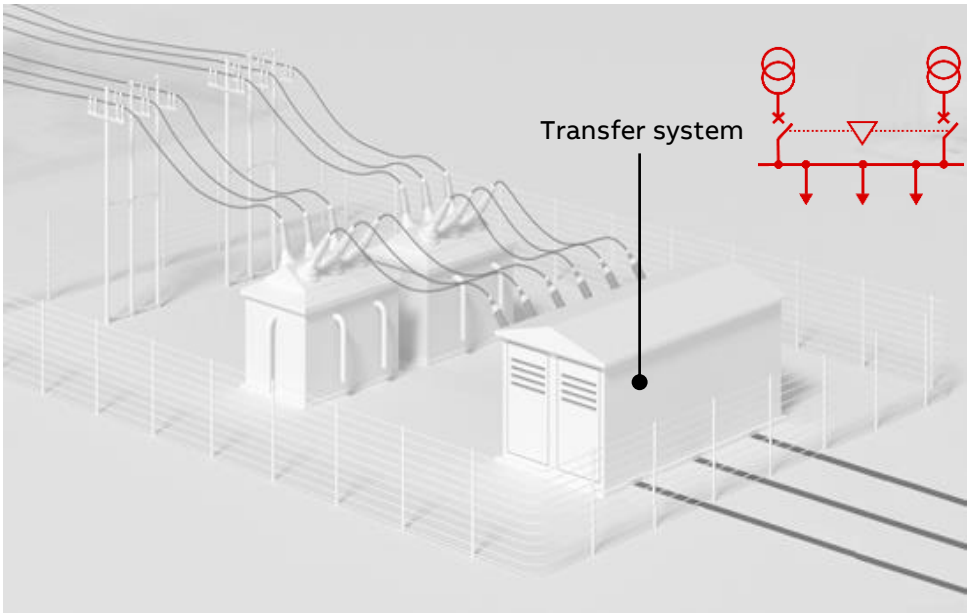
Distribution automation | Application note Technical information

Distribution Network availability

Automatic transfer System



Introduction

Industries need continuous power supply to keep their processes running. Utilities objective is to ensure highest possible supply availability to the consumer. The aim for both, industries and utility, is a reliable grid with enhanced power quality.

Redundancy on one hand increases the availability of the grid on the other hand it increases the amount of manual operations. The manual control of redundant systems is complex and therefor subject to human errors and time consuming. Automation transfer simplifies operation and protects against blackouts. It is the first step to a self- healing grid.

ABBs RTU-based automatic transfer system (ATS) solution combines predefined algorithm and communication features. The main characteristic is simple engineering and flexible adaptation to the primary process of different applications areas and customer requirements.

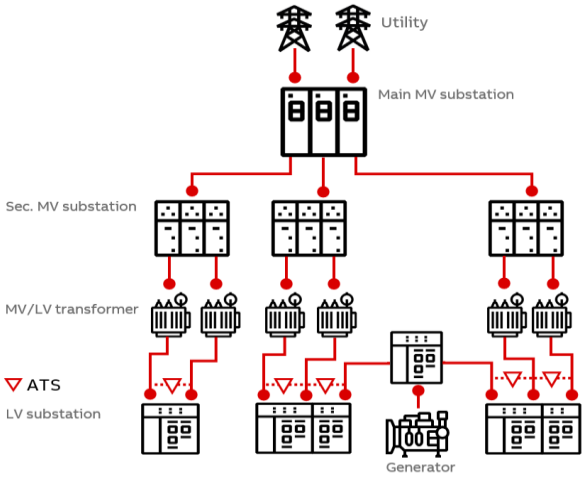
Automatic transfer systems are used in following application areas <60kV:

- Small Industries
- Utilities
- Datacenters
- Transportation
- Commercial and public buildings

The ATS function based on RTU hardware is designed for time delayed transfer used for loads such as:

- Lighting (Emergency lights)
- Motors (Hazard ventilation, cooling systems)
- Communication systems
- Alarm handling & monitoring (fire monitoring, control fire pumps)

