SIPROTEC 4 7VU68

Multi-functional Power Supply Transfer Device

Product Catalogue V1.0

7VU683 V4.60 / 7VU681 V4.60

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KETOP开普

№: JW110274E – Dynamic

Dynamic Test Report

Sample Name: Power Supply Transfer Device **Type:** SIPROTEC 7VU68 **Specification:** AC/DC110V AC100V 1A 50Hz **Sample Quantity:**1 **Sample №:** KP110274	**Client:** Siemens Power Automation Ltd. **Manufacturer:** Siemens Power Automation Ltd. **Agent/Distributor:** / **Testing Site:** KETOP Lab

References:

DL/T 871-2004 The Dynamic Test of the Power System Protective Products
SIPROTEC Power Supply Transfer Device 7VU68 User's Manual

Conclusion:

Based on the test results described in this report, our lab declares that the EUT is in conformance with the requirements of references above.

Edited by: 周鹏鹏 **Tested by:** 周鹏鹏 **Signature:** 周鹏鹏 **Signature:** 周鹏鹏 **Audited by:** 王 伟 **Verified by:** 胡卫东 **Signature:** **Signature:**	China KETOP Laboratory National Center For Quality Supervision & Testing of Relay Protection and Automation Equipment May. 26, 2011

Remark: /

Fig.1 Front illustration of Power Supply Transfer Device 7VU68

DESCRIPTION

The reliable and continuous power supply is always a big concern in power system. Permanent availability of electricity is essential for reliable production of a great number of processes in power stations, chemical plants and petrochemical plants, etc. In power utility, e.g, in substation, although no rotating loads are there, the continuous power supply is also required for station service system.

Fig.2 Switchgears on site

In order to meet this requirement, 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. This switching-over will be automatically executed by power supply transfer device in short time.

The device SIPROTEC 4 7VU68 is specially designed for this application. Based on the existing world-wide used SIPROTEC 4 platform, the reliability, stability and efficiency are guaranteed. Thanks to its powerful and flexible performance, the device integrates all functions in one system, i.e, transfer function, protection and supervision.

The device 7VU68 has two individual categories of HSBT 7VU683 and ATS 7VU681. 7VU683 is designed for high speed busbar transfer system while 7VU681 for low speed automatic transfer system. Then, 7VU68 can serve for all switching-over applications of power stations, industrial plants and power utility.

Also, the application scope is largely extended by the hardware and software design. It fits for the primary connections of single busbar and segmented single busbar. The easy-to-use concept is characterized by the pre-defined and configured settings and large graphic LCD display.

The integrated protection functions are to be implemented in segmented single busbar connection, where tie-CB is to be protected against short-circuit and earth fault.

The integrated supervision function is to monitor the voltage phase sequence of busbar and voltage secondary circuit of both busbar and line, then gives out alarm in case of failure.

The integrated programmable logic (CFC) allows the users to implement their own functions. User-defined messages can be generated as well. The flexible communication interfaces are open for

modern communication architectures with remote control center.

Transfer Functions

- High speed transfer of category HSBT 7VU683, with high speed relay contact for CB closing (only 1ms).
- Low speed transfer of category ATS 7VU681

Protection Functions

- Phase O/C Protection
- Earth O/C Protection
- Phase O/C Protection for Busbar Energization
- Earth O/C Protection for Busbar Energization

Supervision Functions

- Self-supervision of the device
- Oscillographic fault recording
- Voltage phase sequence of busbar
- Voltage circuit monitoring of busbar and line

Communication Interfaces

- PC front port for DIGSI setting, RS232
- System Interface port B
  - IEC 60870-5-103, ST / RS485
  - IEC 60870-5-103, double RJ45
  - IEC 61850, Ethernet, double LC / RJ45
  - Modbus, ST / RS485
  - Profibus-DP, ST / RS485
- Rear service port C for remote DIGSI setting
- Time synchronization port A – DCF 77/IRIG B

Language Support

- English
- Chinese

TYPICAL APPLICATIONS

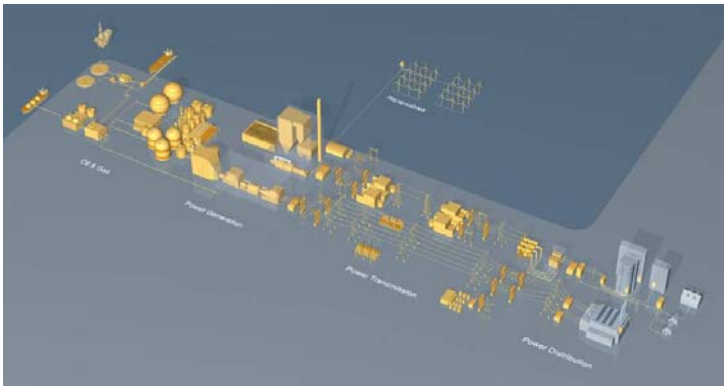

Fig.3 Energy chain

The device 7VU68 is subject to the below typical utilizations of power generation, power utility and industry in the whole energy chain.

Fig.4 Coal-fired power station

Power Generation-high speed transfer

- Coal-fired power station
- Gas-fired power station
- Combined Cycle power station
- Integrated Gasification Combined Cycle (IGCC) power station
- Nuclear power station

Power Generation-low speed transfer

- Hydro power station
- Pumped Storage power station

Fig.5 Substation

Power Utility - low speed transfer

- Substation

Fig.6 Petrochemical plant

Industry

- Chemical plant
- Petrochemical plant
- Refinery plant
- Iron and steel plant
- Cement plant
- ... ...

APPLICATION 1
HIGH SPEED TRANSFER - HSBT 7VU683

For the auxiliary power supply of power stations and certain industrial plants a safe medium voltage supply is extremely important especially for rotating loads. In case of one source interruption or failure, It's required to quickly and safely transfer the power supply to another source. In order to ensure this, such medium voltage busbars are installed with two or more independent incoming feeders to automatically change the source of the power supply via automation device, if necessary.

Such kind of automation equipment to secure the quick and safe transfer of sources is called as High Speed Busbar Transfer device (HSBT). Siemens is very early involved and has tens-year long and experienced history in this field. The technical leading solution type AUE series are now world-widely used in power stations and industrial plants.

The category HSBT 7VU683 of Power Supply Transfer device 7VU68 is a compact solution based on type AUE series. It has incorporated the latest concepts on high speed transfer, i.e, various starting conditions, switching sequences and transfer modes. Additionally, the protection functions for tie-CB in application Segmented Single Busbar and the supervision functions for voltage circuit are integrated.

Starting Conditions

The category 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),

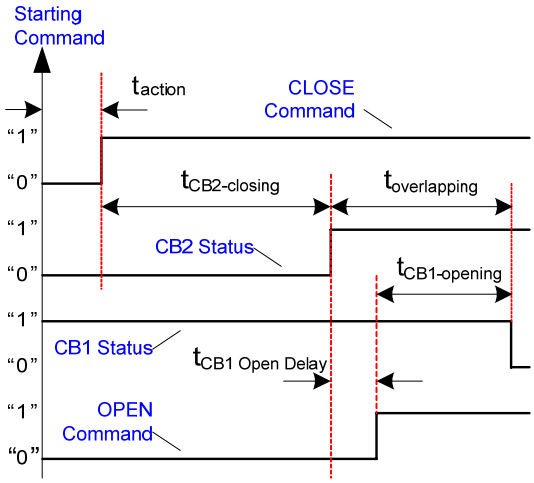

Fig.7 Time sequence of PARALLEL

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 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),

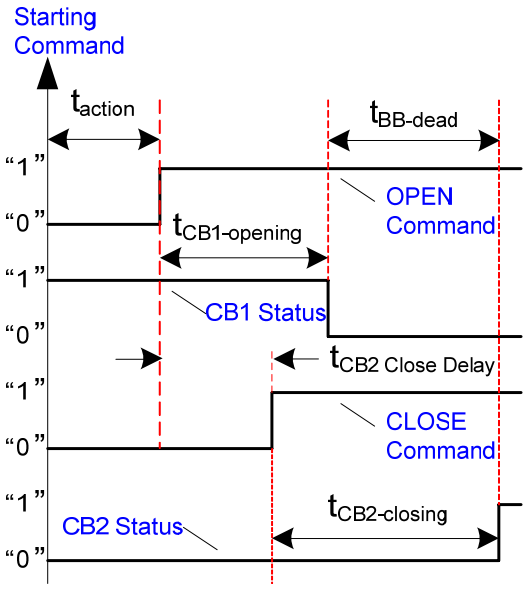

Fig.8 Time sequence of SIMULTANEOUS

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, the SIMULTANEOUS sequence can be used for power supply transfer.

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),

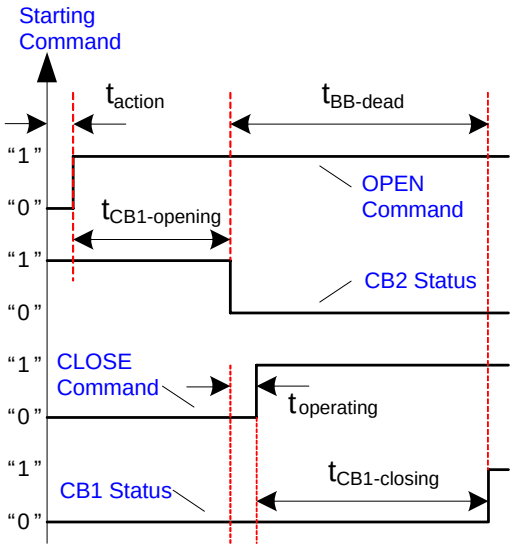

Fig.9 Time sequence of SEQUENTIAL

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.10 shows the well-known typical diagram of vector trajectory of residual voltage.

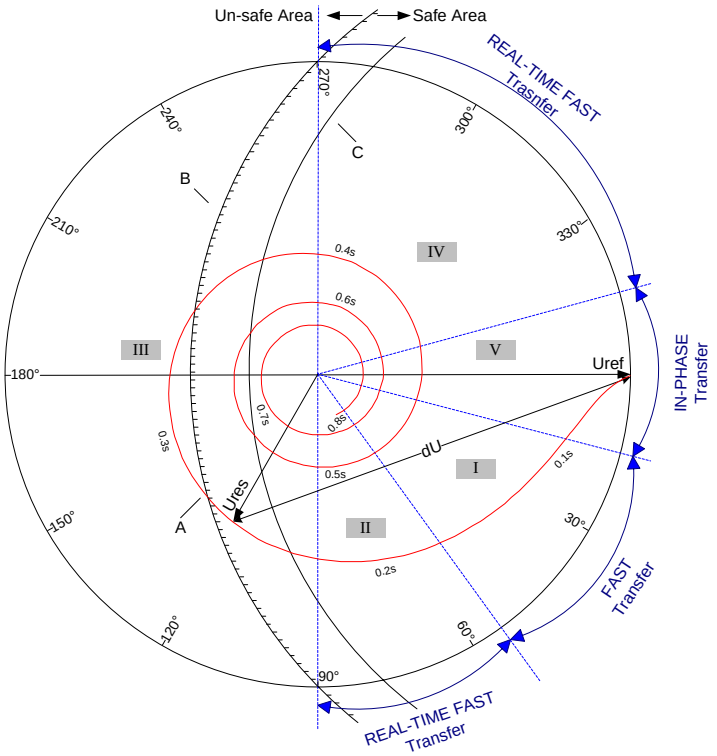

Fig.10 Vector trajectory of residual voltage

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.11 gives more messages to differential voltage.

