

# Automatic transfer switch ATS022

Installation and operating instructions



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# 1. Introduction

This manual describes the installation and the basic operation of the automatic transfer switch ATS022 used with circuit breakers.

## 1.1. Use of symbols



**Hazardous voltage:** warns about a situation where a hazardous voltage may cause physical injury to a person or damage to equipment.



**General warning:** warns about a situation where something other than electrical equipment may cause physical injury to a person or damage to equipment.



**Caution:** provides important information or warns about a situation that may have a detrimental effect on equipment.



**Information:** provides important information about the equipment.

## 1.2. Standards

The ATS022 are compliant with the following standards:

- ▶ European Directive 73/23 “LVD – Low Voltage Directive”
- ▶ EN-IEC 50178 electronic equipment for use in power installations
- ▶ EN-IEC 62103 electronic equipment for use in power installations
- ▶ EN-IEC 60947-5-1 low voltage switchgear and control gear: control circuit devices and switching elements
- ▶ Electromagnetic compatibility EN 50081-2, EN 50082-2
- ▶ Environmental conditions IEC 68-2-1, IEC 68-2-2, and IEC 68-2-3
- ▶ EN-IEC 61000-4-2: Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques
- ▶ Section 2: Electrostatic discharge immunity test Basic EMC Publication (IEC 1000-4-2 [8KV air, 4KV cont])
- ▶ EN-IEC 61000-4-3, Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 3: Radiated, radio-frequency, electromagnetic field immunity test (IEC 1000-4-3 [level 3])
- ▶ EN-IEC 61000-4-4, Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 4: Electrical fast transient/burst immunity test Basic EMC Publication (IEC 1000-4-4 [level 2/3])
- ▶ EN-IEC 61000-4-5, Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques Section 5: Surge immunity test (IEC 1000-4-5 [level 1/2])
- ▶ EN-IEC 61000-4-6: Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques (IEC 1000-4-6 [level 3])

- ▶ EN-IEC 61000-4-8: Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques (IEC 1000-4-8 [level 5])
- ▶ EN-IEC 50093, Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques
- ▶ Section 11: Voltage dips, short interruptions and voltage variations immunity test (IEC1000-4-11, [100ms/5s] B, C criterion)
- ▶ CISPR11 (30MHz...1GHz): Emission (Generic Standard, Industrial) – Radiated
- ▶ CISPR11 (0.15MHz...30MHz): Emission (Generic Standard, Industrial) – Conducted
- ▶ CISPR/CEI 1000-6-3: Part 6: Generic standards – Section 3: Emission standard for residential, commercial and light-industrial environments
- ▶ IEC 60068-2-2: Environmental testing. Part 2: Tests. Test B: Dry heat
- ▶ IEC 60068-2-6: Environmental testing. Part 2: Tests. Test Fc: vibration (sinusoidal)
- ▶ IEC 60068-2-27: Environmental testing. Part 2: Tests. Test Ea and guidance: shock
- ▶ IEC 60068-2-30: Environmental testing. Part 2: Tests. Test Db and guidance: Damp heat, cyclic
- ▶ IEC 60068-2-1: Environmental testing. Part 2: Tests. Test A: cold ( $-20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ , 16 hours)

### 1.3. Safety notes

If there are doubts about safety use, the unit must put out of service.

The automatic transfer switch ATS022 must be prevented from operating the circuit breaker 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

During maintenance, it is advisable to lock the circuit breaker mechanically to the open position

Safe use is not possible if:

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



Even if the unit seems to be in stand by status, switch it OFF before operating on circuit breakers. It may happen that the unit would operate the circuit breakers without warning.

## 1.4. Explanations of abbreviations and terms

<b>ATS:</b>	The control unit of automatic transfer switching equipment, in this document called the automatic transfer switch
<b>ATS022:</b>	The automatic transfer switch, high version with communication and display
<b>Bus tie:</b>	Circuit breaker connecting two section of electrical plant
<b>CB:</b>	Circuit Breaker
<b>Emergency line:</b>	Power supply line, the secondary line used in emergency cases
<b>Modbus RTU:</b>	Bus communication protocol
<b>Normal line:</b>	Power supply line, the primary line normally used
<b>Test sequence:</b>	A sequence to test the functionality of the ATS and the connected circuit breakers
<b>TS:</b>	Switching delay, time after which ATS022 sends an opening command to the protection device on the normal line
<b>TCE:</b>	Close emergency delay, time after which ATS022 sends a closing command to the protection device on the emergency line
<b>TBS:</b>	Back switching delay, time after which ATS022 sends an opening command to the protection device on the emergency line
<b>TCN:</b>	Close normal delay, time after which ATS022 sends a closing command to the protection device on the normal line
<b>TGOFF:</b>	Generator stop delay, time after which the ATS022 sends stopping command to the generator.

## 2. Product overview

The transfer switch concept is applied to any installations requiring switching from the main power circuit to another to ensure the supply of loads.

### 2.1. Typical applications

#### A. Network line – GenSet line

In case of loss of the main's network the ATS022 device manages the switching to the emergency line equipped with a GenSet system

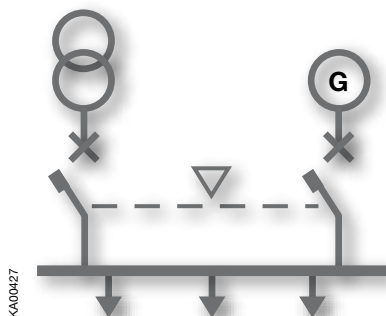


Figure 2.1 Network line - GenSet line

#### B. Network line a – Network line b

In case of loss of the main's network the ATS022 device manages the switching to a second line used as an emergency source.

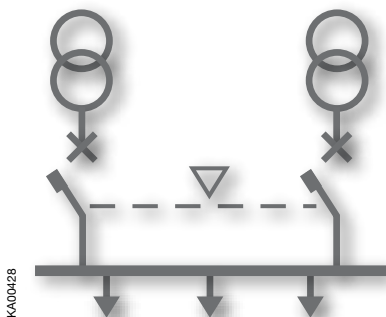


Figure 2.2 Network line a - Network line b

Automatic transfer switch type ATS022 is designed for single- and three-phase distribution systems in diverse applications. ATS022 will control the switching between two power supplies. The ATS022 unit measures the voltage level of the normal line and controls the two main protection devices of the two monitored lines in order to guarantee the continuity of the power supply.

## 2.2. Functions of automatic transfer switch ATS022

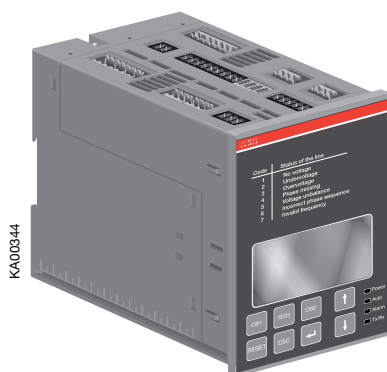


Figure 2.3 Automatic transfer switch ATS022

### ATS022:

Analysing the voltage, frequency and the phase balance. Includes the generator START / STOP command.

Communication via Modbus RTU.

DI/DO, Digital input / output, see control circuit diagrams.

An external 24...110 Vdc auxiliary power supply must be used for:

- ▶ Ue 57.5...109 Vac in single phase functioning
- ▶ 16 Hz rated frequency application
- ▶ Modbus RTU Communication

The ATS022 has two sensors to monitor two power lines; both sensors are able to work with single phase or three-phase lines. The status of ATS022 can be monitored through the Modbus RTU connection. The ATS022 has a graphic display where the user is able to check the settings and get all the information about status of the ATS022.

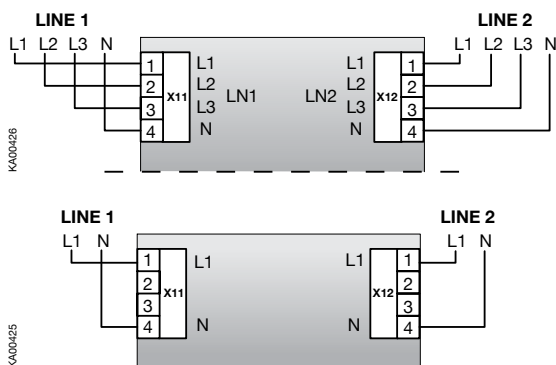


Figure 2.4 ATS022 have the capability to monitor two three-phase power lines, both able to work with single phase, too.



The device has an external auxiliary power supply possibility for guarantying an uninterrupted power supply for the protection devices in the case where they are not powered through the control circuit. From the display, one can choose whether the N-line is connected or not.

