10 seconds before re-energizing the power supply. This wait allows the initial conditions to be firmly established before the device is re-energized.

The limit values given in Technical Data must not be exceeded, neither during testing nor during commissioning.

When testing the device with secondary test equipment, make sure that no other measurement quantities are connected and that the TRIP command lines and possibly the CLOSE command lines to the circuit breakers are interrupted, unless otherwise specified.

**DANGER!**

**Hazardous voltages during interruptions in secondary circuits of current transformers.**

Non-observance of the following measure will result in death, severe personal injury or substantial property damage.

Short-circuit the current transformer secondary circuits before current connections to the device are opened.

For the commissioning switching operations have to be carried out. A prerequisite for the prescribed tests is that these switching operations can be executed without danger. They are accordingly not meant for operational checks.

**WARNING!**

**Warning of dangers evolving from improper primary tests**

Non-observance of the following measures can result in death, personal injury or substantial property damage.

Primary test may only be carried out by qualified personnel, who are familiar with the commissioning of protection systems, the operation of the plant and the safety rules and regulations (switching, earthing, etc.).

## 3.3.1 Test Mode/Transmission Block

If the device is connected to a central or main computer system via the SCADA interface, then the information that is transmitted can be influenced. This is only possible with some of the protocols available

If **Test mode** is set ON, then a message sent by a SIPROTEC 4 device to the main system has an additional test bit. This bit allows the message to be recognized as resulting from testing and not an actual fault or power system event. Furthermore it can be determined by activating the **Transmission block** that no indications at all are transmitted via the system interface during test mode.

The SIPROTEC 4 System Description /1/ describes how to activate and deactivate test mode and blocked data transmission. Note that when DIGSI is being used, the program must be in the **Online** operating mode for the test features to be used.

## 3.3.2 Test System Interface

### Prefacing Remarks

If the device features a system interface and uses it to communicate with the control centre, the DIGSI device operation can be used to test if messages are transmitted correctly. This test option should however definitely "not" be used while the device is in service on a live system.

**DNAGER!**

**Danger evolving from operating the equipment (e.g. circuit breakers, disconnectors) by means of the test function**

Non-observance of the following measure will result in death, severe personal injury or substantial property damage.

Equipment used to allow switching such as circuit breakers or disconnectors is to be checked only during commissioning. Do not under any circumstances check them by means of the testing mode during "real" operation performing transmission and reception of messages via the system interface.

**Note**

After termination of the hardware test, the device will reboot. Thereby, all annunciation buffers are erased. If required, these buffers should be extracted with DIGSI prior to the test.

The interface test is carried out using DIGSI in the Online operating mode:

- Open the Online directory by double-clicking; the operating functions for the device appear.
- Click on Test; the function selection appears in the right half of the screen
- Double-click on Testing Messages for System Interface shown in the list view. The dialog box Generate Annunciations opens (refer to the following figure).

### Structure of the Test Dialogue Box

In the column **Indication** the display texts of all indications are displayed which were allocated to the system interface in the matrix. In the column **Status SCHEDULED** the user has to define the value for the messages to be tested. Depending on the indication type, several input fields are offered (e.g. "ON"/ "OFF"). By double-clicking onto one of the fields the required value can be selected from the list.

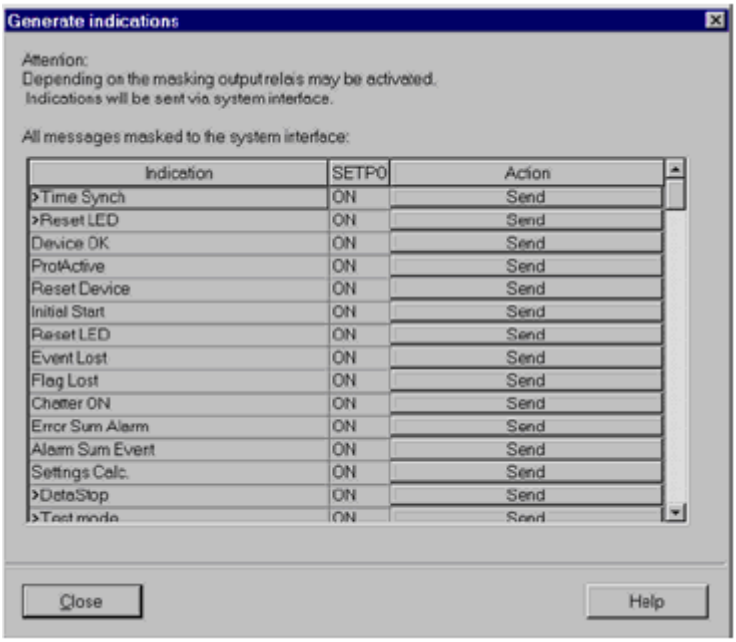



Figure 3-14 System interface test with dialog box: Generate indications - example

### Changing the Operating State

On clicking one of the buttons in the column **Action** you will be prompted for the password No. 6 (for hardware test menus). After correct entry of the password, individual annunciations can be initiated. To do so, click on the button **Send** in the corresponding line. The corresponding annunciation is issued and can be read out either from the event log of the SIPROTEC 4 device or from the substation control center.

As long as the window is open, further tests can be performed.

### Test in Message Direction

For all information that is transmitted to the central station test in Status Scheduled the desired options in the list which appears:

- Make sure that each checking process is carried out carefully without causing any danger (see above and refer to DANGER!)
- Click on Send in the function to be tested and check whether the transmitted information reaches the central station and shows the desired reaction. Data which are normally linked via binary inputs (first character ">") are likewise indicated to the central station with this procedure. The function of the binary inputs itself is tested separately.