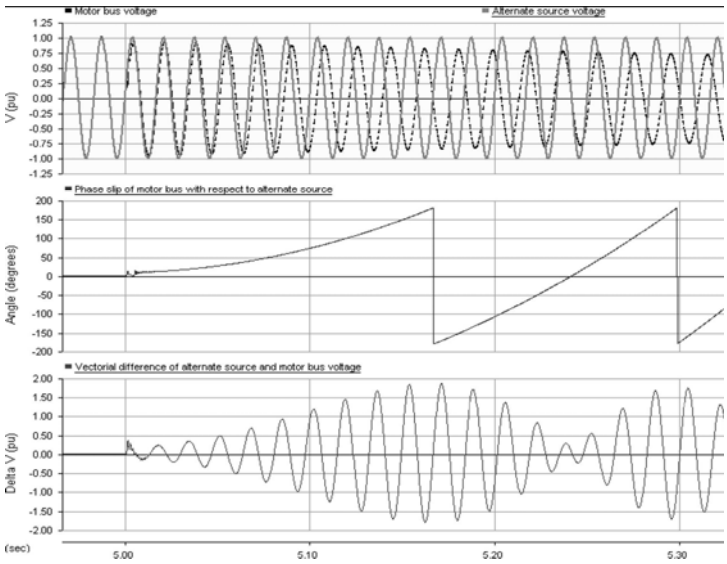

Fig.11 Characteristic of vector dU

The equivalent circuit of residual voltage Ures and referred voltage Uref is shown in Fig.11.

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

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

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

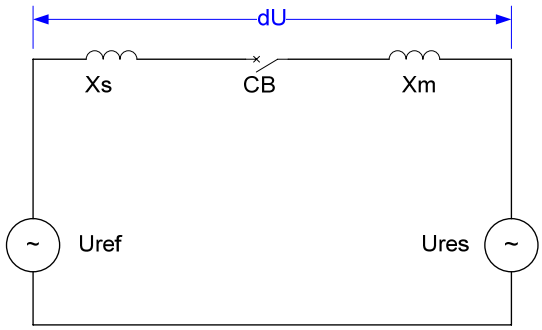

Fig.12 Equivalent circuit of dU

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

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

In case $\mathbf{k}_{o/v}$ = 1.1 and $\mathbf{k}$ = 0.67, the calculated $|dU|_{max}$ should be less than $1.64 \cdot |U_n|$ (refer to curve B in Fig.10). In case $\mathbf{k}_{o/v}$ = 1.1 and $\mathbf{k}$ = 0.95, the calculated $|dU|_{max}$ should be less than $1.15 \cdot |U_n|$ (refer to curve C in Fig.10). 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.10) 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 " **FT Delta f**"
  - |dU| < 8862 "**RTFT Delta U**"
  - dφ < 8863 "**FT 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

Sample of Oscillographic Transfer Record - FAST Transfer Mode

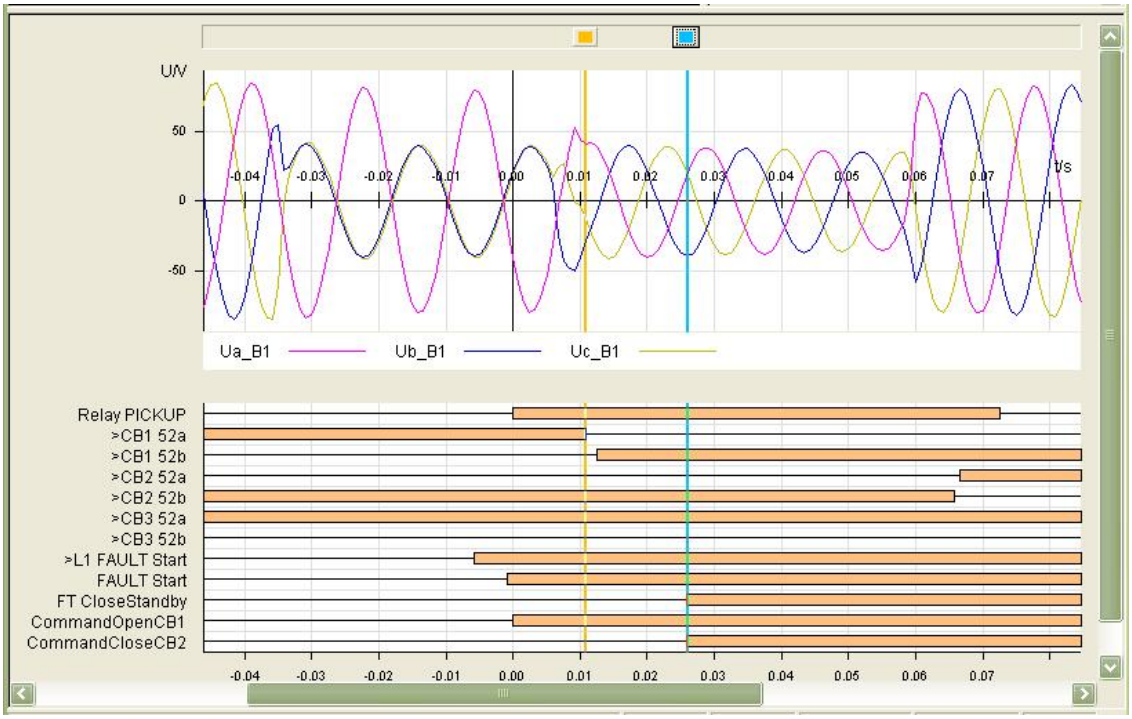

Fig.13 Waveform record of FAST transfer at segmented single busbar

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.14 Event log of FAST transfer at segmented single busbar

