

APPLICATION NOTE

Transfer Switching In Main Distribution Boards

Food And Beverage Industry



ABB offers a wide variety of automatic transfer switching solutions ranging from well-established technologies to the latest digital innovations, all able to ensure continuity of service and production, avoid downtime and financial losses.

What is Transfer Switching?

Transfer switches are devices that switch loads from a primary to a back-up power source if the primary power source fails. A reliable switching device is crucial in a power source failure, whether planned or unplanned.

Why you need a transfer switching solution

At least 350 million people were impacted by power outages last year. Power interruptions or outages in F&B plants can lead to catastrophic economic losses including lost revenue, brand deterioration and failure of process equipment, all of which affect food and people safety. According to industry analysts, the cost of downtime in an F&B facility is an estimated \$100,000 and \$1 million per hour.*

This is why smooth, safe and efficient transfer switching to a reliable back up source is of supreme importance in F&B.

* Source: McKinsey on Food Processing & Handling

Main benefits



24/7 Continuous Operation:

Maximize reliability and reduce the likelihood of downtime by protecting your loads and processes from power outages.



Cost Savings:

Save up to 50% installation time and cabling costs thanks to the built-in integrated design.



Digitalization:

Easy integration into your monitoring and control systems plus real time data availability with out advanced communication capabilities.



Space Savings:

Avoid the typically complex wiring of traditional ATS solutions with external controllers (e.g PLC), CTs and VTs, by opting for an embedded ATS.



Speed up your project:

Ready-to-use, predesigned solutions. Up to 95% reduction in commissioning time using Ekip connect 3 free software for adjusting settings and uploading configurations.



—
Transfer Switching
Solutions



—
Smart Power -
Transfer Switch Solutions

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In this age of continuous operation, uptime and on-time delivery, F&B processors must also adapt production to changes in supplies and demand surges. Food safety & product quality are two important KPIs that ingredient processors, F&B processing & packaging industries need to consider at depth if they are to avoid food recalls.

This is why they need an Automatic Transfer Switch (ATS) to switch the power supply from the main line to an emergency or backup line, thereby reducing problems caused by faulty conditions in the main supply to the minimum. There are various classes and types of ATS solutions on the market, based on low voltage circuit breakers, switch technology and contactors.

ATS equipment can be located in:

- Main Distribution Board (MDB), to back up the power supply for the majority of plant loads
- Sub-Distribution Board (SDB), to back up the power supply for selected critical plant loads
- Emergency Distribution Board (EDB), to back up the power supply for specific loads such as emergency lighting, fire-fighting, security systems etc..

This application note focuses on the main distribution board and covers the most common power supply configurations (Main-Main, Main-Tie-Main, Main-Gen) using ABB ATS solutions based on circuit breakers.



— Despite the investments made by utilities in grid resilience, at least 350 million people, thus more than 4% of the global population, were impacted by major power outages over the past year ⁽¹⁾.

Meanwhile, the demand is growing and many F&B factories worldwide are operating 24/7 to meet higher efficiency, productivity, and sustainability goals. The United Nations predicts food production must increase by 60% by 2050 to meet growing population needs ⁽²⁾.