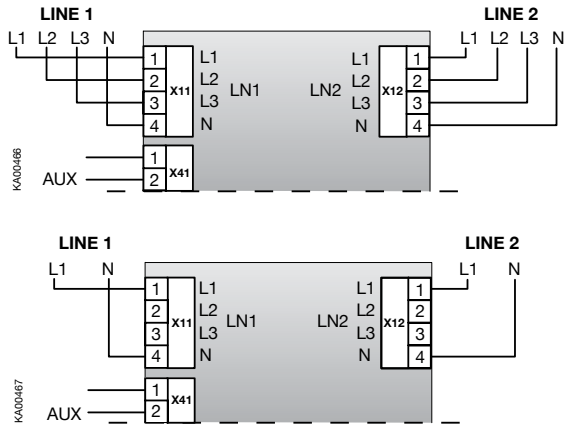


Figure 2.5 An external 24...110 Vdc auxiliary power supply

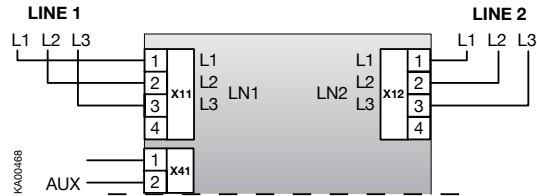


Figure 2.6 The circuit diagram, when N-line is not connected.

## 3. Description

### 3.1. ATS outputs

#### 3.1.1. Opening/closing command to circuit breakers, DO1...DO4

The output relays command the circuit breakers to open and close its releases. The configuration of the output relays has been designed to allow the command of any type of motor operator through a direct connection.



Please, check the rated voltages allowed for motor operators!

The device has been integrated with the automation logic to guaranty the highest-level safety for commanding the circuit breakers.

To do that, the automation logic monitors the correct operation of the circuit breaker after a command has been sent. If the feedback of the CB status is not received within 5 seconds of the sending of the command, the device considers it as a failed command and operates as follows:

- ▶ An alarm is generated: DO6 and DO9 activate.
- ▶ Alarm LED switches on.
- ▶ Alarm is set off by pushing the RESET key. After that the device is always in the Manual Mode to prevent unwanted operation of the circuit breaker.

Exactly the same operations are performed for the protection device on the emergency line during the back-switching sequence.

#### 3.1.2. Gen-Set start/stop, DO5

Gen-Set start and stop is handled by a bistable relay. When the relay is active on DO5 Start X23:1, the generator is started. When the relay is active on DO5 stop X23:3, the generator is stopped.

#### 3.1.3. Alarm signaling, DO6

This contact is closed when the automatic transfer switch logic is active. If the contact is closed, it means the logic is disabled and an alarm is generated.

#### 3.1.4. Protection device alarm signaling, DO9

This contact is closed when opening or closing CB fails.

#### 3.1.5. Auto/Manual signaling, DO10

This contact is closed when the operating mode is Manual.

#### 3.1.6. Disconnection Secondary Loads, DO11

See page 32.

### 3.2. ATS inputs

#### 3.2.1. CBs status Input, DI1, DI2

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

### 3.2.2. CB Withdrawn

In the case of withdrawable circuit breakers, the auxiliary contacts for the CB inserted are connected to these inputs (withdrawn=open contact). In the case of a withdrawn circuit breaker, the transfer switch logic is disabled (DO6 activated, Alarm LED is ON) and the unit goes in the Manual Mode (DO10 activated, Auto LED is OFF). When a CB is re-inserted, the logic is enabled (DO6 disactivated, Alarm LED is OFF) and the ATS022 is in the Manual Mode (DO10 activated, Auto LED is OFF). To set the ATS022 in the Automatic Mode the RESET key must be pushed (DO10 disactivated, Auto LED is ON).

### 3.2.3. CB Trip, DI4, DI5

The signalling contacts for tripping the normal and emergency line circuit breakers are wired to these inputs. In the case of CB tripping, the automation logic is disabled (DO6 activated, Alarm LED is ON). After resetting the signals of CBs trip the logic is enabled again (DO6 disactivated, Alarm LED is OFF).

### 3.2.4. Gen-Set Alarm, DI8

A Gen-set alarm prevents switching to the emergency line. In the case of the power supply from the emergency line, when an alarm occurs, ATS022 keeps the line 2 with logic OFF; to enable the logic the alarm must be reset.

This input can be used to wire several alarms coming from the Gen-set in parallel: oil pressure loss, over temperature, etc.

An alarm is signaled by the Alarm LED on the front of the device, and the relative electrical contact is closed.

### 3.2.5. Forced switching to the emergency supply line, DI9

Some short-period industrial processes require power supplied from a Gen-Set rather than normal line power, to avoid any possible supply anomalies and to guarantee a higher level of reliability.

Forced switching to the emergency line can be easily carried out keeping this input closed (only in the Automatic Mode).

This operation starts the complete transfer to the emergency line switching procedure:

- ▶ Gen-Set start
- ▶ Normal line circuit breaker opening
- ▶ Emergency line circuit breaker closing

The power supply from the emergency line remains as long as this command is active. When the command is disarmed, the reverse transfer to the normal supply line switching procedure is started.

### 3.2.6. Switching logic enable/disabled, DI3

When this input is closed, the switching logic is enabled. The function is used for integrating general alarms originating from the plant.

### 3.2.7. The command to startup the generator, DI10

When this input is activated the generator is started.

### 3.2.8. Third CB status input, DI11

This input is connected to the bus tie circuit breaker auxiliary contact.

### 3.2.9. Voltage sensors input

Voltage sensors are the same on the normal and emergency lines.

The net sensor is able to detect the following anomalies:

- ▶ Undervoltage and overvoltage
- ▶ Phase loss
- ▶ Voltage imbalance
- ▶ Minimum and maximum frequency

The net sensor monitors the normal supply line in order to start the switching procedure from the normal to the emergency line in the case of network anomalies. Equally, the net sensor enables the reverse switching procedure when the normal supply line returns.

### 3.2.10. Measurements

- ▶ Voltage: 1 %
- ▶ Frequency: 1 %

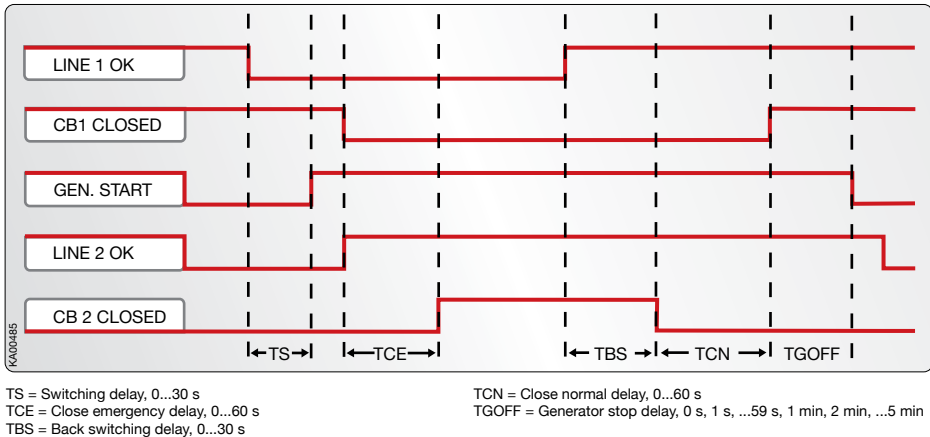


Figure 3.1 Automatic Switching Sequences

## 3.3. Application scenarios

The ATS022 can be used in different installation scenarios:

- ▶ Two transformer incoming lines
- ▶ One transformer incoming line and an emergency generator on the emergency line

### 3.3.1. Two transformer incoming lines

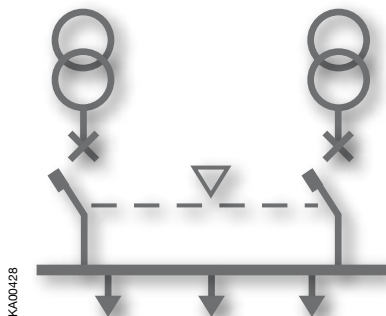


Figure 3.2 Two transformer oncoming lines

In this case, the installation scenario is the following: ATS is connected to two power incoming lines. Both lines are the secondary section of a medium-low voltage transformer or in any case, there are two lines normally present. One of the two lines has more importance; it is normally used to supply the plant. The second line is an emergency line; it is used in case of an emergency.

In standard conditions, the ATS022 monitors the normal line, analyzing whether the voltage, frequency, and phase balance are correct. If one of these values is out of the set threshold, after a time delay TS the ATS022 sends an opening command to the protection device on the normal line. If the emergency line is OK, the closing command to the protection device on the emergency line is executed after a set time delay (TCE). In the same way, the ATS022 will control the back-switching sequence when the normal line will restart properly working:

If Line 1 (= the normal line) comes back, after the set time delay (TBS) the ATS022 sends an opening command to the protection device on the emergency line and the closing command to the protection device on the normal line is executed after a set time delay (TCN).

The switching sequence can be summarized in the following steps:

- ▶ An anomaly occurs on the normal line
- ▶ Delay time TS
- ▶ Opening the protection device on the normal line
- ▶ Delay time TCE
- ▶ Closing the protection device on the emergency line

The back-switching sequence can be summarized in the following steps:

- ▶ The normal line will restart properly working
- ▶ Delay time TBS
- ▶ Opening the protection device on the emergency line
- ▶ Delay time TCN
- ▶ Closing the protection device on the normal line

Many anomalies can occur during both sequences:

#### a. Tripping any of the two protection devices

The ATS022 is connected with the digital trip signalling contacts (DI4, DI5) of the two protection devices. An active trip signal will lock the switching logic in ATS022.