Some notes to Fig.13 and Fig.14,

- 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

Switching Directions and Wiring Diagrams

- Primary connection of single busbar

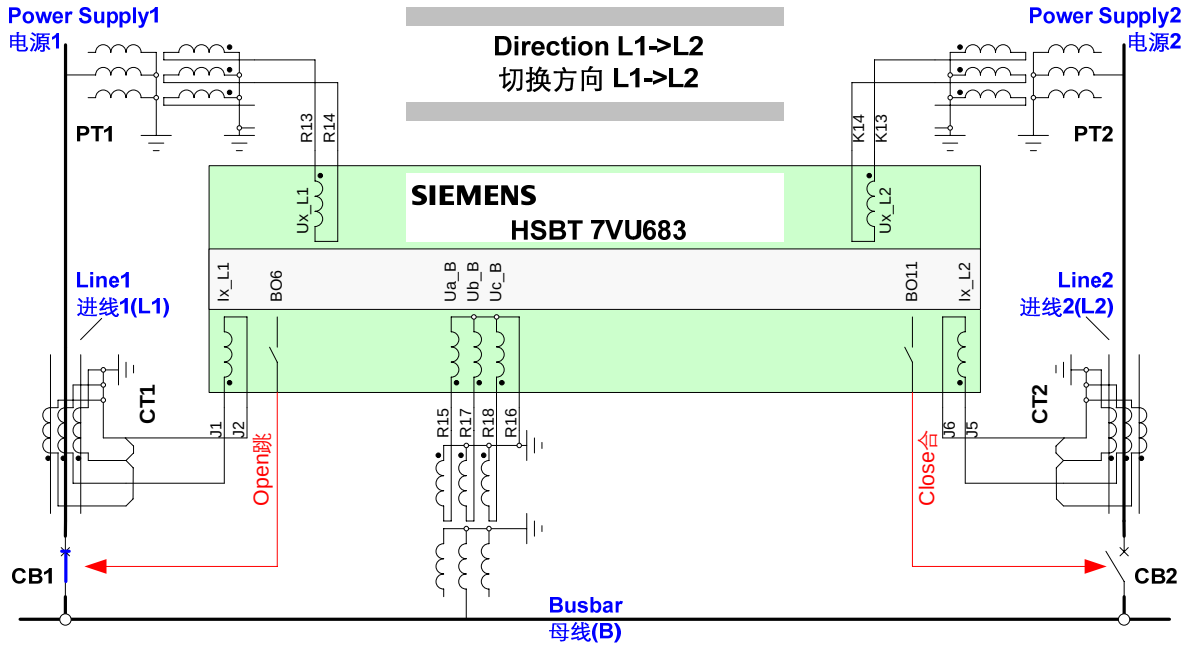

Fig.15 Switching-over L1->L2, single busbar

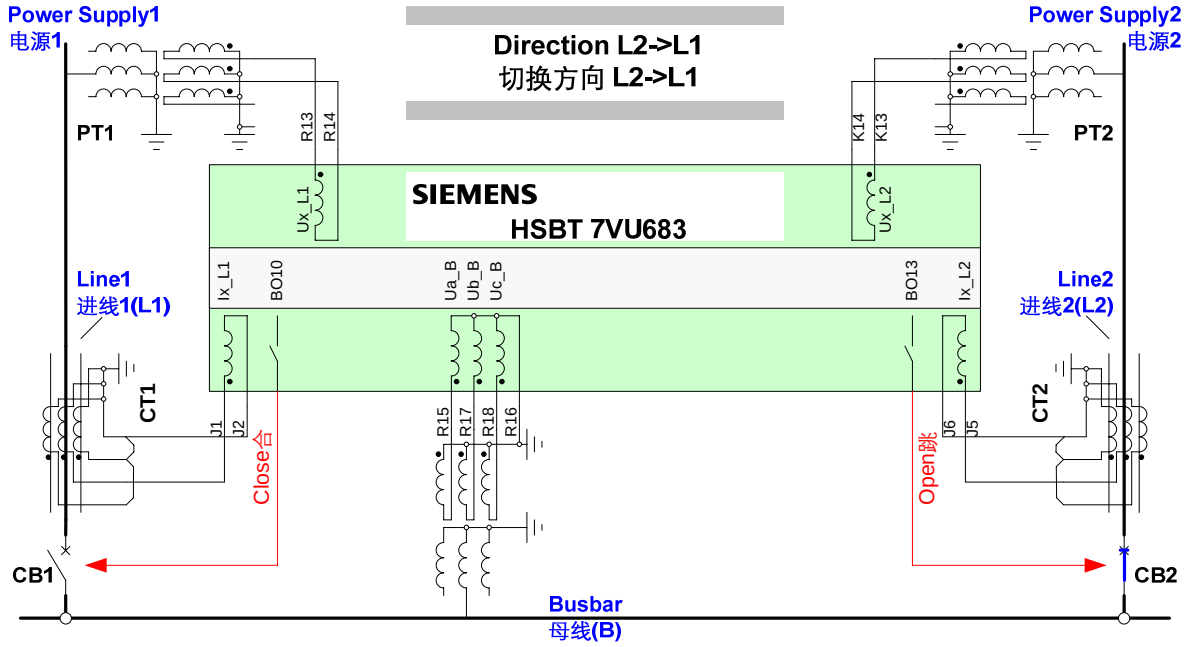

Fig.16 Switching-over L2->L1, single busbar

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

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

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

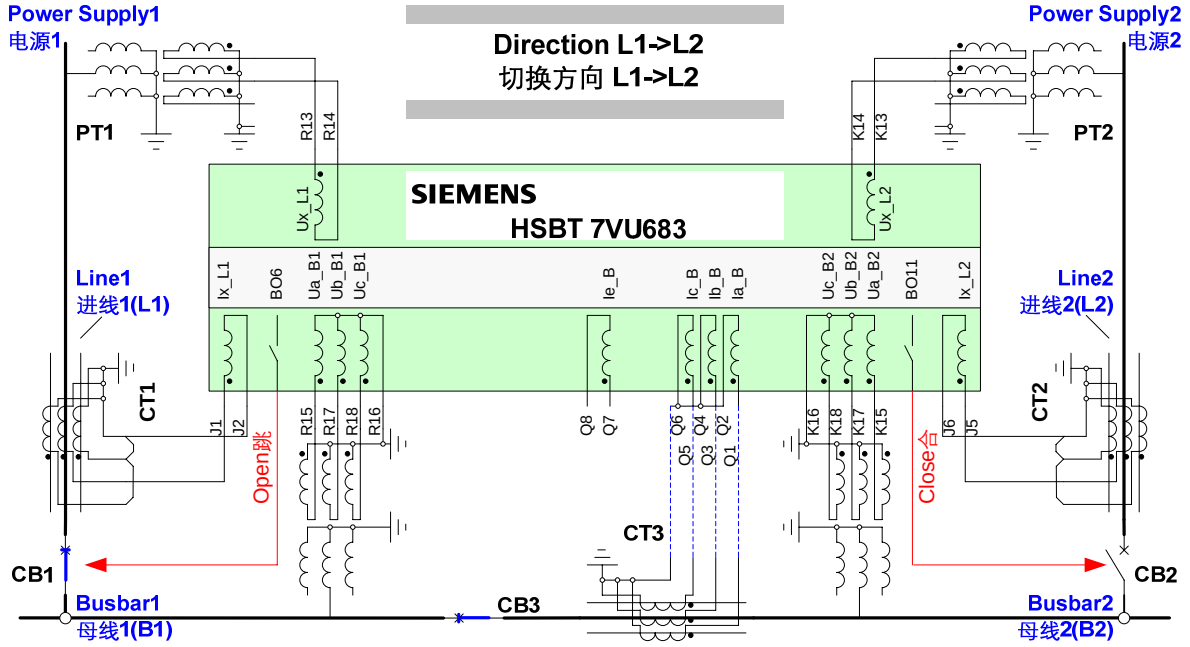

Fig.17 Switching-over L1->L2, segmented single busbar

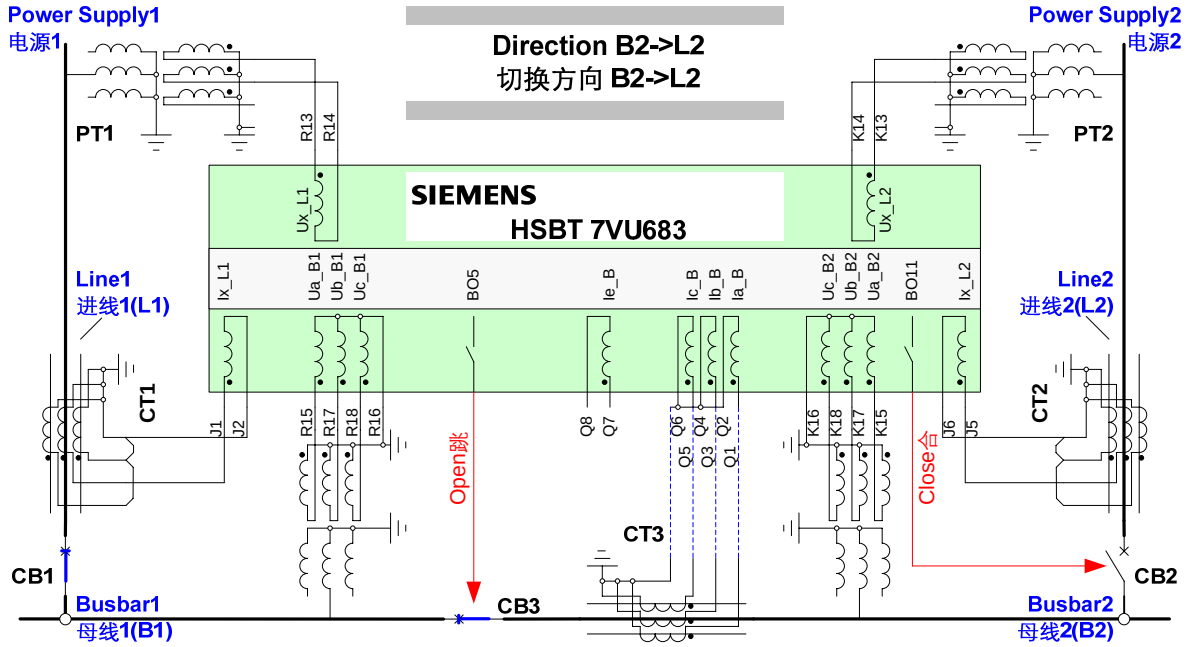

Fig.18 Switching-over B2->L2, segmented single busbar

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.

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

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

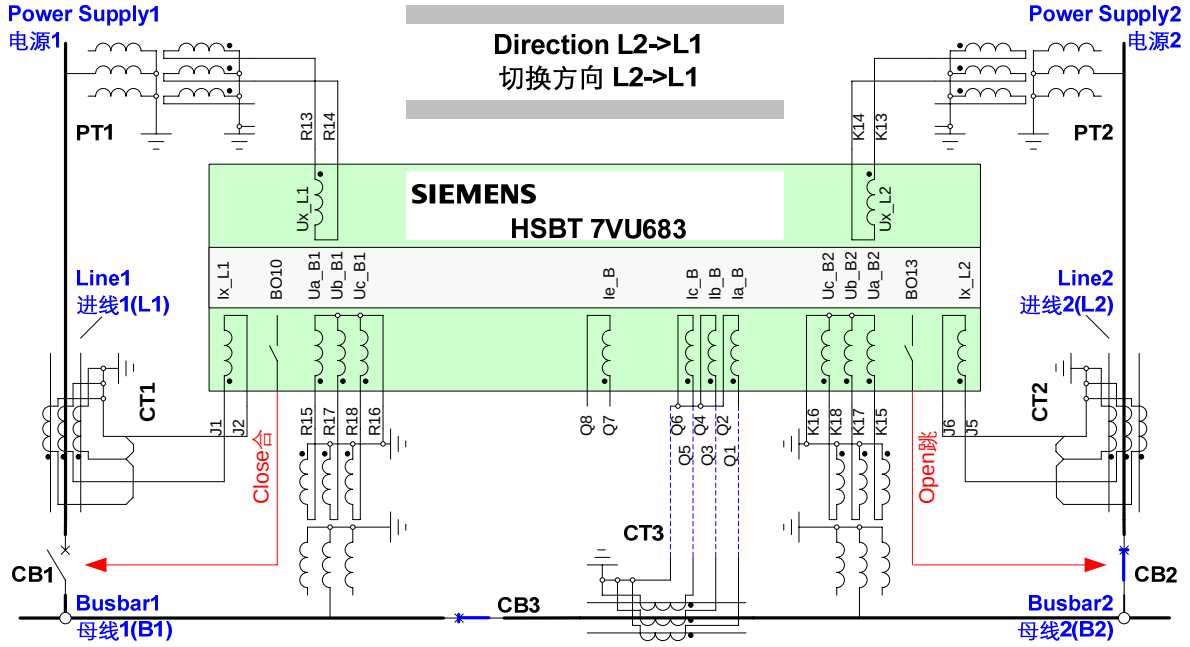

Fig.19 Switching-over L2->L1, segmented single busbar

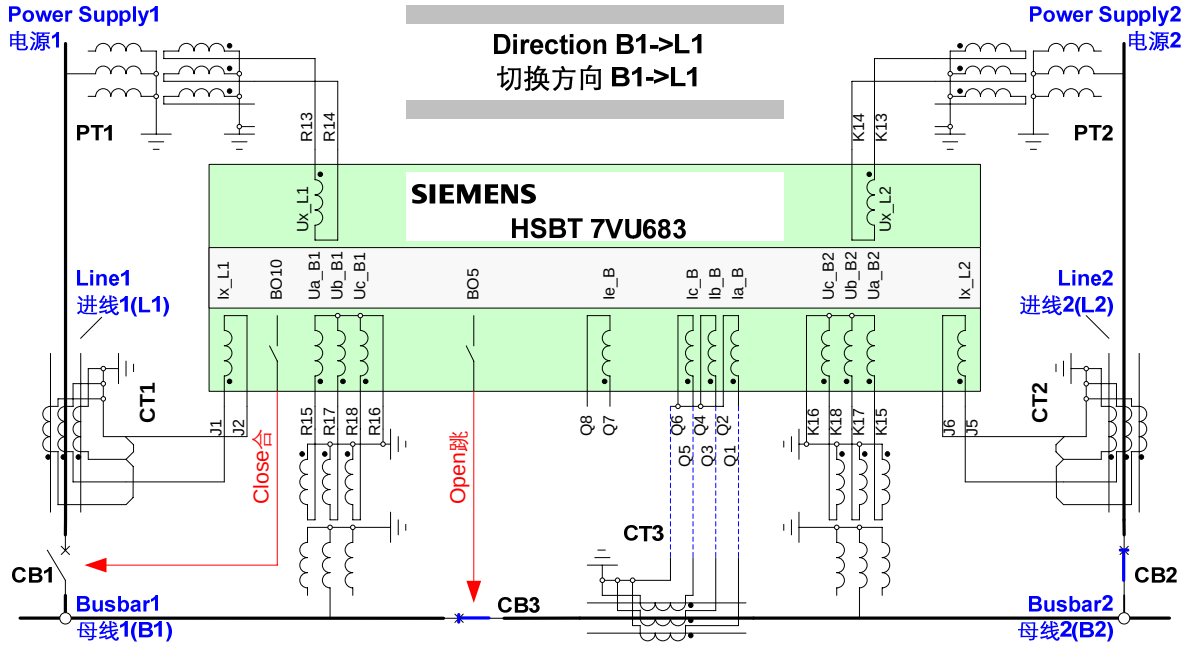

Fig.20 Switching-over B1->L1, segmented single busbar

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.