### Exiting the Test Mode

To end the System Interface Test, click on **Close**. The device is briefly out of service while the start-up routine is executed. The dialogue box closes.

## 3.3.3 Checking the Binary Inputs and Outputs

**Prefacing Remarks**

The binary inputs, outputs, and LEDs of a SIPROTEC 4 device can be individually and precisely controlled in DIGSI. This feature is used to verify control wiring from the device to plant equipment (operational checks) during commissioning. This test option should however definitely "not" be used while the device is in service on a live system.

**DANGER!**

**Danger evolving from operating the equipment (e.g. circuit breakers, disconnectors) by means of the test function**

Non-observance of the following measure will result in death, severe personal injury or substantial property damage.

Equipment used to allow switching such as circuit breakers or disconnectors is to be checked only during commissioning. Do not under any circumstances check them by means of the testing mode during "real" operation performing transmission and reception of messages via the system interface.

**Note**

After termination of the hardware test, the device will reboot. Thereby, all annunciation buffers are erased. If required, these buffers should be extracted with DIGSI prior to the test.

The hardware test can be carried out using DIGSI in the Online operating mode:

- Open the Online directory by double-clicking; the operating functions for the device appear.
- Click on Test; the function selection appears in the right half of the screen.
- Double-click in the list view on Hardware Test. The dialog box of the same name opens (see the following figure).

**Structure of the Test Dialogue Box**

The dialog box is divided into three groups: **BI** for binary inputs, **REL** for output relays, and **LED** for light-emitting diodes. On the left of each group is an accordingly labelled button. By double-clicking these buttons you can show or hide the individual information of the selected group.

In the column **Status** the current status of the particular hardware component is displayed. It is displayed symbolically. The actual states of the binary inputs and outputs are displayed by the symbol of opened and closed switch contacts, those of the LEDs by a symbol of a lit or extinguished LED.

The opposite state of each element is displayed in the column **Scheduled**. The display is made in plain text.

The right-most column indicates the commands or messages that are configured (masked) to the hardware components.

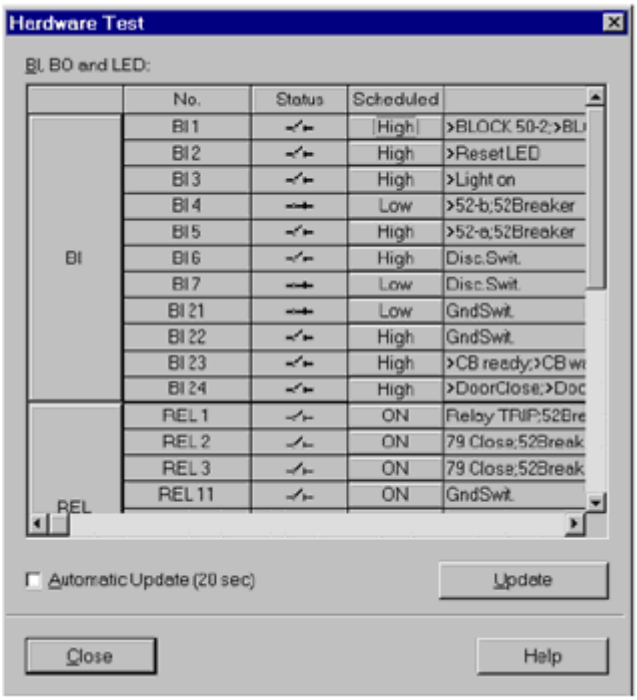



Figure 3-15 Testing of the binary inputs and outputs - example

### Changing the Operating State

To change the condition of a hardware component, click on the associated switching field in the **Scheduled** column.

Password No. 6 (if activated during configuration) will be requested before the first hardware modification is allowed. After entry of the correct password a condition change will be executed. Further condition changes remain possible while the dialog box is open.

### Test of the Binary Outputs

Each individual output relay can be energized allowing a check of the wiring between the output relay of the 7VU683 and the system, without having to generate the message that is assigned to the relay. As soon as the first change of state for any of the output relays is initiated, all output relays are separated from the internal device functions, and can only be operated by the hardware test function. This means, that e.g. a TRIP command coming from a control command from the operator panel to an output relay cannot be executed.

Proceed as follows in order to check the output relay :

Ensure that the switching of the output relay can be executed without danger (see above under DANGER!).

- Each output relay must be tested via the corresponding **Scheduled**-cell in the dialog box.
- The test sequence must be terminated (refer to margin heading "Exiting the Procedure"), to avoid the initiation of inadvertent switching operations by further tests.

### Test of the Binary Inputs

To test the wiring between the plant and the binary inputs of the 7VU683 the condition in the system which initiates the binary input must be generated and the response of the device checked.

To do this, the dialog box **Hardware Test** must again be opened to view the physical state of the binary inputs. The password is not yet required.

Proceed as follows in order to check the binary inputs:

- Activate in the system each of the functions which cause the binary inputs.
- The response of the device must be checked in the **Status** column of the dialog box. To do this, the dialog box must be updated. The options may be found below under the margin heading "Updating the Display".
- Terminate the test sequence (see below under the margin heading "Exiting the Procedure").

If however the effect of a binary input must be checked without carrying out any switching in the plant, it is possible to trigger individual binary inputs with the hardware test function. As soon as the first state change of any binary input is triggered and the password no. 6 has been entered, all binary inputs are separated from the plant and can only be activated via the hardware test function.