The Alarm LED will be switched ON to indicate an active alarm (DO6 activated). To reset this condition, the protection device must be reset by pushing the RESET key. After resetting the device the logic is enabled (DO6 deactivated, Alarm LED is OFF).

**b. Protection devices do not respond**

**Opening Command**

During the switching sequence, the ATS022 sends the opening command to the protection device on the normal line. If this is not effectively opened in five seconds, the “Open 1 Failure” alarm is activated and the Alarm LED will be switched ON. This alarm will lock the switching logic and can only be reset by pushing the RESET key.

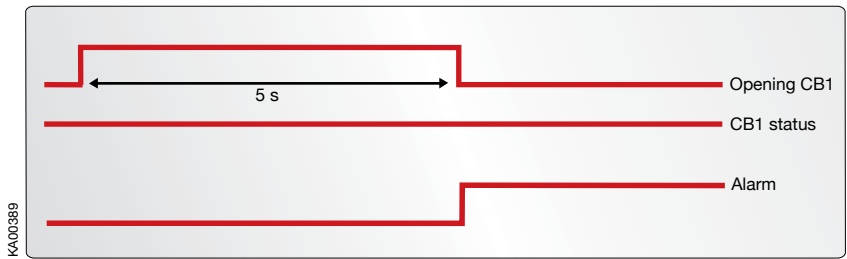


Figure 3.3 Logic operation when opening command fails

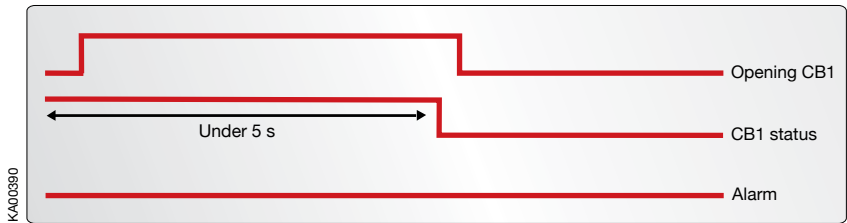


Figure 3.4 Logic operation when opening command is OK

**Closing Command**

During the switching sequence ATS022 sends the closing command to the protection device on emergency line. If this is not effectively closed in five seconds, the “Close 2 Failure” alarm is activated and the Alarm LED will be switched ON. This alarm will lock the switching logic and can only be reset by pushing RESET key.

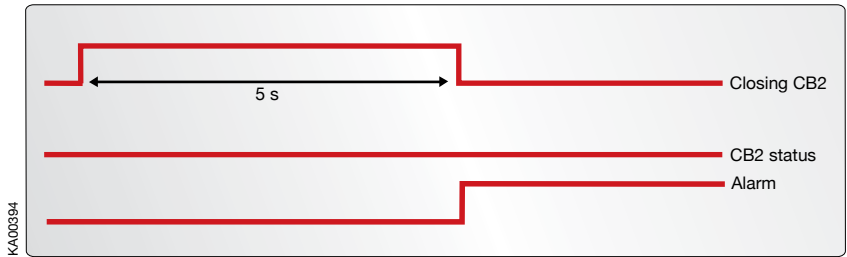


Figure 3.5 Logic operation when closing command fails

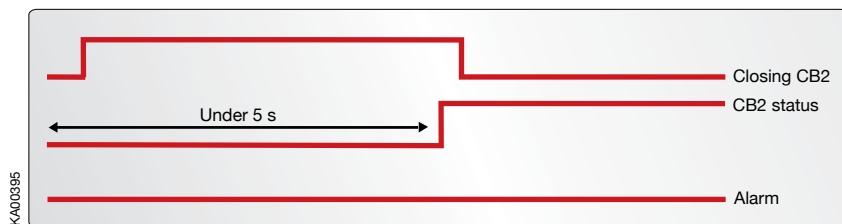


Figure 3.6 Logic operation when closing command is OK

### c. Missing of both lines

The missing of both lines is indicated by a blinking Power LED. In this case, the ATS022 will be in a power saving state. If both lines are missing more than one minute, the ATS022 will shut down.

If the normal line or the emergency line comes back supplying the ATS022 in Auto Mode, it will analyze the conditions of the monitored lines and the status of the two protection devices (or the position of the circuit breaker) and it will switch on the line that is OK giving priority to the normal line.

If the ATS022 is in Manual mode before the voltage drop, it cannot change its state, although the voltage comes back to the other line.



If the auxiliary power is used the device doesn't go to the powersave.

## 3.3.2. Transformer on normal line and generator on emergency line

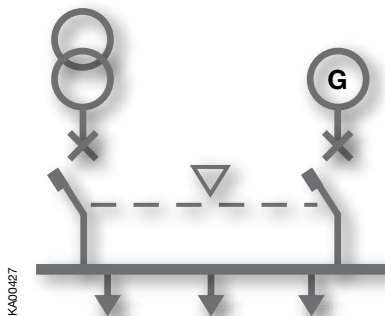


Figure 3.7 Transformer on normal line and generator on emergency line

In this scenario, the ATS022 works in the same way as the previous one. The main difference is that it also manages the status of the generator.

The switching sequence will be the following:

- ▶ An anomaly on the normal line occurs
- ▶ Delay time TS
- ▶ Start command to the generator
- ▶ Emergency line OK
- ▶ Opening of the protection device on the normal line
- ▶ Delay time TCE
- ▶ Closing of the protection device on the emergency line

Meanwhile the back-switching sequence will be:

- ▶ Normal line OK
- ▶ Delay time TBS
- ▶ Opening of the protection device on the emergency line
- ▶ Delay time TCN
- ▶ Closing of the protection device on the normal line
- ▶ Delay time TGOFF
- ▶ Stop command to the generator

Of course the same anomalies in the previous scenario can occur, and in these cases the same operations are performed, but the following must be considered.

#### Generator alarm

If the generator alarm input DI8 is activated, the Alarm LED will be switched ON and an alarm message is shown in the Alarm log of the device (DO6 activated, logic disabled).

### 3.3.3. Special scenarios

The new ATS022 has to be developed to be compliant with special applications too, in details:

**No Line Priority:** in this scenario, none of the two lines is of outmost importance. That means that after switching the ATS022 remains on the selected power supply line although the previous line starts to work properly. The logic of the switching is the same as in other scenarios. The only difference is that in this scenario, there is not a back-switching sequence. This condition has to be set via the Line Priority menu page.

**Two transformers and bus tie (Managing secondary loads):** In this scenario, the ATS022 has to be able to control a third protection device used by the bus tie. ATS022 acquires the open/closed status of this device with digital input DI11 and by activating DO11 ATS022 is able to disconnect the secondary loads.



## 4. Operating

Before using of the automatic transfer switch ATS022, read carefully chapter 1 “Safety notes” in order to avoid malfunctions or dangerous operating conditions.



Never open any covers on the product. There may be dangerous external control voltages inside the ATS022 automatic transfer switch even if the voltage is turned off.



Never handle control cables when the voltage of the ATS022 automatic transfer switch or external control circuits are connected.



Exercise sufficient caution when handling the unit.

### 4.1. Automatic transfer switch ATS022 in Manual Mode

Selecting the automatic transfer switch ATS022 to the Manual Mode:

- Make sure that power LED is ON, see the Figure 4.1/①.
- If Auto LED is OFF /②, the automatic transfer switch is in Manual Mode.
- If the Auto LED is ON, push the RESET key once /③. The Auto LED switches to OFF and the automatic transfer switch ATS022 is in Manual Mode /④.

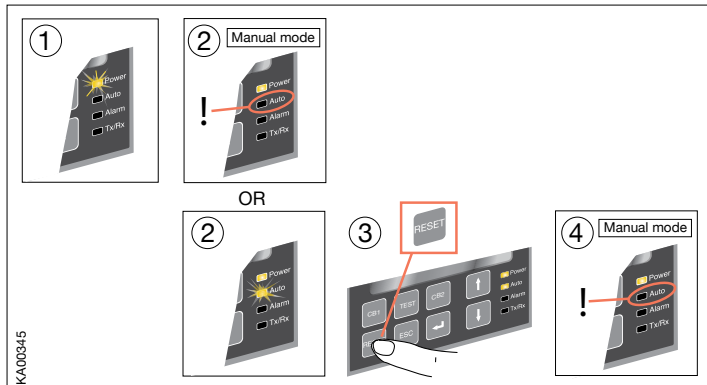


Figure 4.1 Selecting the automatic transfer switch ATS022 to Manual Mode

To select the operating line by the automatic transfer switch ATS022 in Manual Mode:

- a. Push the appropriate CB1 or CB2 key
- b. When pushing the CB1 key (see the Figure 4.2/②), the circuit breaker CB1 will be in the ON position (the status and the line indication, see the Figure 4.2/③) and the circuit breaker CB2 will be in the OFF position. If the circuit breaker CB1 is already in the ON position, pushing the CB1 key opens the circuit breaker.
- c. When pushing the CB2 key, the the circuit breaker CB2 will be in the ON position and the circuit breaker CB1 will be in the OFF position.
- d. If you push the CB1 key while the circuit breaker CB2 is in the ON position, nothing happens. Before pushing the CB1 key, you have to push the CB2 key to open the circuit breaker CB2.