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

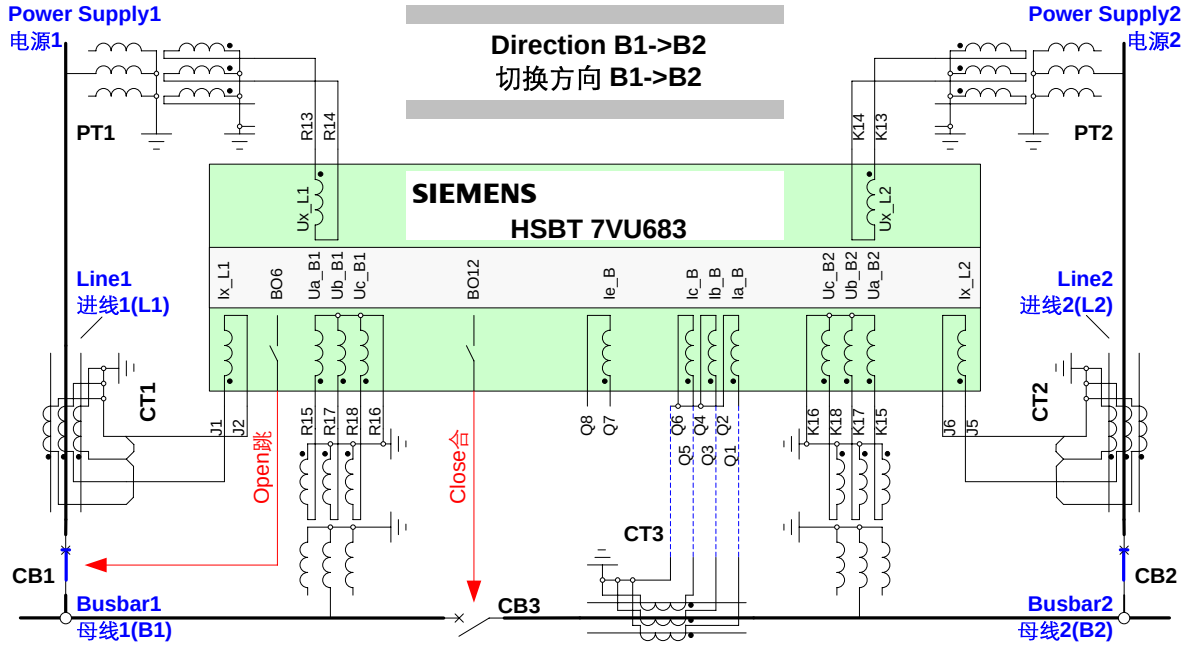

Fig.21 Switching-over B1->B2, segmented single busbar

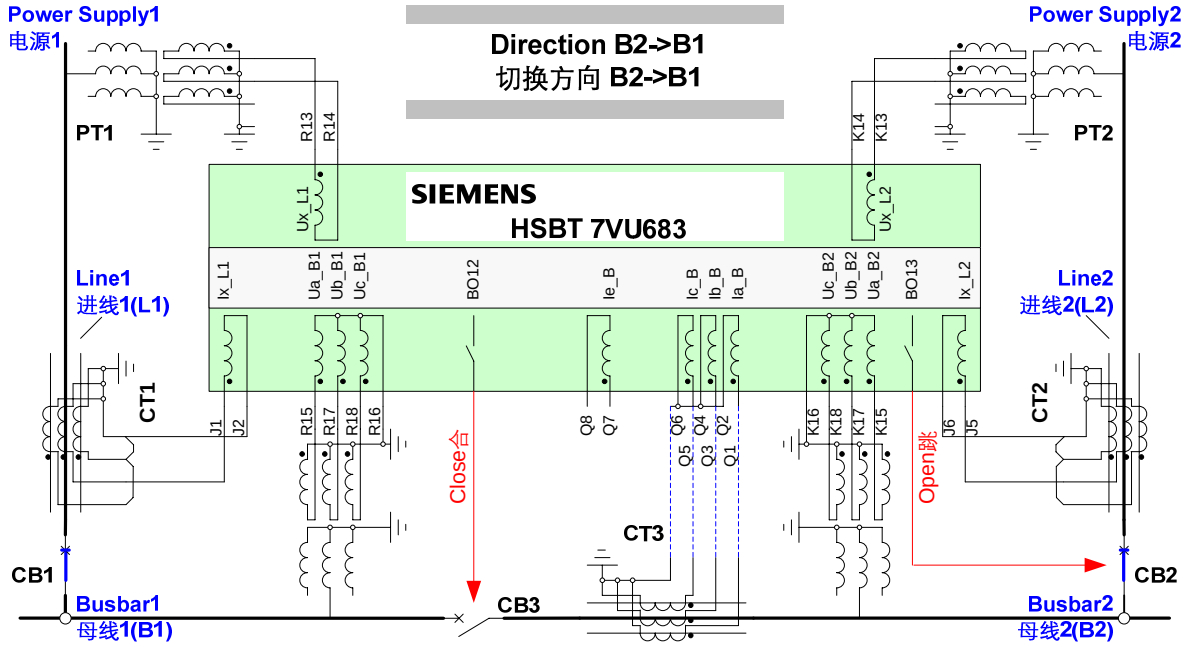

Fig.22 Switching-over B2->B1, segmented single busbar

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.

Summary of 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.15~Fig.22 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 Under-volt.	Inadmissible Under-Freq.	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-1 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 Under-volt.	Inadmissible Under-Freq.	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-2 Transfer permission under default setting, segmented single busbar

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.

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.

APPLICATION 2
LOW SPEED TRANSFER - ATS 7VU681

In some applications, e.g, hydro power station or substation, the continuous power supply is required for station service system in case of power supply failure. The transfer time is not critically assessed for non-rotating loads.

To support the automatic and smooth transfer of sources, the called Automatic Transfer System (ATS) is necessary. The ATS can be realized by intelligent electronic devices (IEDs) installed at MV switchgears via programmable logic. Siemens now provide the compact solution, that is, integrates all necessary measurements, logic binary inputs, binary outputs and wiring into one device ATS 7VU681.

The category ATS 7VU681 of Power Supply Transfer device 7VU68 is designed to support broad applications under the easy-to-use concept. Additionally, the protection functions for tie-CB in application Segmented Single Busbar and the supervision functions for voltage circuit are integrated.

General

The pre-condition to ATS starting is that the device is in Ready status, i.e, the standby source is live, the relative CBs' status is proper, no external blocking indication is there, etc. Oppositely, the device will go into blocking status and any transfer request will be rejected.

The starting of ATS will be internally and automatically executed by device 7VU681 based on the settable parameters. The main criterions are referred to the line voltage and busbar voltage. To secure the starting reliability, line current is used as the additional criterion.

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

If one transfer is executed, 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 0231 "**Manual Restart ATS**" = "***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.

The device ATS 7VU681 has pre-configured eight transfer modes, see Fig.23~Fig.36. Each of them can be individually switched "***ON***" or "***OFF***" remotely via communication or locally at device panel. If other transfers are required, device integrated programmable logic CFC can be practical.

Load-Shedding

If standby transformer has smaller capacity than main transformer, the overloading of the standby transformer could be there after the completion of transfer. Rejecting some loads will be helpful. The integrated Load-Shedding function is specially designed for this utilization.

To over-shot the line current will cause the pickup of Load-Shedding. Depends on the transfer mode, the device will automatically determine which line current will be used.

The function Load-Shedding can be individually activated or de-activated under each transfer mode. It has one stage with two time delays, each time delay can be separately configured to binary output to fit for various load-shedding' plans.

Load-Shifting

In some complex primary connection (see Fig.35), switching will perform among multi-CBs. If the overloading of the standby transformer must be there after the completion of transfer, shifting some loads to other busbar will be helpful. The integrated Load-Shifting function is specially designed for this utilization.

This function can be individually switched "***ON***" or "***OFF***" remotely via communication or locally at device panel.

Transfer Modes and Wiring Diagrams

- Primary connection of segmented single busbar: CB1, CB3, CB4 and CB5 are closed, CB2 is opened

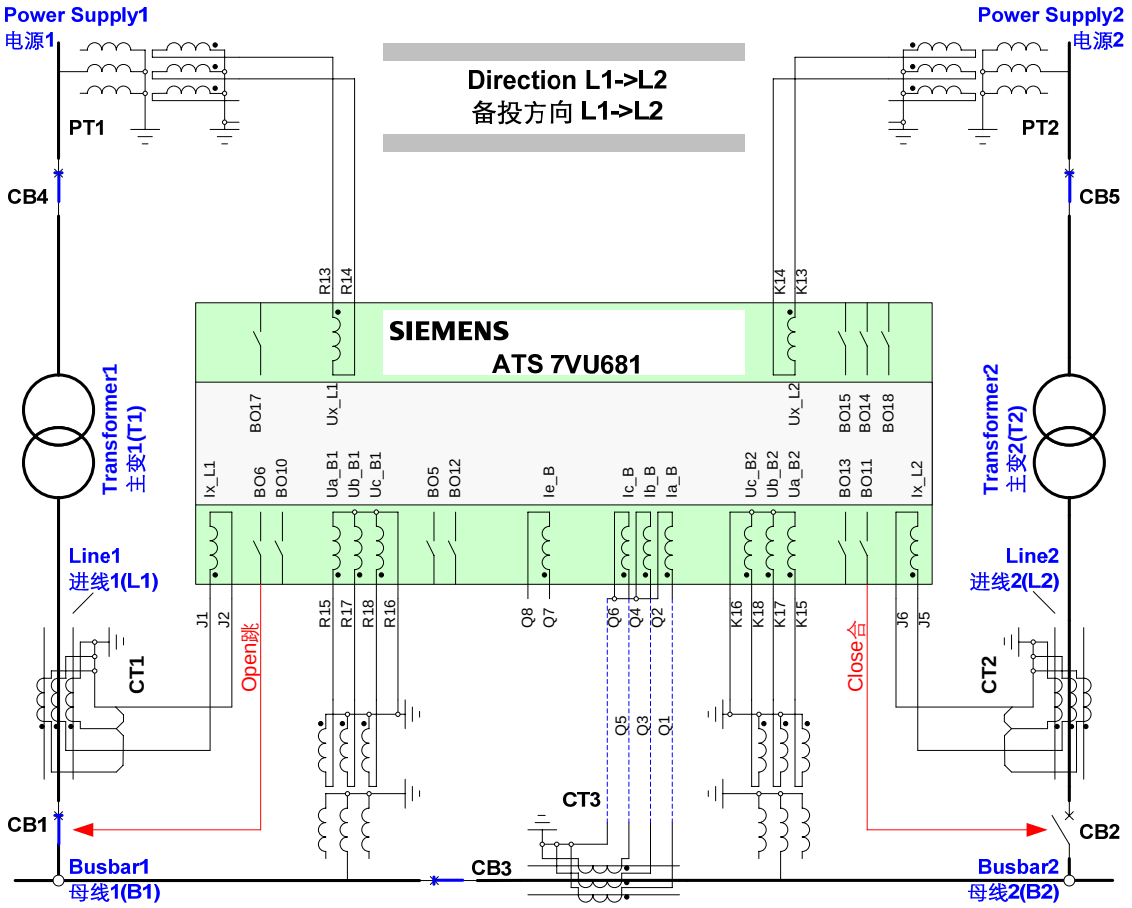

Fig.23 Switching-over L1->L2

Basic criterions to **Ready** status, "AND" logic

- CB1 and CB3 in closing status, CB2 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Ux_L2 > 8902 "**Line Live Voltage Threshold**"

If 0214 "**PT Connection L2**" = "***Not connected***", then L2 will be seen as live.

Basic criterions for ATS pickup, "AND" logic

- U_B1 < 8901 "**Busbar Dead Voltage Threshold**"
- U_B2 < 8901 "**Busbar Dead Voltage Threshold**"
- Ix_L1 < 8904 "**Line Dead Current Threshold**"
- Ux_L2 > 8902 "**Line Live Voltage Threshold**"

The transfer will be immediately terminated as soon as the device goes into **Un-Ready** status. Basic criterions are as below, "OR" logic

- CB1 in opening status
- CB3 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Dropout of Ux_L2 > 8902 "**Line Live Voltage Threshold**"

Operating consequence, see Fig.24

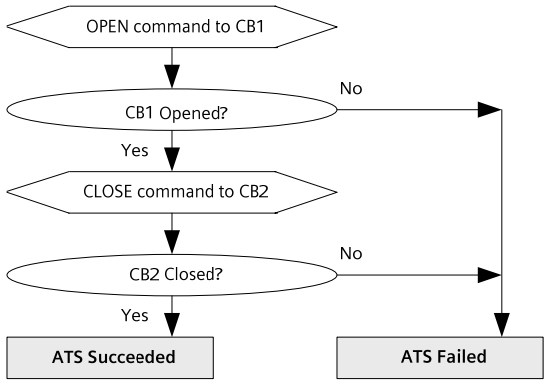

Fig.24 Operating consequence L1->L2

❑ Primary connection of segmented single busbar: CB2, CB3, CB4 and CB5 are closed, CB1 is opened

