Before using the ATS010, read Chapter 1 “Safety notes” very carefully to avoid malfunctions and, in some cases, dangerous conditions.

See Chapter 5 for indications on how to set up the unit. This chapter includes:
- a check list of things to do before starting
- a guided set-up procedure, which identifies problems in wiring or unit installation
- a troubleshooting guide.

Chapter 7, ATS010 Application, describes how to use the ATS010 in the plant and how to select what auxiliary devices are needed.
Remember, always read the whole manual before starting any operations with the ATS010.

Contents

1. Safety notes

If you have any doubts about safe use, the unit must be put out of service, protecting against accidental use.

Safe use is not possible if:

1. the unit shows visible signs of damage
2. the unit does not work
3. the unit has been stored for a long period or has been damaged during transport.

The ATS010 is designed to automatically open and close two circuit breakers (as well as to operate any signal and command devices).

There can be a few minutes' delay before the circuit breakers open or close according to the time delay settings.

Before:
- **accessing the circuit breakers,**
- **performing maintenance on circuit breakers or any electrical circuits powered by them,**
- **performing any other operations where opening/closing the circuit breakers could be dangerous,**

the ATS010 must be prevented from operating these circuit breakers.

During maintenance, it is advisable to mechanically lock circuit breakers in the open position.

WARNING! *Even if the unit appears to be in stand by, switch it off before accessing the circuit breakers or the power supply. The unit could be in a delay phase awaiting a set time delay, or it could be awaiting some other external condition. In such cases and the circuit breakers could start operation without warning.*

2. Definitions and abbreviations

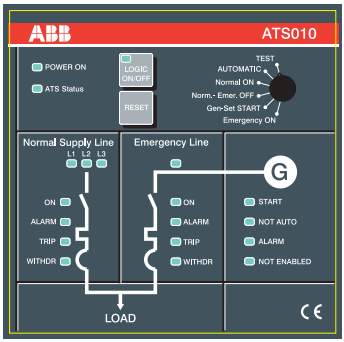
ABIL	Logic enable input
ALGE	Gen set alarm
ATAL	ATS alarm
ATIN	ATS off
ATS	Automatic Transfer Switch
CACBN	Command to open Line N circuit breaker (relay)
CACBE	Command to open Line E circuit breaker (relay)
CAGE	Command to open the gen set (relay)
CB	Circuit Breaker
CB-E	Emergency line circuit breaker (unit)
CB-N	Normal line circuit breaker
CCCBN	Command to close the Line N circuit breaker (relay)
CCCBE	Command to close the Line E circuit breaker (relay)
CCD	Remote switching command
COCO	Switch enable input
CSC	Command to disconnect loads (relay)
GE	Gen set (generator system)
MT	Minimum voltage
NOAU	Unit input not in automatic mode
T1	Delay in opening Normal line circuit breaker after net anomaly is detected
T2	Delay in starting gen set after net anomaly is detected
T3	Delay in stopping gen set after net returns to normal conditions
T4	Delay in opening the unit circuit breaker after net returns to normal conditions
T5	Delay in closing the unit circuit breaker

3. Functions description

3.1 Device and system description

The ATS010 device is typically used in systems with two power supply lines: the first supplies normal power from the net, the second from a gen set. These two power supply lines are connected to the same busbar system through two CBs which are mechanically interlocked so that they cannot trip simultaneously (parallel). The two CBs are controlled by the ATS010.
Using special terminals, the ATS010 is connected to:

- normal and emergency line circuit breakers: it monitors their state and sends open/close commands
- gen set control board: it monitors generator state and sends start/stop commands
- other possible signals incoming from the plant to condition switching logic
- normal power supply line to detect any anomalies
- emergency line to check if it is powered.

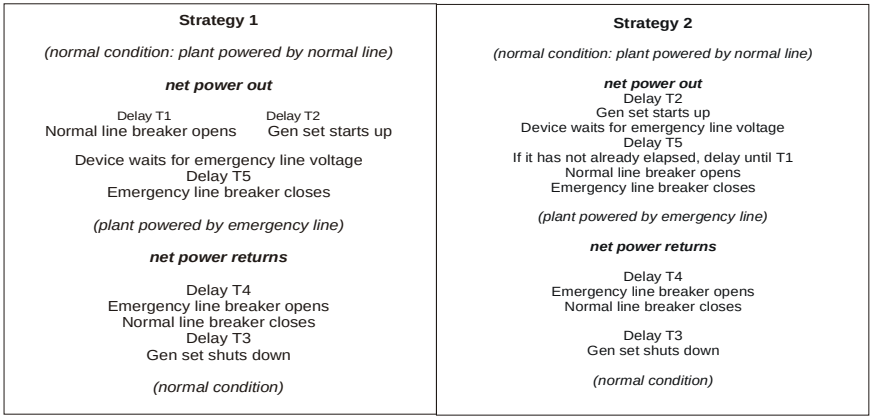


IMPORTANT NOTES:

- In some cases, connecting the ATS010 to CB motor operators and control coils requires external contactors. Chapter 7 describes such cases and explains how to select what contactors to use.
- Depending on the application and current system, use of the ATS010 may require auxiliary devices. Chapter 7 describes when they should be used and explains how to select them.
- The ATS010 only monitors one of the three phase voltages of the emergency power system. Normally the system that generates emergency power has its own electronic control of phase voltages. If precise monitoring of the 3 phases outside of the unit is required, an auxiliary voltage monitoring relay must be added to the ATS010. See Chapter 7 for details.

3.2 Basic switching logic

The following diagram is a simplified illustration of the SACE ATS010 basic switching logic when enabled. The inputs, outputs, selectors and setting trimmers of the device are described in the following paragraphs and for each a description is given of how it operates within the logic itself.



3.3 Regulation

3.3.1 Operating mode selector

By using the front selector it is possible to choose one of the six operating modes described below.

The selector is an electromechanical device and **all operating modes, except 'Automatic', work even in the case of a microprocessor failure.**

This ensures maximum switching system reliability since the system can be controlled in manual mode under any emergency condition.

TEST

In this position the output contact starts the gen set, even if the line is powered. The automatic switching logic is always on.

This operating mode is useful for testing gen set automatic start-up and thus checking emergency line power supply state.

AUTOMATIC

With the selector in this position, the transfer switch logic is on. In the case of net anomalies, it starts the switching procedure to change over from normal to emergency mode and vice versa when normal power returns.

The transfer switch logic can be disabled even when the selector is set to 'Automatic'. It can be disabled by:

- opening the 'Logic enabling' contact described below.
- pressing the 'Logic ON/OFF' push button: the red LED indicates when the logic is disabled.

With the selector set to 'Automatic' and logic disabled, the ATS010 does not send any open/close commands to the circuit breakers irrespective of whether the power comes from the line or the gen set. Thus the circuit breakers can be operated manually in full safety.

NORMAL ON

In this position the Emergency line circuit breaker is forced to open and the Normal line circuit breaker is forced to close. The gen set is shut down and the transfer switch logic is disabled.

This selector position ensures that the emergency line will not close and the gen set will not start up. This is useful when you want to perform maintenance on the emergency line or on the gen set (in these cases we suggest you mechanically lock the emergency line circuit breaker in the open position).

Warning: under such conditions, the open/close commands (to control coils or motor operators) are constantly powered so that the circuit breakers remain in the pre-established state. If you operate them manually, the power causes them to return to the pre-established state. Never use this selector position if tripping the circuit breakers could be dangerous.

NORMAL & EMERGENCY OFF

In this position, both the Normal and Emergency line circuit breakers are forced to open and the gen set start-up command is disabled. Moreover, this does not depend on whether or not the line is powered.

This selector position is useful if you want to disconnect all loads from the power source, for example when performing plant maintenance (in these cases we suggest you mechanically lock the circuit breakers in the open position).

Warning: under such conditions, the open/close commands (to control coils or motor operators) are constantly powered so that the circuit breakers remain in the pre-established state. If you operate them manually, the power causes them to return to the pre-established state. Never use this selector position if tripping the circuit breakers could be dangerous.

Gen-Set START

In this position, both circuit breakers are kept open and the gen set is started up whether the line is powered or not.

Warning: under such conditions, the commands (to control coils or motor operators) are constantly powered so that the circuit breakers remain open. If you close them manually, the power of these commands makes them open again. Never use this selector position if tripping the circuit breakers could be dangerous.
Starting from this position, you can switch the selector to the next position (Emergency ON) and force supply from the emergency line. However, this must only be done when emergency line voltage is present and switching enabled. These controls must be performed by the operator because the ATS010 is in manual mode.
Switching to the emergency line is enabled when any of the following signals are present on the ATS010 front panel:

- 'Emergency line': ON
- Gen set 'Start': ON
- Gen set 'NOT AUTO': OFF
- Gen set 'NOT ENABLED': OFF
- Gen set 'ALARM': OFF
- No circuit breaker alarms.

EMERGENCY ON
In this position, the normal line circuit breaker is forced to open, the emergency line circuit breaker is forced to closed and the gen set start command is given. This condition is maintained whether or not the line is powered because the ATS010 is in manual mode.
Before switching to this position, the selector must first pass through the previous position (Gen-Set START): as described above, it must remain in this position until the conditions required to enable switching are reached.