#### Test of the LEDs

The LEDs may be tested in a similar manner to the other input/output components. As soon as you have initiated the first state change for any LED, all LEDs are disconnected from the functionality of the device and can only be operated by the hardware test function. This means e.g. that no LED is illuminated anymore by a device function or by pressing the LED reset button.

#### Updating the Display

During the opening of the dialog box **Hardware Test** the operating states of the hardware components which are current at this time are read in and displayed.

An update occurs:

- for each hardware component, if a command to change the condition is successfully performed,
- for all hardware components if the **Update** button is clicked,
- for all hardware components with cyclical updating (cycle time is 20 seconds) if the **Automatic Update (20sec)** field is marked.

#### Exiting the Test Mode

To end the hardware test, click on **Close**. The dialog box closes. The device becomes unavailable for a brief start-up period immediately after this. Then all hardware components are returned to the operating conditions determined by the plant settings.

### 3.3.4 Testing User-defined Functions

#### CFC Logic

The device has a vast capability for allowing functions to be defined by the user, especially with the CFC logic. Any special function or logic added to the device must be checked.

Naturally, general test procedures cannot be given. Rather, the configuration of these user defined functions and the necessary associated conditions must be known and verified. Of particular importance are possible interlocking conditions of the switchgear (circuit breakers, isolators, etc.).

## 3.3.5 Commissioning Test

### General Information

**WARNING!**

**Warning of hazardous voltages when operating electrical devices**

Nonobservance of the following measure will result in fatality, severe personal injury or substantial material damage.

Only qualified people shall work on and around this device. They must be thoroughly familiar with all warnings and safety notices in this instruction manual as well as with the applicable safety steps, safety regulations, and precautionary measures.

For the commissioning switching operations have to be carried out. A prerequisite for the prescribed tests is that these switching operations can be executed without danger. They are accordingly not meant for operational checks.

**WARNING!**

**Warning of dangers evolving from improper primary tests**

Non-observance of the following measures can result in death, personal injury or substantial property damage.

Primary test may only be carried out by qualified personnel, who are familiar with the commissioning of protection systems, the operation of the plant and the safety rules and regulations (switching, earthing, etc.).

### Safety Instructions

All relevant safety rules and regulations (e.g. VDE 105, VBG4 or comparable national regulations) must be complied with.

Before undertaking any work, observe the following "5 safety rules":

- Enable
- Secure against reswitching on
- Establish absence of voltage
- Earth and short circuit
- Cover or fence in live parts in the vicinity

In addition the following must be observed:

- Before making any connections, the device must be earthed at the protective conductor terminal.
- Hazardous voltages can exist in all switchgear components connected to the power supply and to measurement and test circuits.
- Hazardous voltages can be present in the device even after the power supply voltage has been removed (capacitors can still be charged).
- After removing voltage from the power supply, wait a minimum of 10 seconds before reenergizing the power supply. This allows defined initial conditions when the device is re-energized.

- The limit values specified in the Technical Specifications (section 4.1) must not be exceeded, also not during testing and during commissioning.

**DANGER!**

**Hazardous voltages during interruptions in secondary circuits of current transformers.**

Nonobservance of the following measure will result in fatality, severe personal injury or substantial material damage.

Short-circuit the current transformer secondary circuits before current connections to the device are opened.

If test switches are installed that automatically short-circuit the current transformer secondary circuits it is sufficient to place them into the "Test" position provided the short-circuit functions has been previously tested.

All secondary test equipment should be removed and the measurement voltages connected. The operational preparations must be completed.

**Preparation**

Please perform the following preparatory commissioning steps:

- Install an EMERGENCY OFF button for direct trip of the excitation
- Check the parameter setting, if need temporarily setting in commissioning, change to temporarily setting.
- Check the binary input and measurement input.
- The mode of power support transfer is same with test scheme, according to the requirement of site.

**Test**

Please perform the following preparatory commissioning steps:

- Manual/remote Open CB. Check device Binary output, LEDs is same with the setting.
- Check function, site/remote start power support transfer function, check device doing is same with the setting.
- According the setting, cut off power of busbar ( fault start mode, undervoltage mode…etc ), check device doing is same with the setting.

## 3.3.6 Checking the Voltage Circuits

**General**

The voltage circuits of the machine are checked to ensure the correct cabling, polarity, phase sequence, transformer ratio etc. of the voltage transformers - not to check individual protection functions of the device.

**Test Instruction**

The checks of all voltage transformer circuits (protection, measuring, metering etc.) are carried out with about 30 % of the rated transformer voltage.

The measuring circuit supervision of the rotor earth fault protection (see below) can be checked when testing the voltage circuits, or after the synchronization.

#### Amplitudes

Read out voltages in all three phases in the operational measured values and compare with the actual voltages. The voltage of the positive sequence system U1 must be approximately the same as the indicated phase voltages. If there are significant deviations, the voltage transformer connections are incorrect.

#### Phase Rotation

The phase rotation must conform with the configured phase sequence ; otherwise an indication "Fail Ph. Seq.V.B1" or "Fail Ph. Seq.V.B2" will be output. The allocation of measured values to phases must be checked and corrected, if necessary. If significant deviations are found, check, and if necessary correct, the voltage transformer circuits and repeat the test. It is also possible to use for this check the operational measured value of positive-sequence component U1 of the voltages: With $U1 \neq U_L$-E a wiring error is indicated.

## 3.3.7 Checking the Current Circuits

#### General

The checks of the current circuits are performed with the generator to ensure correct CT circuit connections with regard to cabling, polarity, phase sequence, CT ratio etc., not in order to verify individual protection functions in the device.

