SIEMENS

Protection Systems

SIPROTEC 4 7VU683 V 4.60
High Speed Busbar Transfer Device

Chapter for the Catalog SIP · Edition No. 7

Answers for infrastructure and cities.

7VU683

High Speed Busbar Transfer

You will find a detailed overview of the technical data under www.siemens.com/siprotec

Fig. 1 SIPROTEC 4 7VU683 multifunction high speed busbar transfer device

Description

Permanent availability of electricity is essential for reliable production of a great number of processes in power stations and industrial plants where lots of inductive motor are installed. To achieve this, a busbar is normally equipped with two or more independent in-coming power sources to provide the possibility to switch to standby source in case of main source interruption or failure.

The power supply interruption with tens of millisecond has small impact to rotating loads. Thus, the High Speed Busbar Transfer (HSBT) device helps to control and monitor the progress to ensure the fast but reliable switching-over. It can be initiated manually or automatically.

Based on the existing world-wide used SIPROTEC 4 platform, the reliability, stability and efficiency of HSBT 7VU683 are guaranteed. Thanks to its powerful and flexible performance, multi functions are integrated into one system, e.g, power supply transfer, relay protection and supervision.

The compact solution HSBT 7VU683 is designed to fit for the primary diagrams of single busbar (2 CBs) and segmented single busbar (3 CBs). It has incorporated the traditional HSBT philosophy. Additionally, the unique Real Time Fast Transfer mode helps to improve the efficiency.

The integrated protective functions are to protect the tie-CB in segmented single busbar diagram against short-circuit and ground fault. The integrated supervision functions are to monitor the voltage phase sequence and voltage secondary circuit , then gives out alarm in case of failure.

The integrated programmable logic (CFC) allows the users to implement their own functions. The flexible communication interfaces are open for modern communication architectures with control system.

Function overview

High speed busbar transfer function

- Starting conditions
  - NORMAL condition
  - FAULT condition
  - Inadmissible under-voltage
  - Inadmissible under-frequency
  - Inadvertent CB open
- Switching sequences
  - PARALLEL Auto switching sequence
  - PARALLEL Half-Auto switching sequence
  - SIMULTANEOUS switching sequence
  - SEQUENTIAL sequence
- Transfer modes
  - FAST transfer mode
  - REAL-TIME FAST transfer mode
  - IN-PHASE transfer mode
  - RES-VOLT transfer mode
  - LONG-TIME transfer mode
- Single busbar and segmented single busbar supported
- High speed contact with approx.1ms for closing
- Permission of bi-direction switching settable
- Low voltage load-shedding settable
- CB de-coupling when OPEN failed
- NORMAL start locally or remotely
- Manual CB closing to block HSBT
- ON/OFF set locally or remotely
- HSBT test mode supported

Protection functions for tie-CB

- Overcurrent protection
- Ground overcurrent protection
- Overcurrent protection for busbar energization
- Ground overcurrent protection for busbar energization

Monitoring functions

- Self-supervision of the device
- Oscillographic fault recording
- Phase sequence of busbar voltage
- Voltage circuit of busbar and line

Communication interfaces

- PC front port for setting with DIGSI 4
- System interface
  - IEC 60870-5-103, redundant optional
  - IEC 61850, Ethernet
  - Profibus-DP or Modbus RTU
- Service interface for DIGSI 4 (modem)
- Time synchronization via IRIG B/DCF 77

High Speed Busbar Transfer - Application

Application

The 7VU683 high speed busbar transfer (HBST) device of SIPROTEC 4 family is compact multifunction unit which has been developed for very fast power supply transfer of busbar which is installed with big rotating loads. It accommodates the primary diagram of both single busbar and segmented single busbar. It incorporates all the necessary HSBT conditions and even some protection functions. It is specially suitable for the power supply transfer of:

- Coal-fired power station
- Gas-fired power station
- Combined cycle power station
- Integrated gasification combined cycle (IGCC) power station
- Nuclear power station
- Chemical plant
- Petrochemical plant
- Refinery plant
- Iron and steel plant
- Cement plant

The numerous other additional functions assist the user in ensuring the cost effective system management and reliable power supply. Local operation has been designed according to economic criteria. A large, easy-to-use graphic display is a major design aim.

HSBT function

In station service system of thermal power station and some industrial plants, a lot of asynchronous motor are connected. The restarting motors after some seconds power loss will cause heavy starting current and system voltage drop. On the other hand, the incorrect reconnecting to stand-by power source will even damage the winding of rotor.

The version HSBT 7VU683 is designed for this case. It will evaluate the necessary switching conditions to ensure the fast but secure transfer. Some improvements like as REAL-TIME FAST transfer mode, additional line current criteria will significantly help to the efficiency and safety.

Protection functions for tie-CB

The integrated protections are intend to protect the tie-CB in segmented single busbar diagram against short-circuit or ground fault.

Some special concerning is done to the busbar switch-onto-fault. Protection functions will only be active for a settable time.

Programmable logic

The integrated logic characteristics (CFC) allow the user to implement their own functions and generate user-defined messages.

Measuring values

The measuring values like as U, I, f, dV, df, dφ, 3I0, 3V0 and CB closing time can be recorded and displayed.

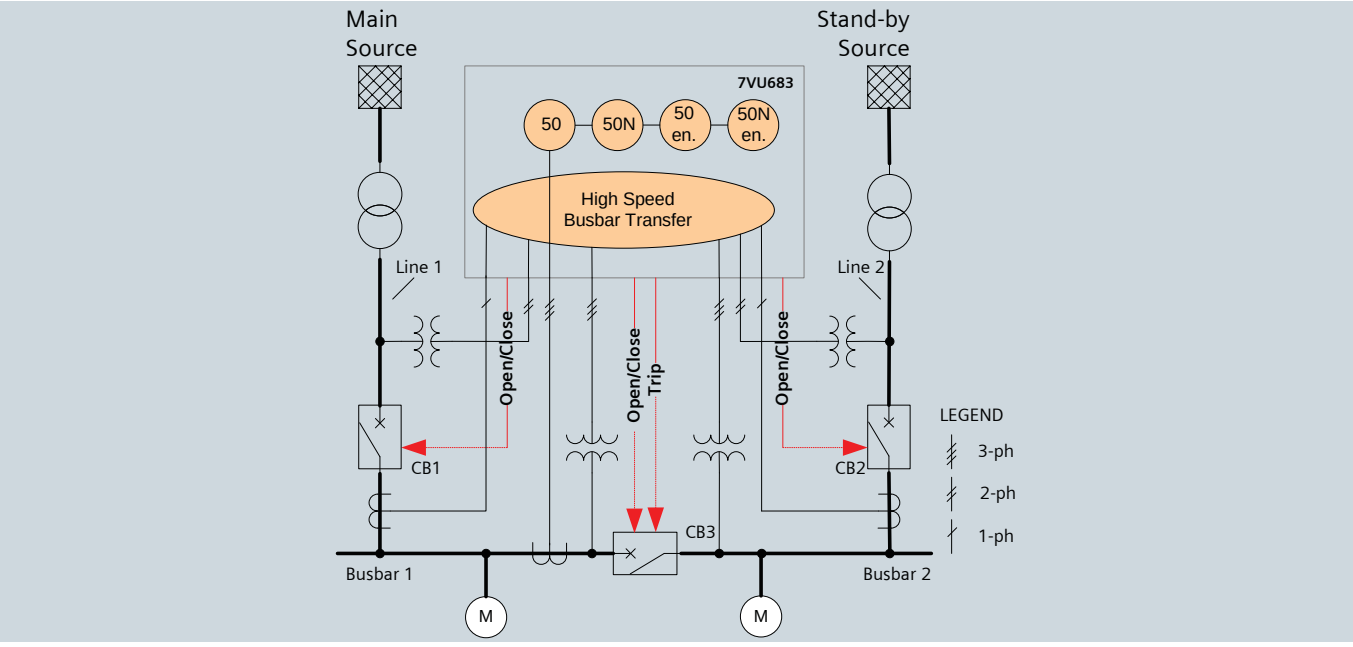

Fig. 2 Function diagram

Function	Abbreviation	ANSI Code	2 Line-CBs	2 Line-CBs + 1 Tie-CB
HSBT				
Line1->Line2			X	X
Line2->Line1			X	X
Busbar1->Busbar2				X
Busbar2->Busbar1				X
Busbar1->Line1				X
Busbar2->Line2				X
Protection				
Definite time-overcurrent protection	I>+V<	50		X
Ground-overcurrent protection	3I0>+3V0>	50N		X
Overcurrent protection for busbar energization	I>+V<	50.en		X
Ground-overcurrent protection for busbar energization	3I0>+3V0>	50N.en		X
Supervision				
Phase sequence		47	X	X
Voltage circuit			X	X

Table1 Functional scope of HSBT 7VU683

Construction

The SIPROTEC 4 units have a uniform design and a degree of functionality which represents a whole new quality. Local operation has been designed according to ergonomic criteria. Large, easy-to read displays were a major design aim. The device HSBT 7VU683 is equipped with a graphic display thus providing and depicting more information especially in industrial applications. The DIGSI 4 operating program considerably simplifies planning and engineering and reduces commissioning times.

1/1-rack size is the available housing width of the device HSBT 7VU683, referred to a 19" module frame system. The height is a uniform 245 mm. Only flush-mounting housing with screw type terminals is available. All cables can be connected with or without ring lugs.

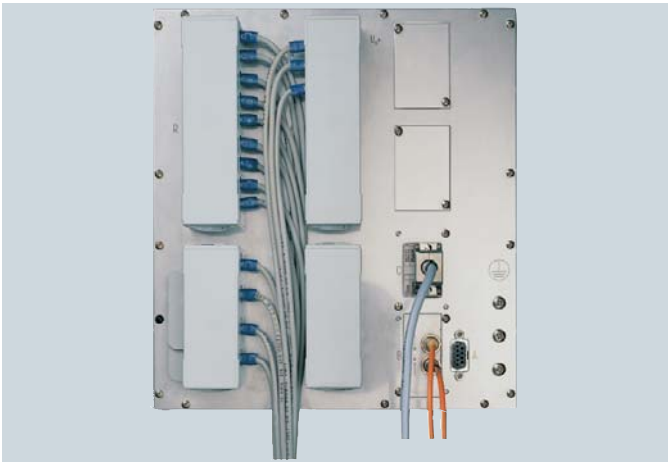

Fig.3 Rear view with wiring terminal safety cover and serial interface

High Speed Busbar Transfer - HSBT functions

HSBT functions

Starting conditions

The device HSBT 7VU683 is designed to support the following staring conditions,

– NORMAL condition
– FAULT condition
– Inadmissible Under-voltage condition
– Inadmissible Under-frequency condition
– Inadvertent CB Open condition

The above conditions can be freely combined together, i.e, one of them can be individually switched "**OFF**".