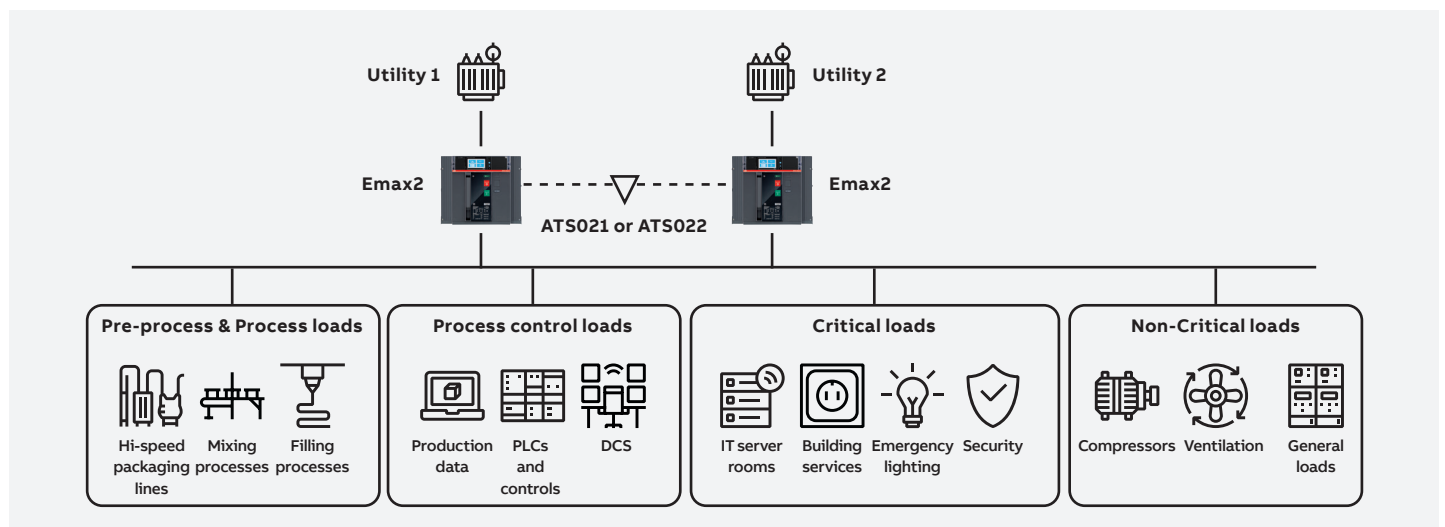
1) Bloomberg (Global Power Crunch Hit at Least 350 Million People With Outages Last Year)

2) UN (Feeding the World Sustainably)

ATS For Main Distribution Boards

Main – Main Configuration

This configuration features two independent lines from the utility. Utility 1 is used as the main line that feeds the whole plant while Utility 2 is a backup line. If the main line goes down, ABB ATS switches the load to the backup line. The network consists of a transformer with the same power rating as the main line transformer.



ATS021 or ATS022 monitors the main line (Utility 1). If a fault occurs, it waits for set delay time (TS) to elapse and then transmits an opening command to the main circuit breaker of the main supply (Utility 1). After the time delay (TF for ATS021 or TCE for ATS022) has elapsed, the ATS transmits a closing command to the circuit breaker on the backup line (Utility 2). The plant and all the electrical installations are now supplied by the backup line (Utility 2). When the electrical parameters of the main line (Utility 1) return within normal acceptable limits and once time delay (TBS) has elapsed, the ATS activates the inverse switching procedures by opening the circuit breaker on the backup line (Utility 2) and then closing the circuit breaker on the main line (Utility 1) after time delay (TF for ATS021 or TCN for ATS022) has elapsed.

Automatic transfer switching can also be obtained without inverse procedures (circuit breaker of the main line (Utility 1) open and circuit breaker of the backup line (Utility 2) closed. In the manual mode, the system can be manually configured to work under line Utility 1 or Utility 2.

The settings and adjustments for ATS021 can be made by means of dip switches and rotary selectors on the device. The settings and configurations of ATS022 can be easily adjusted and uploaded using our free Ekip connect 3 software.



Time delays and limit thresholds

Time delays	Description	ATS021	ATS022	Remarks
TS	Time delay before switching procedure starts	0-30 sec	0-30 sec	The delay prevents the switching procedures from starting due to transients
TF (ATS021) TCE (ATS022)	Time delay before circuit breaker on backup line closes	3.5 sec	0..60 sec	It is advisable to choose a short delay to reduce interruptions in the power supply to loads
TBS	Time delay before circuit breaker on backup line opens (start of inverse switching procedures)	0-30 sec 300 sec	0-59 sec 1-30 min	It is advisable to make the delay as long as possible to ensure total stabilization of the main voltage
TF (ATS021) TCN (ATS022)	Time delay before circuit breaker on main line closes	3.5 sec	0-60 sec	It is advisable to make the delay as short as possible to reduce interruption in the power supply to loads
TL Delay	Delay in activation of outlet DO7 (Alarm) after detection of faults on both lines	0-60 sec	0-60 sec	It is advisable to make this delay as short as possible