Warning: under such conditions, the commands (to control coils or motor operators) are constantly powered so that the circuit breakers remain in the pre-established state. If you operate them manually, the power of these commands causes them to return to the pre-established state. Never use this selector position if tripping the circuit breakers could be dangerous.

3.3.2 'Logic ON/OFF' push button

This membrane push button acts on a bistable relay inside the ATS010 and enables/disables the automatic switching logic. This function is active only when the selector is set to 'Automatic'.
Disabling the logic is useful when the circuit breakers need to be operated directly in manual mode, independently from the ATS010.
There is also an input on the terminal board which can be used to remotely disable the logic.

3.3.3 'Reset' push button

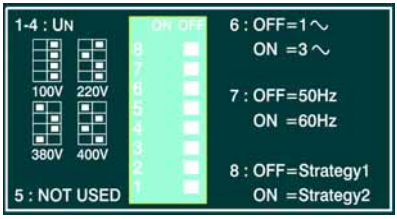
This membrane push button lets you reset/restart the ATS010 logic after it has been locked out for one of the following reasons:

- trip alarm for one of the circuit breakers
- circuit breaker withdrawn/removed signal
- circuit breaker command time-out

3.3.4 Dip-switch selector on side of unit

A dip-switch selector situated on the left side of the ATS010 lets you regulate the following parameters:

- rated voltage
- single- or three-phase net sensor operation
- network frequency
- switching strategy.



Rated voltage regulation

Some examples of regulation are printed directly on the device. Below is a table with all possible settings:

Un	Dip 1	Dip 2	Dip 3	Dip 4
100V	off	off	off	off
115V	ON	off	off	off
120V	off	ON	off	off
208V	ON	ON	off	off
220V	off	off	ON	off
230V	ON	off	ON	off
240V	off	ON	ON	off
277V	ON	ON	ON	off
347V	off	off	off	ON
380V	ON	off	off	ON
400V	off	ON	off	ON
415V	ON	ON	off	ON
440V	off	off	ON	ON
480V	ON	off	ON	ON
500V	off	ON	ON	ON

The voltage ratings refer to:
- phase-to-neutral voltage in the case of single-phase operation
- phase-to-phase voltage in case of three-phase operation.

The single/three phase setting is made using dip switch number 6.

Network frequency
The network frequency is set to 50 Hz or 60 Hz using dip switch number 7. Frequency thresholds will be automatically set to +10% of the rated value.

Switching strategy
Depending on the application in which the ATS010 is to be used, two different switching strategies can be applied.

With **strategy 1** the switching sequence is as follows:
- net anomaly detected
- normal line circuit breaker is opened and the gen set started
- delay until gen set power supply is available after which the gen set circuit breaker is closed.

This can only be used when a safe auxiliary power supply is available to power the circuit breaker motor operators.

With **strategy 2**, before commanding circuit breakers, the ATS010 waits for one of the two power supplies to become available: normal or gen set. The switching sequence is as follows:
- net anomaly detected
- gen set is started
- delay until gen set power supply is available after which the normal circuit breaker is opened
- gen set circuit breaker is closed.

When the electric auxiliaries are powered directly from the net and gen set, this switching strategy is indispensable because a safe power supply to the auxiliaries is not available.
The logic for both switching strategies is explained in detail in Chapter 4. Naturally the connection diagrams differ according to the strategy used.

3.3.5 Trimmers

There are 7 trimmers on the side of the device for setting minimum and maximum voltage thresholds and time delays.

Setting minimum and maximum voltage thresholds

The minimum and maximum voltage thresholds are set using two of the trimmers set on the side of the device. The fixed maximum threshold is +5% and the fixed minimum threshold is –5% of the rated voltage.
The trimmer settings can be within the following ranges:
Minimum voltage: from –5% to –30% of rated voltage
Maximum voltage: from +5% to +30% of rated voltage

Transfer switch delay configuration

T1 Delay between net anomaly detection and opening of Normal line circuit breaker. Setting range: 0 to 32s. This avoids unwanted switching as a result of brief voltage drops.
In Strategy 2, the overall delay before the breaker opens can be longer than T1, because the ATS010 must wait for the gen set to start up before opening/closing the breakers (see diagrams on the following pages).

T2 Delay between net anomaly detection and gen set start up. Setting range: 0 to 32s. As for the previous delay this avoids unwanted unit start-ups as a result of voltage drops.

T3 Delay between return of net power and gen set shut-down. Setting range: 0 to 254s. This allows the gen set to cool before it is shut down.

T4 Delay between return of net power and onset of reverse switching procedure. Setting range: 0 to 254s. This allows the normal line voltage to stabilize before switching back to normal power.

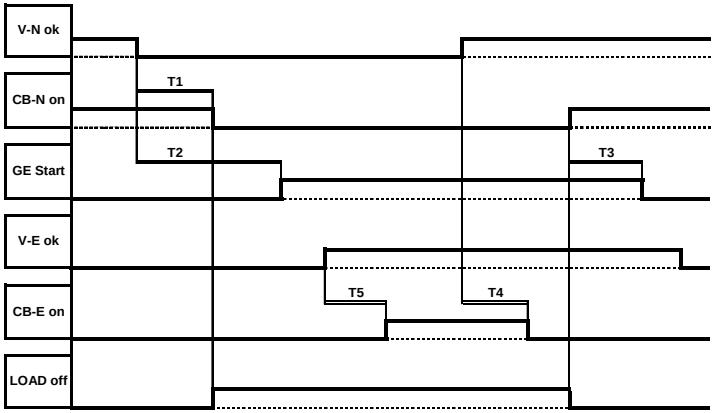
T5 Delay after the gen set is started up to let the unit voltage stabilize. Setting range: 0 to 32s. Once the generator has been started up and the emergency line power detected, the ATS010 waits for this amount of time before considering this voltage ready for use.
In Strategy 1, after detecting the gen set power, the ATS010 waits for a time T5 before closing circuit breaker CB-E.
In Strategy 2, since the circuit breakers cannot be used without a usable voltage, the ATS010 waits for a time T5 before opening circuit breaker CB-N. However, if the delay T1 from net anomaly detection has not yet elapsed, before opening circuit breaker CB-N, the ATS010 waits until delay T1 has run out (see the following diagrams).

Time delay diagrams

The following diagrams provide a simplified explanation of the effects of the ATS010 delays when the switching logic is enabled.
When the ATS010 is operating under Strategy 1, it is possible to open/close circuit breakers even when neither line (normal or emergency) is powered. Therefore, when a power outage is detected on the normal line, ATS010 waits time delay T1 and then opens the normal line circuit breaker (CB-N), whether or not the emergency line is powered.

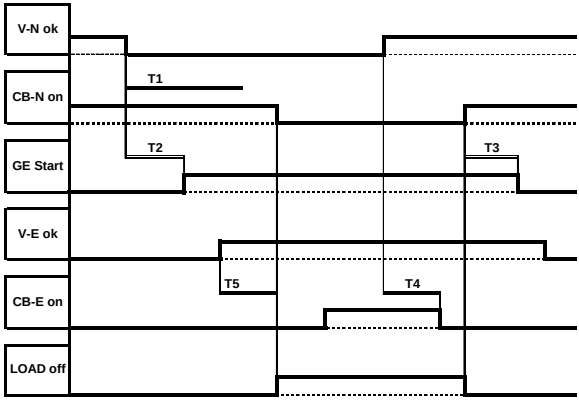
After a power outage is detected on the normal line, the gen set is started after time delay T2. Then, when the emergency line has been powered for time T5, the ATS010 closes the emergency line circuit breaker (CB-E).
Once the normal line power returns, the ATS010 waits a time delay T4, then switches back to normal line, opening CB-E and closing CB-N. The gen set is shut down after a further delay T3.

Note: in Strategy 1, the delay in opening CB-N is fixed, set at T1, and does not depend on emergency line voltage: since the breaker can be opened and closed independently of the gen set, the ATS010 always opens CB-N after a set delay T1 has elapsed from the moment the power failure was detected.



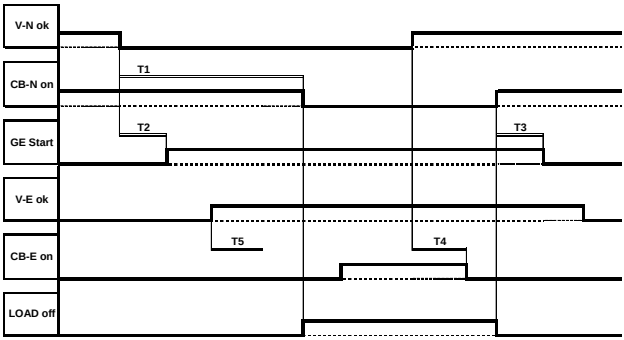
Example of timing diagram, strategy 1 operation

When the ATS010 is operating under Strategy 2, it cannot open or close the circuit breakers unless one of the lines (normal or emergency) is powered (these line voltages are also used to power the breaker motor operators or control coils).
Therefore, when normal line power is lost, the ATS cannot open the normal line breaker CB-N until the emergency line is powered.
Therefore, the ATS010 waits for delay T2 to elapse, then it starts the gen set, waits until the emergency line has been powered for at least a set time T5, and only then does it check whether the T1 delay has elapsed and finally makes the switch.
When power returns it reverts back to normal line operation in the same manner as in Strategy 1.