• NORMAL condition

Under the NORMAL condition, the power system is fault free and the starting command must be manually issued. This command can come from remote control center and/or local controller via wiring connection or communication over protocol, e.g,

– DCS of power station
– Turbine control system
– Local panel

The switching of remote and local starting authority is done by internal CFC logic and controlled by device switching key "Remote/Local". The starting command can only be remotely executed over communication when the switching key is at position "Remote", vice versa.

• FAULT condition

Under the FAULT condition, power system fault must be there on the in-feeder line and the starting command must be externally issued by other device, e.g, protection device.

• Abnormal condition

Under the abnormal condition, voltage disturbance must be there on the busbar due to any causes. The starting command can be internally issued by device HSBT 7VU683 according to the following abnormal conditions

– Inadmissible Under-voltage
– Inadmissible Under-frequency
– Inadvertent CB Open

To secure the starting reliability, line current is used as the additional criterion to the above conditions.

In case the operating CB is manually tripped, transfer must not be started. This can be recognized via indication 17864 "**>NonManu.Op.CB1**" and 17865 "**>NonManu.Op.CB2**" in configuration matrix.

Switching sequences

The category HSBT 7VU683 is designed to serve for the following switching sequences according to CBs' operating behavior,

– PARALLEL switching sequence
– SIMULTANEOUS switching sequence
– SEQUENTIAL switching sequence

PARALLEL and SIMULATEOUS switching sequences can exclusively support the starting condition NORMAL while SEQUENTIAL can support all starting conditions.

• PARALLEL switching sequence

If the two sources are allowed to work on busbar in parallel for a short time, the PARALLEL sequence can be used for power supply transfer.

Under PARALLEL sequence, HSBT 7VU683 will firstly issue a CLOSE command to the to-be-closed CB after the device get the starting command. When the closure is successful, the device will trip the to-be-opened CB. The tripping command can be automatically generated by device or derived from manual operation which are dependent on setting,

– PARALLEL Auto sequence
– PARALLEL Half-Auto sequence

Under PARALLEL Auto sequence, the device will automatically issue an OPEN command after a settable time delay when the closure is successful. Under PARALLE Half-Auto sequence, the device will not issue the OPEN command until the Manual Open command arrived. The criterions are as below,

– df < 8851 "**PARAL. Delta f**"
– |dU| < 8852 "**PARAL. Delta U**"
– dφ < 8853 "**PARAL. Delta PHI**"

If the to-be-opened CB failed to open, the device will automatically de-couple the to-be-closed CB.

The time sequence under PARALLE can be understandable via the below figure (assumed switching of closing CB2 and opening CB1),

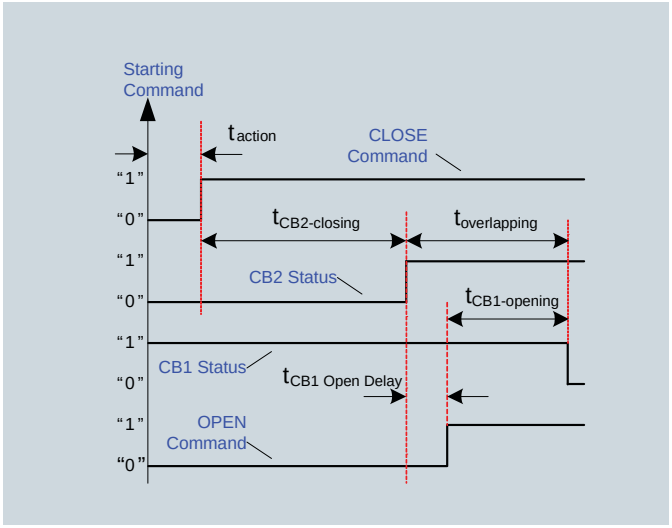

Fig.4 Time sequence of PARALLEL

The advantage of PARALLEL sequence is to avoid any interruption of busbar power supply. PARALLEL Auto sequence should be preferred to reduce the overlapping time of two sources.

- SIMULTANEOUS switching sequence

If the two sources are not allowed to work on busbar in parallel, the SIMULTANEOUS sequence can be used for power supply transfer.Under SIMULTANEOUS sequence, HSBT 7VU683 will firstly issue a OPEN command to the to-be-opened CB after the device gets the starting command. Meanwhile, the device will issue a CLOSE command to the to-be-closed CB if other criterions are met. The overlapping can be avoided via the settable CB close time delay if CB making time is small than breaking time. The criterions are as below,

– df < 8855 "**SIMUL. Delta f**"

– dφ< 8856 "**SIMUL. Delta PHI**"

If the to-be-opened CB failed to open, the device will automatically de-couple the to-be-closed CB.

The time sequence under SIMULTANEOUS can be understandable via the below figure (assumed switching of closing CB2 and opening CB1),

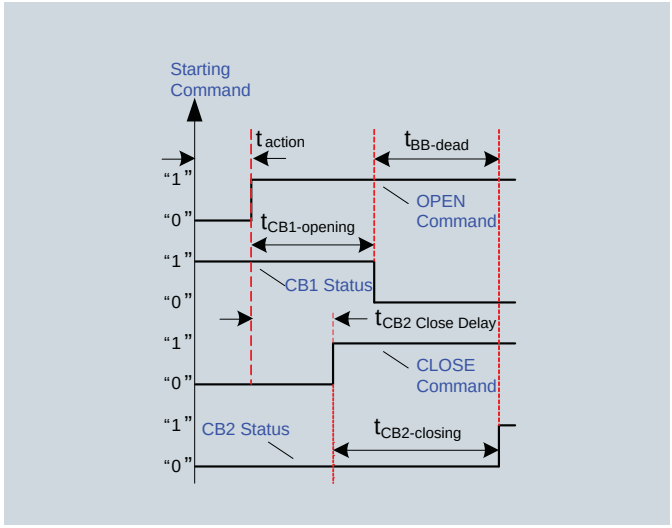

Fig.5 Time sequence of SIMULTANEOUS

Due to the different operating time of the CB(a CB normally opens faster than it close), the power supply of busbar will be interrupted for a few milliseconds. The length of this dead interval depends on the difference of CB operating time.

- SEQUENTIAL switching sequence

Under SEQUENTIAL sequence, HSBT 7VU683 will firstly issue a OPEN command to the to-be-opened CB after the device get the starting command. Differentiate from PARALLEL and SIMULTANEOUS switching sequences, SEQUENTIAL sequence can only issue CLOSE command after the opening succeeded.

The time sequence under SEQUENTIAL can be understandable via the below figure (assumed switching of closing CB2 and opening CB1),

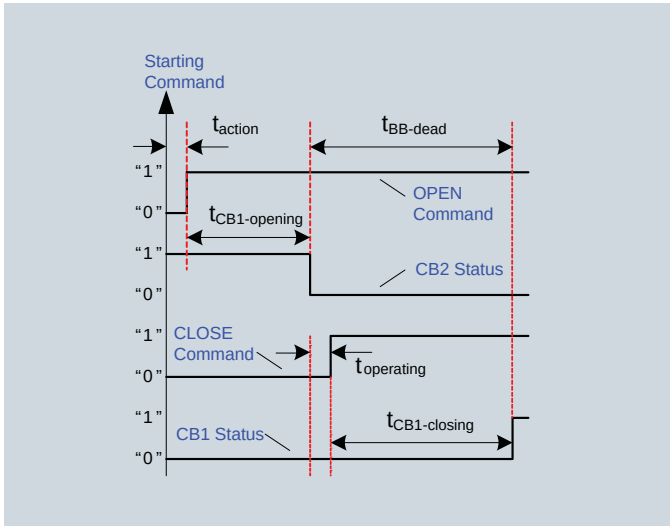

Fig.6 Time sequence of SEQUENTIAL

Transfer modes

In the station service system of power station and industrial plants, lots of asynchronous motors are connected. In case of the main source interruption, the residual voltage of busbar will be induced by connected asynchronous motors. Fig.7 shows the well-known typical diagram of vector trajectory of residual voltage.

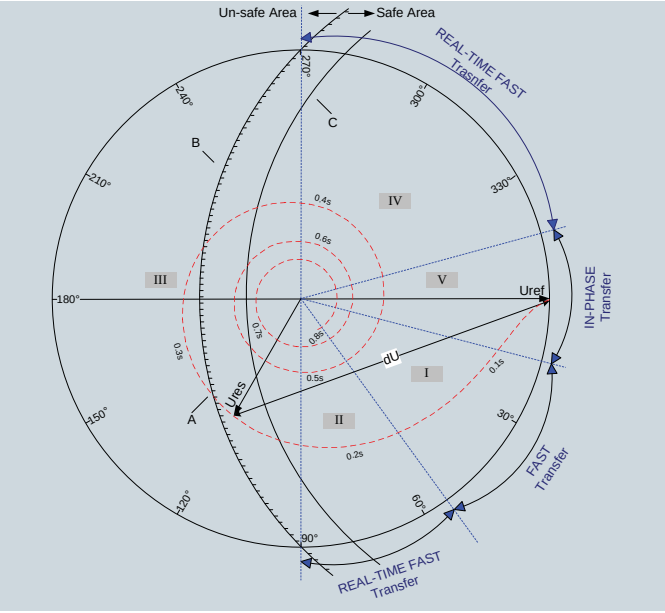

Fig.7 Vector trajectory of residual voltage

Some notes are there regarding curve A according to Fig.10. The amplitude and frequency of residual voltage will decrease regarding time, while the delta phase angle against referred voltage will increase. Fig.8 gives more messages to differential voltage.

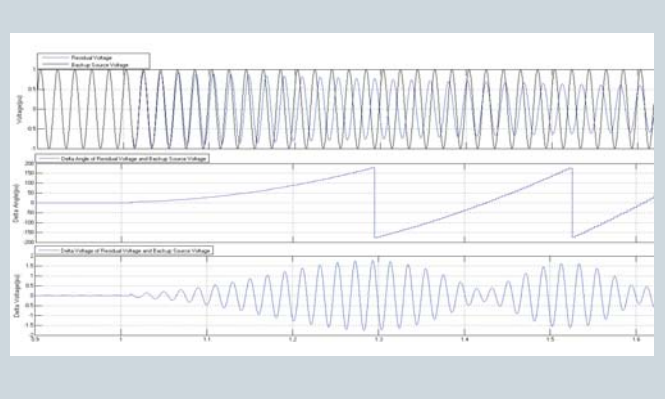

Fig.8 Characteristic of vector dU

The equivalent circuit of residual voltage Ures and referred voltage Uref is shown in Fig.9.

The voltage drop on motor Um at instant of CB closing is calculated by following,

$$U_m = dU \cdot x_m / (x_m + x_s) = \mathbf{k} \cdot dU \qquad \text{(Equa.-1)}$$

Here, x_m and x_s are respectively the equivalent reactance of busbar loading and referred system.