Limit thresholds	Description	Value
Minimum / maximum voltage threshold	Voltage threshold at which the ATS starts the transfer procedure when in the automatic mode	-30% -5% or +30% + 5% (Step \pm 1%)
Minimum / maximum frequency threshold	Frequency threshold at which the ATS starts the transfer procedure when in the automatic mode	-10% -1% or +10% + 1% (Step \pm 1%)

Special Cases

Case	Action
Utility 1 returns to normal during TS	Switching is interrupted
Utility 1 returns to normal during TF/TCE	Switching is completed
Utility 1 fails during TBS	Switching is interrupted
Utility 1 fails during TF/TCN	Switching is completed
Utility 2 is not available during TS	Wait after TS for the presence of Utility 2 to send opening command to the circuit breaker of Utility 1
Utility 2 is not available during TCE	Switching is completed

Main Components

- 2 Air Circuit Breakers: Emax 2
- Automatic Transfer Switch: ATS021 / ATS022.

Application Table

Transformer Rating (kVA)	Emax 2		Air Circuit Breaker			Automatic Transfer Switch
		Current Rating (A)	Icu (kA)	Trip Unit	Accessories for each breaker	
800	E2.2 1250 N	1250	66	Ekip Dip	Mechanical Interlock + Spring Charger Motor + Shunt Opening + Shunt Closing + (key lock against manual operation)	ATS021 or ATS022 (Delayed Transition) ⁽¹⁾
1000	E2.2 1600 N	1600	66			
1250	E2.2 2000 N	2000	66			
1600	E2.2 2500 N	2500	66			
2000	E4.2 3200 N	3200	66			
2500	E4.2 4000 H	4000	100			

Notes:

- Calculations are at 400 V
- ATS022 requires auxiliary power supply in case of communication (Modbus RTU RS485) or 16 2/3 Hz frequency systems.
- Ekip Modbus communication module for Emax 2 can be added if needed
- Ekip Touch / Hi-Touch trip unit can be used.

1) Please consult [annex](#) for further details about transition types.



Emax 2 webpage



Emax 2 Catalog

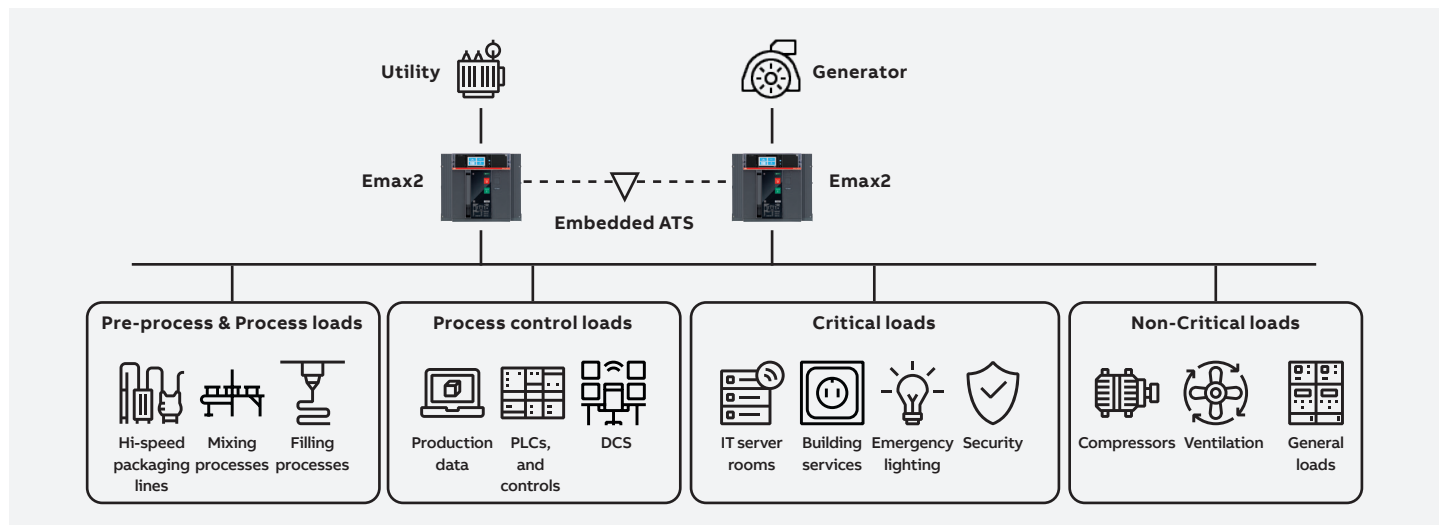


ATS021-022 brochure

ATS For Main Distribution Board

Main-Gen Configuration

This configuration has one line from the utility used as the main line that feeds the plant. This, in addition to another emergency line equipped with generator. If the main line goes down, ABB ATS switches to the emergency line.