Example of timing diagram, strategy 2 operation

In Strategy 2, if delay T1 is set too long compared to the other delays, once the gen set is started and the T5 delay has elapsed, the ATS010 still waits for the net anomaly detection delay, T1, to elapse before opening circuit breaker CB-N.



Example of timing diagram, strategy 2 operation, long delay

Note: In Strategy 2, it is only possible to open CB-N if the emergency line is powered. Therefore, the delay between power loss and the opening of CB-N may be longer than T1 (e.g., if the gen set takes a long time to start up). T1 is only the minimum time delay between a power loss and the opening of the CB-N.

KEY

Indication of the signals in the diagrams:

V-N ok:	normal line voltage present and within set limits (1 = ok, 0 = ko)
CB-N on:	normal line breaker closed (1 = closed, 0 = open)
GE start:	gen set started (1 = start, 0 = stop)
V-E ok:	emergency line voltage present and within set limits (1 = ok, 0 = ko)
CB-E on:	emergency line breaker closed (1 = closed, 0= open)
LOAD off:	disconnect low priority loads output activated (1 = loads disconnected, 0 = loads connected)

3.3.6 Signaling LEDs

ATS010 state

POWER ON : green LED on when power supply is present

ATS State:	LED off in normal operation yellow LED on when automatic logic is disabled red LED on when watchdog alarm is on
LOGIC ON/OFF	green LED on when logic is enabled red LED on when logic is disabled

Normal and emergency line state

L1, L2, L3 or R, S, T:	green LED on for normal state red LED on for under- or over-voltage alarms alternative red/green LED on for inverted voltage sequence red LED flashing for minimum or maximum frequency alarms

For the emergency line, a green LED indicates voltage present.

Circuit breaker state

ON:	red LED on when circuit breaker is in closed position
ALARM	red LED on for circuit breaker anomaly (commands inconsistent with circuit breaker state)
TRIP	red LED on when circuit breaker tripped
WITHDR	yellow LED on when circuit breaker has been withdrawn or removed.

Gen set state LEDs

START	green LED on when gen set start command is sent
NOT AUTO	red LED on when gen set is not operating in automatic mode (gen set cannot start from remote)
ALARM	red LED on when gen set alarm present
NOT ENABLED	red LED on when switching to gen set is not enabled.

3.4 Description of Inputs

3.4.1 Normal power voltage sensor

The net sensor integrated into the SACE ATS010 detects network voltage anomalies. For networks with a rated voltage of up to 500 Vac, the three inputs can be directly connected to the three phases of the normal power supply line. For higher ratings, connect voltage transformers and set the rated voltage for the device to match the secondary voltage (typically 100V).

The net sensor is able to detect the following anomalies:
- minimum and maximum voltage
- phase loss
- voltage imbalance
- voltage sequence inverted
- minimum and maximum frequency.

The anomalies detected are displayed on the front of the unit with three two-color LEDs.
The net sensor monitors the normal power to start the normal-to-emergency line switching procedure if a net anomaly is detected. Likewise it enables the reverse switching procedure when the normal power supply returns.

3.4.2 Emergency power voltage sensor

This input is connected to two phases of the emergency power supply line and makes it possible to detect whether the line is powered. However, the emergency line powered condition alone is not enough for switching; the following additional conditions are required:
- no CB or gen set alarms
- switching enabled input.

3.4.3 Circuit breaker state

Two inputs are connected to the normal and emergency line circuit breaker state contacts (CB open = contact open).

3.4.4 Circuit breaker position

If the circuit breakers are the type that can be withdrawn, auxiliary position contacts are connected to these inputs (withdrawn = contact open). If the circuit breaker is withdrawn, transfer switch logic is disabled.

When the circuit breaker is inserted, the automation logic can be restored by running a Reset (using the push button on the front of the device or through remote input). If fixed circuit breakers are used, this input must be short-circuited.

3.4.5 Circuit breaker trip

The signaling contacts wired to these inputs detect the protections on the normal and emergency line circuit breakers. If one of the protections trips, the automation logic is disabled. After repair, the logic can be restored by running a Reset.

3.4.6 Automation logic enable/disable

When this input is short-circuited, the automatic switching logic is enabled. Following alarms or failures, the logic can still be disabled using the 'Logic ON/OFF' push button on the front of the unit.

This is useful to disable the logic and prevent automatic switching following any alarms originating in the plant.

3.4.7 Gen set state inputs

Three inputs monitor the gen set to control the emergency line switchover procedure and to provide special alarm signals.

Gen set alarm (GEN. ALARM)
A gen set alarm (input short-circuited) prevents switching to emergency line.

When operating with power from the emergency line, if this alarm is detected, the circuit breaker opens and the automation logic remains operative, ready to close the normal line circuit breaker if the normal power supply is restored.
This input can be used to wire several alarms coming from the gen set in parallel: oil leak, overtemperature, etc…
The Alarm is signaled by the 'Alarm' LED on the front of the unit, and the pertinent electrical contact is closed.

Gen set automatic operation (GEN. AUTO)
In the case of a net anomaly, the gen set is only started if it is set for automatic operation (input short-circuited). To prevent unwanted start ups, automatic operation can be disabled for gen set maintenance.
Gen set automatic operation is indicated by the 'Not Auto' LED on the front of the device (red when not in automatic mode).

Switching to emergency line enabled SW.ENABLE
Activation of this input informs the ATS010 that all conditions required to connect the gen set to the loads have been met and therefore the emergency line circuit breaker CB-E can be closed. After the circuit breaker has closed, this input informs the ATS010 that the breaker can remain closed. This function is used to prevent unwanted switching if rated conditions are not met, e.g.:

- correct voltage.
- correct frequency.
- correct synchronization of multiple gen sets in parallel.

Switching to emergency line is not possible when the 'Not Enabled' LED (red) on the front of the device is on.
Switching to emergency line is only enabled if this input is short-circuited. This input must be short-circuited the entire time to ensure that the emergency line breaker CB-E remains closed.

If this input is deactivated (opened) while the emergency line breaker is closed, the ATS010 automation logic interprets this as a failure to meet required conditions for gen set connection. Thus the ATS010 opens the emergency circuit breaker immediately; this circuit breaker will not be closed again until the SW.ENABLE input becomes active once more.
WARNING: under such conditions, the system is not powered, even if the gen set is running. Wiring to SW.ENABLE input must be carefully designed to prevent an undesired SW.ENABLE signal from cutting off power to the plant.

3.4.8 Reset from remote

Apart from the reset push button on the front of the device, there is also an input for a remote reset.
The device must be reset in automatic mode after any of the following events:
- trip alarm from one of the circuit breakers
- circuit breaker withdrawn/removed signal
- circuit breaker command time-out.

3.4.9 Forced switching to emergency power supply

To safeguard against possible power anomalies and to guarantee a higher level of reliability, some industrial processes require that power be supplied from a gen set, rather than from the normal line, for short periods of time.
Switching can be forced to emergency line from remote by simply short-circuiting this input. This operation starts the complete procedure for switchover to emergency line:
- Gen set is started and waits until emergency power is available
- Normal line circuit breaker is opened
- Emergency line circuit breaker is closed.

The Emergency line power supply remains available as long as this command is active. When the command is disabled, the reverse transfer switching procedure is started to return normal supply.

3.5 Description of Outputs

3.5.1 Opening/closing circuit breakers – intrinsic safety

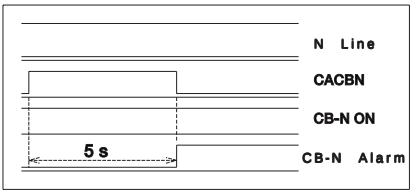
The output relays command the circuit breakers by means of motor operators (for moulded-case circuit breakers) or control coils (for air circuit breakers). The output relay configuration has been designed to make it possible to command any type of motor operator through a direct connection to the SACE ATS010. See Chapter 5 for the allowable voltage ratings for such controls.

The SACE ATS010 has been integrated with **an electrical interlock featuring power relays that guarantee high intrinsic safety** in controlling the circuit breakers. The automation logic software has also been designed to prevent two circuit breakers from closing simultaneously.

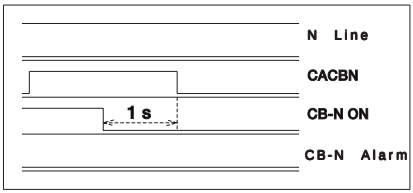
To guarantee maximum reliability, after issuing the command, the automation logic monitors correct circuit breaker operation.
If the operation has been completed successfully, the ATS010 disables the command (powering the coil or motor) after 1 s.
If it does not receive feedback indicating correct CB state within 5 seconds after the command has been issued, the ATS010 considers it a failed attempt. In this case it:

- stops automation logic
- turns on the circuit breaker alarm LED
- closes the Alarm and Logic Disabled output contacts.