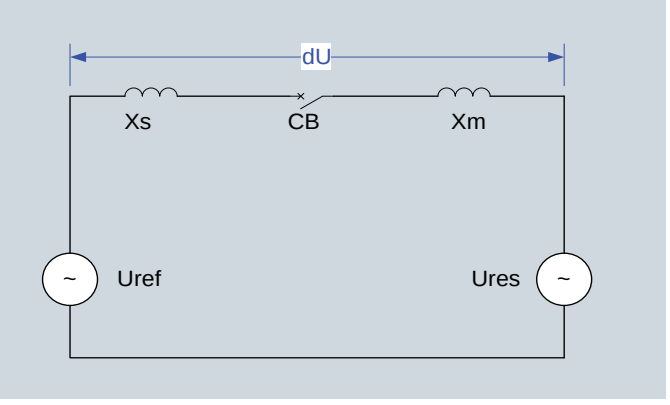

Fig.9 Equivalent circuit of dU

For safety reason, the value $|U_m|$ must not exceed the permissible voltage $k_{o/v} \cdot |U_n|$, Then, the maximum of permissible differential voltage $|dU|_{max}$ will be,

$$|dU|max = k_{o/v} / k \cdot |U_n| \qquad \text{(Equa.-2)}$$

In case $k_{o/v} = 1.1$ and $k = 0.67$, the calculated $|dU|_{max}$ should be less than $1.64 \cdot |U_n|$ (refer to curve B in Fig.7).
In case $k_{o/v} = 1.1$ and $k = 0.95$, the calculated $|dU|_{max}$ should be less than $1.15 \cdot |U_n|$ (refer to curve C in Fig.7). This calculation result would be the base for setting.

The plane is divided into two parts by curve B (or curve C). The left is defined as un-safe area because the value |dU| is bigger than the up-limit $|dU|_{max}$ which could damage the winding of stator. Vice versa, the right is safe area.

Based on the above principles, the category HSBT 7VU683 is designed to have the following modes (refer to Fig.7) to fit for the safe transfer,

- FAST transfer mode (area **I**)
- REAL-TIME FAST transfer mode (area **II** and **IV**)
- IN-PHASE transfer mode (area **V**)
- RES-VOLT transfer mode
- LONG-TIME transfer mode

All of above modes can be freely combined together, i.e, one of them can be individually switched "ON" or "OFF" remotely via communication or locally at device panel.

To be noted that the original dφ and |dU| between busbar voltage and standby voltage due to wiring can be automatically compensated by device during configuration.

• FAST transfer mode

The study and testing results show, in most cases the typical values of df, dφ and |dU| are smaller enough within the first tens of millisecond from the instant the CB opens. It's good to safe and fast transfer due to the slight shock to motors. If the real-time measured df, dφ and |Ures| meet the defined criterions, the device will immediately issue the CLOSE command to the to-be-closed CB. The criterions are as below,

– df < 8858 " **FT Delta f**"
– dφ <8859 "**FT Delta PHI**"
– |Ures| > 8860 "**FT U/V BLK**"

The typical operating time of 7VU683 in this case is approx.20ms. As modern vacuum breaker has less making time, e.g, 60ms, the dead time of busbar will be as short as approx.80ms.

• REAL-TIME FAST transfer mode

When FAST transfer chance is missed, the device will automatically, if activated, turn to next transfer mode REAL-TIME FAST.

This mode has more concerning on the permissible motor voltage, i.e, the differential voltage |dU| across the opened CB must not exceed the value $|dU|_{max}$. The intelligent device 7VU683 then estimates the delta phase angle dφ and differential voltage dU at the instant the CB closes based on real-time slipping rate and the settable "**CBx Closing Time**". If all the quantity of predicted dφ and dU, the real-time df and |Ures| meet the defined criterions, the device will immediately issue the CLOSE command to the to-be-closed CB. The criterions are as below,

– df < 8861 " **RTFT Delta f**"
– |dU| < 8862 "**RTFT Delta U**"
– dφ< 8863 "**RTFT Delta PHI**"
– |Ures| > 8864 "**RTFT U/V BLK**"

• IN-PHASE transfer mode

When the residual voltage comes close to the referred voltage, it comes to transfer mode IN-PHASE. It's good for safe transfer if the CB closes at the instant the value dφ is zero.

The intelligent device 7VU683 estimates the delta phase angle dφ at the instant the CB closes. based on real-time slipping rate and the settable "**CBx Closing Time**". If If all the quantity of predicted dφ, the real-time df and |Ures| meet the defined criterions,, the device will immediately issue the CLOSE command to the to-be-closed CB. The criterions are as below,

– df < 8868 " **IN-PHA Delta f**"
– dφ < 8869 "**IN-PHA Delta PHI**"
– |Ures| > 8870 "**IN-PHA U/V BLK**"

• RES-VOLT transfer mode

If the above mentioned transfer modes failed, the transfer can still go on with mode RES-VOLT.

When the residual voltage |Ures| under-shots the settable parameter 8871 "**RES-VOLT Threshold**", the RES-VOLT transfer mode will perform and the device will immediately issue the CLOSE command to the to-be-closed CB. The typical setting could be 30%U_n.

To reduce the shock under low voltage restarting of motors, two stages of Low Voltage Load-Shedding (LVLSH) function are integrated in the device. LVLSH will pickup before the RES-VOLT transfer mode. This function can be activated or de-activated manually on site.

• LONG-TIME transfer mode

The last criterion to start the transfer is LONG-TIME mode if all above mentioned modes failed.

When the transfer time is more than the settable parameter 8872 "**LONG-TIME Threshold**", the LONG-TIME transfer mode will perform and the device will immediately issue the CLOSE command to the to-be-closed CB. The typical setting could be 3s.

High Speed Busbar Transfer - HSBT functions

Switching directions

The device support bi-direction power transfer under NORMAL condition, i.e, the device can transfer the main source of busbar to standby depending on the actual CBs' status, vice versa.

In most cases, the switching is limited from main source to standby source under starting conditions of FAULT, Inadmissible Under-voltage, Inadmissible Under-frequency and Inadvertent CB Open. The requirement can be met by set the parameter 8831 "**Mono-direction against NORMAL condition**" = "**YES**". The default setting "**YES**" can be changed to "**NO**" if bi-direction transfer is always required in any conditions.

To be noted that power supply 1 is exclusively defined as main source while power supply 2 defined as standby source. Then, if mono-direction against NORMAL condition is required, power supply 1 in Fig.21~Fig.28 should be identified as main source.

The transfer permission under various starting conditions and switching directions can be referred to below two tables.

CB1 Status	CB2 Status	Switching-over		Voltage Comparison		Busbar Transfer Permitted?				
		From	To			NORMAL	FAULT	Inadmissible Undervoltage	Inadmissible Underfrequency	Inadvertent CB Open
Closed	Open	L1	L2	U_B	U_L2	Yes	Yes	Yes	Yes	Yes
Open	Closed	L2	L1	U_B	U_L1	Yes	No[1)]	No[1)]	No[1)]	No[1)]

1) If parameter 8831 "Mono-direction against NORMAL" = "YES", this cell says No. Otherwise, this cell says Yes.

Table 2 Transfer permission under default setting, single busbar

CB1 Status	CB3 Status	CB2 Status	Switching-over		Voltage Comparison		Busbar Transfer Permitted?				
			From	To			NORMAL	FAULT	Inadmissible Undervoltage	Inadmissible Underfrequency	Inadvertent CB Open
Closed	Closed	Open	L1	L2	U_B2	U_L2	Yes	Yes	Yes	Yes	Yes
			B2	L2	U_B2	U_L2	Yes	/ [2)]	/ [2)]	/ [2)]	/ [2)]
Closed	Open	Closed	B1	B2	U_B1	U_B2	Yes	Yes	Yes	Yes	Yes
			B2	B1	U_B2	U_B1	Yes	No[1)]	No[1)]	No[1)]	No[1)]
Open	Closed	Closed	L2	L1	U_B1	U_L1	Yes	No[1)]	No[1)]	No[1)]	No[1)]
			B1	L1	U_B1	U_L1	Yes	/ [2)]	/ [2)]	/ [2)]	/ [2)]

1) If parameter 8831 "Mono-direction against NORMAL" = "YES", this cell says No. Otherwise, this cell says Yes.
2) Not applicable for this cell

Table 3 Transfer permission under default setting, segmented single busbar

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HSBT test mode

To facilitate the functional testing and site commissioning, the Test Mode is specially designed for this purpose. This function can be activated on site by parameter setting 8820 "**HSBT Test Mode**" = "**Yes**" or by indication 18020 "**>HSBT Test Mode**" via binary input.

If the function HSBT goes into Test Mode, the transfer process is the same except that the CLOSE command will be blocked. Instead, CLOSE command with test mark will be issued for indicating.

HSBT Test Mode could be helpful before the device is put into service. When CB is manually tripped, HSBT 7VU683 picks up and goes into transfer process. Under the assistance of integrated Fault Recorder and Event Log, the operating consequence and settings can be assessed. Optimization to parameter settings can be done based on the assessment.

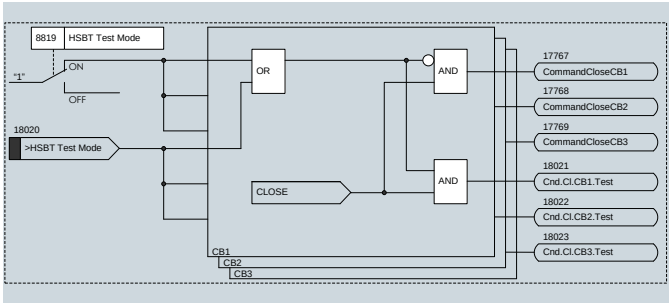


Fig.10 Logic diagram of test mode

Reset of transfer

The default setting is to block the device after once transfer is executed, i.e, either failure or success, the device goes into blocking status till to the reset indication via binary input or LED button on device panel. This can be changed by setting the parameter 8817 "**Manual Restart HSBT**" = "**NO**". Then, after once successful transfer, the device will automatically execute a new transfer request before the reset indication arrives. But, after once failed transfer, the device will go into blocking status till to the reset indication.