An embedded ATS monitors the main utility line. If a failure occurs, the embedded ATS starts the generator. As soon as the generator is ready and power is available, the embedded ATS starts the automatic switching procedures after the delay (TS) and (TCE) times. When the main utility line returns, the embedded ATS starts the inverse switching procedures and returns to normal operation by closing the circuit breaker of the main utility line and opening the circuit breaker of the generator (with break before make switching) according to the delay times (TBS & TCN). After the transition is complete, the generator switches off according to the delay time (TGOFF).

Automatic transfer switching can be obtained without inverse procedures (circuit breaker of main utility line open, circuit breaker of generator emergency line closed, while the generator keeps running). In the manual mode, the system can be manually configured to work under the main utility line or generator emergency line.

The customer must install switches (auto-manual selector switch/manual selection switch/inverse procedure selector switch) on the panel door. The settings and configurations can be easily adjusted and uploaded thanks to our free Ekip connect 3 software.



Time delays and limit thresholds

Time delays	Description	Value	Remarks
TS	Generator start delay after fault detection in main utility line	0-30 sec	Delay prevents switching procedures from starting due to transients
TCE	Time delay before circuit breaker on emergency generator line closes	0-60 sec	It is advisable to choose a short delay to reduce interruptions in the power supply to loads
TBS	Time delay before circuit breaker on the emergency generator line opens (start of inverse switching procedures)	0-100 sec	It is advisable to make the delay as long as possible to ensure total stabilization of the main voltage
TCN	Time delay before circuit breaker on main utility line closes	0-60 sec	It's recommended to make it as short as possible to reduce interruption in the power supply to the loads
TGOFF	Generator switch-off time after closure of circuit breaker on main utility line	0-100 sec	It is advisable to make the delay as long as possible to ensure the generator is running should another power failure occur in main line
TL Delay	Delay in activation of outlet DO7 (Alarm) after detection of faults on both utility and emergency lines	0-60 sec	It's recommended to make it as short as possible

Limit thresholds	Description	Value
Minimum / maximum voltage threshold	The voltage threshold at which the ATS starts the transfer procedure when in automatic mode	-30% -5% or + 30% + 5% (Step \pm 1%)
Minimum / maximum frequency threshold	Frequency threshold at which the ATS starts the transfer procedure when in the automatic mode	-10% -1% or + 10% + 1% (Step \pm 1%)

Special Cases

Case	Action
Utility line returns to normal before emergency generator line is ready	Switching is interrupted and generator is switched off
Utility line returns to normal during TCE	Switching is completed
Utility line fails during TBS	Switching is interrupted
Utility line is unavailable during TCN	TS starts to re-switch to emergency generator line

Main Components

- 2 Air Circuit Breakers: Emax 2
- Automatic Transfer Switch: Embedded ATS.

Application Table

Transformer Rating (kVA)	Emax 2		Air Circuit Breaker			Automatic Transfer Switch
	Emax 2	Current Rating (A)	Icu (kA)	Trip Unit	Accessories per each breaker	
800	E2.2 1250 N	1250	66	Ekip Touch + Measuring Package	Ekip Link +	Embedded ATS (Delayed Transition) ⁽¹⁾
1000	E2.2 1600 N	1600	66		Ekip Com Actuator +	
1250	E2.2 2000 N	2000	66		Ekip Signalling 2k +	
1600	E2.2 2500 N	2500	66		Ekip Supply +	
2000	E4.2 3200 N	3200	66		Spring charger motor +	
2500	E4.2 4000 H	4000	100		Shunt opening + Shunt closing + Mechanical interlock	