In case of command failure, if the plant is powered through the emergency line (CB-E closed), the ATS010 keeps the generator running to guarantee the most continuous power supply possible.
Warning: ATS010 release 07 or lower always stops the gen set in case of failed circuit breaker command. See section 7.8 to determine the release number for your ATS010 unit.
The figures below provide a graphic indication of this control function when the normal line circuit breaker is opened. The commands to open CB-E and close CB-N and CB-E work in a similar manner.



Command failed



Command successful

3.5.2 Gen set start/stop

A changeover contact commands the gen set to start up and shut down.

3.5.3 Low priority load Connection/Disconnection

A changeover contact makes it possible to disconnect low priority loads when the normal line circuit breaker opens. Loads are reconnected during reverse switching back to normal line operation when the Normal line circuit breaker closes.

3.5.4 Alarm signaling

A contact (NC) signals the presence of a circuit breaker alarm, a gen set alarm or an alarm of the ATS itself. This contact operates with intrinsic safety and is normally kept open during normal device operation. When the contact is closed, there is either an alarm present or no auxiliary power supply.

3.5.5 Logic state

This contact is closed and kept closed, with intrinsic safety, when automatic transfer switch logic is active. If the contact is open, it means the logic has been disabled for some reason (e.g. alarm, microprocessor failure, power outage, etc…).

4. Operating logic

4.1 Detailed description

The whole switching logic is described by means of a finite-state machine with 6 possible states. Switching from one state to another and relevant conditions are described using simple tables. In the tables, state 1 means input present, 0 input absent, X non-conditioning (0 or 1).

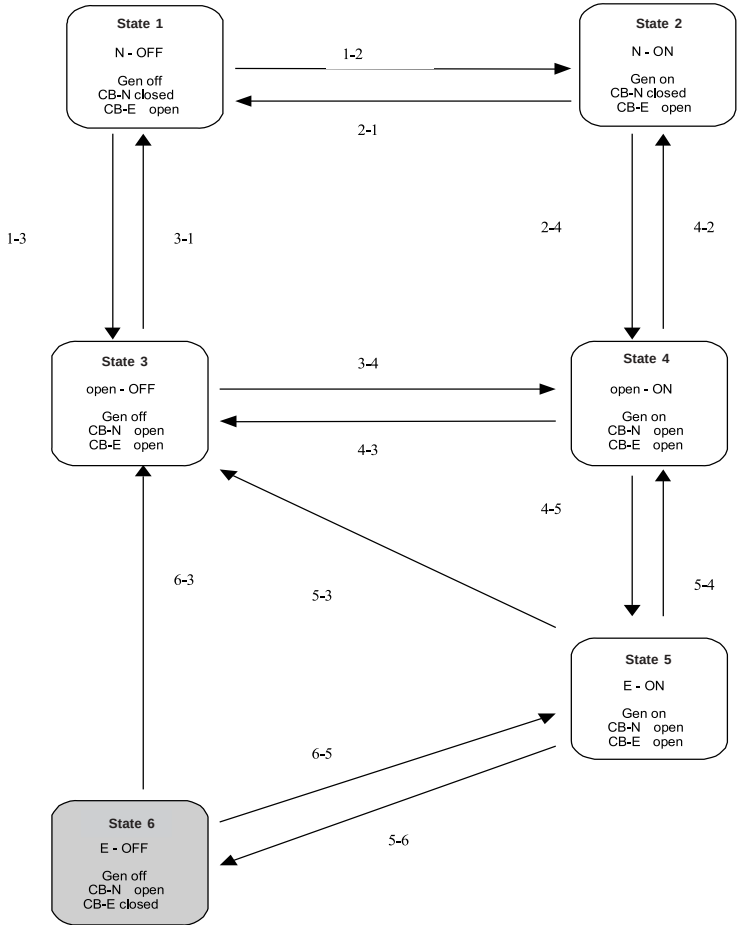
There are 6 possible states, depending on the circuit breaker and gen set outputs:

1. N + OFF: normal line circuit breaker closed, gen set off
2. N + ON: normal line circuit breaker closed, gen set on
3. Open + OFF: both circuit breakers open, gen set off
4. Open + ON: both circuit breakers open, gen set on
5. E + ON: gen set circuit breaker closed, gen set on
6. E+OFF: gen set circuit breaker closed, gen set off (this state is present only with strategy 2 and only in case of need).

An “ATS locked” state is also possible (waiting for reset) for which:

- logic is locked (no operations carried out on circuit breakers)
- Alarm signal (ATAL) and logic disabled (ATIN) are activated.

Finite-state machine diagram:



Automatic mode, strategy 1

From	To	CCD	CoCo	NoAu	ALGE	Other conditions
1	2	0	X	0	0	No power on normal line for at least T2
1	2	1	X	0	0	
1	3	0	X	X	X	No power on normal line for at least T1
2	1	0	X	0	0	State 2 present for at least T3 Power OK on Normal line for at least T4
2	1	X	X	1	X	
2	1	X	X	X	1	
2	4	0	X	0	0	No power on normal line for at least T1
2	4	1	X	0	0	Power supplied by Gen-set for at least T5
3	1	0	X	X	X	Power OK on Normal line for at least T4
3	1	1	X	1	X	Power OK on Normal line for at least T4
3	1	1	X	X	1	Power OK on Normal line for at least T4
3	4	0	X	0	0	No power on normal line for at least T2
3	4	1	X	0	0	
4	2	0	X	0	0	Power OK on Normal line for at least T4
4	3	X	X	1	X	
4	3	X	X	X	1	
4	5	0	1	0	0	Power supplied by Gen-set for at least T5 No power on normal line
4	5	1	1	0	0	Power supplied by Gen-set for at least T5
5	3	X	X	1	X	
5	3	X	X	X	1	
5	4	0	X	0	0	Power OK on Normal line for at least T4 State 5 or 6 present for at least T4
5	4	X	X	0	0	State 5 or 6 present for at least T4
5	4	X	X	0	0	No power supply from Gen-set
6	3	X	X	X	X	

Automatic mode, strategy 2

From	To	CCD	CoCo	NoAu	ALGE	Other conditions
1	2	0	X	0	0	No power on normal line for at least T2
1	2	1	X	0	0	
2	1	0	X	0	0	State 2 present for at least T3 Power OK on Normal line for at least T4
2	1	X	X	1	X	
2	1	X	X	X	1	
2	4	0	X	0	0	No power on normal line for at least T1 Power supplied by Gen-set for at least T5
2	4	1	X	0	0	Power supplied by Gen-set for at least T5
3	1	0	X	X	X	Power OK on Normal line for at least T4
3	1	1	X	1	X	Power OK on Normal line for at least T4
3	1	1	X	X	1	Power OK on Normal line for at least T4
3	4	0	X	0	0	No power on normal line for at least T2
3	4	1	X	0	0	
4	2	0	X	0	0	Power OK on Normal line for at least T4
4	3	X	X	1	X	
4	3	X	X	X	1	
4	5	0	1	0	0	Power supplied by Gen-set for at least T5 No power on normal line
4	5	1	1	0	0	Power supplied by Gen-set for at least T5
5	3	X	X	1	X	Power OK on Normal line for at least T4
5	3	X	X	X	1	Power OK on Normal line for at least T4
5	4	0	1	0	0	Power OK on Normal line for at least T4 State 5 or 6 present for at least T4
5	4	X	0	0	0	Power OK on Normal line for at least T4 State 5 or 6 present for at least T4
5	4	X	0	0	0	Power supplied by Gen-set for at least T5 State 5 or 6 present for at least T4
5	6	X	X	1	X	Normal line not powered or powered for less than T4
5	6	X	X	X	1	Normal line not powered or powered for less than T4
6	3	X	X	X	X	Power OK on Normal line for at least T4

In Test mode, the tables change as follows. It is assumed that no gen set alarms are present and that the gen set is working in automatic mode.