Sample of oscillographic FAST transfer

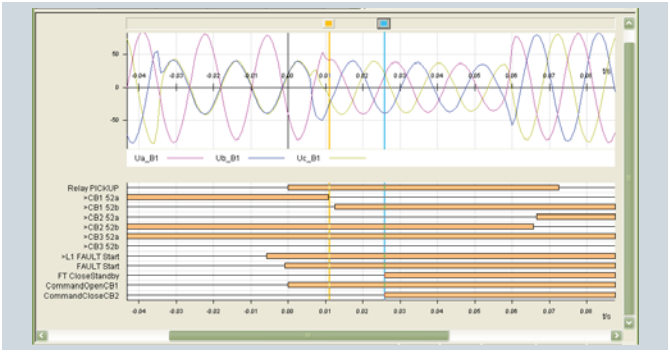
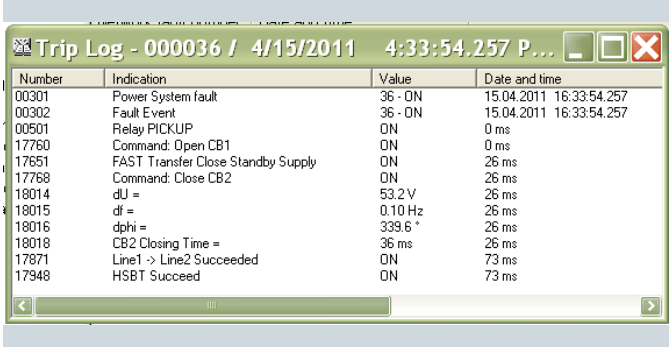


Fig.11 Oscillographic FAST transfer at segmented single busbar



Number	Indication	Value	Date and time
00301	Power System fault	36 - ON	15.04.2011 16:33:54.257
00302	Fault Event	36 - ON	15.04.2011 16:33:54.257
00501	Relay PICKUP	ON	0 ms
17760	Command: Open CB1	ON	0 ms
17651	FAST Transfer Close Standby Supply	ON	26 ms
17768	Command: Close CB2	ON	26 ms
18014	dU =	53.2 V	26 ms
18015	df =	0.10 Hz	26 ms
18016	dphi =	339.6 °	26 ms
18018	CB2 Closing Time =	36 ms	26 ms
17871	Line1 -> Line2 Succeeded	ON	73 ms
17948	HSBT Succeed	ON	73 ms

Fig.12 Trip log of FAST transfer at segmented single busbar

Some notes to the two figures,

- Primary connection of segmented single busbar
- Line1 in operating while Line2 in standby, CB3 serve as tie-CB which is in closed status
- Fault is there in Line1 and cleared by protection relay. Meanwhile, HSBT is started
- Switching-over between Line1 and Line2 are defined
- Instant 0ms, device picked up, CommandOpenCB1 issued
- Instant 12ms, CB1 opened
- Instant 26ms, CommandCloseCB2 issued
- Instant 62ms, CB2 closed
- FAST transfer succeeded, approx. 50ms dead time interval of busbar

Protection function

The Power Supply Transfer device 7VU68 integrates protection functions for tie-CB in primary connection of Segmented Single Busbar. This function can be set "**Enabled**" or "**Disabled**" during configuration.

The protection include the following functions,

– Phase overcurrent protection

– Ground overcurrent protection

– Phase overcurrent protection for Busbar Energization

– Ground overcurrent protection for Busbar Energization

To secure the reliability and sensitivity, the voltage element is additionally introduced to current criterion to release trip command.

For functions of Phase-overcurrent protection and Phase overcurrent for Busbar Energization, compound voltage element is used. The criterion of compound voltage element is illustrated in Fig.13

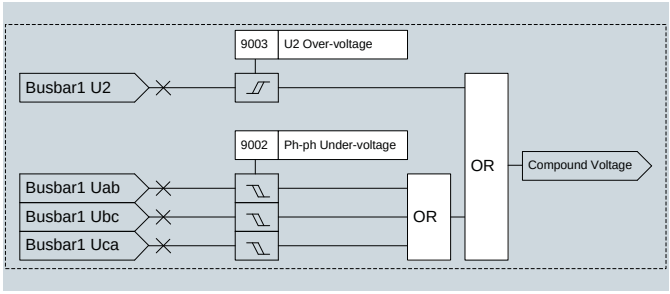


Fig.13 Logic of compound voltage element

For functions of ground overcurrent protection and ground overcurrent protection for Busbar Energization, the element of zero sequence over-voltage is used. The quantity is derived from calculated 3U0 based on measured busbar1 voltage.

The validity of protections in case of busbar energization can be set under parameter 9019A "A**ctive Time for Busbar Energization**".

Each of above functions can be separately switched "**ON**" or "**OFF**" remotely via communication or locally at device panel.

Phase-overcurrent protection

This function is designed to detect any short-circuit faults in MV system. The device will evaluate all current inputs at channel I_B and will pickup immediately if one of phase current over-shots the settable threshold.

The function has two stages, one time delay for each stage.

The voltage element can be activated or de-activated under parameter 9001 "**Compound Voltage Control**".

Ground-overcurrent protection

This function is designed to detect ground fault in MV system. The device will evaluate zero sequence current and will pickup immediately if it over-shots the settable threshold.

The quantity of zero sequence current is derived from calculated 3I0 or measured ground current Ie. This can be

set under parameter 9018 "**3I0/Ie Assignment**".

The function has two stages, one time delay for each stage.

The voltage element can be activated or de-activated under parameter 9011 "**3U0 Control**".

Phase-overcurrent protection for busbar energization

To avoid any switch-onto-fault, the function phase-overcurrent protection can be activated for some time after the busbar is energized when tie-CB is closed. An individual function phase-overcurrent protection for busbar energization is specially designed for this utilization.

The function has the same criterion and stages to phase-overcurrent protection. The function will not be activated until the tie-CB is closed.

Ground-overcurrent protection for busbar energization

To avoid any switch-onto-fault, the function ground-overcurrent protection can be activated for some time after the busbar is energized when tie-CB is closed. An individual function ground-overcurrent protection for busbar energization is specially esigned for this utilization.

The function has the same criterion and stages to ground-overcurrent protection. The function will not be activated until the tie-CB is closed.

Communication

With respect to communication, particular emphasis has been placed on high levels of flexibility, data integrity and utilization of standards common in energy automation. The design of the communication modules permits interchangeability on the one hand, and on the other hand provides openness for future standards (for example, Industrial Ethernet).

Local PC interface

The PC interface from the front of the unit permits quick access to all parameters and fault event data. The use of the DIGSI 4 operating program during commissioning is particularly advantageous.

Rear mounted interface

At the rear of the unit there is one fixed interface and two communication modules which incorporate optional equipment complements and permit retrofitting. They assure the ability to comply with the requirements of different communication interfaces (electrical or optical) and protocols (IEC 60870, PROFIBUS, DIGSI). The interfaces make provision for the following applications:

Service interface (fixed)

In the RS485 version, several protection units can be centrally operated with DIGSI 4. By using a modem, remote control is possible. This provides advantages in fault clearance, in particular in unmanned substations.

System interface

This is used to communicate with a control or protection and control system and supports, depending on the module connected, a variety of communication protocols and interface designs. Furthermore, the units can exchange data through this interface via Ethernet and IEC 61850 protocol and can also be operated by DIGSI.

IEC 61850 protocol

As of mid-2004, the Ethernet-based IEC 61850 protocol is the worldwide standard for protection and control systems used by power supply corporations. Siemens is of the first manufacturer to support this standard and has 200.000 IEC61850 devices in operation. By means of this protocol, information can also be exchanged directly between bay units so as to set up simple masterless systems for bay and system interlocking. Access to the units via the Ethernet bus will also be possible with DIGSI.

IEC 60870-5-103

IEC 60870-5-103 is an internationally standardized protocol for communication in the protected area. IEC 60870-5-103 is supported by a numerous of manufacturers and is used worldwide.

PROFIBUS-DP

PROFIBUS is an internationally standardized communication system (EN 50170). PROFIBUS is supported internationally by several hundred manufacturers and has to date been used in more than 1,000,000 applications all over the world. With the PROFIBUS-DP, the device can be directly connected to a SIMATIC S5/S7. The transferred data are fault data, measured values and information from or to the logic (CFC).

MODBUS RTU

MODBUS is also a widely utilized communication standard and is used in numerous automation solutions.

Safe bus architecture

- RS485 bus

With this data transmission via copper conductors, electromagnetic interference influences are largely eliminated by the use of twisted-pair conductor. Upon failure of a unit, the remaining system continues to operate without any faults.

- Fiber-optic double ring circuit

The fiber-optic double ring circuit is immune to electromagnetic interference. Upon failure of a section between two units, the communication system continues to operate without disturbance.

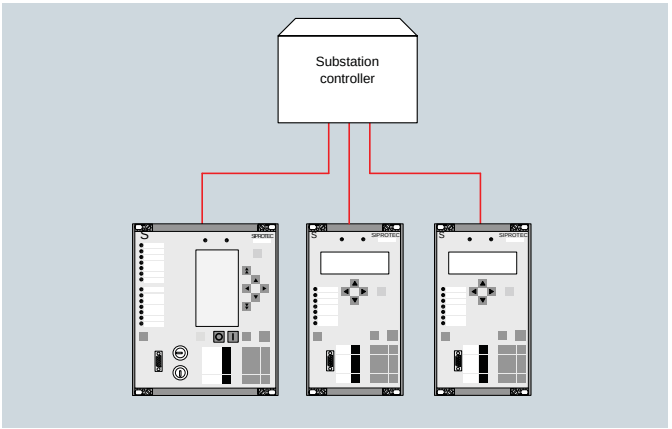


Fig. 14 IEC 60870-5-103: Radial electrical or fiber-optic connection

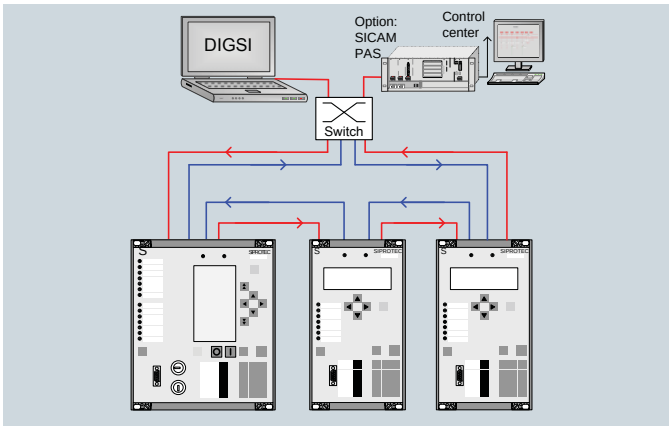


Fig.15 Bus structure for station bus with Ethernet and IEC 61850, fiber-optic ring