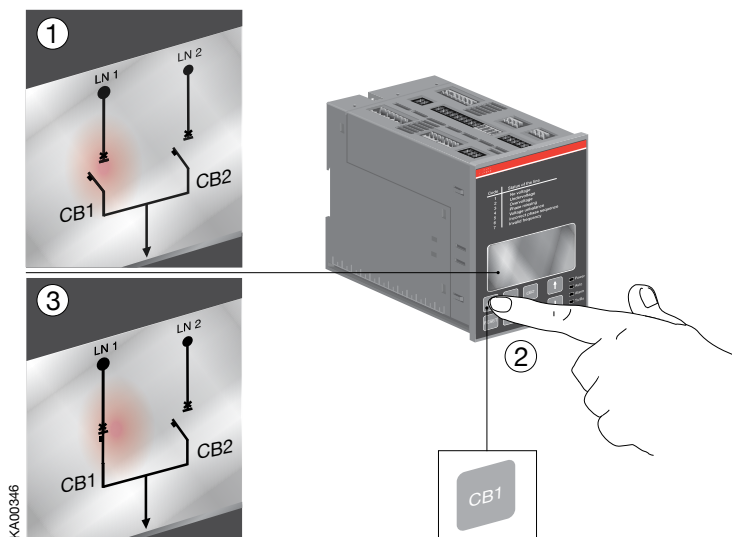


Figure 4.2 Selecting the operating line, the circuit breaker status and the chosen line indication in display terminal in ATS022

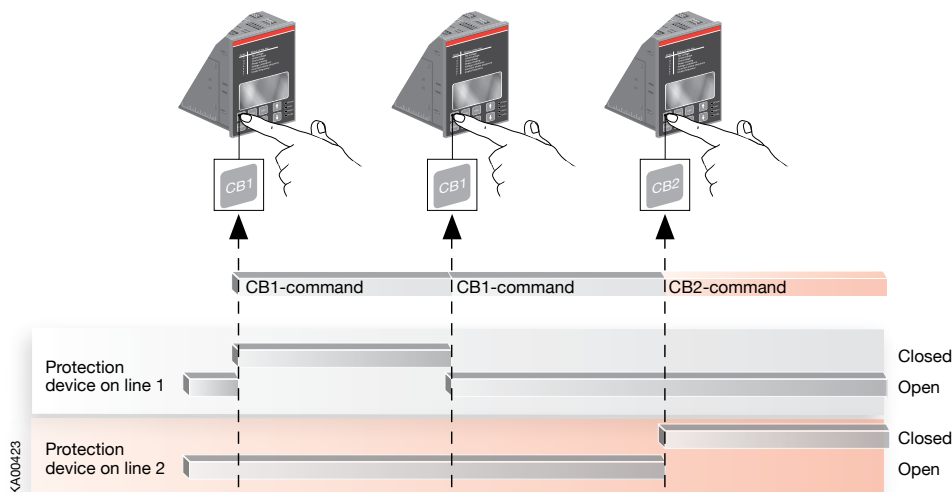


Figure 4.3 Manual Mode control

## 4.2. Automatic transfer switch ATS022 in Automatic Mode

Selecting the automatic transfer switch ATS022 to the Automatic Mode:

- Make sure that power LED is ON, see the Figure 4.4/①.
- Push the RESET key once /②.
- If Auto LED is ON, the automatic transfer switch is in Automatic Mode /③.
- If the Auto LED is OFF, push the RESET key again /④, the Auto LED switches to ON /⑤ and the automatic transfer switch is in Automatic Mode.

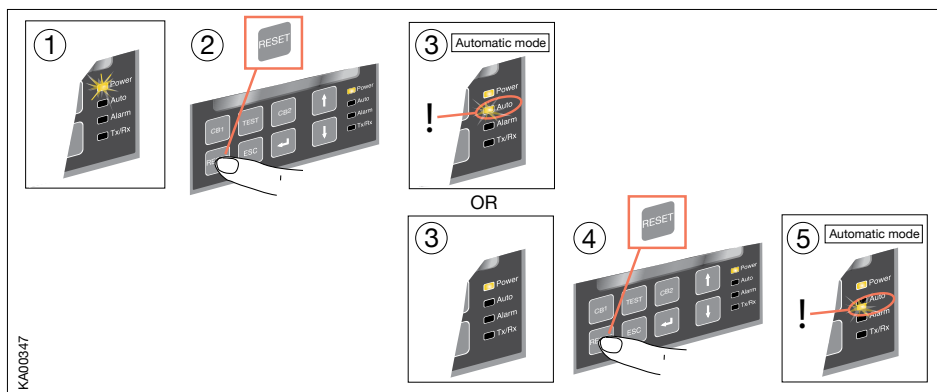


Figure 4.4 Selecting the automatic transfer switch ATS022 to Automatic Mode

### 4.3. TEST sequence

When pushing the TEST key, the automatic transfer switch (ATS022) enters the test sequence in which it is possible to simulate switching and back-switching sequences step-by-step, by pressing the TEST key. ATS022 must be in MANUAL mode before entering the test sequence. Exiting from test sequence is done by RESET key.

Steps in the TEST sequence are:

1. Press TEST; generator starts (skipped if the generator is not in use)
2. Press TEST; Open CB1
3. Press TEST; Close CB2
4. Press TEST; Open CB2
5. Press TEST; Close CB1
6. Press TEST; stop generator (skipped if the generator is not in use)

Pressing TEST after that; sequence restarts. Alarms are activated in the same way as in automatic sequences, if circuit breaker control fails. The user can stop the TEST sequence by pressing the RESET key. After stopping the TEST sequence the device returns to the default page and the settings are exactly the same as they were before starting the TEST sequence.



Figure 4.5 TEST sequence to simulate the functions



Before starting the TEST sequence, please, make sure that CB1 is in closed position and the both lines have the voltage on.

## 5. Installation



Only an authorised electrician may perform the electrical installation and maintenance of automatic transfer switch. Do not attempt any installation or maintenance actions when an automatic transfer switch is connected to the electrical mains. Before starting work, make sure that the circuit breaker is de-energised.

The automatic transfer switch ATS022 can be mounted on the door or the DIN-rail.

### 5.1. Automatic transfer switch ATS022, door mounting

The automatic transfer switch ATS022 can be mounted on the door with the fastener, see Figure 5.1. Door drilling according to Figure 5.1.

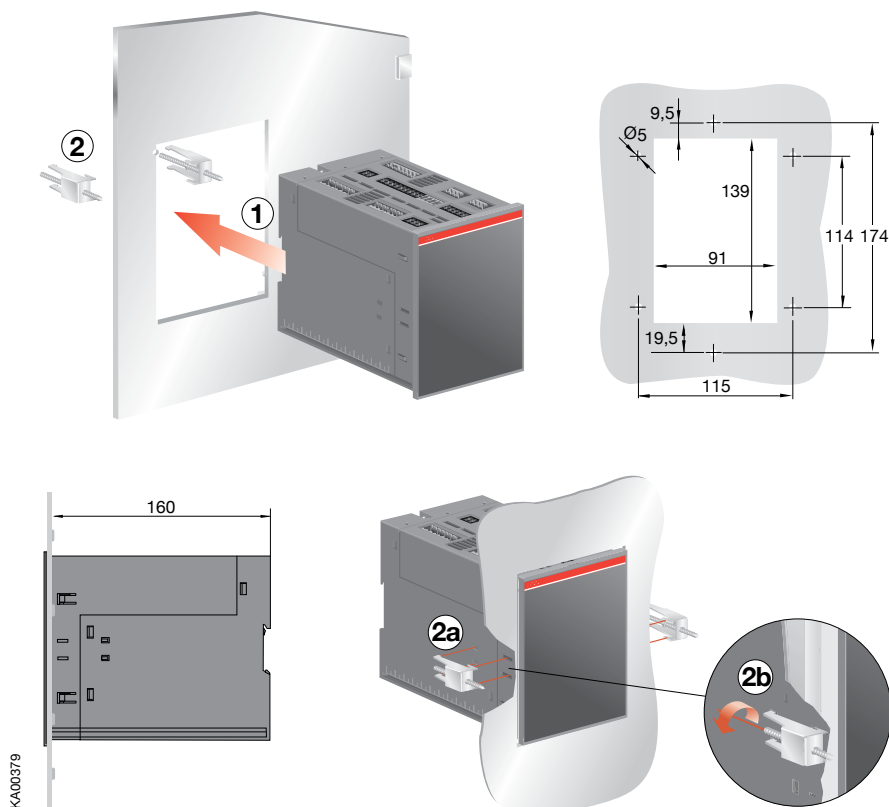


Figure 5.1 Automatic transfer switch ATS022, door mounting

## 5.2. Automatic transfer switch ATS022, DIN-rail mounting

The automatic transfer switch ATS022 can be mounted on the 35 mm DIN-rail, see the Figure 5.2. Door drilling, if needed, according to Figure 5.2.

