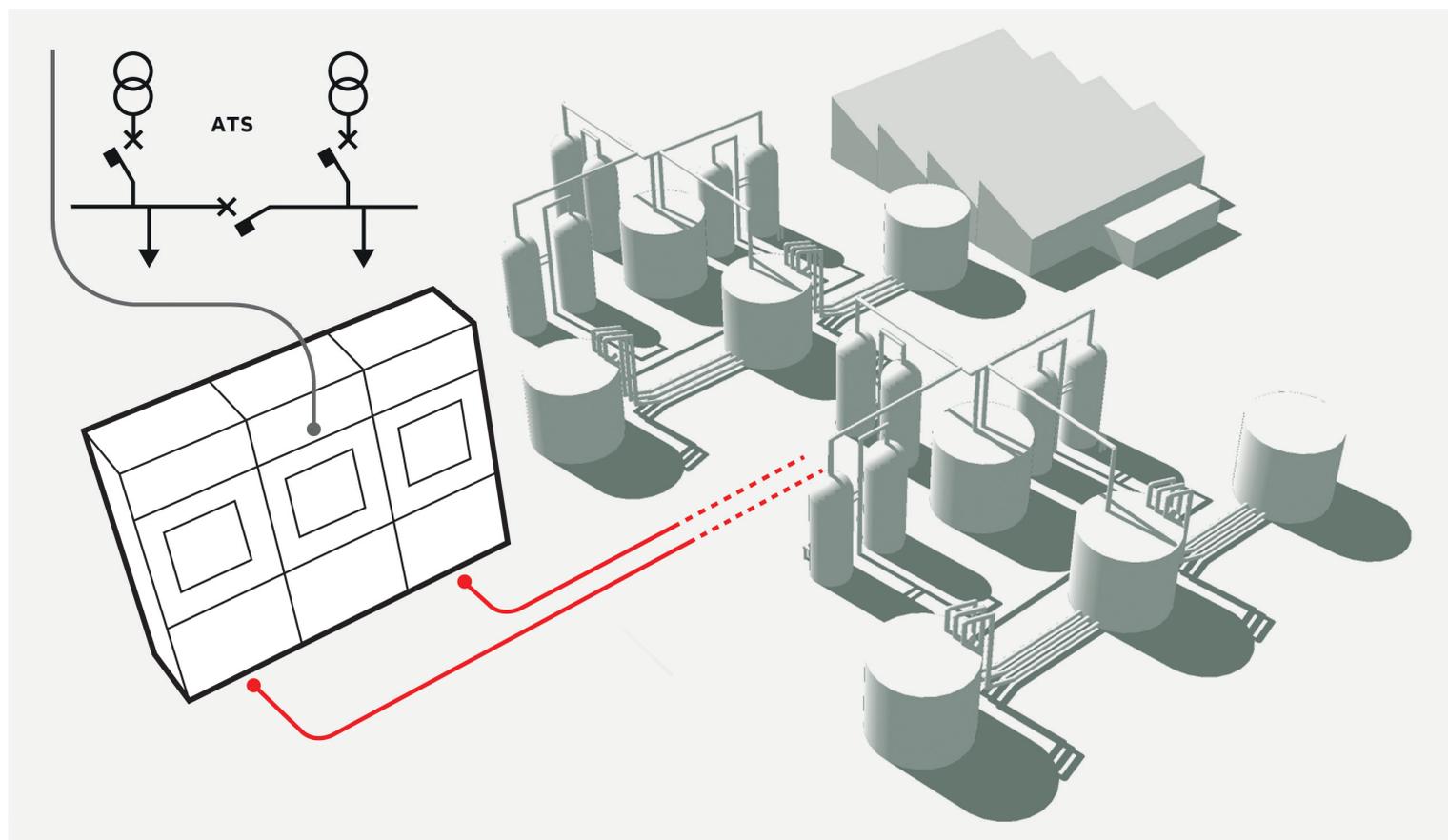


WHITE PAPER

SACE Emax 2 and Tmax XT, the All-In-One innovation

Embedded ATS system



Index

2 – 7	General introduction
8 – 11	How it works
12	How to buy the license and how to use it
13 – 23	Annex A Main-Tie-Main Closed transition
14 – 27	Annex B Main-Gen Open transition
28	Annex C Embedded ATS: Grey vs Black trip units

General introduction

ABB Embedded ATS system makes it easy to monitor, control and communicate in power networks

Over the last years, service continuity in low voltage electrical installations has played an increasingly leading role. In actual fact, this requirement is a fundamental characteristic if economically and functionally efficient installations have to be created.