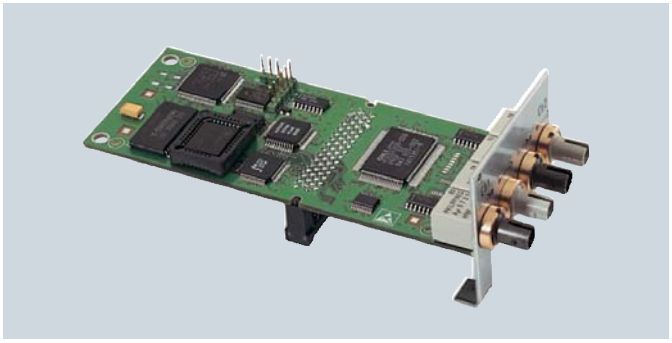


Fig.16 PROFIBUS communication module, optical, double ring

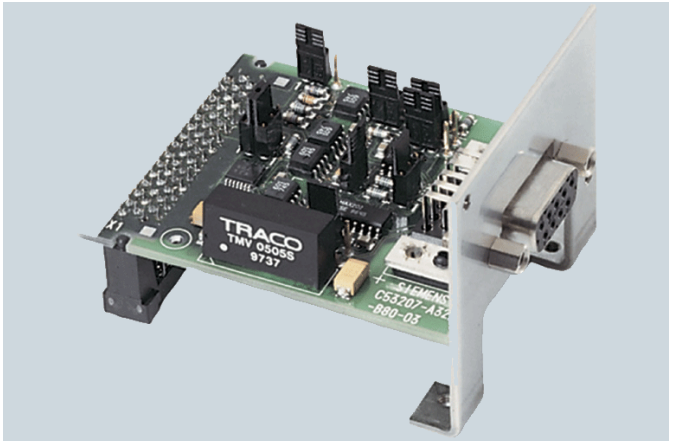


Fig.17 RS232/RS485 electrical communication module

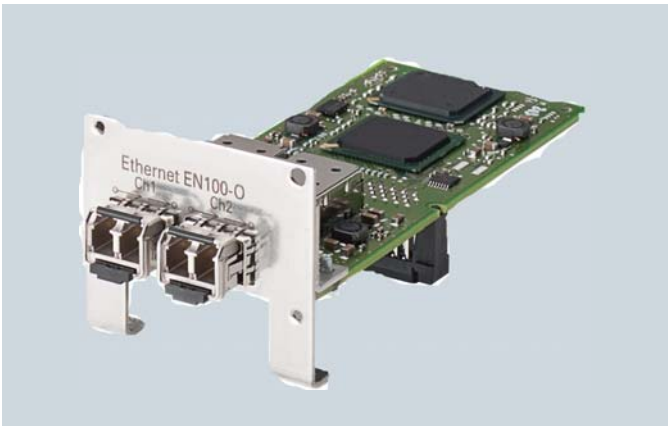


Fig.18 Optical Ethernet communication module for IEC 61850 with integrated Ethernet-switch

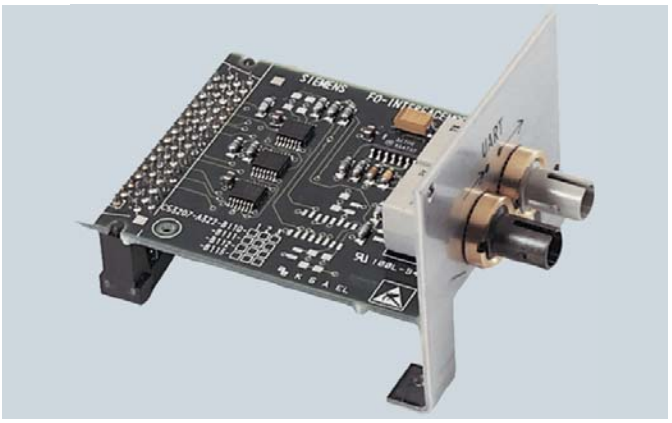


Fig.19 Fiber-optic communication module

System solution

SIPROTEC 4 is tailor-made for use in SIMATIC-based automation systems.

Via the PROFIBUS-DP, indications (pickup and tripping) and all relevant operational measured values are transmitted from the HSBT device.

Via modem and service interface, the electric engineer has access to the protection devices at all times. This permits remote maintenance and diagnosis (cyclic testing).

Parallel to this, local communication is possible, for example, during a major inspection. For IEC 61850, an interoperable system solution is offered with SICAM PAS. Via the 100 Mbit/s Ethernet bus, the unit are linked with PAS electrically or optically to the station PC. The interface is standardized, thus also enabling direct connection of units of other manufacturers to the Ethernet bus. With IEC 61850, however, the units can also be used in other manufacturers' systems.

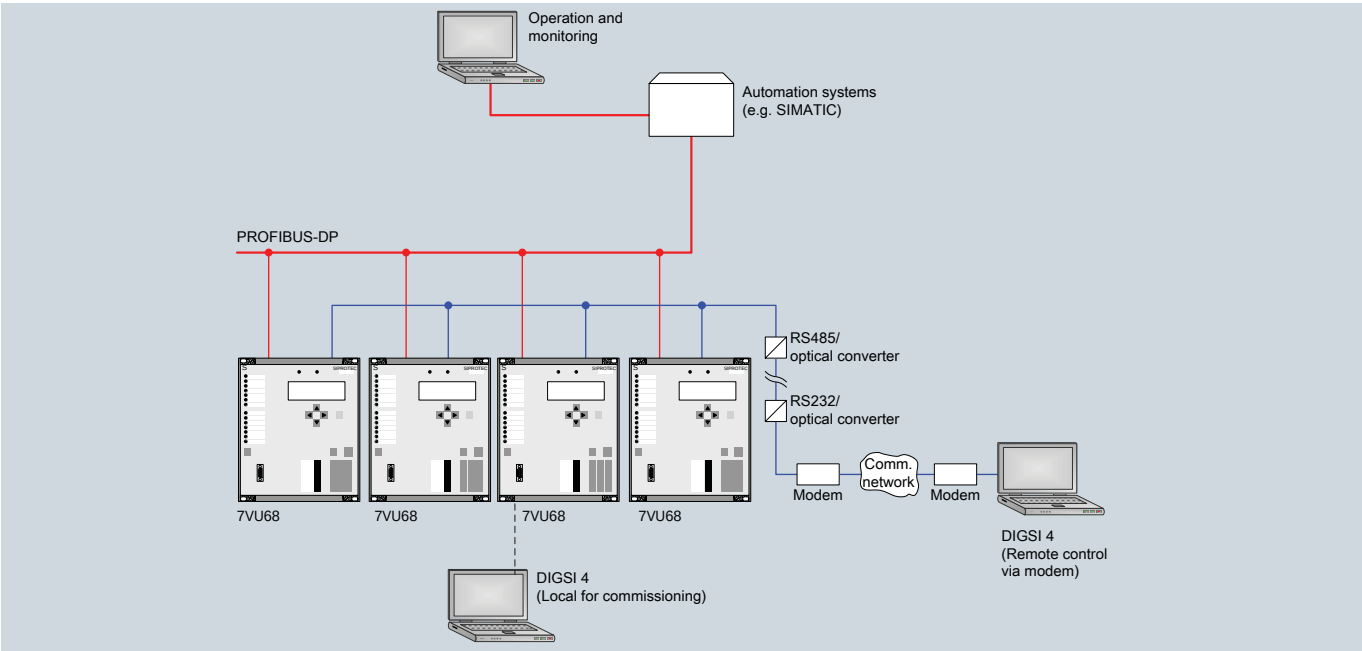


Fig.20 System solution: communication

High Speed Busbar Transfer - Typical applications

Typical applications

Primary connection of single busbar

The device HSBT 7VU683 will automatically determine the switching direction based on the actual CBs' status.

Each switching-over can be individually switched "**ON**" or "**OFF**" remotely via communication or locally at device panel.