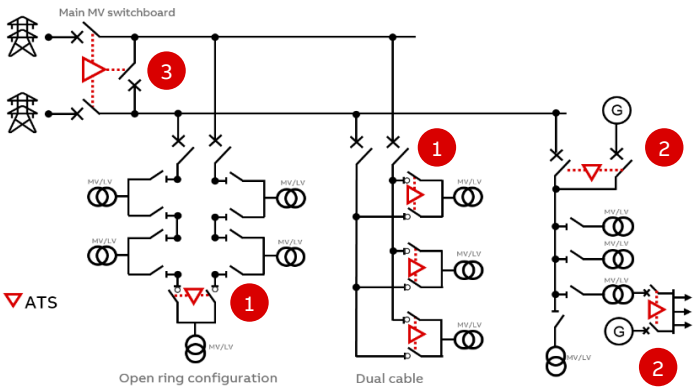
It ensures continuous power supply in combination with battery system or generator. ATS fits perfectly to realize an automatic change over for non-permanent occupied areas.



ATS application example for industrial power supply systems

Applications

An automatic transfer system (ATS) is particularly suited to avoid long interruptions in power supply at medium and low voltage grid.



The ATS supports three main application types:

1. One type is typical used in case of dual power feed e.g. in a dual cable or ring structured grid. In such application one of the incoming feeder will be the main energy source, while the second incoming line will be the reserve source in a kind of standby mode.

2. Alternative the ATS application supports also backup generator as an emergency source instead using a second incoming feeder.

3. The third application is mainly located in primary substation. Two independent and active power sources are connected to the bus separated by bus-tie breaker. The transfer will be between the affected source and the bus-tie breaker in case of a fault.

ATS functionality

The ATS- algorithm transfers the load from the main source to an alternative energy source. The automatic changeover is triggered by a failure at the active main source. When the main source comes back on line, the loads will be reconnected to the main source. This could be configured automatic or by operator control.

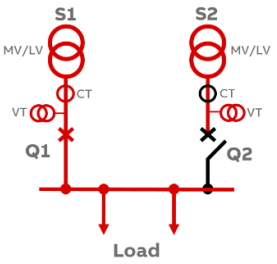
Failure on the active source will be detected by undervoltage detection. In combination with a direction overcurrent or earth fault detection it is possible to locate up- or downstream failure.

The ATS initiate the change-over to the reserve or emergency source in case of an upstream failure. The transfer system is blocked if a directional overcurrent or earth fault is detected downstream. Downstream failure could happen on the busbar or at the connected load.

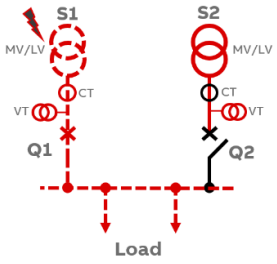
The Grid operation topology includes protection and re-configuration of the network. The ATS takes over the part of recovering the power supply.

Transfer Sequence

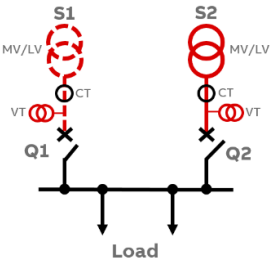
Below an example for line-line- variant without back switching and line priority 1->2. The min performance time without CB operation time is around 3sec.



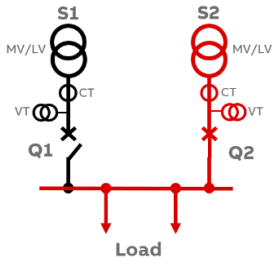
- Both lines are normally present (OK status)
- Main line S1
- Emergency Line S2



- Main line S1 voltage drop
- Under voltage detection (Un<80%)
- Start of ATS sequence



- Q1 open command
- Busbar is de-energized



- S2 still ready
- Q2 close command
- Transfer completed

Priority of feeding source

The ATS functionality allows to select which of the incoming feeder will be the main source (priority).
The priority configuration result in predefined transfer direction from source 1 to source 2 or source 2 to source 1, as defined by user.
A fault in the main source initiate the transfer to the reserve incoming feeder. If priority mode is set to main source, and the main source comes back to a health condition, an automatic switch back starts a reverse transfer to the main source.

If no priority is configured, the automatic switch back mode is deactivated. The ATS swaps automatically the definition of main and reserve source regarding the position of the circuit breakers Q1 and Q2. So, the main source become the reserve source and vice versa after each transfer sequence.

Auto/manual and local/remote mode

The selection of those modes can be done via a selection switch on a local control panel or via a local graphical user interface (WebHMI).

Automatic mode means that the ATS, will perform the reconfiguration automatically if the trigger occurs. No manual interaction is required to switch between the sources. This also concern the automatic switch back if not separately blocked.