#### Test Instruction

Then the checks of the current transformer circuits are carried out with max. 20 % of the rated transformer current. Tests with generator currents of more than 20 % are not normally required for digital protection.

#### Amplitude Values

The currents can be read out from the device front panel or from the PC via the operator interface under operational measured values and compared with the actual measured values. If significant deviations are found, the CT connections are not correct.

## 3.3.8 Creating a Test Fault Record

#### General

At the end of commissioning, an investigation of switching operations of the circuit breaker(s) or primary switching device(s), under load conditions, should be done to assure the stability of the protection during the dynamic processes. A maximum of information on protection behaviour is supplied by fault recordings.

#### Requirement

Along with the capability of storing fault recordings via pickup of the protection function, the 7VU683 also has the capability of capturing the same data when commands are given to the device via the service program DIGSI, the serial interface, or a binary input. For the latter, event ">Trig.Wave.Cap." must be allocated to a binary input. Triggering of the recording then occurs, for example, via the binary input when the protection object is energised.

Such externally started test fault recordings (that is, without a protection pickup) are handled by the device as normal fault recordings, i.e. for each measurement record a fault log is opened with its own number, for unequivocal allocation. However, these recordings are not displayed in the fault indication buffer, as they are not fault events.

### Start Waveform Recording

To trigger test measurement recording with DIGSI, click on **Test** in the left part of the window. Double click the entry **Test Wave Form** in the list of the window.

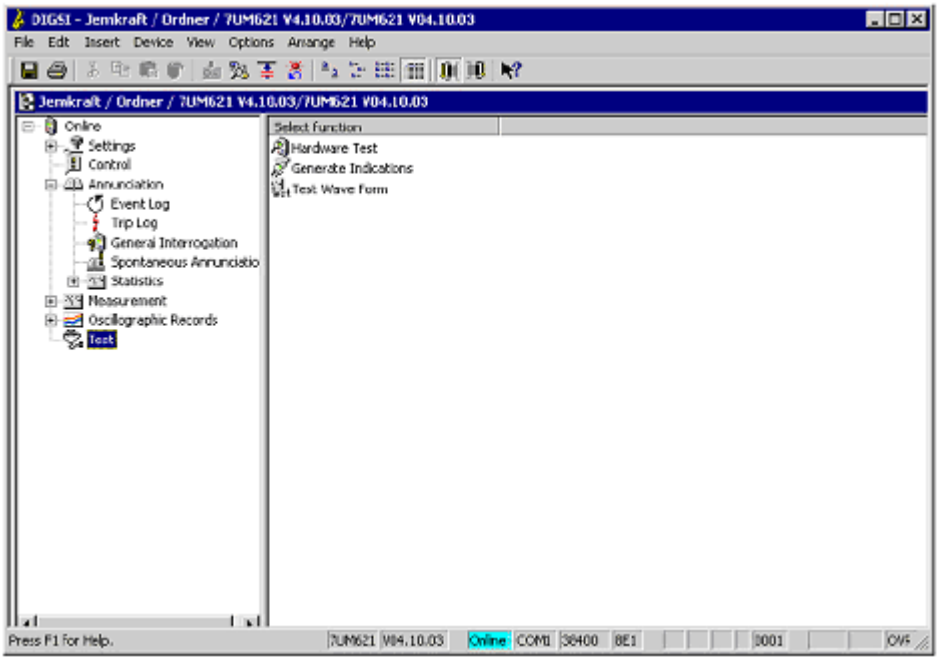



Figure 3-16 Figure 3-40Triggering Oscillographic Recording with DIGSI - Example

A test measurement record is immediately started. During recording, an indication is given in the left part of the status bar. Bar segments additionally indicate the progress of the procedure.

For display and evaluation of the recording you require one of the programs SIGRA or ComtradeViewer.

# 3.4 Final Preparation of the Device

Firmly tighten all screws. Tighten all terminal screws, including those that are not used.

---

**Caution!**

**Inadmissable tightening torques**

Non-observance of the following measure can result in minor personal injury or property damage.

The tightening torques must not be exceeded as the threads and terminal chambers may otherwise be damaged!

---

**In case service settings were changed, check if they are correct.** Check if power system data, control and auxiliary functions to be found with the configuration parameters are set correctly (Section 2). All desired elements and functions must be set **ON**. Keep a copy of all of the in-service settings on a PC.

Check the internal clock of the device. If necessary, set the clock or synchronize the clock if the element is not automatically synchronized. For assistance, refer to the SIPROTEC 4 System Description /1/.

The indication buffers are deleted under **MAIN MENU→ Annunciation →Set/Reset,** so that in the future they only contain information on actual events and states (see also /1/). The counters in the switching statistics should be reset to the values that were existing prior to the testing (see also SIPROTEC 4 System Description /1/).

The counters of the operational measured values (e.g. operation counter, if available) are reset under **Main Menu→ Measurement Reset**.

Press the ESC key, several times if necessary, to return to the default display. The default display appears in the display (e.g. display of operation measured values).

Clear the LEDs on the front panel by pressing the LED key, so that they only show real events and states. In this context, also output relays probably memorized are reset. Pressing the LED key also serves as a test for the LEDs on the front panel because they should all light when the button is pushed. Any LEDs that are lit after the clearing attempt are displaying actual conditions.

The green "RUN" LED must be on. The red "ERROR" LED must not be lit.

Close the protective switches. If test switches are available, then these must be in the operating position.

The device is now ready for operation.