A system able to switch the supply from the main line to an emergency line reduces problems caused by faulty conditions in the public network to the minimum. These operations, commonly known as “automatic switching”, comprise sequences that automatically control the installation components (the circuit-breakers play a fundamental role) without interventions from the operator.

To guarantee that power is supplied to the loads, a fundamental requirement in an installation is to have a redundancy in supply sources type N+1, usually consisting of a transformer and emergency generator (or, as an alternative, a second transformer).

Installations with an automatic switching system:

- Maximize the service continuity of any processes
- Provide a power supply with high quality voltage if the main network is out of service

- Manage microgrid connection and disconnection from the main grid
- Reduce the effects caused by network faults on parts of the installation (voltage reduction leads to loss of stability in the rotating Machines, a higher voltage drop, faults in the equipment, etc.)
- Achieve a good compromise amongst reliability, simplicity and cost-effectiveness
- Provide the maintenance staff and managing system with a power source able to supply the installation or part of it when the transformer is being serviced.

The ATS solution

The Embedded ATS is a high-performances energy automation system, easy to install and program.

In a world where digital communication is the predominant agent responsible for improved efficiencies and performances in industrial and power applications, ABB is moving to re-invent how digital systems are embedded.

The Embedded ATS system exploits the full capabilities of SACE Emax 2 and Tmax XT circuit-breakers and Ekip Connect 3 commissioning tool to deliver compact and reliable solutions.

The All-In-One innovation improves efficiency in any electrical plants. SACE Emax 2 and Tmax XT circuit breakers offer the highest short circuit performances in the most compact size and integrate in one single device both protection functions and automatic transfer switching logics. Ekip Connect 3 permits to exploit the full potential of the Ekip trip units. Thanks to this tool, the user can manage power, acquire and analyze electrical values, test protection, maintenance and diagnostic functions. Where are you going to use the Embedded ATS function? And why?

Where can ATS be applied?

Automatic Transfer Switch systems are common in all applications where service continuity is essential and there are multi power sources. The main applications are:

- Oil & Gas
- Operating theatres and primary hospital services
- Emergency power supplies for civil building, hotels and airports
- Data banks and telecommunication systems
- Power supply of industrial line for continuous processes

Another case is when ATS is used in applications where a portion of grid with local generation (called microgrid) can be disconnected from the main network.

The benefits

Ready-to-go solution

If you have ever programmed a power automation switchboard, you know that it requires PLC programming skills and electrical knowledge. Moreover, every custom-engineered system demands individual effort and personal responsibility. If settings need to be modified, the engineer may have to re-open the project, which has associated time and money costs.

ABB Embedded ATS cuts this long story by offering a general template, already tested and ready-to-go, that can be easily customized. The user can modify basic settings via an intuitive graphical interface. When all the parameters have been properly set, a simple tool allows to upload the template to the devices. And that's it, the system is up and running.

If settings need to be modified another time, just connect your laptop and implement the changes required through the same easy graphical interface.

The screenshot displays the 'Embedded ATS' software interface. The main window is titled 'New Main-Tie-Main Closed transition project' and contains the instruction 'Configure set points and roles for the breakers'. A schematic diagram shows two busbars connected by a 'BUS TIE' breaker. Each busbar has a 'MAIN BREAKER' (labeled 'MAIN BREAKER 1' and 'MAIN BREAKER 2') and a power source symbol. The 'BUS TIE' breaker is currently in the closed position. To the right, a 'Global set points' panel is visible, showing 'Parallel time' set to '300 ms' with a '10 s' scale indicator. At the bottom, there are three buttons: 'Start Over', 'Save project', and 'Transfer'.