Generator rating (kVA)	Emax 2		Air Circuit Breaker			Automatic Transfer Switch
	Emax 2	Current Rating (A)	Icu (kA)	Trip Unit	Accessories per each breaker	
800	E2.2 1250 N	1250	66	Ekip G Touch	Ekip Link +	Embedded ATS (Delayed Transition) ⁽¹⁾
1000	E2.2 1600 B	1600	42		Ekip Com Actuator +	
1250	E2.2 2000 B	2000	42		Ekip Signalling 2k +	
1600	E2.2 2500 N	2500	66		Ekip Supply +	
2000	E4.2 3200 N	3200	66		Spring charger motor +	
2500	E4.2 4000 N	4000	66		Shunt opening + Shunt closing + Mechanical interlock	

Notes:

- Calculations are at 400 V
- The Embedded ATS is available for all Emax 2 frames, fixed version, 3 poles or 4 poles
- The embedded ATS Main-Gen license can be purchased from ABB Ability Marketplace™
- Ekip Hi Touch or Ekip G Hi-Touch can be used.

1) Please consult [annex](#) for further details about transition types.



Emax 2 webpage



Emax 2 Catalogue



Embedded ATS
White paper

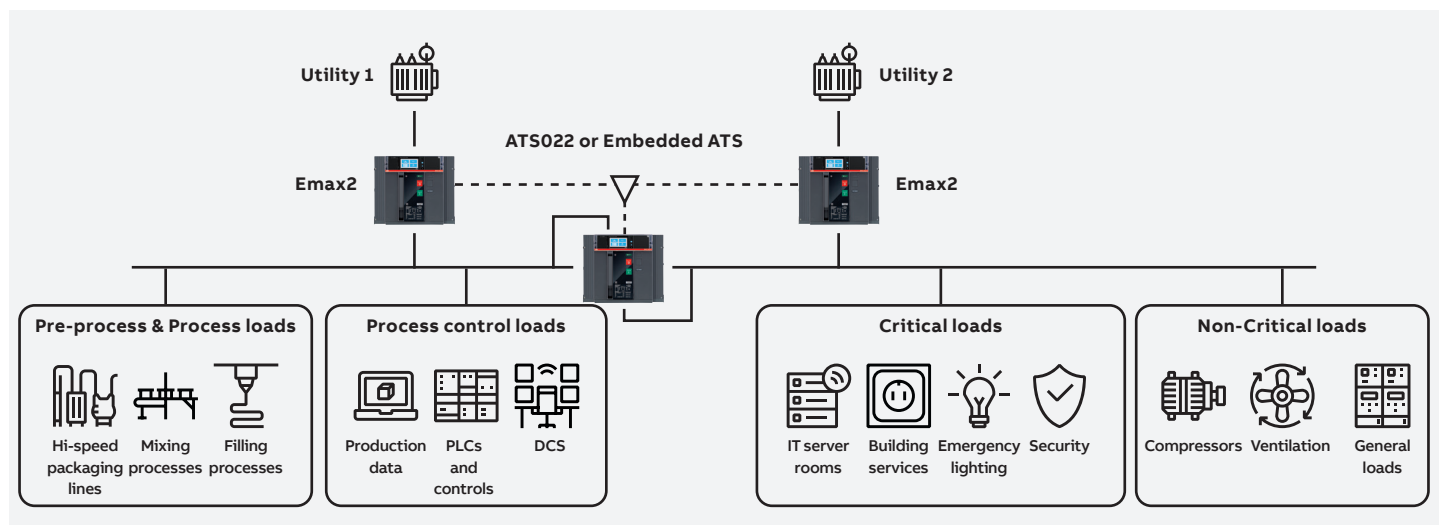


ABB Ability Marketplace™

ATS For Main Distribution Board

Main-Tie-Main Configuration

In this configuration, there are two independent lines from utility. Each line supplies a different section of the plant (usually half of the plant loads) separated by a bus tie circuit breaker (normally open). If one of the lines goes down, the other line supplies both sections, where ABB ATS closes the bus tie breaker.