■

# Technical Data

# 4

This chapter provides the technical data of SIPROTEC 4 devices 7VU683 and their individual functions, including the limiting values that must not be exceeded under any circumstances. The electrical and functional data for the device with all options, as well as the mechanical data with dimensional drawings, are provided in the following.

# 4.1 General

**Current Input**

| | |
|---|---|
| Recommended permanent operating temperature | -5~55 |
| Limiting temporary (transient) operating temperature | -20~70°C |
| Limit temperatures during transport | -25~70°C |

# 4.2 Rated electrical parameters

| | |
|---|---|
| Rated auxiliary direct voltage: | 220V,110V |
| Tolerance | +20%,-20% |
| Alternating Voltage | 80~125/3V(Un) |
| Rated current | 5 A,1 A (In) |
| Rated frequency | 50Hz,60Hz |
| Overload capability:: | |
| Current overload capability | 4 IN continuous |
| | 30 IN for 10 s |
| | 100 IN for 1 s |
| Voltage path overload capacity | 230 V continuous |
| Power consumption: | |
| Current | Approx. 0.3 VA(In=5 A) |
| | Approx. 0.05 VA(In=1 A) |
| Voltage | Approx. 0.10 VA/Phase |
| Power Consumption: | Quiescent, Approx. 8 W |
| | Energized, Approx. 15 W |

# 4.3 Functional Data

## 4.3.1 HSBT

| | |
|---|---|
| Resolution of external Binary Inputs | 1ms |
| High speed output relay (only make contact) | 1ms |
| fastest transfer time of HSBT | < 20ms + CB closing time |
| Angle Tolerance | <0.2° |
| Frequency Tolerance | <0.02Hz |
| Voltage Tolerance | <0.2V |
| Current Tolerance | <0.01In |
| Frequency Range | 0Hz ~ 66Hz |
| External BI filter time | 10ms |

## 4.3.2 Protection

| | |
|---|---|
| Frequency Tolerance | 50Hz, Frequency Range: 20Hz~66Hz |
| | 60Hz, Frequency Range:25Hz~66Hz |
| Pick-Up Time | < 50ms |
| Delay Time tolerance | < 10ms |
| Voltage Tolerance | 1%Uset or 0.5V |
| Current Tolerance | 1%Iset or 0.01In |
| Current Dropout Value | Approx. 0.95 Iset or 0.015In |
| External BI filter time | 10ms |

## 4.3.3 Electrical Tests

**Immunity test**

| | | |
|---|---|---|
| Standards: | | IEC 60255-6 and -22<br>EN 60082-6-2 |
| High frequency test<br>IEC 60255-22-1, class III | | 2.5 kV (peak); 1 MHz; $\tau$ = 15 $\mu$s; 400 surges per s; test duration 2s; $R_i$ = 200 $\Omega$ |
| Electrostatic discharge<br>IEC 60255-22-2 class IV<br>IEC 61000-4-2, IV | | 8 kVcontact discharge; 15 kV air discharge; both polarities;<br>150 pF; $R_i$ = 330 $\Omega$ |
| Irradiation with RF field,<br>frequency sweep,<br>IEC 60255-22-3,<br>IEC 61000-4-3 class III | | 10 V/m and 20 V/m; 80 MHz to 1000 MHz; 80 % AM; 1 kHz<br>10 V/m; 800 MHz to 960 MHz; 80 % AM; 1 kHz<br>20 V/m; 1,4 GHz to 2,0 GHz; 80 % AM; 1 kHz |
| Fast transients interference, bursts<br>IEC 60255-22-4 and<br>IEC 61000-4-4, class IV | | 4 kV; 5/50 ns; 5 kHz;<br>burst length = 15 ms;repetition rate 300 ms; both polarities<br>; $R_i$ = 50 $\Omega$; test duration 1 mIn |
| High-energy surge voltages<br>(SURGE), IEC 61000-4-5, installation<br>class III | | Impulse: 1.2/50 $\mu$s |
| | Auxiliary supply | Common (longitudinal) mode:2 kV; 12 $\Omega$; 9 $\mu$F<br>Differential (transversal) mode:1 kV; 2 $\Omega$; 18 $\mu$F |
| | Analog inputs, binary inputs, binary outputs | Common (longitude) mode: 2 kV; 42 $\Omega$; 0.5 $\mu$F<br>Differential (transversal) mode: 1 kV; 42 $\Omega$; 0.5$\mu$F |
| Line-conducted HF, amplitudemodulated<br>IEC 61000-4-6, class III | | 10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz |
| Fast transient surge withstand<br>capability, ANSI/IEEE C37.90.1 | | 4 kV; 5/50 ns; 5 kHz; burst 15 ms;<br>repetition rate 300 ms;<br>both polarities; duration 1 min.;<br>Ri=80 |

**EMC tests for interference emission**

| | |
|---|---|
| Standards： | EN 61000-6-3 |

| | |
|---|---|
| Conducted interference,<br>only auxiliary supply<br>IEC-CISPR 22 | 150 kHz to 30 MHz<br>Limit class B |
| Radio interference field strength<br>IEC-CISPR 22 | 30 MHz to 1000 MHz<br>Limit class B |

**Insulation tests**

| | |
|---|---|
| Standards: | IEC60255-5-2000 |
| Voltage test (100 % test)<br>All circuits except for auxiliary supply, binary inputs and communication interfaces | 2.5 kV (rms), 50 Hz |
| Auxiliary voltage and binary inputs (100 % test) | 3.5 kV– |
| RS485/RS232 rear side communication interfaces and time synchronization interface (100 % test) | 500 V (rms), 50 Hz |
| Impulse voltage test (type test)<br>All circuits except for communication interfaces and time synchronization interface, class III | IEC60255-5-2000 |
| | 5 kV (peak); 1.2/50 μs; 0.5 J<br>3 positive and 3 negative impulses<br>at intervals of 5 s |

■

# Appendix A

This appendix is primarily a reference for the experienced user. This section provides ordering information for the models of this device. Connection diagrams for indicating the terminal connections of the models of this device are included. Following the general diagrams are diagrams that show the proper connections of the devices to primary equipment in many typical power system configurations. Tables with all settings and all information available in this device equipped with all options are provided. Default settings are also given.