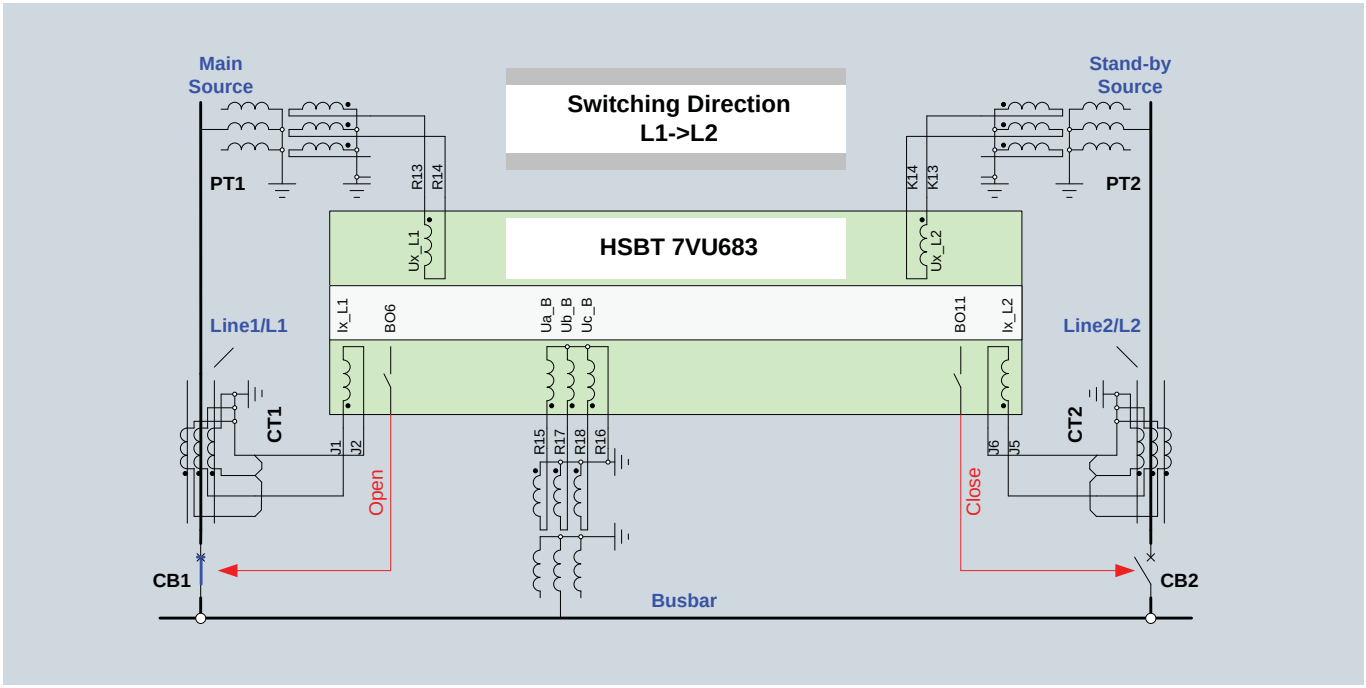


Fig.21 Switching-over L1->L2, single busbar

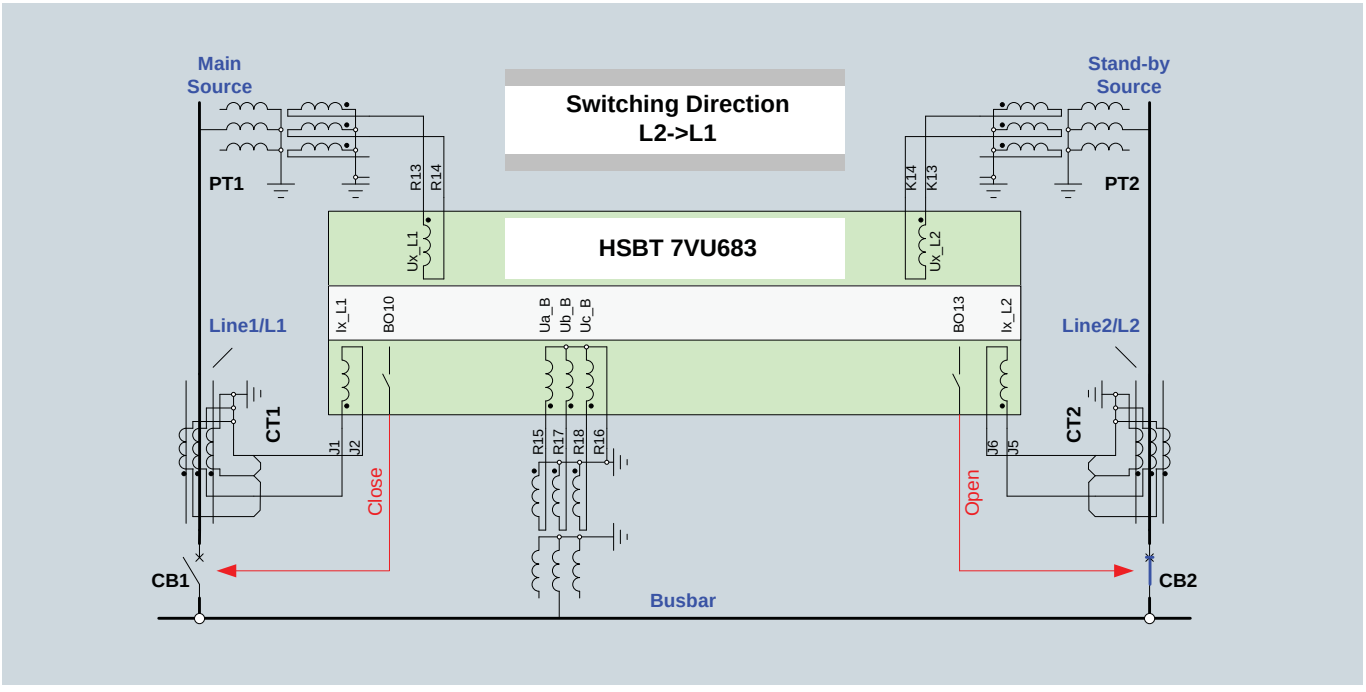


Fig.22 Switching-over L2->L1, single busbar

Primary connection of segmented single busbar: CB1 and CB3 are closed, CB2 is opened

In case of these CBs' status, two possible switching directions are there. Then, the starting command of two switching directions must be externally separately routed to device's binary inputs, e.g, starting command L1->L2 routed to BI13, B2->L2 to BI12. The device will properly execute the switching direction based on the command input under this case.

Each switching-over can be individually switched "**ON**" or "**OFF**" remotely via communication or locally at device panel.

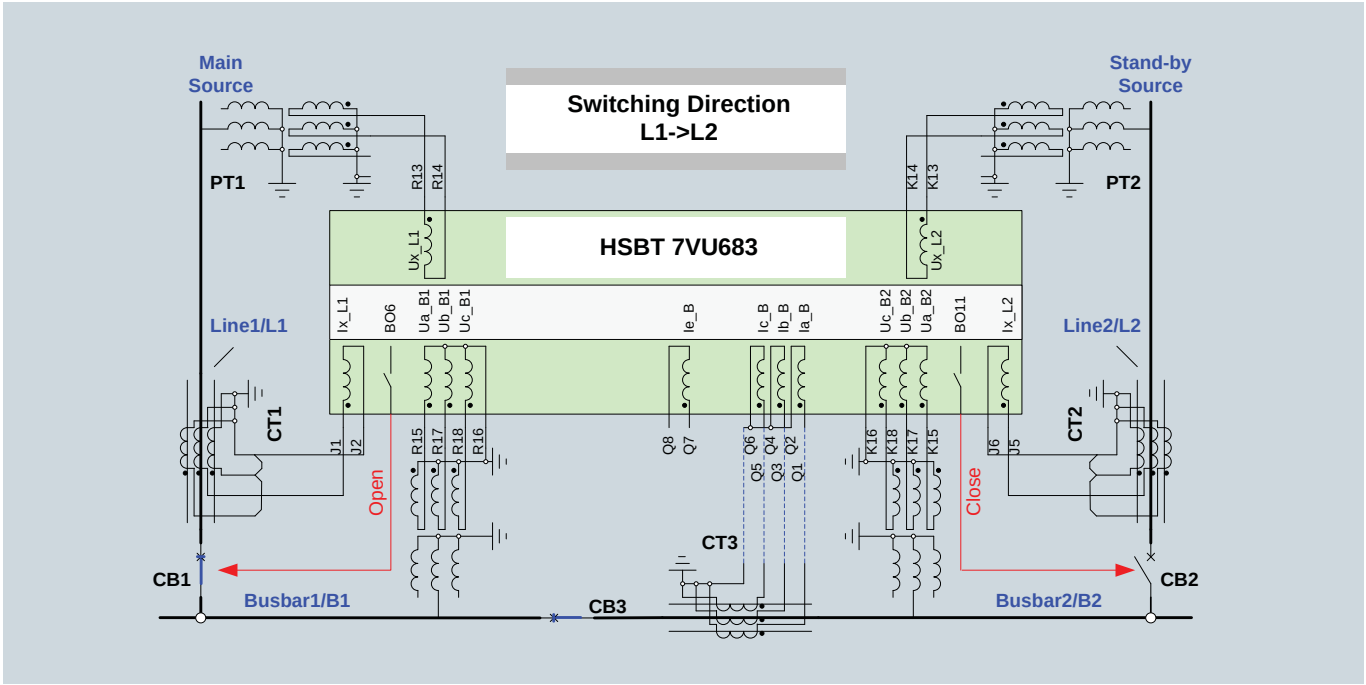


Fig.23 Switching-over L1->L2, segmented single busbar

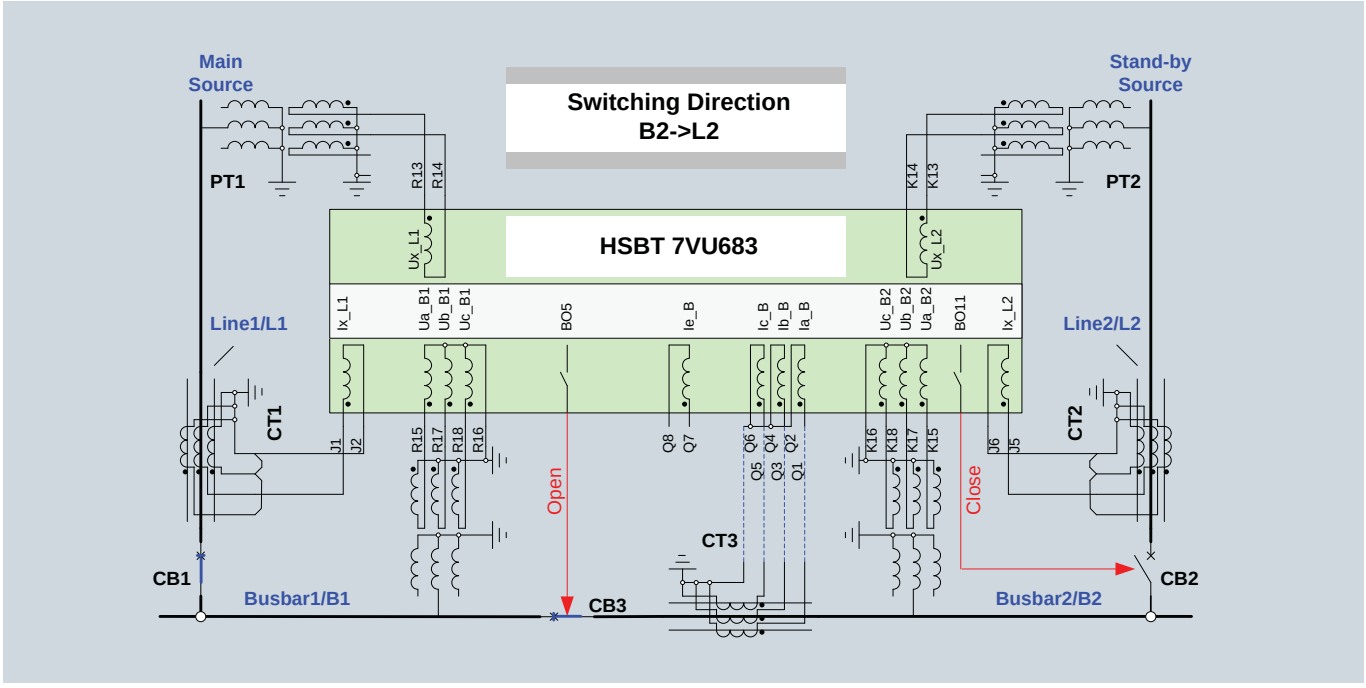


Fig.24 Switching-over B2->L2, segmented single busbar

High Speed Busbar Transfer – Typical applications

Primary connection of segmented single busbar: CB2 and CB3 are closed, CB1 is opened

In case of these CBs' status, two possible switching directions are there. Then, the starting command of two switching directions must be externally separately routed to device's binary inputs, e.g, starting command B1->L1 routed to BI13, L2->L1 to BI12. The device will properly execute the switching direction based on the command input under this case.

Starting command B1->L1 can be designated to BI13 too even if starting command L1->L2 is already there, the reason is only one of these two switching directions will be automatically executed by device based on the actual CBs' status. The same situation applies to L2->L1.

The above switching-overs can be individually switched "**ON**" or "**OFF**" remotely via communication or locally at device panel.