Option 1 ATS022

ATS022 monitors both lines (Utility 1 and Utility 2). When a fault occurs in one of the lines (e.g. Utility 1), ATS022 waits for set delay time (TS) to elapse, after which it sends an opening command to the circuit breaker of the faulty line (e.g. Utility 1). ATS022 closes the bus-tie circuit breaker after time delay (TC) has elapsed. Thus all the plant loads are supplied by the other line (e.g. Utility 2). When the electrical parameters of the faulty line (Utility 1) return within normal acceptable limits and once time delay (TBS) has elapsed, the ATS activates the inverse switching procedures by opening the bus-tie circuit breaker and

then closing the circuit breaker on the first line (e.g. Utility 1) after time delay (TCN) has elapsed. The plant thus returns to normal operating conditions where each line supplies half of the plant loads. Automatic transfer switching can be obtained without inverse procedures (circuit breaker of the first line (Utility 1) open while the circuit breakers of the other line (Utility 2) and bus-tie are kept closed). In the manual mode, the system can be manually configured to work under line Utility 1 or Utility 2. The settings and configurations can be easily adjusted and uploaded thanks to our free Ekip connect 3 software.



Time delays and limit thresholds

Time delays	Description	Value	Remarks
TS	Time delay before start of the switching procedure	0-30 sec	The delay prevents switching procedures from starting due to transients
TC	Time delay before bus tie closes	0-60 sec	TC must be set only for management of 2 independent supply lines separated by a bus-tie
TBS	Time delay before circuit breaker on bus-tie opens (start of inverse switching procedures)	0-59 sec 1-30 min	It is advisable to make the delay as long as possible to ensure total stabilization of the main voltage
TCN	Time delay before circuit breaker on Utility 1 line closes	0-60 sec	It's recommended to make it as short as possible to reduce interruption in the power supply to the loads
TL Delay	Delay in activation of outlet DO7 (Alarm), after detection of the fault on both lines	0-60 sec	It's recommended to make it as short as possible

Limit thresholds	Description	Value
Minimum / maximum voltage threshold	The voltage threshold at which the ATS starts the transfer procedure when in automatic mode	-30% -5% or + 30% + 5% (Step \pm 1%)
Minimum / maximum frequency threshold	The frequency threshold at which the ATS starts the transfer procedure when in automatic mode	-10% -1% or + 10% + 1% (Step \pm 1%)

Special Cases

Case	Action
Utility 1 returns to normal during TS	Switching is interrupted
Utility 1 returns to normal during TC	Switching is completed
Utility 1 fails during TBS	Switching is interrupted
Utility 1 fails during TCN	Switching is completed
Utility 2 fails during TS	Switching is interrupted
Utility 2 fails during TC	Switching is completed

Main Components

- 3 Air Circuit Breakers: Emax 2
- Automatic Transfer Switch: ATS022.

Application Table

Transformer Rating (kVA)	Emax 2		Air Circuit Breaker			Automatic Transfer Switch
	Emax 2	Current Rating (A)	Icu (kA)	Trip Unit	Accessories per each breaker	
800	E2.2 1250 N	1250	66	Ekip Dip	Mechanical Interlock + Spring Charger Motor + Shunt Opening + Shunt Closing + (key lock against manual operation)	ATS022 (Delayed Transition) ⁽¹⁾
1000	E2.2 1600 N	1600	66			
1250	E2.2 2000 N	2000	66			
1600	E2.2 2500 N	2500	66			
2000	E4.2 3200 N	3200	66			
2500	E4.2 4000 H	4000	100			

Notes:

- Calculations are at 400 V
- ATS022 does not require auxiliary power supply
- ATS022 requires auxiliary power supply in case of communication (Modbus RTU RS485) or 16 2/3 Hz frequency systems.
- It's possible to add Ekip Modbus communication module for Emax 2 if needed
- Ekip Touch / Hi-Touch trip unit can be used.

1) Please consult [annex](#) for further details about transition types.