# A.1 Ordering Information

| Power supply Transfer device | 7 | V | U | 6 | 8 | 6 | 7 | – | 8 | 9 | 10 | 11 | 12 | – | 13 | 14 | 15 | 16 | + | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 3 | | | | | | | | | | | A | **0** | | | | |

| Housing, Number of Binary Inputs and Outputs | Pos. 6 |
|---|---|
| High Speed Bus transfer device, Housing 1/1 19", 17 BI, 18 BO(include 5 High Speed contact), 1 Live Status Contact | 3 |

| Rated current | Pos. 7 |
|---|---|
| IN=1A | 1 |
| IN=5A | 5 |

| Auxiliary Voltage (Power Supply, Binary Input Threshold) | Pos. 8 |
|---|---|
| 24 to 48 VDC, binary input threshold 17 V | 2 |
| 60 to 125 VDC, binary input threshold 17 V | 4 |
| 110 to 250 VDC, 115 to 230 VAC, binary input threshold 73VDC | 5 |
| 220 to 250 VDC, 115 to 230 VAC, binary input threshold 154 VDC | 6 |

| Construcion | Pos. 9 |
|---|---|
| Flush mounting case, screw-type terminals (direct connection / ring and spade lugs) | E |

| Region-specific Default / Language Settings and Function Versions | Pos. 10 |
|---|---|
| Region World, 50/60 Hz, IEC/ANSI, Language English | B |
| China, 50/60 Hz, Chinese | W |

| System Interfaces or Analog Output (Port B) | Pos. 11 |
|---|---|
| No system interface | 0 |
| IEC 60870-5-103 Protocol, electrical RS 232 | 1 |
| IEC 60870-5-103 Protocol, RS485 | 2 |
| IEC 60870-5-103 Protocol, Optical, 820 nm, ST Connector | 3 |
| For further interface options see the following Additional Information **L** | 9 |

| Additional Information L for Further System Interfaces (Rear Side, Port B) | Supple-mentary |
|---|---|
| PROFIBUS DP Slave, RS485 | + L 0 A |
| Profibus DP Slave, 820 nm, Optical Double Ring, ST Connector | + L 0 B |
| Modbus, RS485 | + L 0 D |
| Modbus, 820 nm, Optical, ST Connector | + L 0 E |
| IEC 60870-5-103 Protocol, redundant, electrical RS485, RJ45-connector | + L 0 P |
| IEC 61850, electrical with EN100, with RJ45 connector | + L 0 R |
| IEC 61850, optical with EN100, with LC connector, 1300 nm | + L 0 S |

| Service Interface (Port C) | Pos. 12 |
|---|---|
| DIGSI, Modern RS232 | 1 |
| DIGSI, Modern/RS485 | 2 |

| Measuring functions | Pos. 13 |
|---|---|
| Basic measured values | 1 |

| Functionality | | Pos. 14 |
|---|---|---|
| Designation | Description | |
| Basic Elements | High Speed Busbar Transfer | |
| | Protection function | |
| | Measurement function | A |