Test mode, strategy 1

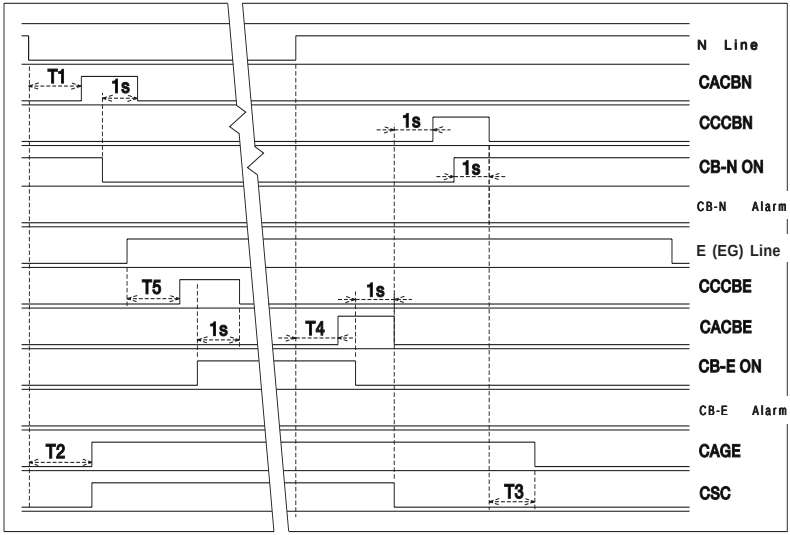
From	To			
		CoCo	ALGE	Other conditions
1	2	X	0	
1	3	X	X	No power on normal line for at least T1
2	1	X	1	
2	4	X	0	No power on normal line for at least T1
3	1	X	X	Power OK on Normal line for at least T4
3	4	X	0	
4	2	X	0	Power OK on Normal line for at least T4
4	3	X	1	
4	5	1	0	Power supplied by Gen-set for at least T5 No power on normal line
5	3	X	1	
5	4	1	0	Power OK on Normal line for at least T4 State 5 or 6 present for at least T4
5	4	0	0	State 5 or 6 present for at least T4
5	4	X	0	No power supply from Gen-set
6	3	X	X	

Test mode, strategy 2

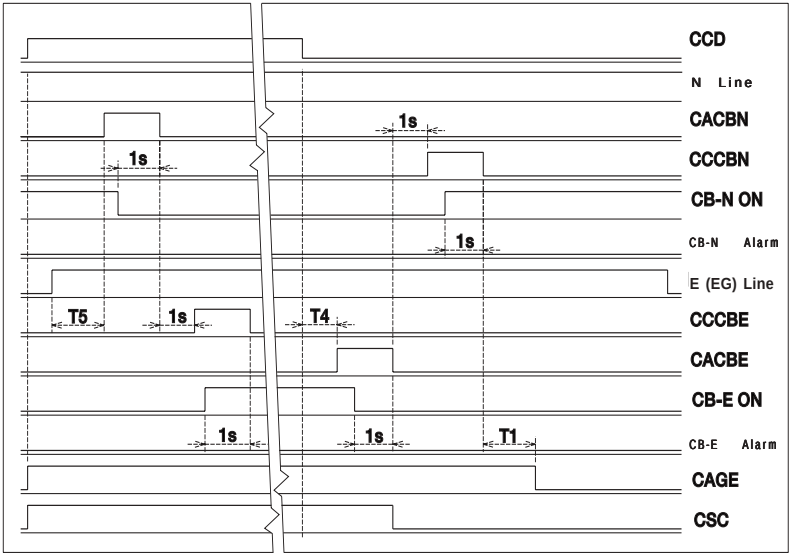
From	To			
		CoCo	ALGE	Other conditions
1	2	X	0	
2	1	X	1	
2	4	X	0	No power on normal line for at least T1 Power supplied by Gen-set for at least T5
3	1	X	X	Power OK on Normal line for at least T4
3	4	X	0	
4	2	X	0	Power OK on Normal line for at least T4
4	3	X	1	
4	5	1	0	Power supplied by Gen-set for at least T5 No power on normal line
5	3	X	1	Power OK on Normal line for at least T4
5	4	1	0	Power OK on Normal line for at least T4 State 5 or 6 present for at least T4
5	4	0	0	Power OK on Normal line for at least T4 State 5 or 6 present for at least T4
5	4	0	0	Power supplied by Gen-set for at least T5 State 5 or 6 present for at least T4
5	6	X	1	Normal line not powered or powered for less than T4
6	3	X	X	Power OK on Normal line for at least T4

4.2 Examples of operation

Switching sequence in the case of normal line anomaly and subsequent return:



Switching sequence in the case of forced switching:



5. Installation and set-up

This chapter contains a practical guide for ATS010 installation and set-up.
The guide includes:
- a note for checking the correct installation of the ATS010
- a guide to the **set-up** procedure to check for wiring errors
- a **troubleshooting guide** indicating the problems most frequently encountered during installation.

Use the following pages as a checklist, ticking each operation and test as you go along.

5.1 Before set up

CHECKING THE PLANT AND CIRCUIT BREAKERS

Ensure that the plant in question is compatible with the ATS:

- ❑ the gen set must operate “in isolation”
- ❑ net rated voltage and frequency must be within the accepted range
- ❑ ATS010 power supply must be guaranteed even if both net and gen set power are out.

Make certain that both circuit breakers controlled by the ATS have the correct characteristics. The circuit breakers must be:

- ❑ mechanically interlocked
- ❑ acceptable in terms of type and rating
- ❑ fitted with the required accessories (see 5.4)

WIRING CHECK

Wiring diagrams needed to use the ATS010 with Isomax, Tmax and Emax circuit breakers are included with this manual.

- ❖ If an independent power supply is available for CB motor operators (or control coils), follow the diagram indicated as “With safe auxiliary power supply”
- ❖ If instead the motor operators (or control coils) are powered by the net or gen set, follow the diagram indicated as “Without safe auxiliary power supply”.

Make certain that all necessary connections are made:

Connections to gen set control board

- ❑ Gen set start up.
- ❑ Gen set alarm signal. In the absence of this signal, do not connect the input.
- ❑ Gen set in automatic/manual mode. In the absence of this signal, short-circuit the input.

Other inputs

- ❑ Switching to gen set enabled. In the absence of this signal, short-circuit the input.
- ❑ Remote switching command.
- ❑ Logic enabled.
- ❑ Remote Reset command.

Connections to normal and emergency line circuit breakers

- ❑ CB motor operator or control coil.
- ❑ Open /close signal.
- ❑ Protection relay trip signal. In the absence of this signal, short-circuit the input.
- ❑ Circuit breaker withdrawn signal. In case of fixed circuit breaker, short-circuit the input.

Signal contacts (if used)

- ❑ Alarm.
- ❑ Automation logic activated.

Command contacts (if used)

- ❑ Low priority load disconnection.

Net sensor

- ❑ Network.
- ❑ Gen set.

Power supply and ground

- ❑ Power supply.
- ❑ Ground connection.

UNIT REGULATIONS

Set the DIP-Switches on the side panel (see 3.3.4.)

- ❑ Single-phase or three-phase operation.
- ❑ Rated Frequency: 50 Hz or 60 Hz.

- ❑ Operating voltage
  Single-phase: select value for voltage between phase and neutral
  Three-phase: select value for phase to neutral voltage

- ❑ Switching strategy
  - If CB motor operators (or control coils) are powered directly from the normal and gen set lines, select **strategy 2** only.

Adjust trimmer on side panel (see 3.3.5).

- ❑ Maximum and minimum voltage
- ❑ Time delays

Naturally these settings can be modified after the unit has been set up. However, it is not advisable to start operations without knowing the positions of the regulations.

5.2. Set-up

Following this procedure lets you set up the unit and, at the same time, check that installation has been carried out correctly.
After each step, check that the expected result is achieved.
If not, see **Trouble-shooting guide** (5.3).

- ❑ Initiate set-up with: ATS010 not powered and with both circuit breakers in the open position.
  Warning*: the alarm signal contact is closed!*
- ❑ Set the selector to norm-emer. OFF.
  With selector in this position, the unit will keep the circuit breakers open during set-up.
- ❑ Power the ATS010.
  All LEDs on the front panel flash briefly and then go on in sequence.
  If an alarm device is present, it stops functioning.
  At the end of this sequence, only the Power LED (green) remains on.
  The two breaker LEDS remain off.
  If normal line voltage is present without anomalies, the green LEDS L1, L2, L3 or R,S,T are on (in single-phase operating mode only green LED L1 or R is on).
- ❑ For circuit breakers that can be withdrawn or removed: switch off power supply to the CB motor operators or control coils, place both circuit breakers in the withdrawn position and then return them to the connected position.

For each circuit breaker, the Withdrawn LED goes on when circuit breaker is withdrawn.

To turn off the LED, after returning the circuit breakers to the connected position, reboot the unit by turning the power off and on again (if in manual mode) or run a Reset (if in AUTOMATIC mode).

- ❑ For circuit breakers with protection relays: switch off power supply to the CB motor operators or control coils, and then run a trip test on each circuit breaker.

  The red trip LED for each CB goes on during the trip test.

  To turn off the LED, after resetting the CB, reboot the unit by turning the power off and on again (if in manual mode) or run a Reset (if in AUTOMATIC mode).
- ❑ Set gen set to manual mode and then to automatic.

  The "Not Auto" LED goes on when the gen set is in manual mode and goes off when it is in automatic mode.
- ❑ If present in your plant, activate the gen set switching signal and deactivate it again.

  The "Not Enabled" LED goes on when switching is disabled and goes off again when enabled.
- ❑ If your gen set is so arranged, trip the gen set alarm signal and then return it to normal conditions.

  The gen set Alarm LED goes on when there is a generator alarm and goes off again when the alarm is removed.
- ❑ Switch the front selector to Gen-Set Start.

  The Start LED goes on, indicating that the ATS010 is sending the gen set the start signal.

  The gen set starts up and begins supplying power to the emergency line (depending on the characteristics of your plant, the amount of time required for this may vary).

  The green Emergency Line LED goes on, indicating that the emergency line is powered.
- ❑ Switch selector to Emergency ON.

  The circuit breaker connecting the power supply to the emergency line closes.

  Power is supplied by the gen set.

  The emergency line circuit breaker ON LED turns red signaling that it is closed.
- ❑ Return front selector to Gen-Set Start.