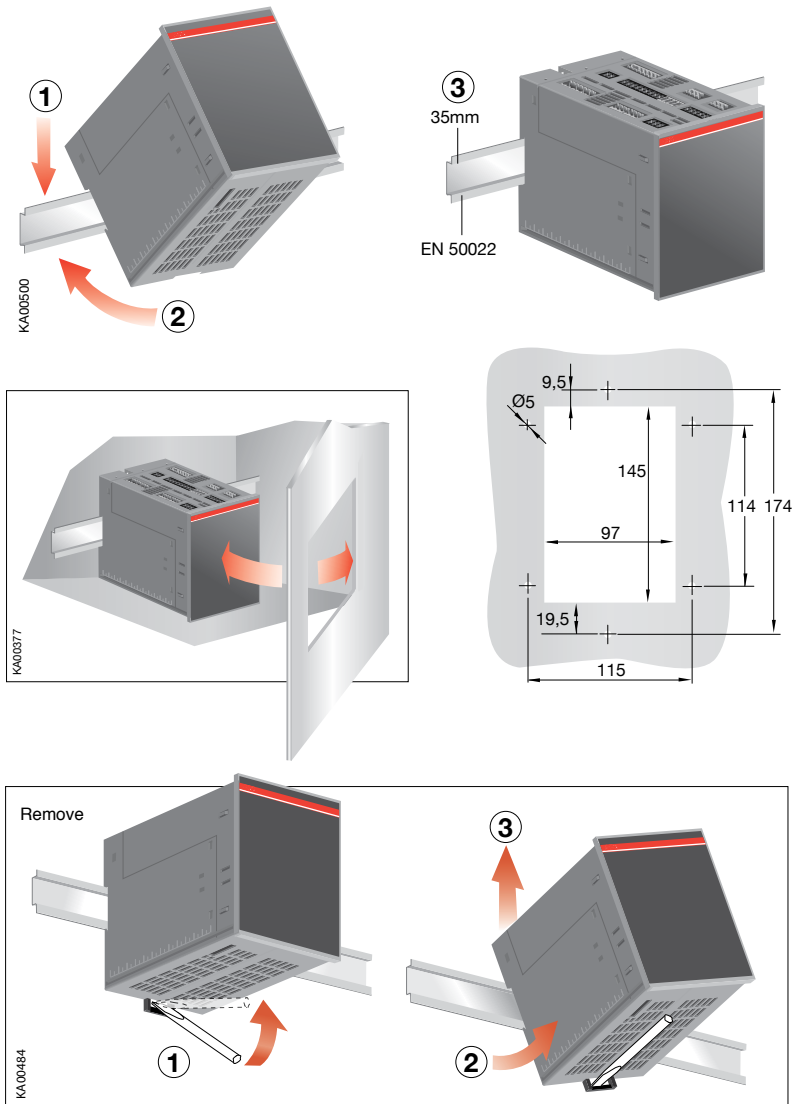


Figure 5.2 Automatic transfer switch ATS022, DIN-rail mounting

## 6. Connecting



Only an authorised electrician may perform the electrical installation and maintenance of automatic transfer switches. Do not attempt any installation or maintenance actions when an automatic transfer switch is connected to the electrical mains. Before starting work, make sure that the circuit breaker is de-energised.

### 6.1. Power circuit of the automatic transfer switch ATS022

#### Operating and measuring voltage area on 3 phase system

**Main voltage:** 100Vac - 480Vac ( $\pm 20\%$ )

**Phase voltage:** 57.7Vac - 277Vac ( $\pm 20\%$ )

**AUX voltage:** 24Vdc - 110Vdc (-10 to +15%)

**Frequency:** 50Hz - 60Hz, 16 2/3 Hz, 400 Hz ( $\pm 10\%$ )

#### Operating and measuring voltage area on 1 phase system

**Phase voltage:** 57.7Vac - 240Vac ( $\pm 20\%$ )

**AUX voltage:** 24Vdc - 110Vdc (-10 to +15%)

**Frequency:** 50Hz - 60Hz - 400 Hz - 16 2/3 Hz ( $\pm 10\%$ )

Phase setting, see the Chapter 8.

If the main voltage level is between 57.7Vac - 109Vac, the auxiliary power supply (AUX) must be used. If the frequency is 16 2/3 Hz, the auxiliary power supply (AUX) and external transformer must be used.

### 6.2. Control circuit



When relay outputs are used with inductive loads (such as relays, contactors and motors), they must be protected from voltage peaks using varistors, RC-protectors (AC current) or DC current diodes (DC current).

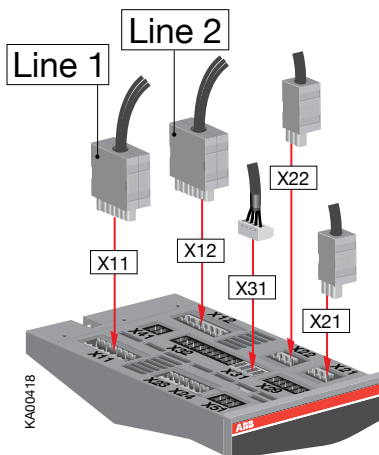


Figure 6.1 Control circuit connections in ATS022

6.2.1. Control circuit of the automatic transfer switch ATS022

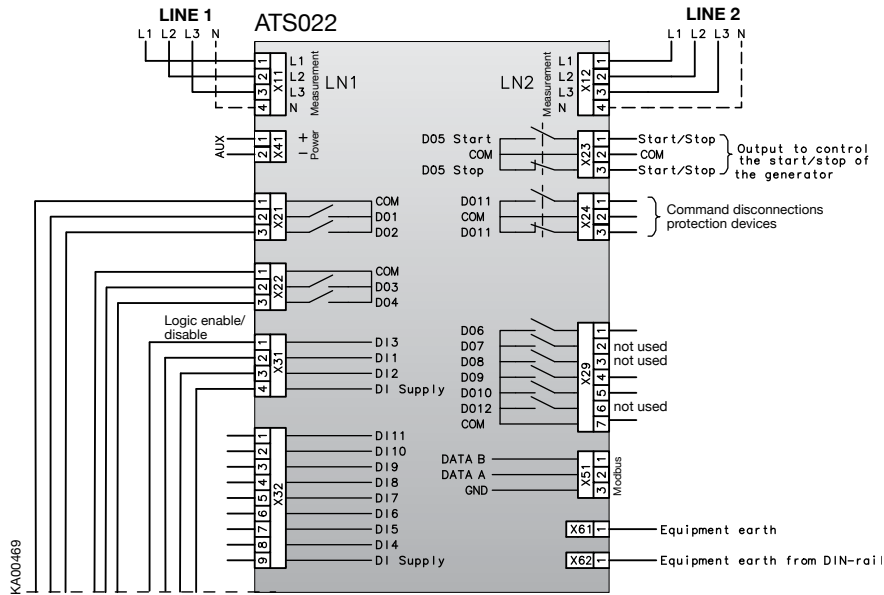


Figure 6.2 Control circuit diagram ATS022

Digital input	Description
DI1	Protection device on normal line status input (0 open, 1 close)
DI2	Protection device on emergency line status input (0 open, 1 close)
DI3	Logic enable/disable
DI4	Normal line protection device tripped input (normally closed)
DI5	Emergency line protection device tripped input (normally closed)
DI6	Normal line protection inserted (normally closed)
DI7	Emergency line protection inserted (normally closed)
DI8	Generator alarm input
DI9	Command to force commutation
DI10	Command to startup generator
DI11	3rd circuit breaker status (bus tie) (0 open, 1 close)

Digital output	Description
DO1	Output to open the protection device of the normal line (normal open)
DO2	Output to close the protection device of the normal line (normal open)
DO3	Output to open the protection device of the emergency line (normal open)
DO4	Output to close the protection device of the emergency line (normal open)
DO5	Output to control the start/stop of the generator (exchange)
DO6	Signaling emergency / alarm (normal open)
DO9	Signaling protection device alarm (normal open)
DO10	Signaling ATS manual mode (normal open)
DO11	Command disconnection protection devices (exchange)