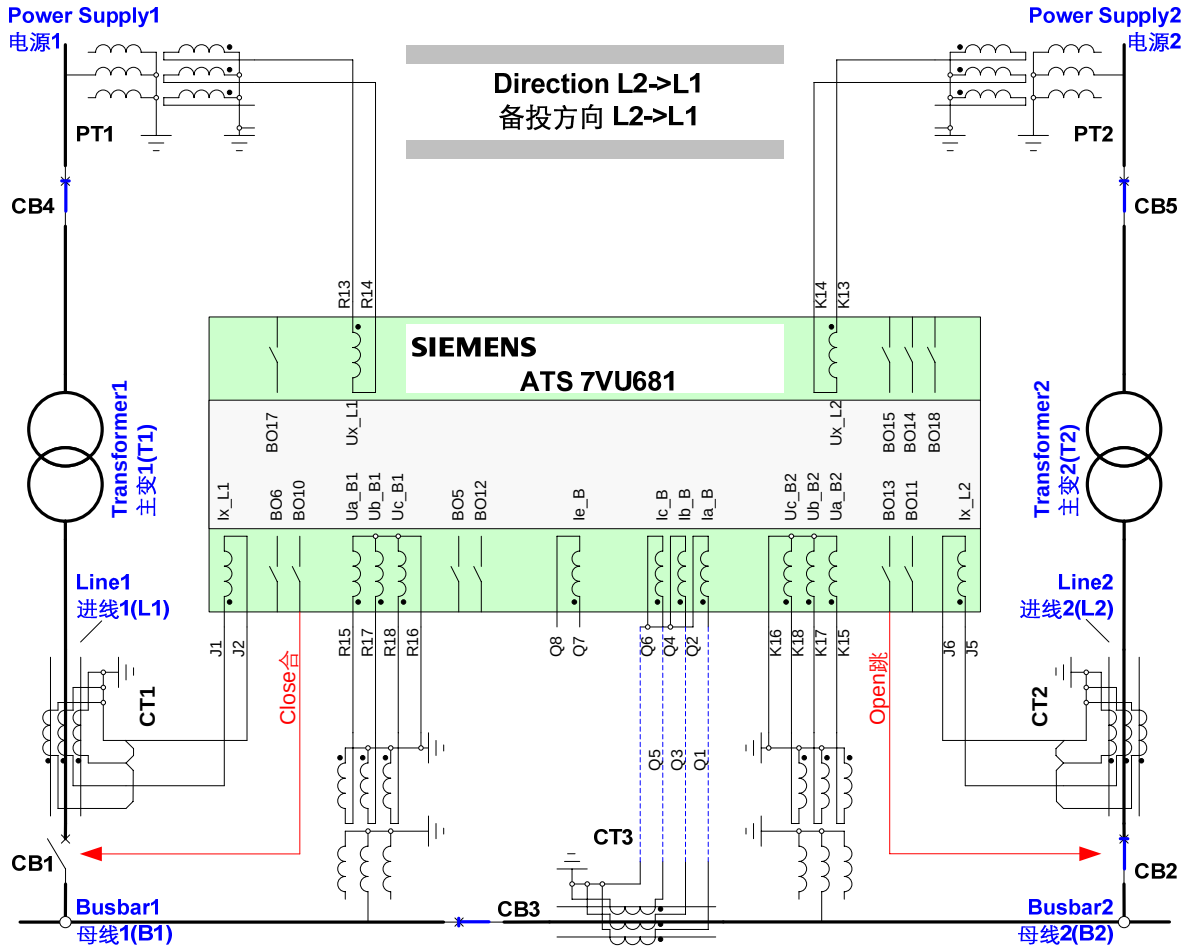

Fig.25 Switching-over L2->L1

Basic criterions to **Ready** status, "AND" logic

- CB2 and CB3 in closing status, CB1 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Ux_L1 > 8902 "**Line Live Voltage Threshold**"

If 0213 "**PT Connection L1**" = "***Not connected***", then L1 will be seen as live.

Basic criterions for ATS pickup, "AND" logic

- U_B1 < 8901 "**Busbar Dead Voltage Threshold**"
- U_B2 < 8901 "**Busbar Dead Voltage Threshold**"
- Ix_L2 < 8904 "**Line Dead Current Threshold**"
- Ux_L1 > 8902 "**Line Live Voltage Threshold**"

The transfer will be immediately terminated as soon as the device goes into **Un-Ready** status. Basic criterions are as below, "OR" logic

- CB2 in opening status
- CB3 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Dropout of Ux_L1 > 8902 "**Line Live Voltage Threshold**"

Operating consequence, see Fig.26

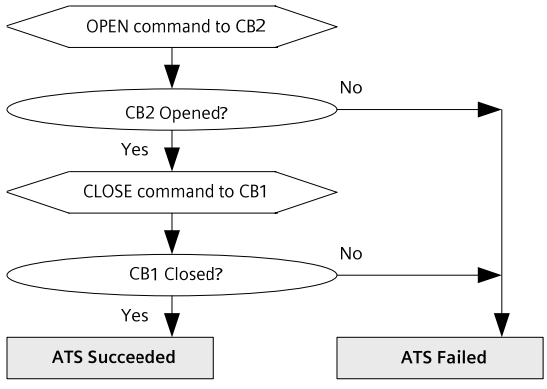

Fig.26 Operating consequence L2->L1

❑ Primary connection of segmented single busbar: CB1, CB2, CB4 and CB5 are closed, CB3 is opened

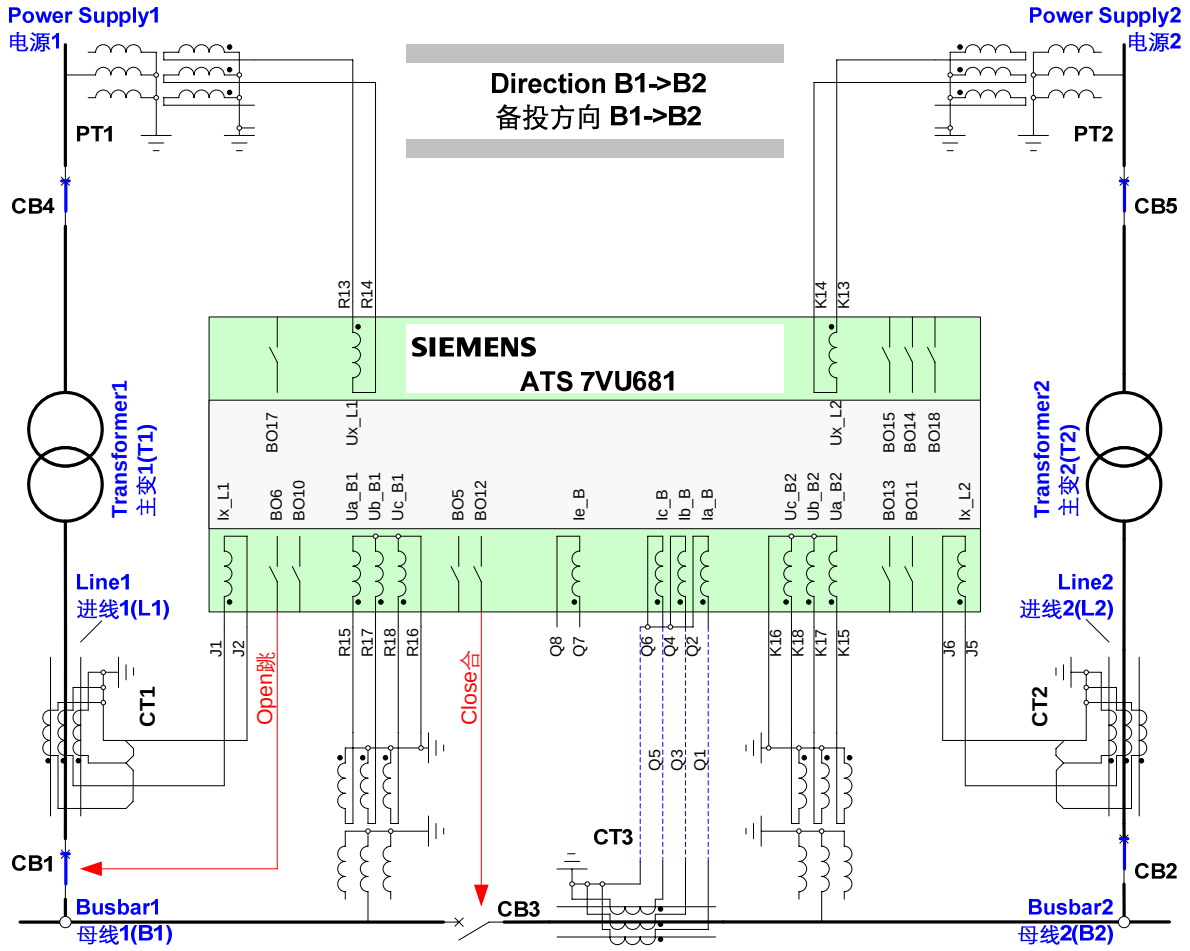

Fig.27 Switching-over B1->B2

Basic criterions to **Ready** status, "AND" logic

- CB1 and CB2 in closing status, CB3 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"

Basic criterions for ATS pickup, "AND" logic

- U_B1 < 8901 "**Busbar Dead Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Ix_L1 < 8904 "**Line Dead Current Threshold**"

The transfer will be immediately terminated as soon as the device goes into **Un-Ready** status. Basic criterions are as below, "OR" logic

- CB1 in opening status
- CB2 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"

Operating consequence, see below,

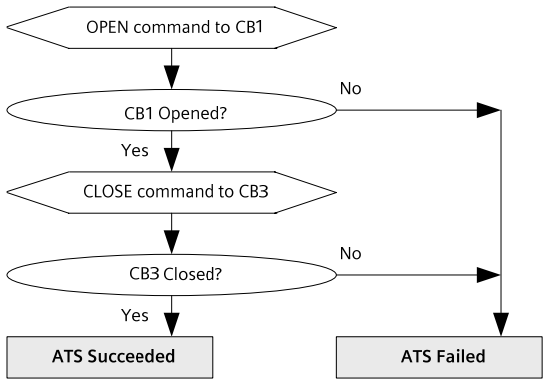

Fig.28 Operating consequence B1->B2

❑ Primary connection of segmented single busbar: CB1, CB2, CB4 and CB5 are closed, CB3 is opened