# A.2 Terminal Assignments

## A.2.1 7VU683 terminal assignments

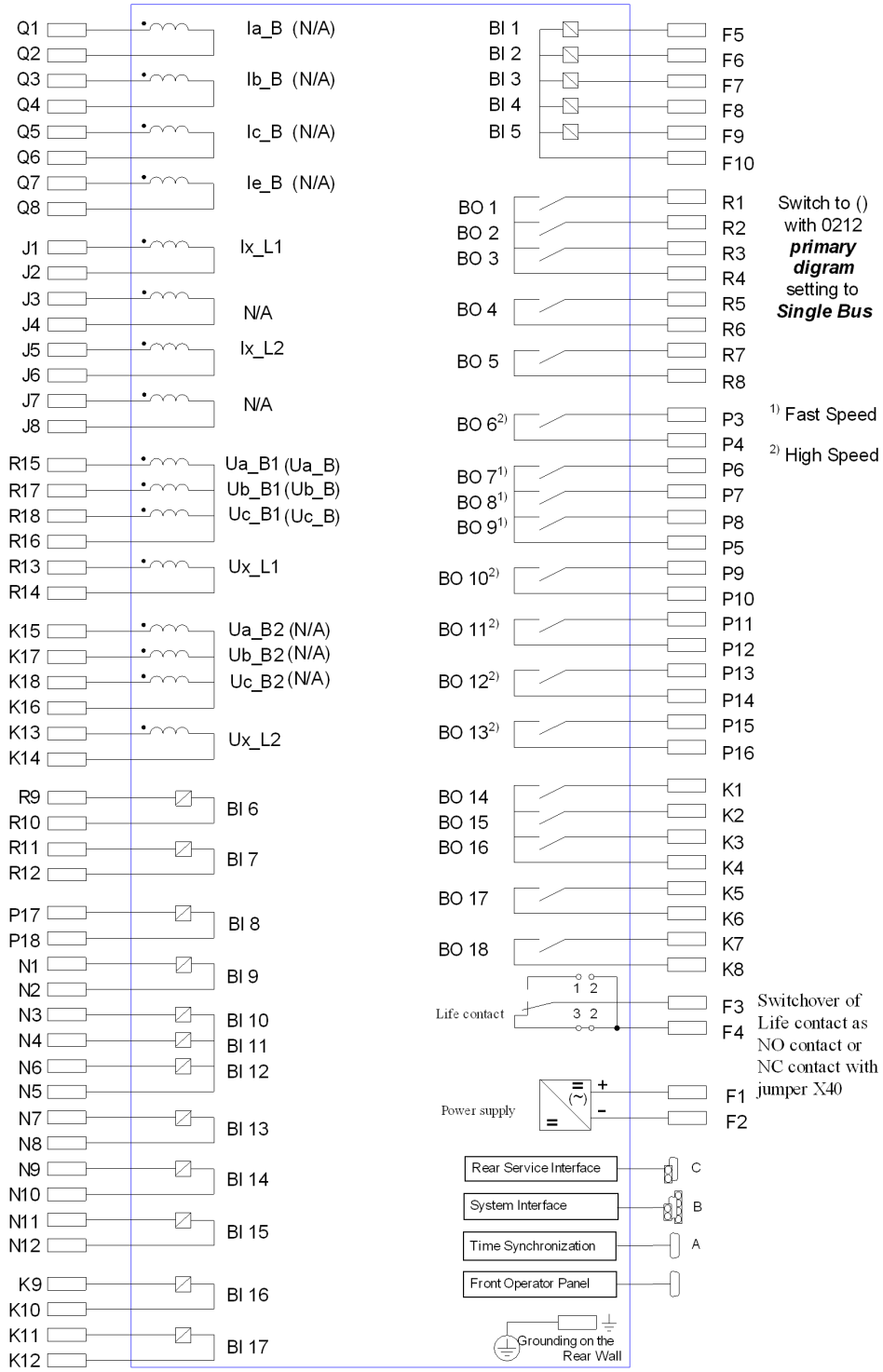



Figure A-1 Terminal Assignment of 7VU683

# A.3 Default Settings

When the device leaves the factory, a large number of LED indicators, binary inputs and outputs as well as function keys are already preset. They are summarized in the following table.

## A.3.1 LEDs

### A.3.1.1 7VU683 LED default configuration

| LEDs | Function No. | Allocated Function |
|---|---|---|
| LED1 | 17760 | CommandOpenCB1 |
| LED2 | 17761 | CommandOpenCB2 |
| LED3 | 17762 | CommandOpenCB3 |
| LED4 | 17767 | CommandCloseCB1 |
| LED5 | 17768 | CommandCloseCB2 |
| LED6 | 17769 | CommandCloseCB3 |
| LED7 *) | 17828 | PhaseO/C-1 Trip |
| | 17830 | PhaseO/C-2 Trip |
| | 17837 | ZSOC-1 Trip |
| | 17839 | ZSOC-2 Trip |
| | 17929 | Ph.O/C-1Ene.Tr. |
| | 17931 | Ph.O/C-2Ene.Tr. |
| | 17933 | Ea.O/C-1Ene.Tr. |
| | 17935 | Ea.O/C-2Ene.Tr. |
| LED8 | 18012 | HSBT is Ready |
| LED9 | 17644 | NORMAL Start |
| | 17645 | FAULT Start |
| | 17646 | UnderVolt.Start |
| | 17647 | UnderFreq.Start |
| | 17648 | CB Inadv.Op.St. |
| LED10 | 17948 | HSBT Succeed |
| LED11 | 17949 | HSBT Failed |
| LED12 | 17879 | B1 LVLSH-1 Trip |
| | 17881 | B1 LVLSH-2 Trip |
| | 17883 | B2 LVLSH-1 Trip |
| | 17885 | B2 LVLSH-2 Trip |
| LED13 | 00140 | Error Sum Alarm |
| | 00160 | Alarm Sum Event |
| LED14 | No functions configured | |

*) Setting ***protection functions*** to ***Enable*** in ***device configuration***

## A.3.2 Binary Input Default Configuration

| Binary Input | Function No. | Binary Input Allocated Function |
|---|---|---|
| BI1 | 17620 | >BLOCK HSBT |
| BI2 | 17863 | >Manual Restart |
| BI3 | 17627 | >L1 FAULT Start |
| BI4 | 17667 | >L2 FAULT Start |
| | 17630 | >NORMAL B1->B2 |
| | 17631 | >NORMAL B1->L1 |
| BI5 | | Local ST.L1->L2 |
| BI6 | 17622 | >CB1 52b |
| | | CB1 Op/Cl |
| | | >CB1 52a |
| BI7 | 17621 | CB1 Op/Cl |
| | | >CB2 52b |
| BI8 | 17624 | CB2 Op/Cl |
| | | >CB2 52a |
| BI9 | 17623 | CB2 Op/Cl |
| | | >CB3 52b |
| BI10 | 17626 | CB3 Op/Cl |
| | | >CB3 52a |
| BI11 | 17625 | CB3 Op/Cl |
| | 17632 | >NORMAL B2->B1 |
| | 17633 | >NORMAL B2->L2 |
| BI12 | | Local ST.L2->L1 |
| BI13 | 17870 | >Manual Open |
| BI14 | 17864 | >NonManu.Op.CB1 |
| BI15 | 17865 | >NonManu.Op.CB2 |
| BI16 | No functions configured | |
| BI17 | No functions configured | |