Table 6.1 Digital inputs / outputs, ATS022



Connectors, ATS022

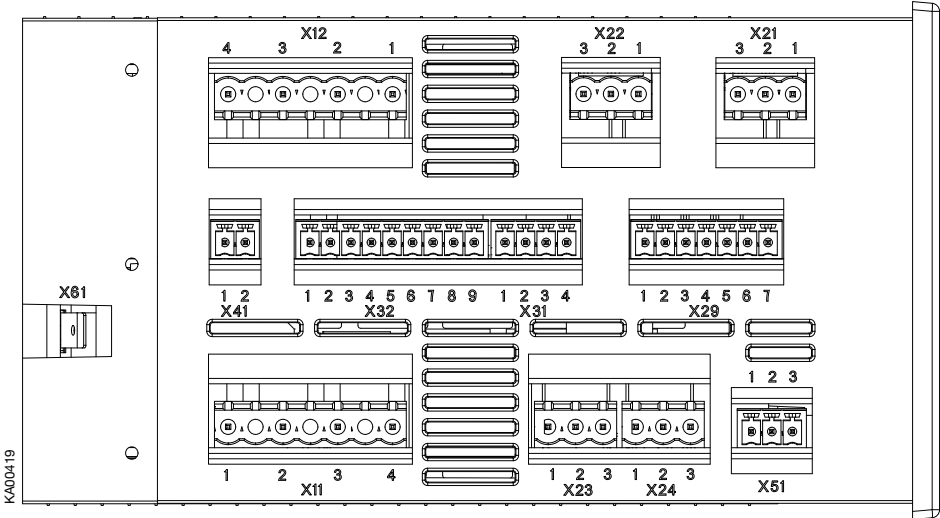


Figure 6.3 Connectors, ATS022

Con- nector	Description	Con- nector	Description
X11:1	Normal line LN1: L1	X29:1	DO6
X11:2	Normal line LN1: L2	X29:2	not used
X11:3	Normal line LN1: L3	X29:3	not used
X11:4	Normal line LN1: N	X29:4	DO9
X12:1	Emergency line LN2: L1	X29:5	DO10
X12:2	Emergency line LN2: L2	X29:6	not used
X12:3	Emergency line LN2: L3	X29:7	Common
X12:4	Emergency line LN2: N	X31:1	DI3
X41:1	AUX +	X31:2	DI1
X41:2	AUX -	X31:3	DI2
X21:1	Common	X31:4	DI supply
X21:2	DO1	X32:1	DI11
X21:3	DO2	X32:2	DI10
X22:1	Common	X32:3	DI9
X22:2	DO3	X32:4	DI8
X22:3	DO4	X32:5	DI7
X23:1	DO5 start	X32:6	DI6
X23:2	Common	X32:7	DI5
X23:3	DO5 stop	X32:8	DI4
X24:1	DO11	X32:9	DI supply
X24:2	Common	X51:1	Modbus DATA B
X24:3	DO11	X51:2	Modbus DATA A
		X52:3	Modbus GND
		X61	Equipment earth
		X62	Equipment earth

Table 6.2 Connectors ATS022

# 7. Technical data

## 7.1. Automatic transfer switch ATS022, power circuits

Power circuit	Value
ATS022	
Rated operational voltage $U_e$	100 - 480 Vac $\pm 20\%$
Phase - neutral	57.7 - 277 Vac $\pm 20\%$
Rated frequency	50 - 60 Hz, 16 2/3 Hz, 400 Hz $\pm 10\%$
Rated impulse withstand voltage $U_{imp}$	6 kV
1-phase system:	
Rated operational voltage $U_e$	
Phase - neutral	57.7 - 240 Vac $\pm 20\%$
AUX voltage, if voltage 57.7 - 109 Vac	24Vdc - 110Vdc (-10 to +15%)
Operating temperature, without derating	-20... +60 °C
Transportation and storage temperature	-40... +70 °C
Altitude	Max. 2000m

<sup>1)</sup> In a single-phase system, if  $U_e$  is between 57,7 and 109 V, a safety auxiliary supply is necessary

Table 7.1      General technical data of automatic transfer switches

## 8. Using automatic transfer switch ATS022

### 8.1. Interface



Figure 8.1 Interface of ATS022

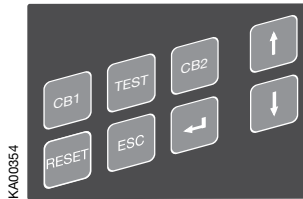


Figure 8.2 Keypad of ATS022

## 8.2. Configuration

### 8.2.1. Keypad

#### RESET

Selecting the automatic transfer switch ATS022 to the manual or automatic mode. An active alarm is set off by pushing the RESET key.

#### TEST key

Setting the automatic transfer switch to test sequence in which it is possible to simulate switching and back-switching sequences step-by-step, by pressing the TEST key. This is possible only if the automatic transfer switch is in manual mode. Exiting from test sequence is done by RESET key.

#### CB1 key

Setting in manual mode the circuit breaker CB1 to open/close position. When the circuit breaker CB1 will be in the ON position then the circuit breaker CB2 will be in the OFF position.

#### CB2 key

Setting in manual mode the circuit breaker CB2 to open/close position. When the circuit breaker CB2 will be in the ON position then the circuit breaker CB1 will be in the OFF position.

#### Browsing keys (Enter, ESC, Up, Down)

There are four browsing keys to operate the automatic transfer switch ATS022 from the display.

KA00362		<b>Enter</b>	is used to accept function
		<b>ESC</b>	is used to return one step backwards
		<b>UP</b>	is used to move one step up on the menu
		<b>DOWN</b>	is used to move one step down on the menu

8.2.2. LEDs

Alarm

A red Alarm LED signals an active alarm with continuous red signal (Logic disabled, CBs commands failure, CBs trips, CBs withdrawn, Gen. alarm input DI8, DI3 activated).

Auto

A green Auto LED signals the automatic or the manual mode. When the automatic transfer switch ATS022 is in automatic mode, the Auto LED is ON. When the device is in manual mode, the Auto LED is OFF. In test sequence the Auto LED is blinking.

Power

A green Power LED signals the power status. When power is ON, the Power LED is ON. The automatic transfer switch ATS022 will remain in standby state at least one minute after power failure. A blinking Power LED indicates standby mode.

Tx/Rx

A green Tx/Rx LED signals the state of communication bus. When the LED is ON, the automatic transfer switch ATS022 is sending data to the bus. When the led is OFF, data is not transferred.

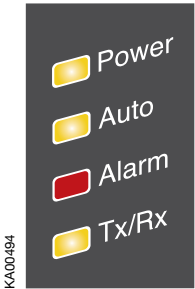


Figure 8.3 LEDs on ATS022

8.2.3. Display

The display is a graphic display with following menu pages:

8.2.3.1 Default page

Default page shows the status of the protection devices and the status of two monitored lines and eventually of the generator. Status is shown as a graphic picture, where graphic LEDs and a specific line status code indicates the status of LN1 and LN2. When the LED is OFF, there is an anomaly in the line and the status code for the line is 1. When the LED is ON, there is voltage in the line and the status code is missing. In the case of an anomaly, the LED is OFF and the status code indicates what is at fault. Below the line status code the measured values of voltage and frequency are shown. Status codes are defined in the table below:

Code	Status of the line
1	No voltage
2	Undervoltage
3	Overvoltage
4	Phase missing
5	Voltage unbalance
6	Incorrect phase sequence
7	Invalid frequency

Table 8.1 Line status codes

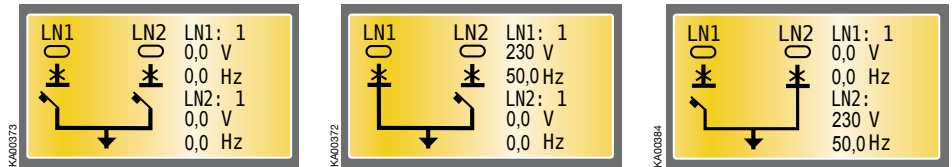


Figure 8.4 The Default pages show the status of the device and the monitored lines

When the generator is started, the letter G and the “arrow up” symbol on the right side of line 2 (LN2) status are in the default page. When the generator is stopped, the letter G and the “arrow down” symbol on the right side of line 2 (LN2) status are in the default page. When the generator is not used, there is no sign in the default page (see the page 32, Generator Usage).

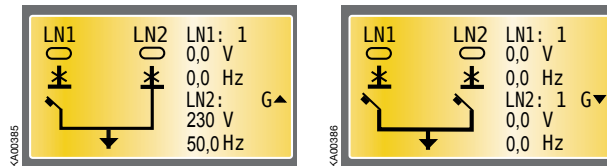


Figure 8.5 The Default pages show the status of the generator; started or stopped, when in System Configuration/Generator Usage “Generator in Used” is defined, see page 32

### 8.2.3.2 Main Menu page

From Default page is entered to Main Menu page by pushing the Enter key. Main Menu page is the main page that allows entering in all the configuration sub-pages:

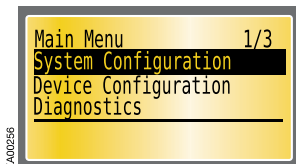


Figure 8.6 The Main Menu page allows the entering in all the configuration sub-pages

### 8.2.3.3 System Configuration

The System Configuration sub-page can be configured with the attributes of the monitored lines; see table 8.2. The attribute selection and its value changes are made by using UP, DOWN and ENTER keys.

The system configuration requires a password. Password consists of 4 numbers, it is given by UP, DOWN and ENTER keys. The password for the first entering to the system is 0001. Please, change the password to your own according the guidelines under the subpage Device Configuration; see pages 35 and 36. The password is valid one minute after leaving System Configuration; for example, back to the Main Menu page. After that time you have to give the password again when returning to the System Configuration pages. If the password is forgotten/lost, please, contact product support.

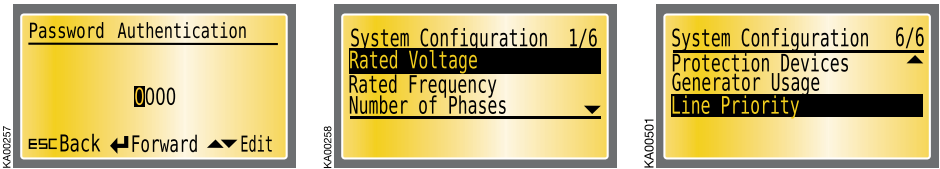


Figure 8.7 System Configuration requires a password

Attribute	Values
Rated operational voltage $U_e$	100V/57V– 115V/66V - 120V/70V - 208V/120V - 220V/127V - 230V/132V - 240V/138V - 277V/160V - 347V/200V - 380V/220V - 400V/230V - 415V/240V - 440V/254V - 480V/277V
Rated frequency	50Hz - 60 Hz, 16 2/3 Hz, 400 Hz
Number of phases	1-phase / 3-phases with N / 3-phases without N
Protection devices	CBs / CBs + Bus Tie
Generator usage	No Generator / Generator in use
Line Priority	No Line Priority / Line 1 (LN 1)

Table 8.2 Attributes and values of the System Configuration

Rated Operational Voltage  $U_e$

Rated Operational Voltage  $U_e$  is the rated voltage of the system. Value is announced as main voltage/ phase voltage, Volts. Factory setting is 400/230 V.