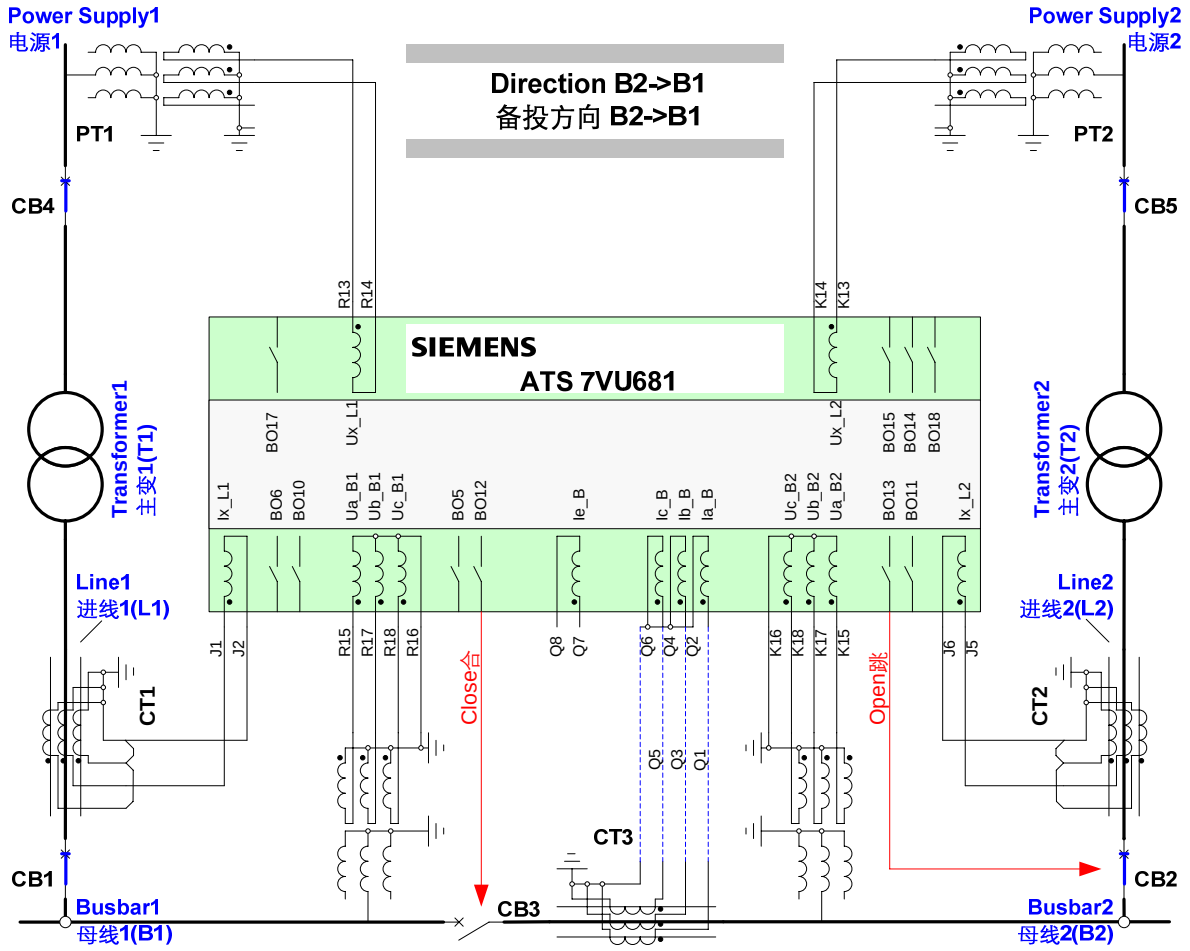

Fig.29 Switching-over B2->B1

Basic criterions to **Ready** status, "AND" logic

- CB1 and CB2 in closing status, CB3 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"

Basic criterions for ATS pickup, "AND" logic

- U_B2 < 8901 "**Busbar Dead Voltage Threshold**"
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- Ix_L2 < 8904 "**Line Dead Current Threshold**"

The transfer will be immediately terminated as soon as the device goes into **Un-Ready** status. Basic criterions are as below, "OR" logic

- CB1 in opening status
- CB2 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"

Operating consequence,

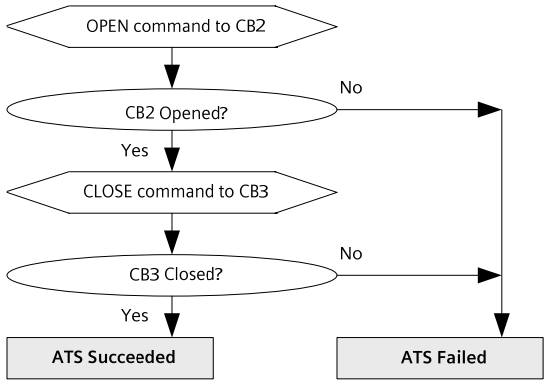

Fig.30 Operating consequence B2->B1

❑ Primary connection of segmented single busbar: CB1, CB3 and CB4 are closed, CB2 and CB5 are opened

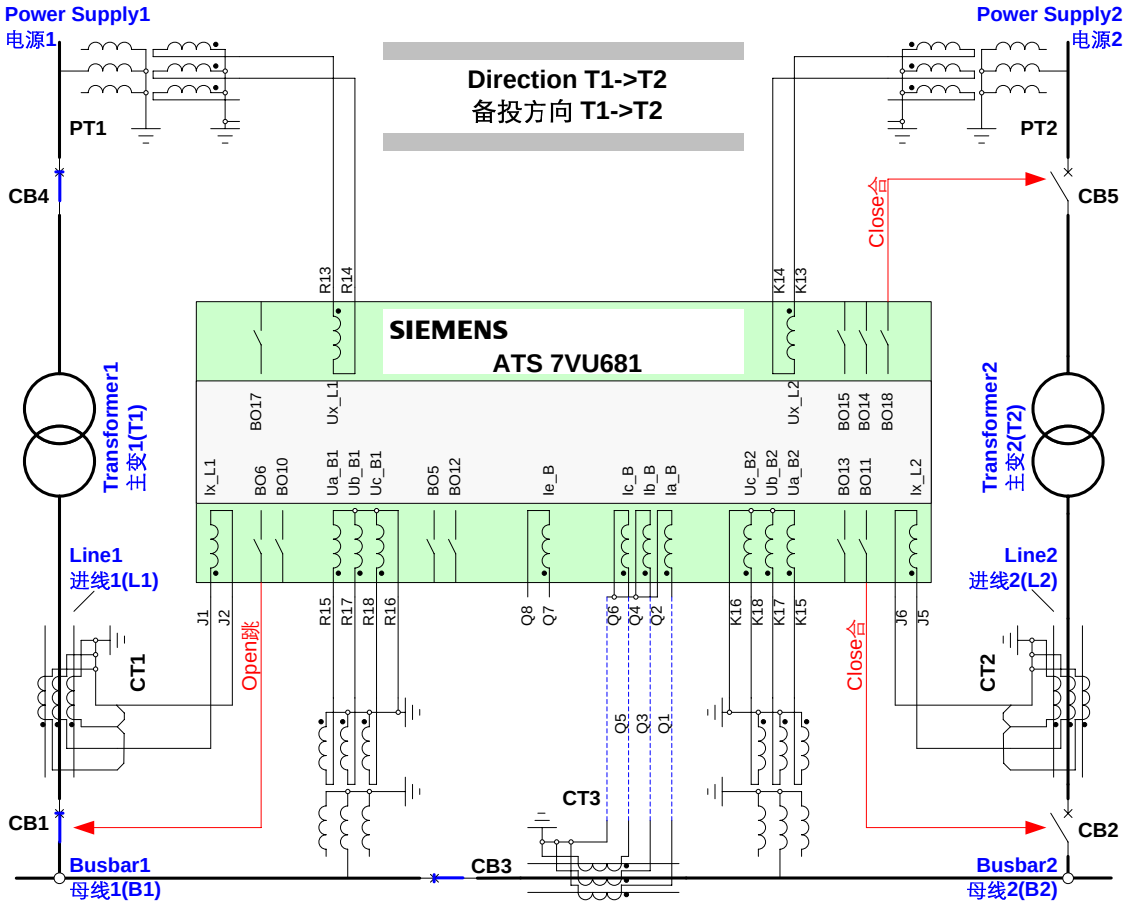

Fig.31 Switching-over T1->T2

Basic criterions to **Ready** status, "AND" logic

- CB1 and CB3 in closing status, CB2 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Ux_L2 > 8902 "**Line Live Voltage Threshold**"

If 0214 "**PT Connection L2**" = "***Not connected***", then L2 will be seen as live.

Basic criterions for ATS pickup, "AND" logic

- U_B1 < 8901 "**Busbar Dead Voltage Threshold**"
- U_B2 < 8901 "**Busbar Dead Voltage Threshold**"
- Ix_L1 < 8904 "**Line Dead Current Threshold**"
- Ux_L2 > 8902 "**Line Live Voltage Threshold**"

The transfer will be immediately terminated as soon as the device goes into **Un-Ready** status. Basic criterions are as below, "OR" logic

- CB1 in opening status
- CB3 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Dropout of Ux_L2 > 8902 "**Line Live Voltage Threshold**"

Operating consequence, see Fig.32

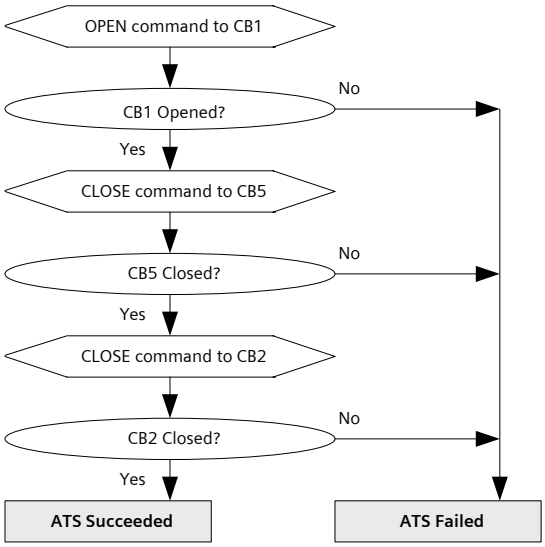

Fig.32 Operating consequence T1->T2

❑ Primary connection of segmented single busbar: CB2, CB3 and CB5 are closed, CB1 and CB4 are opened

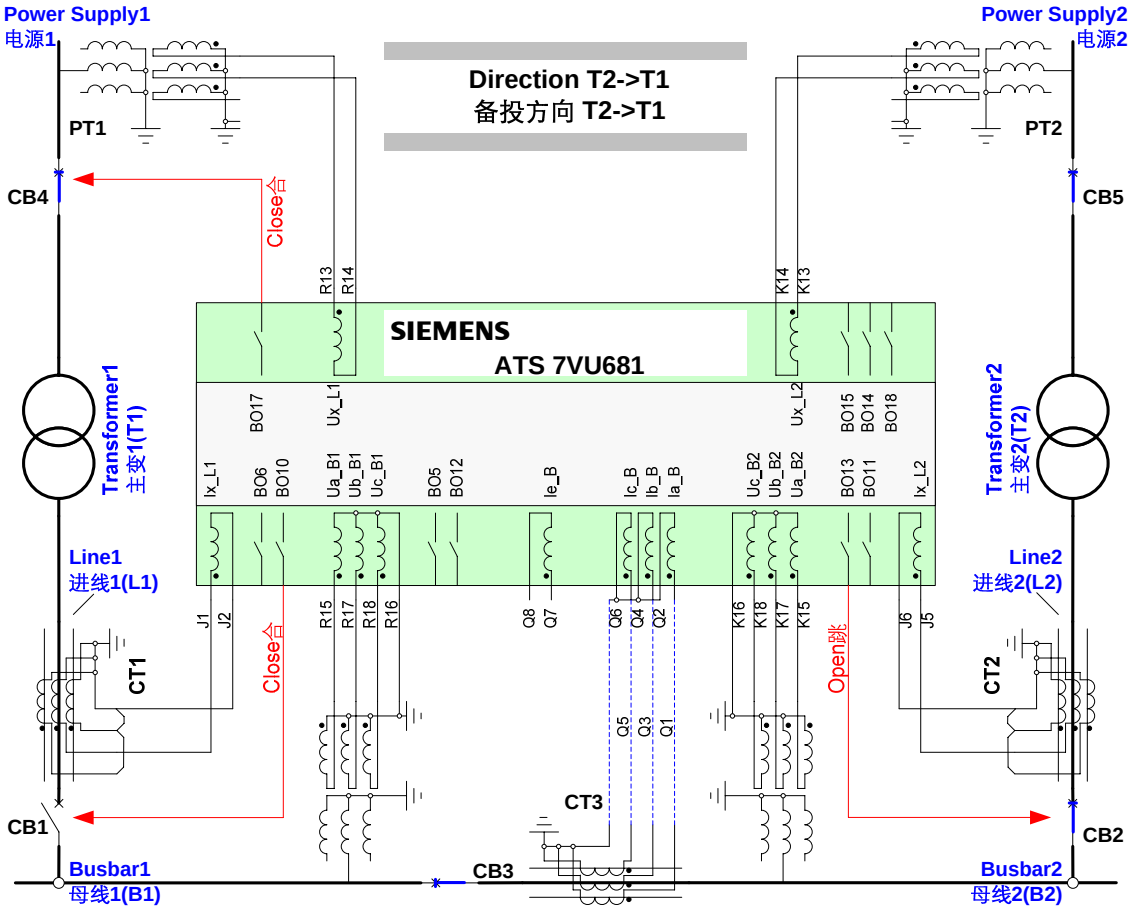

Fig.33 Switching-over T2->T1

Basic criterions to **Ready** status, "AND" logic

- CB2 and CB3 in closing status, CB1 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Ux_L1 > 8902 "**Line Live Voltage Threshold**"

If 0213 "**PT Connection L1**" = "***Not connected***", then L1 will be seen as live.