Manual operation mode in combination with remote condition, considers that ATS can be operated remotely from the SCADA.

In local control mode the ATS is blocked for safety reasons. Resetting alarms is still possible.

Load shedding to protect loads and grid

In case of islanding and supplied by an emergency generator, the load shedding functionality protects the grid and its loads e.g. motors in case of under frequency or unbalanced failure. It will be initiated by:

- No voltage or under voltage
- Overvoltage
- Unbalanced mode
- Invalid frequency

Based on direct fault detection the ATS could be used to:

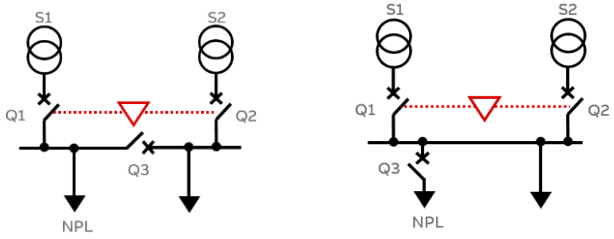
- switch off loads to avoid frequency drop and ensure power balance or
- switch off sensitive loads which could be damaged in the event of abnormal power supplies.

Management of non-priority loads (NPL)

The ATS support a grid structure, which divides its load in priority or non-priority load to realize load-shedding. Compare to the load shedding initiated by direct unbalance detection, the management of non-priority loads realizes the load-shedding by physically arrangement of the loads connected to the busbar.

Using this kind of physical arrangement, the Q3 is normally closed. The transfer from S1 to S2 throw off the non-priority

Physical structure to manage non-priority loads (NPL):



loads (NPL) by opening Q3 in case the reserve incoming feeder S2 has less power capacity than the main incoming feeder S1. The reverse switch back procedure reconnects the non-priority loads by closing circuit breaker Q3.

Generator control

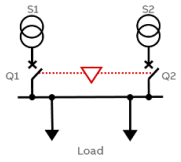
Grid emergency generator used to support the grid in case of power supply in self-sustaining isolated operation or parallel operation meeting increased power needs.

ATS sends the signal to the generator to start and stop during the transfer sequence. The generator is supervised by measuring of power flow, frequency and integrated detection function.

Customized generator control, such as a cold start, allows a forced switching and control of the generator bypassing the ATS.

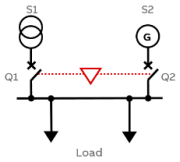
Supported - Variants

Line-Line



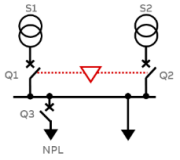
Q1	Circuit breaker S1
Q2	Circuit breaker S2
Q3	N.a.
Switch back	Enable/disable
Set line priority	Yes
Load- shedding	Enable/disable
Opt. generator (S2)	See separate variant **Line-Generator**
Auto- reclose Q3	N.a.

Line-Generator



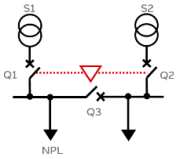
Q1	Circuit breaker S1
Q2	Circuit breaker S2
Q3	N.a.
Switch back	Enable/disable
Set line priority	No
Load- shedding	Enable/disable
Opt. generator (S2)	N.a.
Auto- reclose Q3	N.a.

3CB_NPL



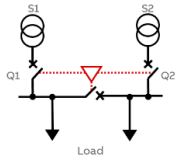
Q1	Circuit breaker S1
Q2	Circuit breaker S2
Q3	NPL-Breaker
Switch back	Enable/disable
Set line priority	No
Load- shedding	N.a.
Opt. generator (S2)	Yes
Auto- reclose Q3	Enable/disable

3CB_NPL_BUS_TIE



Q1	Circuit breaker S1
Q2	Circuit breaker S2
Q3	NPL- Bus- separator
Switch back	Enable/disable
Set line priority	No
Load- shedding	N.a.
Opt. generator (S2)	Yes
Auto- reclose Q3	Enable/disable