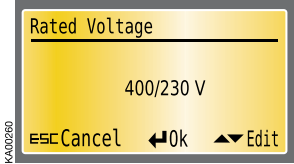


Figure 8.8 Rated Operational Voltage  $U_e$ , factory setting is 400/230 V

Rated Frequency

Rated Frequency means assigned frequency of the system. Value is announced as Hertz. Factory setting is 50 Hz.

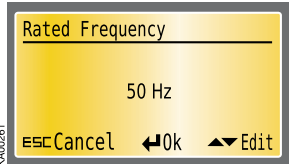


Figure 8.9 Rated Frequency, factory setting is 50 Hz

Number of Phases

User can choose between a one-phase and a three-phase system with or without N. Three-phase system with N is the default.

### Number of Phases

User can choose between a one-phase and a three-phase system with or without N. Three-phase system with N is the default.

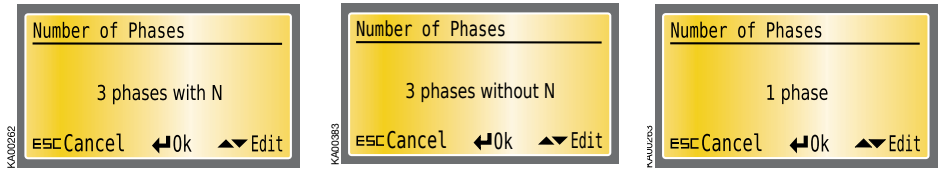


Figure 8.10 Number of phases, three phases with N is the default

### Protection Devices

User can choose whether protection devices is CBs or CBs + Bus Tie. CBs is the default.

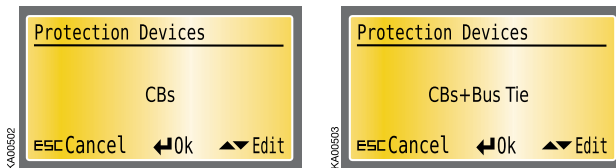


Figure 8.11 Protection Devices, CBs is the default

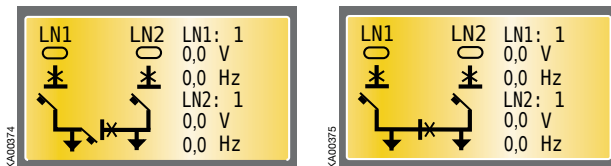


Figure 8.12 Protection Devices, status is shown as a graphic picture

### Generator Usage

User can choose No Generator, when generator is not used or Generator in Use, when it is used in the Line 2 (LN 2). No Generator is the default.

**NOTE:** Generator should always be connected to the Line 2 (LN 2).

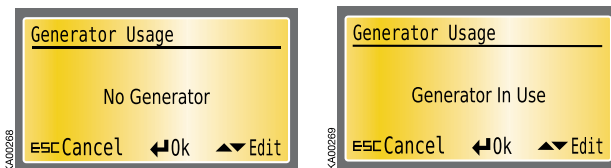


Figure 8.13 Generator Usage, No Generator is the default

Line Priority

User can select the line priority to the Line 1 (LN 1) (default) or No Line Priority.

**NOTE:** Line 2 (LN 2) can never have higher priority.

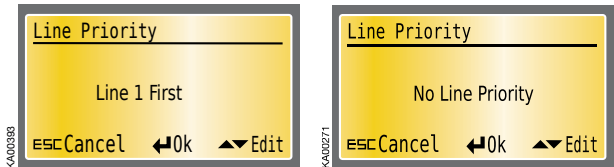


Figure 8.14 Line Priority, Line LN 1 is the default

8.2.3.4 Device configuration

In this sub-page you can set the threshold of all monitored parameters and the time delay, see the table 8.3. You can change the password in this subpage. The password consists of four numbers, and is chosen with the arrow and enter keys. For all other attributes you can select and change the value by using the UP, DOWN and ENTER keys.

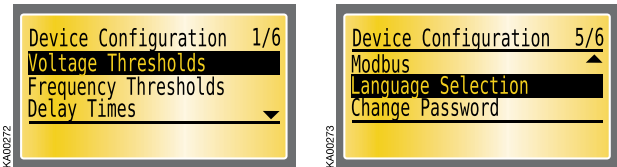


Figure 8.15 ATS022 configuration, requires a password

Attribute	Values
Voltage Thresholds	-30% ...-5%, +5% ... +30%, step $\pm$ 1% (unbalance is set to same level)
Frequency Thresholds	-10% ... -1%,+1% ... +10%, step $\pm$ 1%
Delay Times	Delay TS, 0...30s Delay TCE, 0...60s Delay TBS, 0...30s Delay TCN, 0...60s Delay TGOFF, 0s, 1s, ...59s, 1min, 2min, ..., 5min
Modbus	Modbus Address Modbus Baud Rate Modbus Stop Bits Modbus Parity
Language Selection	English Francais Italiano Espanol Suomi Deutsch
Change password	Four numbers
Retype new password	Four numbers

Table 8.3 Attributes and values for the Device Configuration



### Voltage Thresholds

User can set voltage thresholds both minimum and maximum values. Factory settings are min -15% and max 15%.

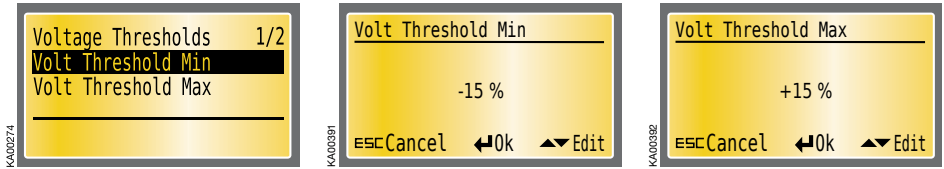


Figure 8.16 Voltage Threshold, factory settings: min -15%, max 15%

### Frequency Thresholds

User can set frequency thresholds both minimum and maximum values. Factory settings are min -1% and max 1%.

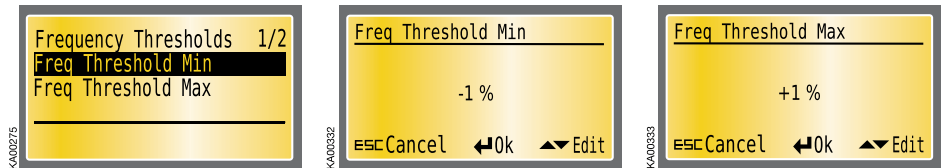


Figure 8.17 Frequency Threshold, factory settings: min -1%, max +1%

### Delay Times

User can set delay times for switching delay (TS), back switching delay (TBS), close emergency delay (TCE), close normal delay (TCN) and generator stop delay (TGOFF). Values for delays are in the table 8.3. Factory settings for delay times: TS 0s, TCE 3s, TBS 0s, TCN 3s and TGOFF 5s.



Figure 8.18 Factory settings for delay times: TS 0s, TCE 5s, TBS 0s, TCN 3s and TGOFF 5s.

Modbus

Communication protocol. User can set Address, Baud Rate, Stop Bits and Parity for the Modbus. Address means the Modbus address of the device. The address can be chosen between 1 ... 247. The Baud Rate can be 9600 –19200 – 38400 kbps. Stop bit can be set 0 or 1 and the parity can be set even, odd or none. Factory settings are Modbus address 1, Modbus Baud Rate 9600, Modbus Stop Bit 1 and Modbus Parity None.

Tx/Rx LED indicates data transmission: LED is ON only when data is transmitted from the ATS022.

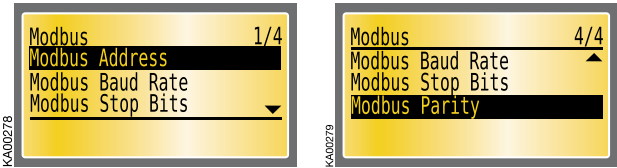


Figure 8.19 Modbus

Language Selection

In this page it is possible to choose the language. The choices are English, French, Italian, Spanish, Finnish and German. Factory setting is English.