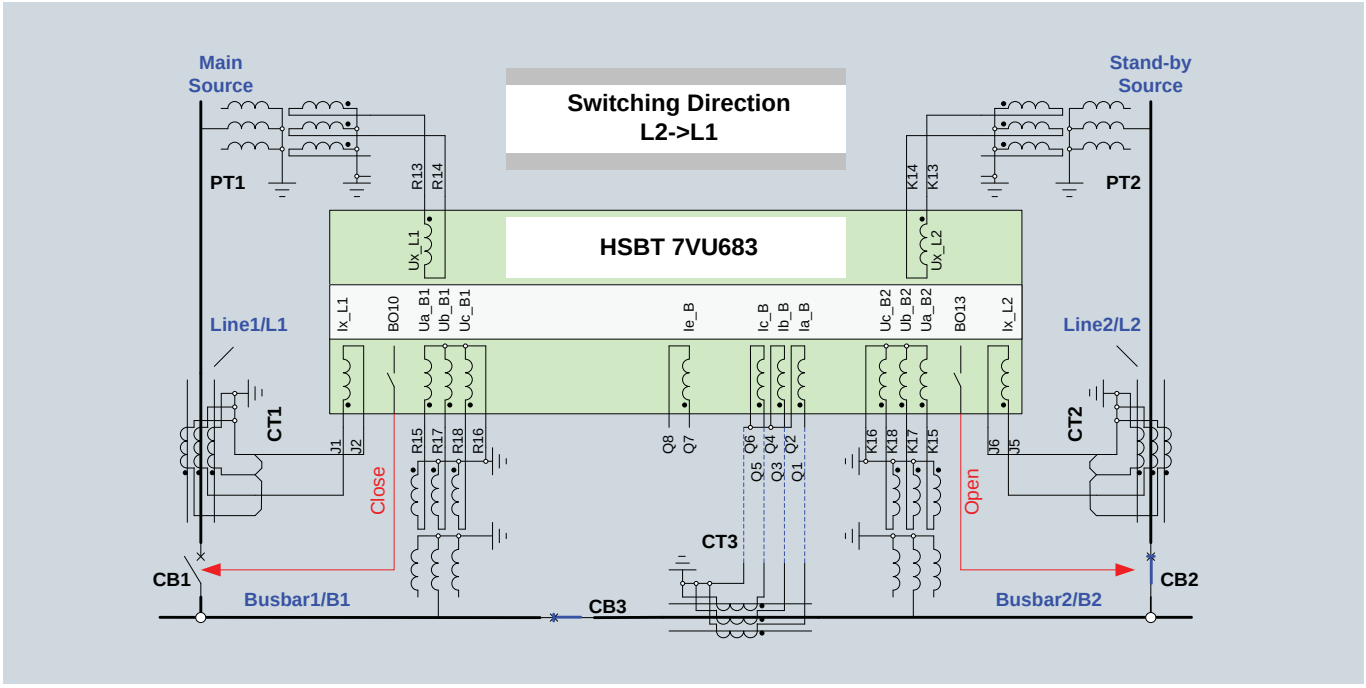


Fig.25 Switching-over L2->L1, segmented single busbar

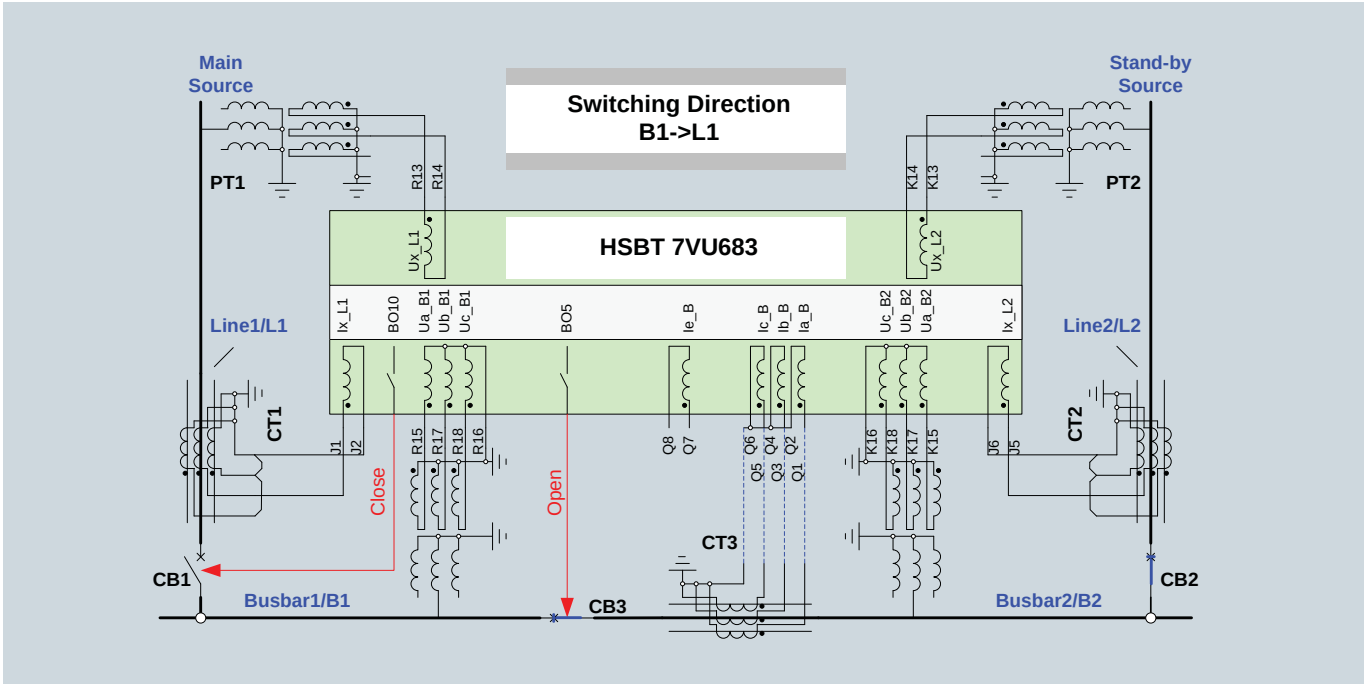


Fig.26 Switching-over B1->L1, segmented single busbar

Primary connection of segmented single busbar: CB1 and CB2 are closed, CB3 is opened

In case of these CBs' status, two possible switching directions are there. Then, the starting command of two switching directions must be externally separately routed to device's binary inputs, e.g, starting command B1->B2 routed to BI13, B2->B1 to BI12. The device will properly execute the switching direction based on the command input under this case.

Starting command B1->B2 can be designated to BI13 too even if starting command L1->L2 and B1->L1 are already there, the reason is only one of these three switching directions will be automatically executed by device based on the actual CBs' status. The same situation applies to B2->B1.

The above switching-overs can be individually switched "**ON**" or "**OFF**" remotely via communication or locally at device panel.