  The circuit breaker connecting the power supply to the emergency line opens.

  The ON LED goes off.

- ❑ Switch front selector to Norm.-Emergency Off.
  The green Emergency Line LED goes off indicating that the ATS010 is sending the gen set stop command.
  The gen set stops (depending on the characteristics of your plant, the amount of time required for this may vary).
  The green Emergency Line LED goes off indicating that the line is not powered.
- ❑ Switch front selector to Normal ON mode.
  The normal line circuit breaker closes.
  Normal line circuit breaker ON LED turns red, indicating that the circuit breaker is closed.
- ❑ Switch front selector to Normal-Emergency OFF position.
  The normal line circuit breaker opens.
  The emergency line circuit breaker ON LED goes off.
- ❑ Switch front selector back to Normal ON mode.
  The Normal line circuit breaker closes, and the ON LED turns red.
- ❑ Switch front selector to Automatic position.
  If automatic logic is disabled, the LED in the Logic ON/OFF push button is red.
  In this case press the "Logic ON-OFF" push button to enable the logic.
  The LED on the button turns green.
  The ATS010 unit starts operating in automatic mode:
  - *if normal line voltage is OK, the normal line circuit breaker remains closed and powered.*
  - *otherwise the unit starts the gen set switching sequence and supplies power from the generator.*
- ❑ Press the Logic ON-OFF push button to reboot the logic.
  The ATS State LED turns yellow when logic is not active and is off when logic is active.
  The Output contact for Logic State is closed when automatic logic is active and open when logic is disabled.
- ❑ If present in your plant, open and close the logic state input.
  ATS State LED turns yellow when logic is not active and is off when logic is active.
  Output contact for Logic State is closed when automatic logic is active and open when logic is disabled.
- ❑ If present in your plant, send the remote switching command.
  The unit performs the switching procedure: it starts the gen set, commands the circuit breakers and begins supplying power through the emergency line.
  When the remote switching command is deactivated, if normal line

voltage is OK, the unit performs inverse switching procedure to return to normal line power.

- ❑ If present in your plant, send the remote Reset command.
  The unit runs a reset cycle, all front panel LEDS go on in sequence, and then the previous state is restored.
- ❑ If necessary use trimmers to set time delays and if necessary maximum/minimum voltage thresholds, as required for your plant.

Set-up is complete! The ATS now guarantees your plant's power supply!

5.3. Troubleshooting

POWER ON AND SET-UP

PROBLEM	DESCRIPTION	POSSIBLE CAUSES
The ATS010 does not turn on.	No auxiliary power supply to electronic circuit	- power supply wiring error - power supply voltage too low - ATS is receiving 24 V power through 48 V terminals
ATS continually repeats starting sequence, turning on all LEDs	Reset command is constantly present	Reset terminal is not wired correctly

CIRCUIT BREAKER STATE

PROBLEM	DESCRIPTION	POSSIBLE CAUSES
"Withdrawn" LED goes ON but the CB is a fixed version	ATS010 has detected an open circuit at the terminals connected to the "CB withdrawn" signal auxiliary contact	- the withdrawn terminal for the CB in question has not been connected
"Withdrawn" LED goes on even when the CB is in the connected position	ATS010 has detected an open circuit at the terminals connected to the "CB withdrawn" signal auxiliary contact	- Wiring error - The ATS010 has not been reset or rebooted (powered off and on again) after the CB was last removed.
"Withdrawn" LED does not go on even if the CB is withdrawn	ATS010 has detected a short circuit at the terminals connected to the "CB withdrawn" signal auxiliary contact	- Wiring error
Trip LED goes ON, but the CB does not have a protection trip relay	ATS010 has detected an open circuit at the terminals connected to the "relay tripped" signal auxiliary contact	- the trip terminal for that CB has not been connected
Trip LED goes ON, but the relay has not tripped	ATS010 has detected an open circuit at the terminals connected to the "relay tripped" signal auxiliary contact	- Wiring error - The ATS010 has not been reset or rebooted (powered off and on again) after last relay trip.
Trip LED does not go on when CB relay is tripped	ATS010 has detected a short circuit at the terminals connected to the "relay tripped" signal auxiliary contact	- Wiring error
ON LED remains off when the CB is opened and closed	ATS010 has detected an open circuit at the terminals connected to the "open/closed" signal auxiliary contact and thus considers the CB open	- the closed terminal for that CB has not been connected
ON LED remains red when the CB is opened and closed	ATS010 has detected a short circuit at the terminals connected to the "open/closed" signal auxiliary contact and thus considers the CB closed	- Wiring error
When using the front selector, the normal line CB does not open, or does not close	The motor operators or control coils do not receive power	- Wiring error - motor operators or control coils are not powered

GEN-SET

PROBLEM	DESCRIPTION	POSSIBLE CAUSES
The front selector does not start the generator		- Wiring error. Make certain that you are using the correct type of contact (NC or NO) required by the device controlling your - Generator problem.
The generator is always running		- Wiring error. Make certain that you are using the correct type of contact (NC or NO) required by the device controlling your generator
Gen-set alarm LED goes ON but generator is operating normally	ATS010 detects a short circuit between the terminals connected to the alarm signal contact	- Wiring error.
Gen-set alarm LED does not go ON even if there is an alarm	ATS010 detects an open circuit between the terminals connected to the alarm signal contact	- Wiring error.
"Not Auto" LED goes on but the generator is in automatic mode	ATS010 detects an open circuit between the terminals connected to the manual mode signal contact	- relative terminal is not connected
"Not Auto" LED does not go on even if the generator is set to manual mode	ATS010 detects a short circuit between the terminals connected to the manual mode signal contact	- Wiring error.

NET SENSOR

PROBLEM	DESCRIPTION	POSSIBLE CAUSES
Normal line voltage is OK but the ATS010 indicates voltage too high or too low		- DIP-switch rated voltage regulation is not correct
		- Minimum and maximum voltages set with the trimmers are unsuitable for the rated voltage of your system
		- Wiring error
Only the L1 or R LED goes on. **The LEDs for phases L2 (or S) and L3 (or T) remain off.**	The ATS010 is working in single-phase mode	- DIP-switch regulation of single/three phase operating mode is not correct
The device signals phase sequence inversion	The ATS010 detects phase sequence contrary to what is expected	- Wiring error. Two of the phases have been inverted.
Emergency Line LED does not go on even if the generator is running	ATS010 does not detect power on emergency line.	- Wiring error

CONTROLS AND SIGNALS

PROBLEM	DESCRIPTION	POSSIBLE CAUSES
"Not enabled" LED goes on but the input is not used	ATS010 detects an open circuit between the terminals connected to the enable contact	- The input has not been connected - Wiring error
"Not enabled" LED is ON but input is in the "enabled" position	ATS010 detects an open circuit between the terminals connected to the enable contact	- Wiring error
"Not enabled" LED does not go on even if the input is in the "disabled" position	ATS010 detects a closed circuit between the terminals connected to the enable contact	- Wiring error
External alarm signal does not operate correctly	*Warning: when the unit is not powered, the alarm signal contact is closed: in this mode, if a failure cuts off the power to the unit, an alarm signal is given*	- Wiring error
External automation active logic signal does not function properly		- Wiring error

LOW-PRIORITY LOAD DISCONNECTION

PROBLEM	DESCRIPTION	POSSIBLE CAUSES
Low priority loads are not disconnected or remain always connected		- Wiring error. Make certain that you are using the correct contact type (NC or NO).

AUTOMATIC OPERATION

WARNING! *Even if the unit appears to be in stand by, switch it off before accessing the circuit breakers or the power supply. The unit could be in a delay phase awaiting a set time delay, or it could be awaiting some other external condition. In such cases, the circuit breakers could start operation without warning.*

PROBLEM	DESCRIPTION	POSSIBLE CAUSES
Alarm LED for one of the two CBs goes on	ATS010 attempt to open or close the CB has failed	- Switching strategy selection error The motor operators or control coils are powered by normal and gen set lines but the ATS010 is configured for STRATEGY1, e.g. as though there were a dedicated power supply for the commands.
		- motor operators or control coils are not powered
		- the motor charging the springs that open/close the CB (EMAX) does not function properly; thus, the springs are still discharged when the unit attempts to operate the CB.
The unit does not run switching procedure ATS State LED is yellow	Automation logic is OFF	- Automation logic has been disabled using the push button on the front panel
		- Automation logic has been disabled using external command
		- Wiring error The terminal to enable the logic has not been connected
The unit does not run switching procedure ATS State LED is OFF and all other LEDs on the front panel indicate operating conditions are OK.		- Switching strategy selection error. For example, strategy 2 has been set and the unit is waiting for the generator to supply line power before operating the CBs
		The unit is receiving a command to force switching
The unit switches to the emergency line even if normal supply is OK (green LEDs L1, L2, L3 or R,S,T)		The unit is receiving a command to force switching.
Normal supply is OK (green LEDs L1, L2, L3 or R,S,T) but the unit does not close the net CB		- The unit is receiving a command to force switching
		- The unit is waiting for the set delay time to run out
		- Automation logic has been disabled through the push button on the front panel or has been forced

6. Mechanical and electrical characteristics

Reference standards

EN 50178 (1997): "Electronic devices used in power plants"
Compliance with EEC Low Voltage Directive 73/23, compliance with EEC Directive on Electromagnetic compatibility 89/336.