Basic criterions for ATS pickup, "AND" logic

- U_B1 < 8901 "**Busbar Dead Voltage Threshold**"
- U_B2 < 8901 "**Busbar Dead Voltage Threshold**"
- Ix_L2 < 8904 "**Line Dead Current Threshold**"
- Ux_L1 > 8902 "**Line Live Voltage Threshold**"

The transfer will be immediately terminated as soon as the device goes into **Un-Ready** status. Basic criterions are as below, "OR" logic

- CB2 in opening status
- CB3 in opening status
- U_B1 > 8900 "**Busbar Live Voltage Threshold**"
- U_B2 > 8900 "**Busbar Live Voltage Threshold**"
- Dropout of Ux_L1 > 8902 "**Line Live Voltage Threshold**"

Operating consequence, see Fig.34

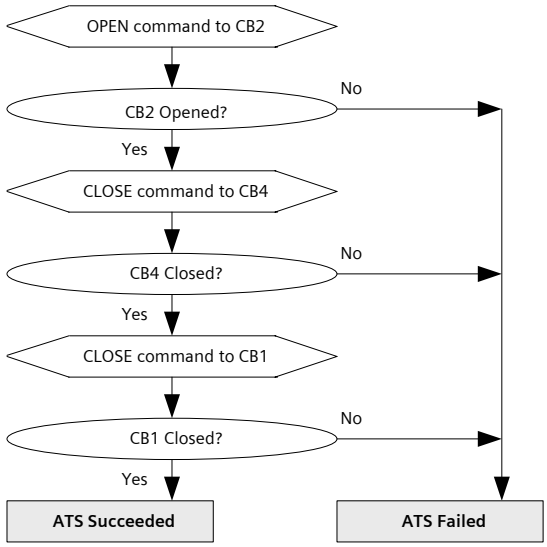

Fig.34 Operating consequence T2->T1

- Primary connection of segmented single busbar: CB1, CB2, CB4, CB5 and CB6 are closed, CB3 and CB7 are opened

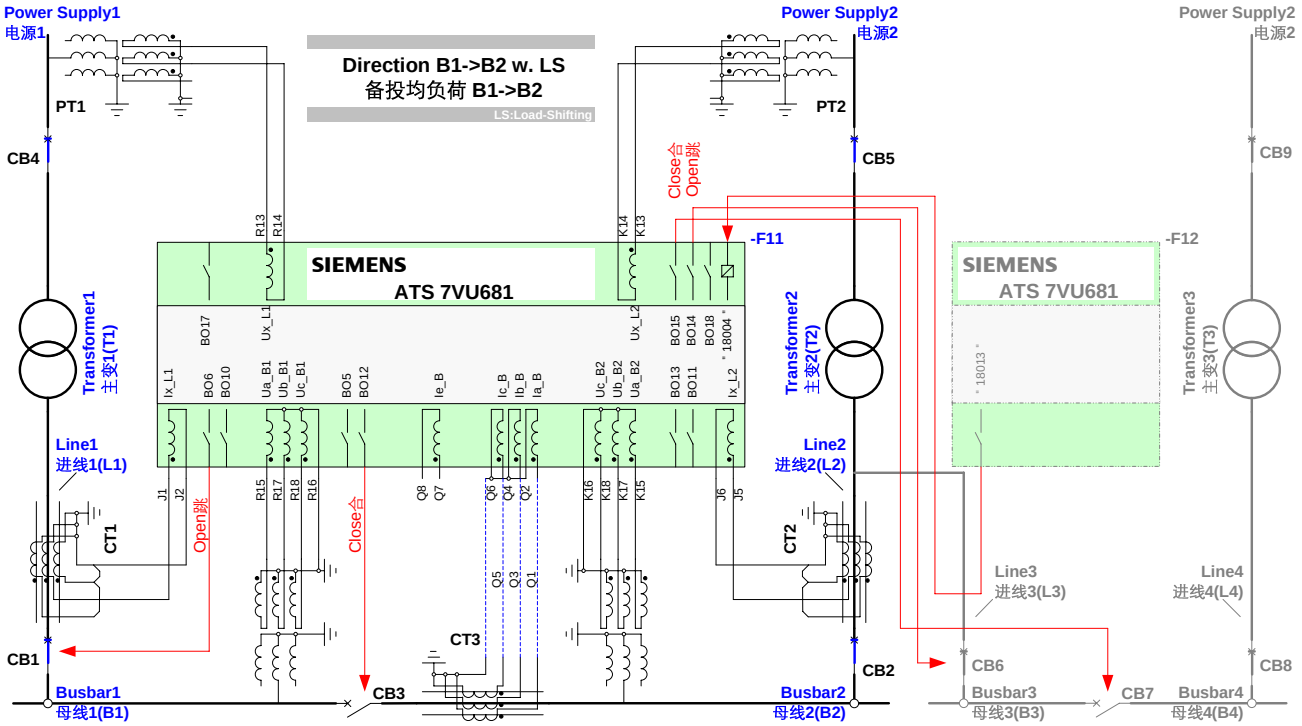

Fig.35 Switching-over B1->B2 with Load-Shifting

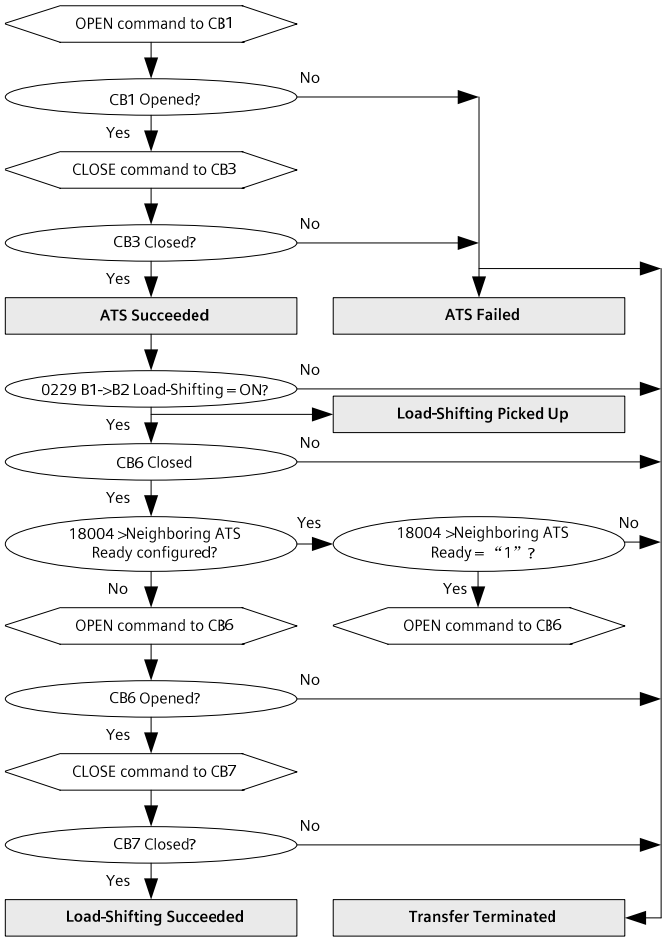

Fig.36 Operating consequence B1->B2 with Load-Shifting

Basic criterions to **Ready** status, "AND" logic

- the same as Fig.27

Basic criterions for ATS pickup, "AND" logic

- the same as Fig.27

The transfer will be immediately terminated as soon as the device goes into **Un-Ready** status. Basic criterions are as below, "OR" logic

- the same as Fig.27

Operating consequence, see Fig.36

PROTECTION FUNCTIONS

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 Over-current Protection
- Earth Over-current Protection
- Phase Over-current Protection for Busbar Energization
- Earth Over-current 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 Over-current Protection and Phase Over-current for Busbar Energization, compound voltage element is used. The criterion of compound voltage element is illustrated in Fig.37,

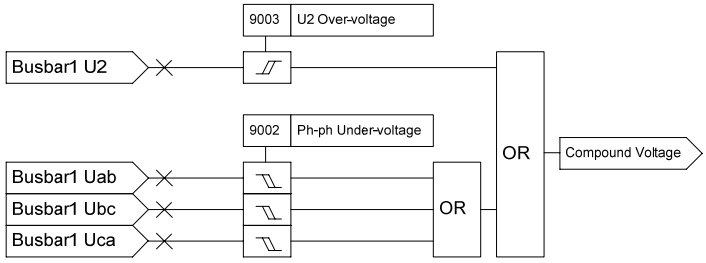

Fig.37 Logic of compound voltage element

For functions of Earth Over-current Protection and Earth Over-current 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 "**Active Time for Busbar Energization**".

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

Phase Over-current 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**".

Earth Over-current Protection

This function is designed to detect earth 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 be derived from calculated 3I0 or measured earth 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 Over-current Protection for Busbar Energization

The function Phase Over-current Protection can be activated for some time after the busbar is energized when tie-CB is closed. An individual function Phase Over-current Protection for Busbar Energization is specially designed for this utilization.

The function has the same criterion and stages to Phase Over-current Protection. The function will not be activated until the tie-CB is closed.

Earth Over-current Protection for Busbar Energization

The function Earth Over-current Protection can be activated for some time after the busbar is energized when tie-CB is closed. An individual function Earth Over-current Protection for Busbar Energization is specially designed for this utilization.

The function has the same criterion and stages to Earth Over-current Protection. The function will not be activated until the tie-CB is closed.