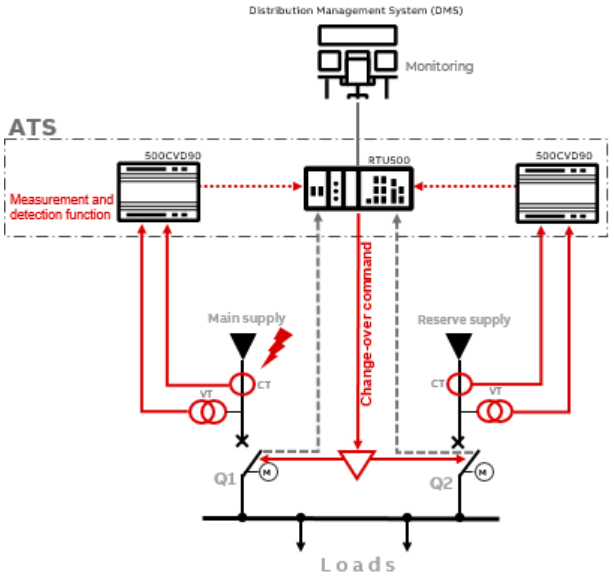
3CB



Q1	Circuit breaker S1
Q2	Circuit breaker S2
Q3	Tie breaker
Switch back	N.a.
Set line priority	Yes
Load- shedding	Enable/disable
Opt. generator (S2)	No
Auto- reclose Q3	N.a.

RTU- Hardware

The ATS function is based on RTU DIN-Rail portfolio. Predefined hardware package in combination with ATS-Library and its description allows a simple implementation with one engineering tool. Configuration example and functionality is shortly described below:



RTU500

- Controller for ATS- algorithm
- Connectivity to SCADA systems

BID/BOD-Module

Input/ Output interface to the process such as:

- Switch/ Breaker/ load break switch status and control of Q1, Q2 and Q3
- Local keys (e.g. local/ remote)
- Generator monitoring and control
- Load shedding command

500CVD90

Measuring and fault detection unit

Input channel:

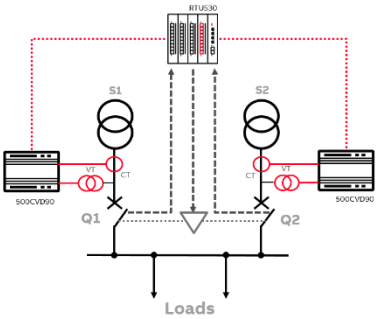
- 3 phase Voltage measuring
- 3 phase current measuring
- Separate measuring of residual current and voltage

Detection function:

- Under- and overvoltage (27,59)
- Directional overcurrent and earth fault (67,67N)
- Negative sequence overcurrent (46)
- Phase sequence voltage (47)
- Invalid frequency (81U, 81O)
- Optional overcurrent detection 50/50N, 51/51N

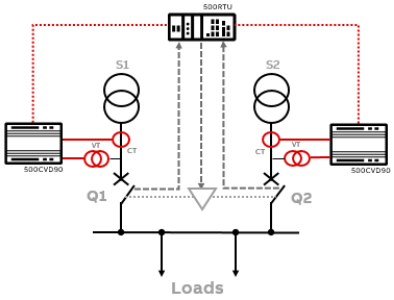
Ordering information

Configuration example 1



Total No.	Product	Ident no	Comment
1	530CID01 R0001	1KGT049400R0001	Controller, 8 BI 24-60V, 4 BO
1	500SDA License ATS	1KGT036601R0001	Library license
1	Basic license 250DP	1KGT201798R001	Rel.13 Basic License
2	500CVD90 R0021 **or**	1KGT039100R0021	1A CT interface
	500CVD90 R0025	1KGT039100R0025	5A CT interface
1	530BID01 R0001 **or**	1KGT049800R0001	16 BI 24…60V
2	530BID01 R0002	1KGT049800R0002	16 BI 110…125V
3	530BOD01 R1002	1KGT049900R0001	8 BO single pole, max. switching voltage 150V DC

Configuration example 2



Total No.	Product	Ident no	Comment
1	540CMD01 R0001	1KGT037400R0001	Controller
1	500SDA License ATS	1KGT036601R0001	Library license
1	Basic license 250DP	1KGT201648R0012	Rel.12 Basic License, SD-card
3	500CVD90 R0021 **or**	1KGT039100R0021	1A CT interface
	500CVD90 R0025	1KGT039100R0025	5A CT interface
2	520BID01 R0001 **or**	1KGT033200R0001	16 BI 24…60V
	520BID01 R0002	1KGT033200R0002	16 BI 110…125V
3	520BOD01 R1002	1KGT033300R1002	8 BO single pole, max. switching voltage 150V DC
1	520ADD01 R0001	1KGT033000R0001	IO adapter

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