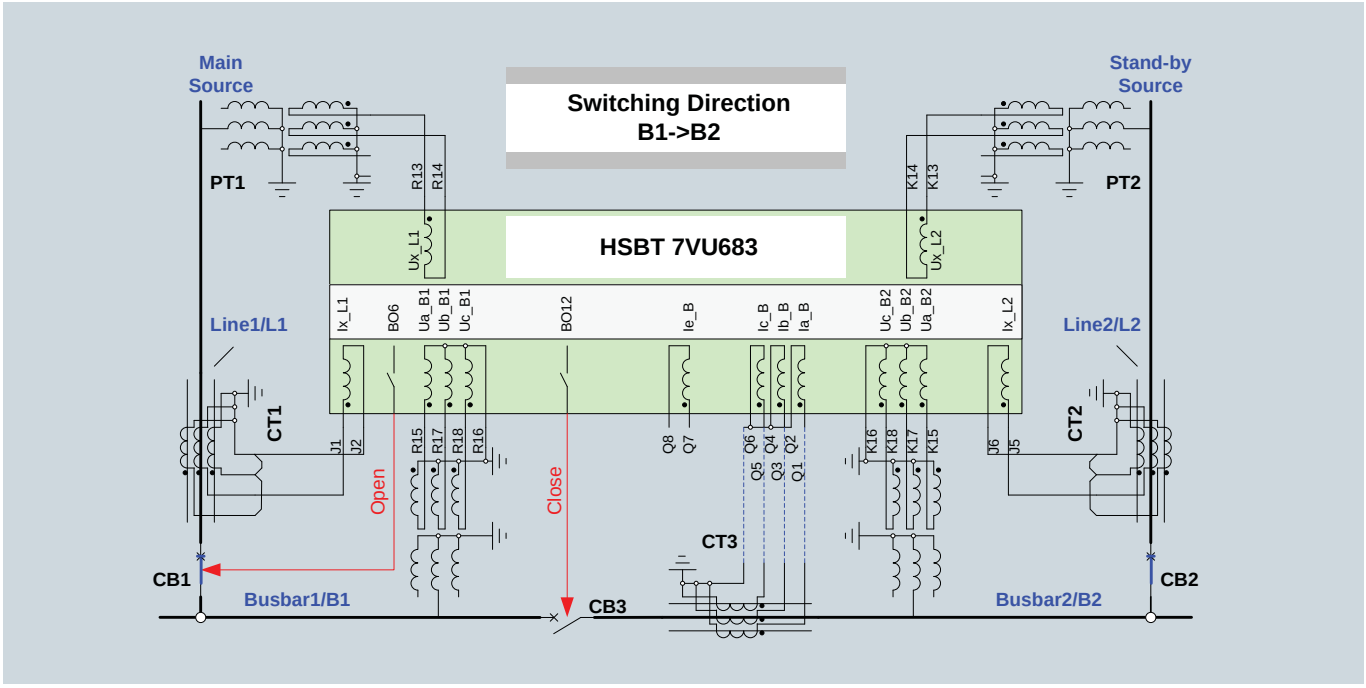


Fig.27 Switching-over B1->B2, segmented single busbar

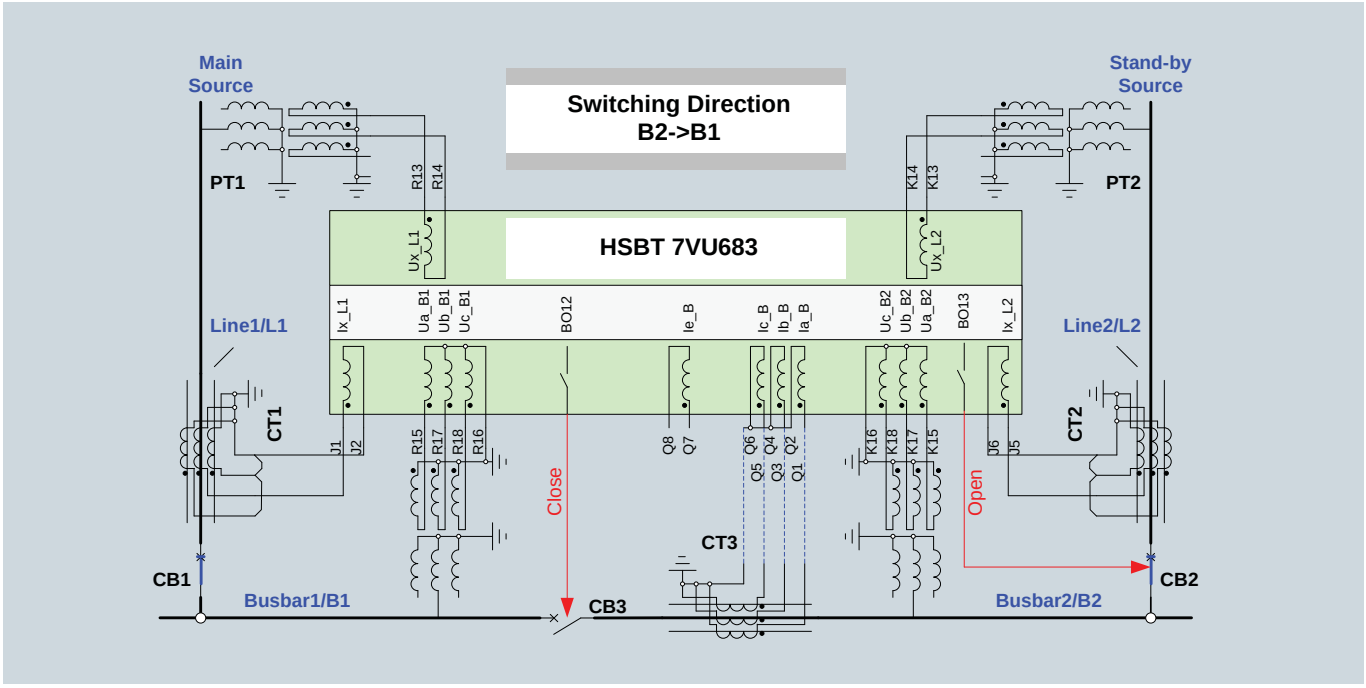


Fig.28 Switching-over B2->B1, segmented single busbar

7VU683

High Speed Busbar Transfer – Selection and ordering data

Description	Order No.	Short code
	7VU683 □ - □ E □□□ - 1 A A 0 - □□□	
7VU683 high speed busbar transfer device		
Housing binary inputs and outputs Housing 1/1 19", 17 BI, 18 BO (incl.5 High Speed), 1 live-status contact		
Current transformer: In		
IN=1A[1)]	1	
IN=5A[1)]	5	
Auxiliary Voltage		
DC 24 to 48 V, binary input threshold DC 19 V[3)]	2	
DC 60 to 125 V[2)], binary input threshold DC 19 V[3)]	4	
DC 110 to 250 V[2)], 115/230 V AC, binary input threshold DC 88 V[3)]	5	
DC 220 to 250 V[2)], 115/230 V AC, binary input threshold DC 176 V[3)]	6	
Construction		
Flush-mounting housing, screw-type terminals	E	
Region-specific default settings/ language Settings		
Region World,English[4)], 50/60Hz	B	
Region China,Chinese[4)], 50/60Hz	W	
Port B: (System port on rear of device)		
No system port	0	L 0 □
IEC 60870-5-103 Protocol, electrical RS232	1	
IEC 60870-5-103 Protocol, electrical RS485	2	
IEC 60870-5-103 Protocol, 820 nm fibre, ST-connector	3	
Profibus DP Slave, RS485	9	A
Profibus DP Slave, 820 nm fibre, double ring, ST-connector	9	B
Modbus, RS485	9	D
Modbus, 820 nm fibre, ST-connector	9	E
IEC 60870-5-103 Protocol, redundant RS485	9	P
IEC 61850, 100 Mbit Ethernet, electrical, double, RJ45-connector	9	R
IEC 61850, 100 Mbit Ethernet, with integrated switch optical, double, LC-connector	9	S
Port C (Service)		
Port C: DIGSI 4/Modem, electrical RS232;	1	
Port C: DIGSI 4/Modem/ RTD-box, electrical RS485;	2	
Measuring/ fault recording		
Basic measured Values	1	
Functions		
High Speed Busbar Transfer (HSBT) (2 or 3 circuit breakers) Protection functions (Overcurrent phase/earth (50, 50N); Overcurrent phase/ earth for busbar energization Supervision functions	A	

1) Rated current 1/5 A can be selected by means of jumpers.

2) Transition between the three auxiliary voltage can be selected by mean of jumpers;

3) The threshold of each binary input can be set via jumpers.

4) Device language can be selected via DIGSI,

Description	Order No.
DIGSI 4 Software for configuration and operation of Siemens protection units running underMSWindows XP Professional Edition, Windows 7 (32- and 64-bit) and Windows Server 2008 R2 64-bit, device templates, Comtrade Viewer, electronic manual included as well as "Getting started" manual on paper, connecting cables (copper), Basis Full version with license for 10 computers, on CD-ROM (authorization by serial number)	7XS5400-0AA00
Professional DIGSI 4 Basis and additionally SIGRA (fault record analysis), CFC Editor (logic editor), Display Editor (editor for default and control displays) and DIGSI 4 Remote (remote operation)	7XS5402-0AA00
Professional + IEC 61850 Complete version DIGSI 4 Basis and additionally SIGRA (fault record analysis), CFC Editor (logic editor), Display Editor (editor for default and control displays) and DIGSI 4 Remote (remote operation) + IEC 61850 system configurator	7XS5403-0AA00
IEC 61850 Systemconfigurator Software for configuration of stations with IEC 61850 communication under DIGSI, Optional package for DIGSI 4 Basis or Professional License for 10 PCs. Authorization by serial number. On CD-ROM	7XS5460-0AA00
SIGRA 4 (generally contained in DIGSI Professional, but can be ordered additionally) Software for graphic visualization, analysis and evaluation of fault records. Can also be used for fault records of devices of other manufacturers (Comtrade format). Incl. templates, electronic manual with license for 10 PCs. Authorization by serial number. On CD-ROM.	7XS5410-0AA00
Connecting cable Cable between PC/notebook (9-pin connector) and protection unit (9-pin connector) (contained in DIGSI 4, but can be ordered additionally)	7XV5100-4

High Speed Busbar Transfer - Accessories

Description		Order No.		Size of package	Supplier	Fig.
Mounting rail		C73165-A63-D200-1		1	Siemens	29
Short-circuit link	For current terminals For other terminals	C73334-A1-C34-1 C73334-A1-C34-1		1 1	Siemens Siemens	30 31
Safety cover for terminals	Large Small	C73334-A1-C31-1 C73334-A1-C32-1		1 1	Siemens Siemens	

1) Your local Siemens representative can inform you on local suppliers.

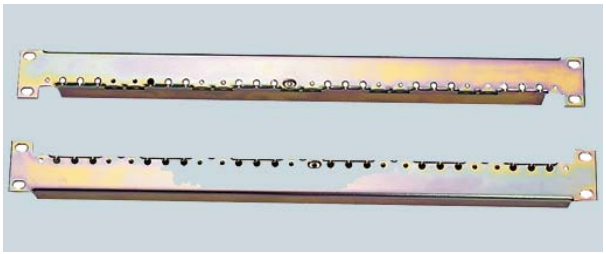


Fig.29 Mounting rail for 19" rack

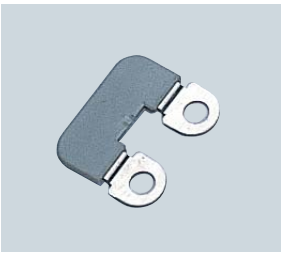


Fig.30 Short-circuit link for current terminals

Fig.31 Short-circuit link for voltage terminals/indications terminals

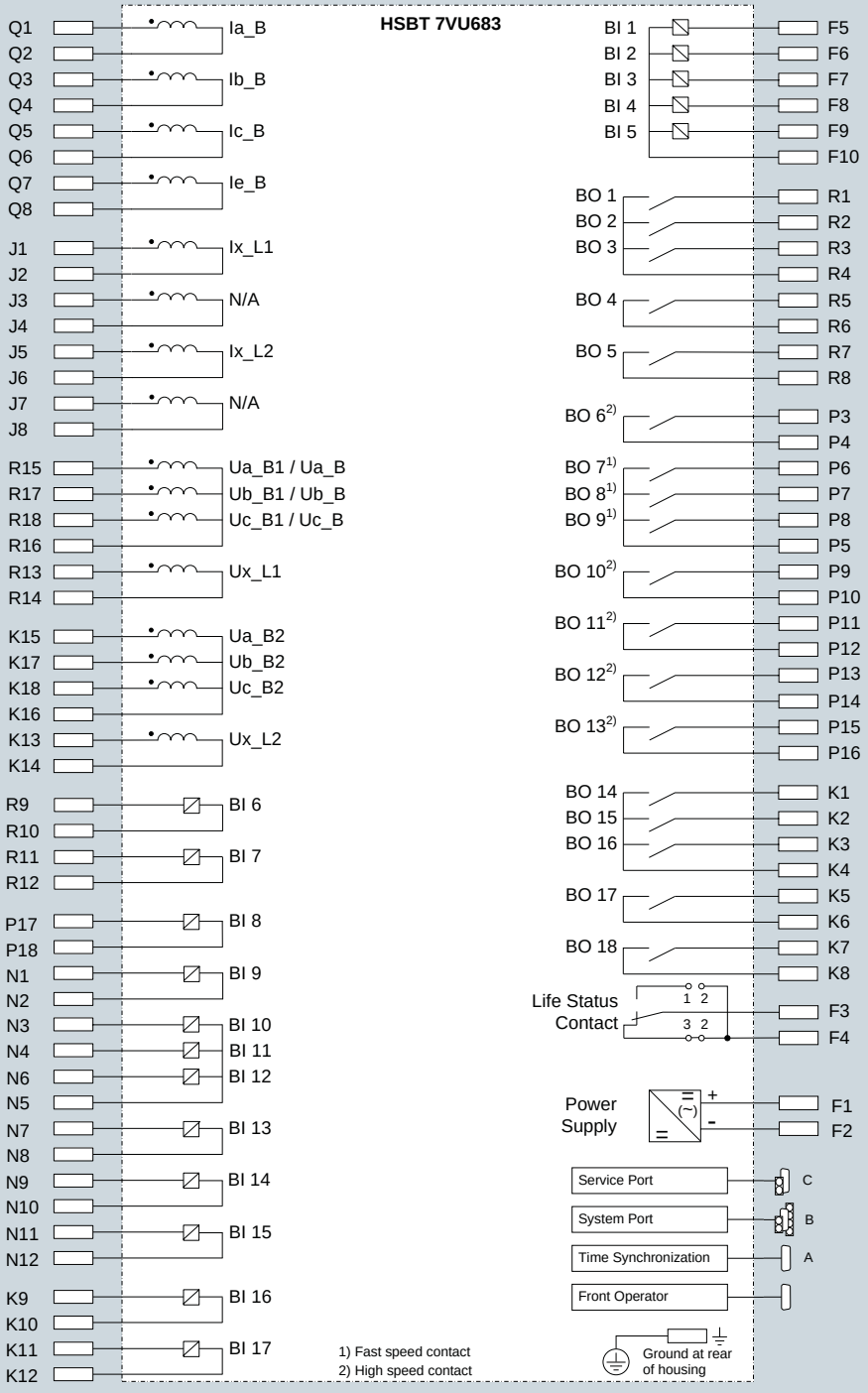


Fig.34 7VU683 connection diagram

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