Emax 2 webpage



Emax 2 Catalogue



ATS021-ATS022 brochure



Ekip connect 3



Emax 2 webpage



Emax 2 Catalogue



Embedded ATS
Whitepaper



ABB Ability Marketplace™

Option 2 Embedded ATS

The embedded ATS solution mainly consists of 4 elements, Ekip trip units, Ekip link, Ekip Synchro-check and the Ekip connect 3 tool. Starting from the normal operation condition, both utility line circuit breakers are closed and the bus tie circuit breaker is open. In the case of undervoltage (ANSI 27) or a fault in one of the lines, the digital input of Ekip signalling 4K is activated and opens the relative circuit breaker within the set time. The bus tie circuit breaker closes after the preset time and when certain checks have been performed (checking for ready to close state, checking for dead busbar (under 10% of U_n), checking that none of the electric protection elements has caused the line to open, checking that the other line is available and healthy (over 90 percent of U_n)).

ATS operates under the following conditions:

- ATS Emergency latching push-button S4 not pressed
- Bus-tie open
- Other bus bar voltage levels are more than 90% of the nominal value

ATS will be locked if:

- There has been a protection Trip or alarm (protection activation and the settings must be performed by the customer)
- The emergency push-button has been pressed

The lock can be removed by resetting the circuit breaker either locally or remotely. Further details about the operating modes of the embedded ATS solution are available.

The customer must install switches (auto-manual selector switch/manual selection switch/inverse procedure selector switch) on the panel door.

The settings and configurations can be easily adjusted and uploaded thanks to our free Ekip connect 3 software.

Available setting points

CB-A and CB-B

Name	Description	Threshold	Step
Set point A	Opening time after a voltage drop below the ANSI 27 threshold	0...60 s	1s
Set point B	Parallel time	300 ms...10 s	300 ms, 500 ms, 800 ms, 1 s, 3 s, 5 s, 10 s
UV (ANSI 27)	Undervoltage protection	$U_8=0.5...0.98 \times U_n$	$0.001 \times U_n$

UV setting available in the "protection" section of Ekip Connect 3

Fixed settings

Synchrocheck	ΔU threshold	Voltage difference	10%
	Δf threshold	Frequency difference	0.2 Hz
	Δp threshold	Phase angle difference	10°
	Dead busbar threshold		$0.1 \times U_n$
	Live busbar threshold		$0.8 \times U_n$
	Synchro voltage	Reference voltage for synchronism check	U12
	Synchro Primary voltage		400 V
	Synchro Secondary voltage		100 V

SOS Opening Sequence: C - A - B

Main Components

- 3 Air Circuit Breakers: Emax 2.
- Automatic Transfer Switch: Embedded ATS.

Application Table

Transformer Rating (kVA)	Emax 2		Air Circuit Breaker			Automatic Transfer Switch
		Current Rating (A)	Icu (kA)	Trip Unit	Accessories per each breaker	
800	E2.2 1250 N	1250	66	Ekip Touch + Measuring Package	Ekip Link +	Embedded ATS (Closed Transition) ⁽¹⁾
1000	E2.2 1600 N	1600	66		Ekip Com Actuator +	
1250	E2.2 2000 N	2000	66		Ekip Signalling 4k +	
1600	E2.2 2500 N	2500	66		Ekip Supply +	
2000	E4.2 3200 N	3200	66		Spring charger motor +	
2500	E4.2 4000 H	4000	100		Shunt opening + Shunt closing + Mechanical interlock	

Notes:

- The Embedded ATS is available for all Emax 2 frames, fixed version, 3 poles or 4 poles
- The Embedded ATS Main-Tie-Main license can be purchased from ABB Ability Marketplace™
- Ekip Hi Touch can be used.

1) Please consult [annex](#) for further details about transition types.

Annex

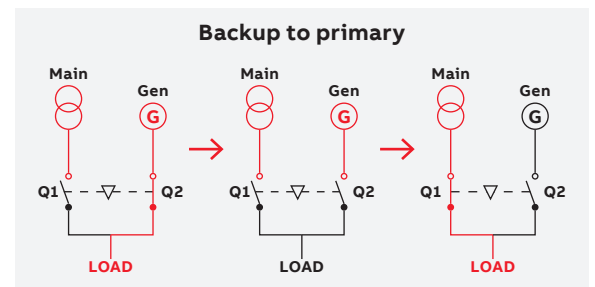
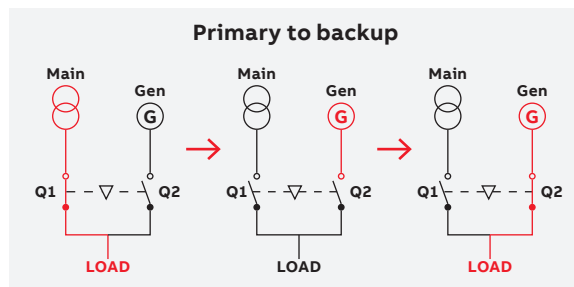
Transition Types

There are 3 main transition types: delayed, open and closed transitions.