SELECTION AND ORDERING CODE

1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
7	V	U	6	8			–		E				–	1	A	A	0

Multi-functional Power Supply Transfer Device 7VU68

Use Case

ATS 17BI/18BO	1
HSBT 17BI/18BO(include 5HS)	3

CT Secondary Rated Current

In = 1A[1)]	1
In = 5A[1)]	5

Auxiliary Voltage（Power Supply/Pickup Threshold BI）

24-48V DC, BI threshold 17V DC[3)]	2
60-125V DC[2)], BI threshold 17V DC[3)]	4
110-250V DC[2)],115-230V AC, BI threshold 73V DC[3)]	5
220-250V DC[2)],115-230V AC, BI threshold 154V DC[3)]	6

Construction

Flush mounting with screw terminals	E

Region Specific Default / Language Settings

World, English[4)], 50/60Hz	B
China, Chinese[4)], 50/60Hz	w

Port B (System)

None	0	
IEC 61870-5-103 protocol, electrical RS232	1	
IEC 61870-5-103 protocol, electrical RS485	2	
IEC 61870-5-103 protocol, optical 820nm， ST connector	3	
Profibus DP Slave, electrical RS485	9	L0A
Profibus DP Slave, optical 820 nm, double ring, ST connector	9	L0B
Modbus, electrical RS485	9	L0D
Modbus, optical 820 nm, ST connector	9	L0E
IEC 60870-5-103 protocol, redundant electrical, RJ45 connector	9	L0P
IEC 61850, 100 Mbit Ethernet, redundant electrical, RJ45 connector	9	L0R
IEC 61850, 100 Mbit Ethernet, optical, LC connector,1300nm,multi-mode	9	L0S

Port C (Service)

DIGSI 4/modem, electrical RS232	1
DIGSI 4/modem, electircal RS485	2

Measurement

Basic measured values	1

Functions

Power Supply Transfer（ATS 7VU681 / HSBT 7VU683）	A
Protection (Ph. O/C, Earth O/C, Ph. O/C Energiz., Earth O/C Energiz.)	
Supervision	

1) Secondary rated current In can be selected via Jumpers

2) Power supply can be selected via Jumpers

3) Pickup threshold BI can be selected via Jumpers

4) Device language can be selected via DIGSI

CONNECTION DIAGRAM

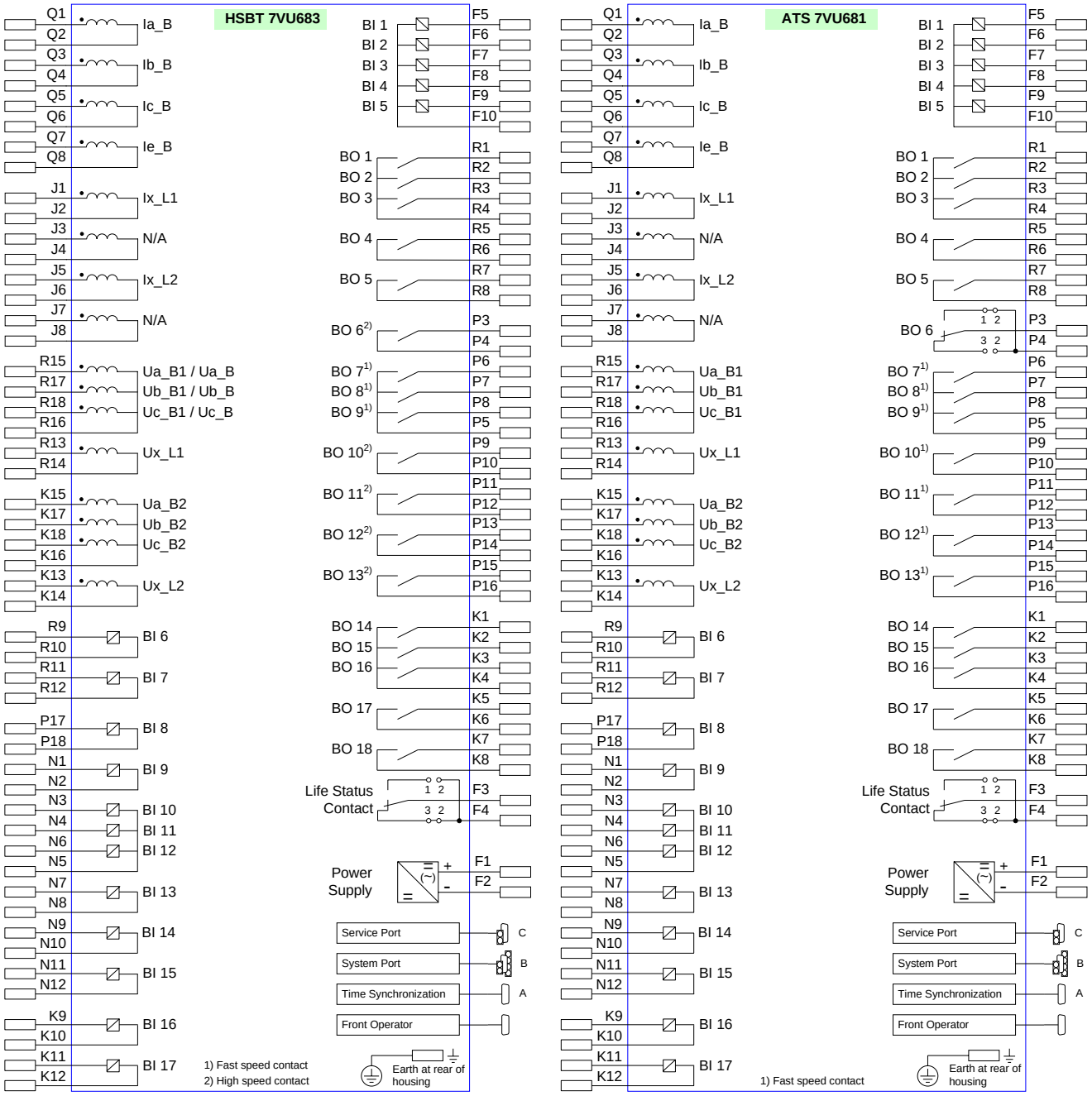

Fig.38 Connection diagram of HSBT 7VU683 and ATS 7VU681

BOARDS LAYOUT – FRONT VIEW

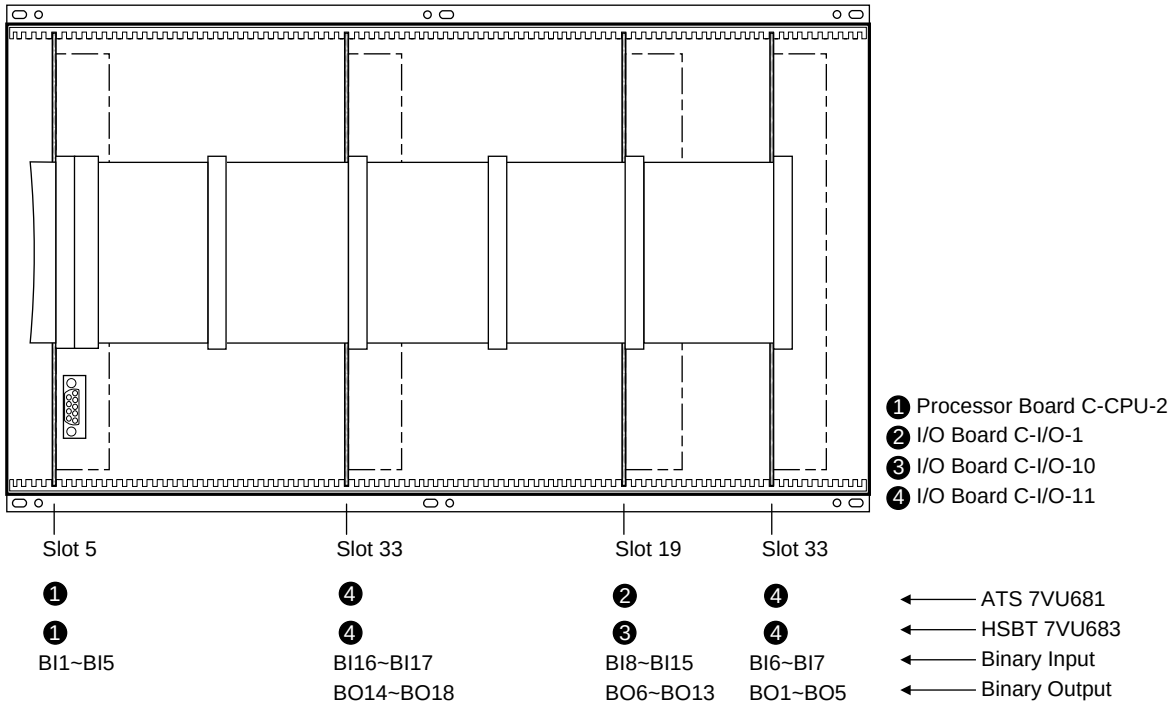

Fig.39 Boards layout of the device 7VU68

DIMENSIONS

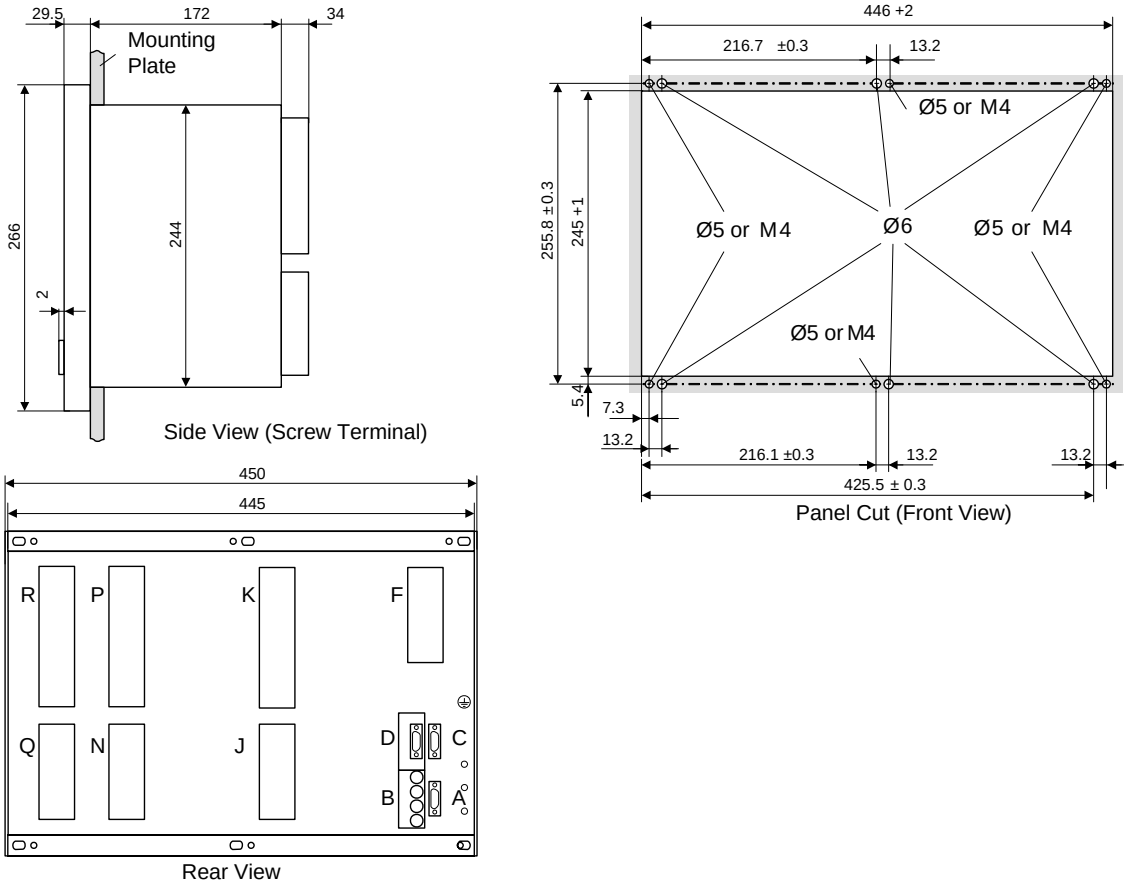

Fig.40 Dimensions of the device 7VU68

Siemens Energy Automation
Website: www. siemens.com.cn/ea
Service hotline: 800 828 9887
(for mobile phones or areas where 800 number network is not available, please dial 400 828 9887)

Siemens Power Automation Ltd.
Building 4, Hua Rui Industry Park, Cheng Xin Avenue,
Jiangning Economic & Technological Development Zone,
Nanjing, China 211100
Tel: 86 25 51170188
Fax: 86 25 52114982

Sales Contacts

Beijing	Tel: 86 10 64763842	
Shanghai	Tel: 86 21 24085218	
Guangzhou	Tel: 86 20 37182571	
Wuhan	Tel: 86 27 85486688	ext: 5009
Chengdu	Tel: 86 28 86199499	ext: 4005
Xi'an	Tel: 86 29 88319898	ext: 6626
Shenzhen	Tel: 86 755 26935188	ext: 3311
Hangzhou	Tel: 86 571 87652999	ext: 6013
Jinan	Tel: 86 531 82666088	ext: 6506
Fuzhou	Tel: 86 591 87500888	ext: 5800