## A.3.3 Binary Output Default Configuration

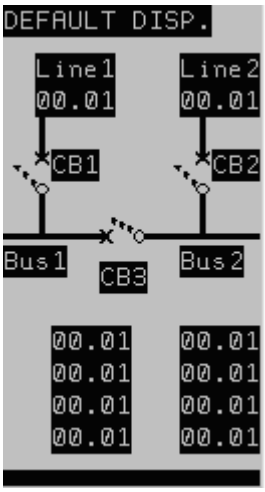
| Binary Output | Function No. | Allocated Function |
|---|---|---|
| BO1 | 17948 | HSBT Succeed |
| BO2 | 17949 | HSBT Failed |
| BO3 | 18012 | HSBT is Ready |
| BO4 *) | 17828 | PhaseO/C-1 Trip |
| | 17830 | PhaseO/C-2 Trip |
| | 17837 | ZSOC-1 Trip |
| | 17839 | ZSOC-2 Trip |
| | 17929 | Ph.O/C-1Ene.Tr. |
| | 17931 | Ph.O/C-2Ene.Tr. |
| | 17933 | Ea.O/C-1Ene.Tr. |
| | 17935 | Ea.O/C-2Ene.Tr. |
| BO5 | 17762 | CommandOpenCB3 |
| BO6 | 17760 | CommandOpenCB1 |
| BO7 | 17883 | B2 LVLSH-1 Trip |
| BO8 | 17885 | B2 LVLSH-2 Trip |
| BO9 | No functions configured | |
| BO10 | 17767 | CommandCloseCB1 |

| Binary Output | Function No. | Allocated Function |
|---|---|---|
| BO11 | 17768 | CommandCloseCB2 |
| BO12 | 17769 | CommandCloseCB3 |
| BO13 | 17761 | CommandOpenCB2 |
| BO14 | 17879 | B1 LVLSH-1 Trip |
| BO15 | 17881 | B1 LVLSH-2 Trip |
| BO16 | No functions configured | |
| BO17 | No functions configured | |
| BO18 | No functions configured | |

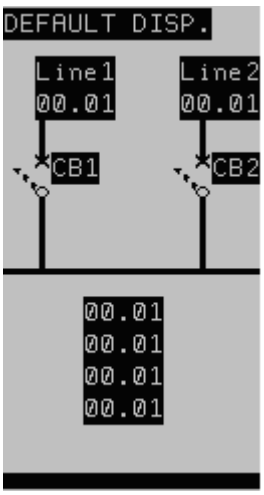
*) Setting ***protection functions*** to ***Enable*** in ***device configuration***

## A.3.4 Default Display

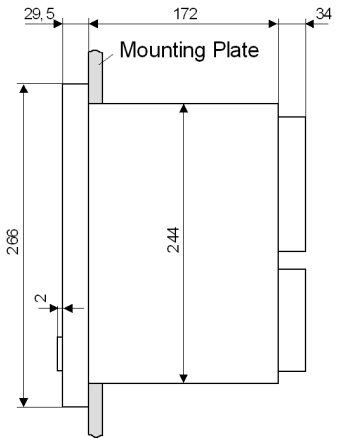
For devices with a graphic display, the basic displays show below:




When ***0212 primary diagram*** setting to ***Single Bus***, default display show below:

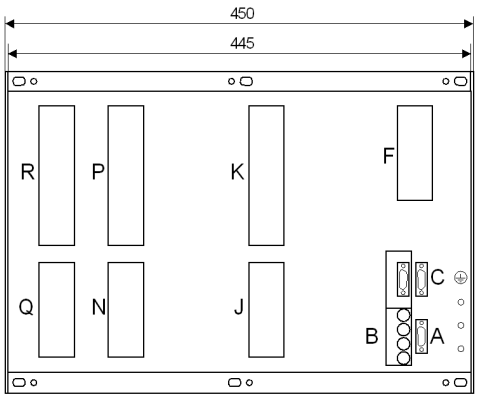


# A.4 Dimension

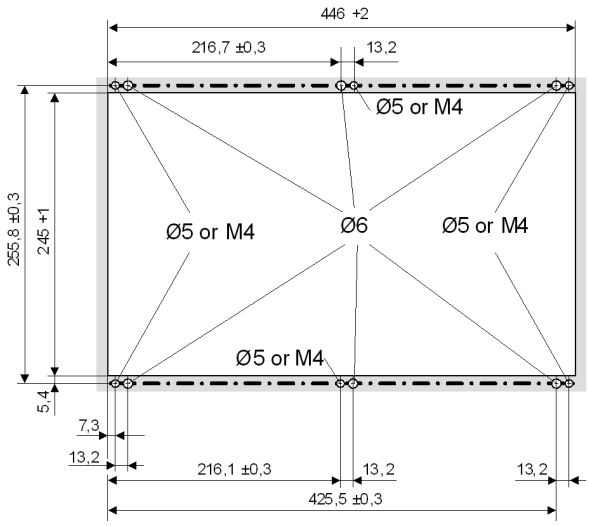



Side View (with Screwed Terminal)

Dimension mm




Rear View




Panel Cut-Out
(Regarded from the Front Side)

Figure A-2 7VU683 dimensions for panel flush mounting or cubicle mounting (housing size 1/1)

■

# Literature


/1/ SIPROTEC 4 System System Description; E50417-H1176-C151-B1

/2/ SIPROTEC DIGSI, Start UP; E50417-G1176-C152 -A3

/3/ DIGSI CFC, Manual; E50417-H1176-C098 -A9

/4/ SIPROTEC SIGRA 4, Manual; E50417-H1176-C070

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