Electromagnetic compatibility:	EN 50081-2, EN 50082-2
Environmental conditions:	IEC 68-2-1, IEC 68-2-2, IEC 68-2-3

General characteristics

Net power supply voltage	24Vdc +/-20%
(galvanically insulated from ground)	48Vdc +/-10%
	(max. ripple +/- 5%)
Maximum power consumption	5W @ 24Vdc
	10W 48Vdc
Rated power (net present and CBs not operated)	1.8W @ 24Vdc
	4.5W 48Vdc
Operating temperature	-25°C...+70°C
Maximum humidity	90% without condensation
Storage temperature	-25°C...+80°C
Protection rating	IP54 front panel
Dimensions mm	144 x 144 x 85
Weight [kg]	0.8

Net sensor

Normal line rated voltage	100...500Vac with direct connection
	Over 500Vac with external VT
Rated frequency	50Hz, 60 Hz
Impulse voltage on R S T inputs	6 kV

Output contact ratings

Rated current at 40°C	12 A
Maximum switchable AC voltage	250 Vac (150Vac for logic state and alarm signals)
Switchable rated apparent power	AC15 750VA
	AC1 3000VA
Switchable minimum load	300mW 10V / 5mA
Electrical life	10^5 operations in AC1 at 3000VA
Maximum switchable DC voltage	220V
Breaking capacity DC1	12A@24V
	1.4A@48V
	0.3A 110V

Suitable CB motor operators or control coils

Emax	24V dc
	48V dc
	60V dc
	110V dc
	24V ac
	30V ac
	48V ac
	60V ac
	110V..127V ac
	220V..250V ac
Isomax S3-S4-S5	24V dc
	48V dc
	60V dc
	110V dc
	100V...127V ac
	220V...250V ac
Isomax S6-S7	24V dc
	48V dc
	60V dc
	110V dc
	110V ac
	120V...127V ac
	220V...250V ac
Tmax T4-T5	24V dc
	48V dc
	60V dc
	110V dc
	24V ac
	48V...60V ac
	110V...125V ac
	220V...250V ac
Warning: Only listed values are allowed. **NEVER** use any other voltages (**e.g. 54V dc, 100V dc, 120V dc**)	

Connection terminals

Use cables: 0.2 ... 2.5 mm^2 (AWG 24…12)

Threshold and time setting ranges

Minimum voltage	-5%...-30% Un
Maximum voltage	+5%...+30% Un
Fixed frequency thresholds	-10%...+10% fn
T1: CB-N opening time delay	0...32s
T2: Gen-set start time delay	0...32s
T3: Gen-set stop time delay	0...254s
T4: Reverse transfer switch time delay	0...254s
T5: CB-N closing time delay	0...32s

7. ATS010 Application

7.1 Introduction

The ATS010 is an automatic transfer switching unit used together with ABB SACE low voltage circuit breakers.
This chapter provides information on application of the ATS010:

- wiring diagrams
- ATS010 power requirements
- circuit breaker accessory equipment
- additional required devices

This chapter also describes some special cases that require particular wiring (see below: Special Applications – Notes). **Please read this part carefully before application of the ATS010 unit**.

7.2 Wiring diagrams

The ATS010 wiring diagrams are published in the ABB Library (http://www.abb.com) under the following numbers:

ITSCE-RM0020001	use of ATS010 with Emax circuit breakers
ITSCE-RM0021001	use of ATS010 with Isomax S3-S4-S5 circuit breakers
ITSCE-RM0022001	use of ATS010 with Isomax S6-S7 circuit breakers
1SDM000033R0001	use of ATS010 with Tmax T4-T5 circuit breakers

Additional diagrams for special application are given in paragraph 7.7.

7.3 ATS010 Power Supply

The unit requires a 24 or 48 Vdc power supply with a buffer battery, or a 24 or 48 Vdc battery with a battery charger.
Power supply should be dimensioned according to the ATS010 power requirements: 5W at 24V, or 10W at 48V.
Minimum battery capacity: 10 Ah.

7.4 Circuit Breaker accessories

Each of the circuit breakers used with the ATS010 must be fitted with the following accessories:

Emax	Shunt opening release YO
	Shunt closing release YC
	Gearmotor to automatically charge closing springs
	Auxiliary contact for signaling of circuit-breaker open/closed
	Auxiliary contact for signaling of overcurrent release tripped
	Auxiliary contact for signaling of circuit-breaker connected/cut-off
Isomax S3-S4-S5	direct action motor operator
	Auxiliary contacts: 1 open/close changeover contact and 1 release tripped contact contact for signaling circuit breaker connected (only for circuit breakers that can be removed or withdrawn)
Isomax S6-S7	Stored energy motor operator
	Auxiliary contacts:
	1 open/close changeover contact and 1 release tripped contact contact for signaling circuit breaker connected (only for circuit breakers that can be removed or withdrawn)
	key lock to protect against manual operation
Tmax T4-T5	Stored energy motor operator MOE
	Cabled auxiliary contacts AUX-C: 1 open/closed and 1 release tripped (1Q 1SY)
	Auxiliary position contact AUP for signaling of circuit-breaker connected (only for circuit breakers that can be removed or withdrawn)

In addition, a mechanical interlock is required between the two breakers, as follows:

Emax	Mechanical interlock across two circuit-breakers
Isomax S3-S4-S5	Mechanical interlock across two circuit-breakers
Isomax S6-S7	Mechanical interlock across two circuit-breakers
Tmax T4-T5	Interlocking mechanism including plates (MIR-P) and horizontal (MIR-HB) or vertical (MIR-VB) frame

The following power voltages can be used for the CB motor operators and control coil:

Emax	24V dc
	48V dc
	60V dc
	110V dc
	24V ac
	30V ac
	48V ac
	60V ac
	110V..127V ac
	220V..250V ac
Isomax S3-S4-S5	24V dc
	48V dc
	60V dc
	110V dc
	100V...127V ac
	220V...250V ac
Isomax S6-S7	24V dc
	48V dc
	60V dc
	110V dc
	110V ac
	120V...127V ac
	220V...250V ac
Tmax T4-T5	24V dc
	48V dc
	60V dc
	110V dc
	24V ac
	48V...60V ac
	110V...125V ac
	220V...250V ac
Warning: Only listed values are allowed. **NEVER** use any other voltages (**e.g. 54V dc, 100V dc, 120V dc**)	

7.5 Auxiliary components

Depending on the application, one or more of the following auxiliary components may be required, as shown in the wiring diagrams:

- protection devices Q61/1, Q61/2
- contactors K1, K2
- contactors KC1, KC2, KO1, KO2

7.5.1 Protection devices Q61/1, Q61/2

These devices are used to protect:
- the ATS010 input circuits
- the circuit breaker motor operators or control coils, if they are powered by normal and emergency lines (see circuit diagram "Without safe auxiliary power supply").

How to select Q61/1 and Q61/2

Fuses or modular circuit breakers may be used, depending on specific installation requirements.

Fuses are selected as follows:
- if application is WITH safe auxiliary AC or DC power supply (as in diagrams 3 and 4), 30 mA fuses should be used.
- if application is WITHOUT safe auxiliary power supply (as in diagram 2), fuses must be selected according to the electrical rating of the motor operators or control coils (see technical catalogue for relevant circuit breaker range).

For line-to-line voltages of 400V or lower, ABB modular circuit breakers can be selected as follows:
- if application is WITH safe auxiliary AC or DC power supply (as in diagrams 3 and 4):
  Q61/1 : 2-pole modular circuit breaker In=1A(C) (S252 C1)
  Q61/2: 4-pole modular circuit breaker In=1A(C) (S254 C1)

- if application is WITHOUT safe auxiliary power supply (as in diagram 2), devices must be selected according to the short-circuit current calculated at the main breakers:

short circuit current	
<= 7.5 kA	Q61/1 : 2-pole modular circuit breaker In=6A(C), series S240 (S242 C6) Q61/2 : 4-pole modular circuit breaker In=6A(C), series S240 (S244 C6)
<= 10 kA	Q61/1 : 2-pole modular circuit breaker In=6A(C), series S250 (S252 C6) Q61/2 : 4-pole modular circuit breaker In=6A(C), series S250 (S254 C6)
<= 15 kA	Q61/1 : 2-pole modular circuit breaker In=6A(C), series S270 (S272 C6) Q61/2 : 4-pole modular circuit breaker In=6A(C), series S270 (S274 C6)
<= 50 kA	Q61/1 : 2-pole modular circuit breaker In=6A(C), series S500 (S502 C6) Q61/2 : 4-pole modular circuit breaker In=6A(C), series S500 (S504 C6)
> 50 kA (**)	Q61/1 and Q61/2 : 6A fuses gG6 (total quantity: 6)

(**) NOTE: if allowed by application, 6A gG6 fuses can also be used for lower short circuit currents.