1) Delayed transition

The ATS breaks the load current from one source prior to making it to the other source, so there is a period (can be set with time delay) of OFF-time when the load is neither connected to the main nor

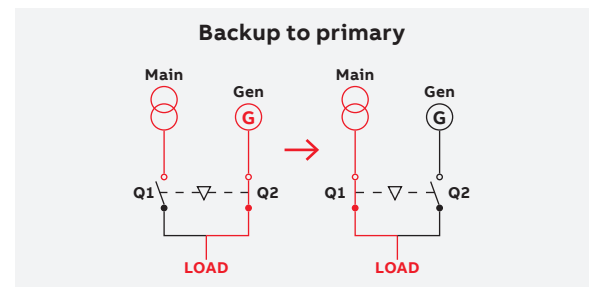
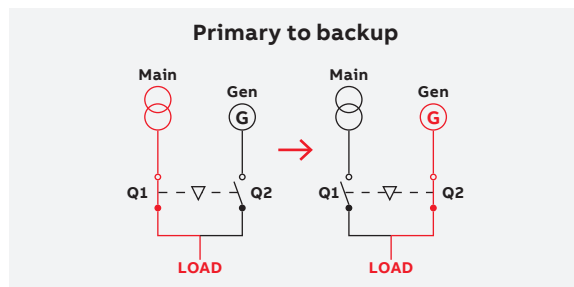
to the backup power sources. The typical delayed transition transfer sequence for the Main-Gen power supply configuration with reverse switching procedure is shown below.



2) Open transition

Similarly to Delayed transition, in the open transition mode, the ATS breaks the load current from one source prior to making it to the other source. However, the open transition ATS is without the "0" / "OFF" position. Thanks to this feature, transfer between two sources is accomplished very rapidly

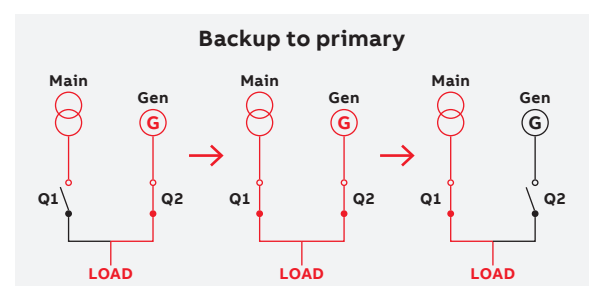
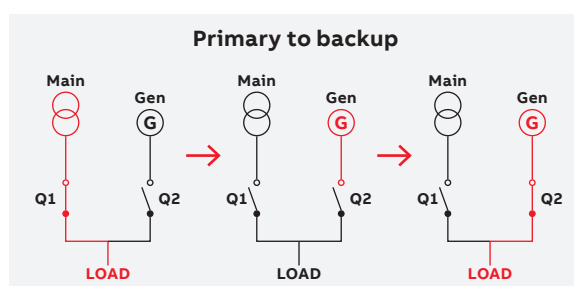
(less than 50 ms). Equipped with an in-phase monitor, transfer occurs when the sources are synchronized with zero degrees phase shift. The typical open transition transfer sequence for the Main-Gen power supply configuration is shown below.



3) Closed transition

When the two power sources are available, the transfer switch makes the load current of a second synchronized source before breaking it from the first source, so that both power sources supply the load in a parallel way for a short period of time. Synchronization conditions between two power sources (such as voltage, frequency and phase angle differences) must

be checked. The closed transition transfer switch allows power interruption to be completely eliminated during transfers between the two available power sources. The typical closed transition transfer sequence for the Main-Gen power supply configuration is shown below.



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