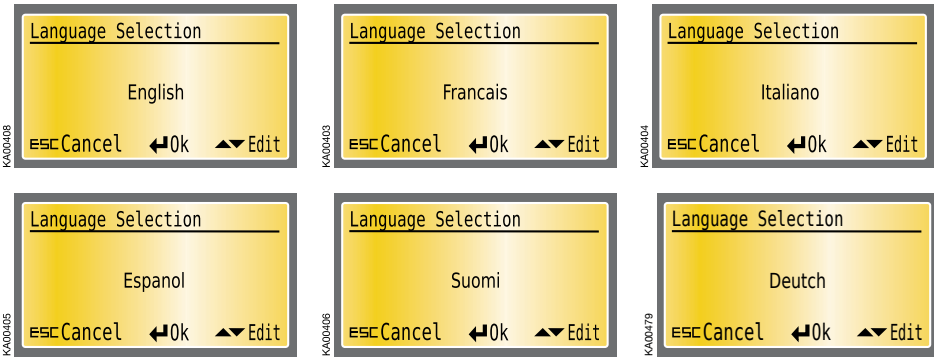


Figure 8.20 Language selection, English as default

Change Password

In this page it is possible to change password. The password consists of four numbers. In this page it is always shown as 0000. New password is set by using UP, DOWN and ENTER keys.

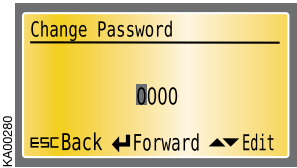


Figure 8.21 Change the password

### Retype New Password

The new password has to be confirmed by retyping it. After confirmation, the user is returned to the Device Configuration menu and on the bottom of the display the message PASSWORD CHANGED is shown. If password confirmation does not succeed, on the bottom of the display is shown the message INVALID PASSWORD and the old password is still valid.

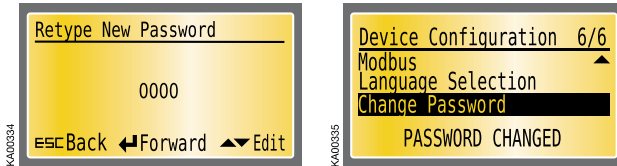


Figure 8.22 Confirmation of the new password

### 10.2.3.5 Diagnostics

Under Diagnostics are submenus: Measured Values, Alarm Log and Counters.

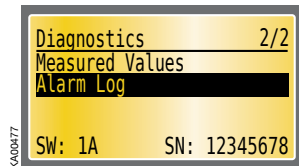


Figure 8.23 Diagnostics

### Measured Values

On the display the measurements of Main Voltages and Phase Voltages are shown. The frequency is also shown on both pages.

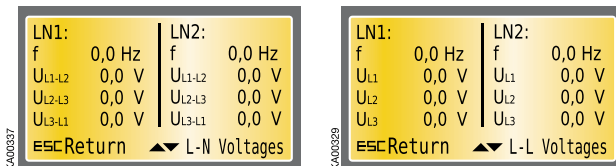


Figure 8.24 Measured Values: Main Voltages with frequency and Phase Voltages with frequency

### Alarm log

Under Alarm Log are submenus: View Log and Clear Log.

### View Log

On this page the latest alarms are shown. The number of alarms is shown at the top of the page. The log can contain a maximum of the 20 latest alarms. The latest alarm is always at the top of the list.

Clear Log does not have its own page. The log is cleared when Clear Log is chosen and the Enter key is pressed.

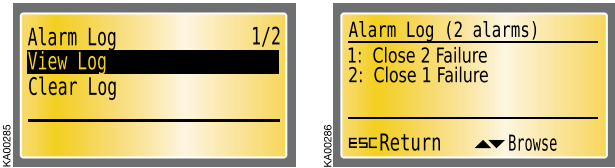


Figure 8.25 Alarm Log: 20 latest alarms, Clear Log will empty the log

8.2.4. Communication via Modbus

An RS485 link is used to connect ATS022 with a PC or a PLC over a distance of 500 meters using Modbus protocol:

RS485	2 or 3 wires half duplex
Protocol	Modbus in RTU mode
Speed	2400, 4800, 19200, 38400 Bauds
Galvanic insulation	4 kV (1 min 50 Hz)

Table 8.4 ATS022 communication with a PC or a PLC

The configuration of ATS022 can be done only by display and keypad, but the status information of the monitored lines and of the ATS022 can be monitored via Modbus. The following information is available:

Func. code	Address	Description	Type	Values
3	2000	Normal line status	Uint16	0x0 = Voltage OK 0x1 = Voltage zero 0x2 = Voltage under 0x3 = Voltage over 0x4 = Phase missing 0x5 = Unbalance 0x6 = Incorrect phase sequence 0x7 = Frequency out of range
3	2001	Emergency line status	Uint16	0x0 = Voltage OK 0x1 = Voltage zero 0x2 = Voltage under 0x3 = Voltage over 0x4 = Phase missing 0x5 = Asymmetry 0x6 = Incorrect phase sequence 0x7 = Frequency out of range
3	2002	Switching status	Uint16	0x0 = Sequence not required (line used = N) 0x1 = Sequence in progress (N -> E) 0x2 = Sequence completed (line used = E) 0x3 = Sequence rev in progress (E -> N) 0x4 = Sequence failed
3	2003	Normal line protection device status	Uint16	0x1 = Open 0x2 = Close 0x3 = withdrawn
3	2004	Emergency line protection device status	Uint16	0x1 = Open 0x2 = Close 0x3 = withdrawn
3	2006	Generator status	Uint16	0x1 = ON (emerg. line voltage > 0) started 0x2 = OFF (emerg. line voltage = 0) stopped 0x3 = ALARM
3	2007	ATS emergency	Uint16	0x0000 = No Alarms 0x0001 = Open 1 Failure 0x0002 = Open 2 Failure 0x0004 = Open 3 Failure 0x0008 = Close 1 Failure 0x0010 = Close 2 Failure 0x0020 = Close 3 Failure 0x0100 = Logic Disable 0x0200 = External Alarm 0x0400 = CB1 Trip 0x0800 = CB2 Trip 0x1000 = Generator Alarm

Table 8.5 Dialogue functions of ATS022

## 9. Technical data of the automatic transfer switch

ATS022	Value
Operating and measuring voltage area on 3 phase system:	
Main voltage	100Vac - 480Vac ( $\pm 20\%$ )
Phase voltage	57,7Vac - 277Vac ( $\pm 20\%$ )
AUX voltage	24Vdc - 110Vdc (-10% to 15%)
Frequency	50Hz - 60Hz, 16 2/3 Hz <sup>(3)</sup> , 400 Hz ( $\pm 10\%$ )
Operating and measuring voltage area on 1 phase system:	
Phase voltage	57,7Vac - 240Vac <sup>(1) (2)</sup> ( $\pm 20\%$ )
AUX voltage	24Vdc - 110Vdc <sup>(1)</sup> (-10% to 15%)
Frequency	50Hz and 60Hz, 16 2/3 Hz <sup>(3)</sup> , 400 Hz ( $\pm 10\%$ )
Voltage and frequency sensing precision	
Voltage	1 %
Frequency	1 %
Relay utilisation category	8 A, AC1, 250 V
Relay utilisation category for connector X26:	6 A, AC1, 250V
Over voltage category	III, Uimp 6 kV
IP rating	IP20 for the front panel
Temperature area	- 20 to + 60 °C <sup>(4)</sup>
Transportation and storage temperature	- 40 to + 90 °C
Humidity	r.h. = 95 % T = 25...55 °C

<sup>(1)</sup> On 1 phase system is not allowed to choose 100 V, 115 V and 120 V.

<sup>(2)</sup> If voltage level is between 57,7 – 109 Vac, AUX power supply must be used.

<sup>(3)</sup> In system with rated frequency is 16 2/3 an AUX voltage have to be used; if rated voltage is higher than 100Vac external voltage transformer must be used.

<sup>(4)</sup> Whenever ATS022 is used at low temperatures (lower than -10°C) it is advisable to use an external voltage to avoid any visualization problems on the graphical display.

Table 9.1      Technical Data of ATS022

## 10. Troubleshooting

### 10.1. Alarms in ATS022

Alarms are showed with a dedicate message on the display of ATS022. Alarm messages are explained in the table below.

Message	Fault	Action
Open 1 Failure	The protection device CB1 does not open in 5 s	The alarm can be reset by the RESET key
Open 2 Failure	The protection device CB2 does not open in 5 s	The alarm can be reset by the RESET key
Open 3 Failure	The protection device CB3 does not open in 5 s	The alarm can be reset by the RESET key
Close 1 Failure	The protection device CB1 does not close in 5 s	The alarm can be reset by the RESET key
Close 2 Failure	The protection device CB2 does not close in 5 s	The alarm can be reset by the RESET key
Device 1 Withdrawn	CB1 withdrawn	The logic is locked and ATS goes to the manual mode. Reset by inserting CB1
Device 2 Withdrawn	CB2 withdrawn	The logic is locked and ATS goes to the manual mode. Reset by inserting CB2
Logic Locked	Logic Enable / Disable input DI3 inactivated	The logic is locked. Reset by activating DI3
External Fault	Status of both CB1 and CB2 is closed (DI1 and DI2 activated)	Check wiring
Device 1 Trip	CB1 tripped	The logic is locked as long as trip input DI4 inactive
Device 2 Trip	CB2 tripped	The logic is locked as long as trip input DI5 inactive
Generator Alarm	Generator alarm input activated	The logic is locked as long as alarm input DI8 active

Table 10.1 Alarms in ATS022

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Due to possible developments of standards as well as of materials, the characteristics and dimensions specified in the present installation and operating instructions may only be considered binding after confirmation by ABB SACE Division.

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