7.5.2 Contactors K1, K2

These auxiliary contactors are only used in applications Without safe auxiliary power supply. Their purpose is to switch the power supply to the circuit breaker motor operators or control coils back and forth between the Normal and Emergency lines.

How to select K1 and K2

ABB interlocked contactors (compact reversing contactors) VB6 are recommended for K1 and K2. Contactors with at least two main contacts and one auxiliary contact are required.

K1 and K2 are selected according to the motor operator or control coil operating voltage, as follows:

	Type of contactor	ABB code
110V...127V AC	VB6-30-01 110V...127Vac	GJL 121 1901 R 8014
220V...250V AC	VB6-30-01 220V...250Vac	GJL 121 1901 R 8010

7.5.3 Contactors KO1, KC1, KO2 and KC2

These contactors are only used if application is With DC safe auxiliary power supply. They serve to control the motor operators or control coils.

How to select KO1, KC1, KO2 and KC2

ABB contactors AL9 are recommended for this application.

They must be selected according to the type of breakers and the auxiliary power supply voltage rating as follows:

		Type of contactor	ABB code
Emax Isomax S6-S7 Tmax T4-T5	24 Vdc	AL9-30-10 24Vdc	1SBL 14 3001 R 8110
	48 Vdc	AL9-30-10 48Vdc	1SBL 14 3001 R 8310
	60 Vdc	AL6-30-10 60Vdc	1SBL 14 3001 R 8410
	110 Vdc	AL9-30-10 110Vdc	1SBL 14 3001 R 8610
Isomax S3-S4-S5	24 Vdc	AL9-22-00 24Vdc	1SBL 14 3501 R 8100
	48 Vdc	AL9-22-00 48Vdc	1SBL 14 3501 R 8300
	60 Vdc	AL9-22-00 60Vdc	1SBL 14 3501 R 8400
	110 Vdc	AL9-22-00 110Vdc	1SBL 14 3501 R 8600

7.6 Special applications - Notes

This section describes some special cases in which the ATS010 wiring diagrams indicated must be modified. The modifications are found in the attachment.
Please read this carefully before application of the ATS010.

7.6.1 Switch Enable

ATS010 terminal 5 is used to enable switching (Switch Enable function). A “clean” contact (potential-free) must be connected between this input and terminal 8.

However the wiring shown in diagram 7.7.1 is also possible. An external contactor is used to remove the emergency voltage signal from the ATS010 measurement inputs until switching is enabled.

Such alternative wiring has to be used in the following cases:
- if the gen set voltage transient is slow (i.e. longer than 10s)
- **always, if the ATS010 unit is a release 06 or lower.**

See section 7.8 for the release number of your ATS010.

Contactor KE shown in the diagram is a 3-pole mini-contactor with 24Vdc or 48Vdc coil.
For example, the following ABB contactors can be used:

Coil	Type of contactor	ABB code
24V DC	KC6-31 Z-P 24Vdc	GJH 121 3001 R 3101
48V DC	KC6-31 Z-P 48Vdc	GJH 121 3001 R 3106

The 24Vdc or 48Vdc power supply used for this application must be present when the ATS010 is powered.

Using the wiring shown in diagram 7.7.1, when operating the ATS010 in strategy 2, if there is a power failure on the normal line, the ATS010 waits for the Switch Enable contact to close before opening the Normal Line Circuit Breaker.

The user is responsible for ensuring that the power supply used can feed enough current to activate the contactor coil.

7.6.2 Applications in 3-wire systems

When the ATS010 is used in three-wire systems (i.e., three-phase systems without neutral wire), wiring must be modified as in diagram 7.7.2.
An external single-phase transformer (10VA min.) with a primary voltage equal to the phase-to-phase voltage and a secondary voltage of 110V must be used. In the diagrams, the transformer is labeled TR.

7.6.3 Monitoring the 3 phases of the emergency line

The ATS010 monitors only one of the emergency line phase voltages. If the application requires monitoring of all three phases, an external 3-phase monitoring relay must be used, as shown in diagram 7.7.3.
The voltage monitoring relay (labeled as KM in the diagram) closes a “clean” (potential-free) contact when the voltages of the three-phase system fall within predefined limits.

For example, ABB relays CM-MPS, CM-PFN or CM-PVN may be used. Selection of the device depends on the application. The characteristics of the monitoring relays are found in ABB technical catalogue 2CDC110004C0201.

7.6.4 Use of an external DC/DC converter for 48V applications

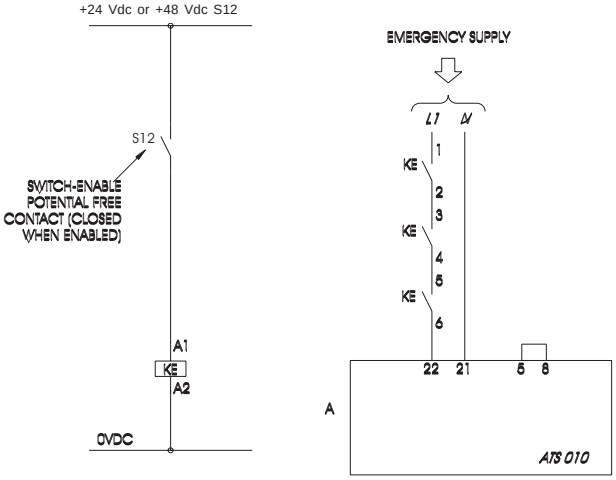
When powering with a 48Vdc power supply, if the ATS010 unit release is number 06 or lower (see section 7.8 for the release of the ATS010 installed in your plant), an external DC/DC converter must be used (as in diagram 7.7.4)

For ambient temperatures between 0°C and 50°C, we advise using SVA24SC48 DC/DC converters from ETA Inc. Any equivalent DC/DC converter may be used as well.

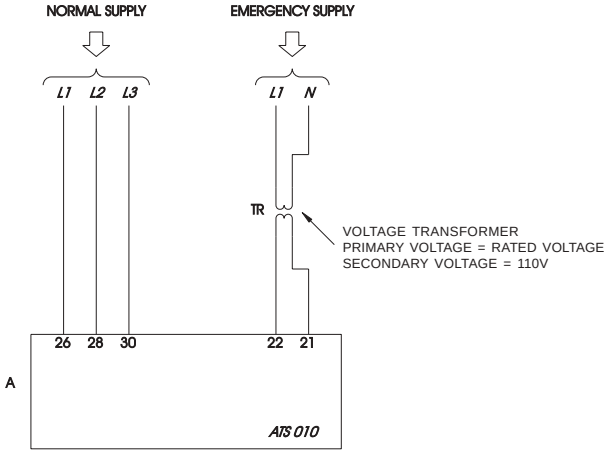
When powering with a 24Vdc power supply, no modifications are required to the standard wiring diagrams.

7.7 Additional wiring diagrams

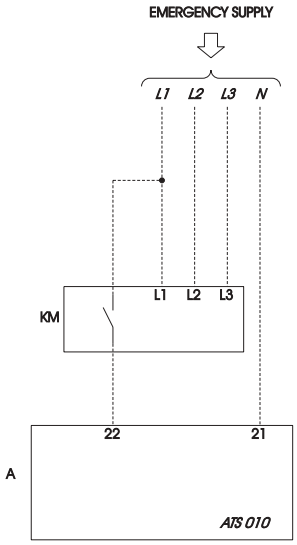
7.7.1 Alternative switch-enable input connection



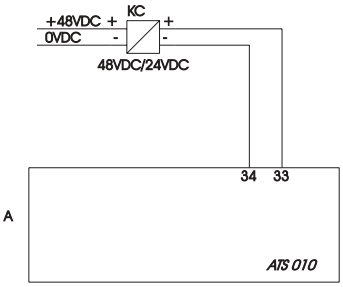
7.7.2 Wiring for 3-phase systems without neutral



7.7.3 Monitoring of 3-phase emergency line



7.7.4 48 Vdc power supply with external converter



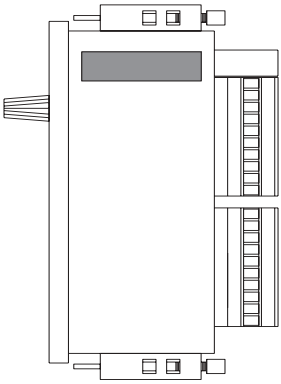
7.8. ATS010 ID: serial and release numbers

Serial number

Each ATS010 unit has a side panel with a label bearing the serial number.

When installing an ATS010, jot down the serial number and keep it together with the plant documentation.

You must report the serial number whenever you contact ABB SACE customer services in the case of breakdowns or for clarification regarding ATS010 operation.



Release number

Some of the operating modes described in this manual (e.g. sections 3.5.1., 7.6.1., 7.6.4.) depend on the release of the ATS010 unit installed.
The release number is a two-digit number obtained by removing the final letter from the serial number and taking the last two digits (see the example below).

X 1 2 3 4 K **0 4** A Example of label with serial number
^ ^ In the example, the release number = 04

When the functions described in sections 3.5.1., 7.6.1., 7.6.4. are used, check the release number before starting up the unit.

At the time this manual was printed, the most recent release of the ATS010 was release 08.
When designing new plants, this number can be considered valid.