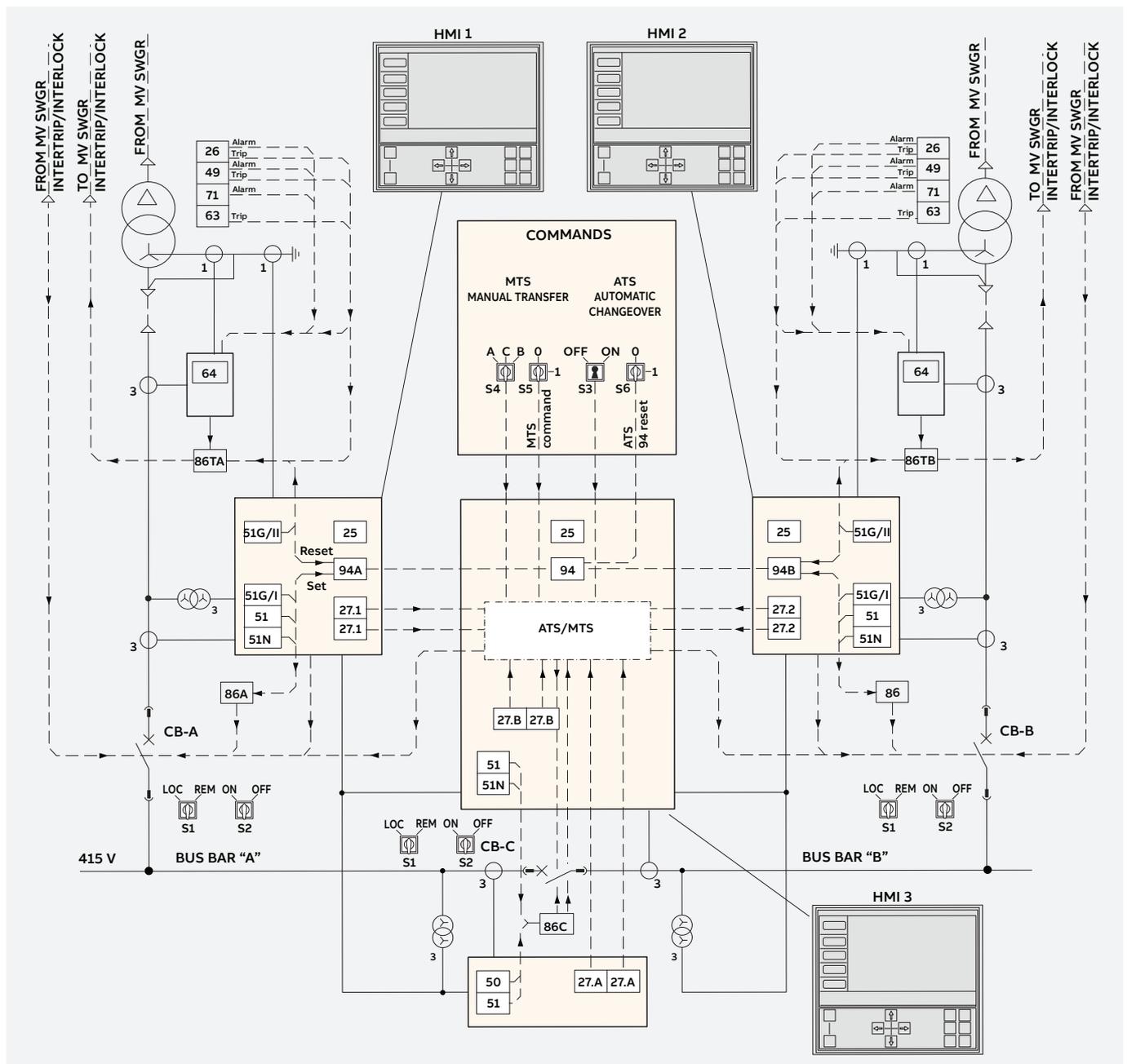
General introduction

Simplify the connections

The idea for the Embedded ATS solution emerged considering the complexity of the traditional solutions for power ATS. In the past, whether you were using a PLC or an external protection unit, you would have needed complex, hard-wired cabling between the protection devices, the operating devices (switch disconnectors) and the PLC,

as well as the CTs (current transformers) and VTs (voltage transformers). See picture below.

The introduction of the IEC 61850 communication standard for substation automation systems simplified things considerably by defining how devices should report their status and generally transfer data.

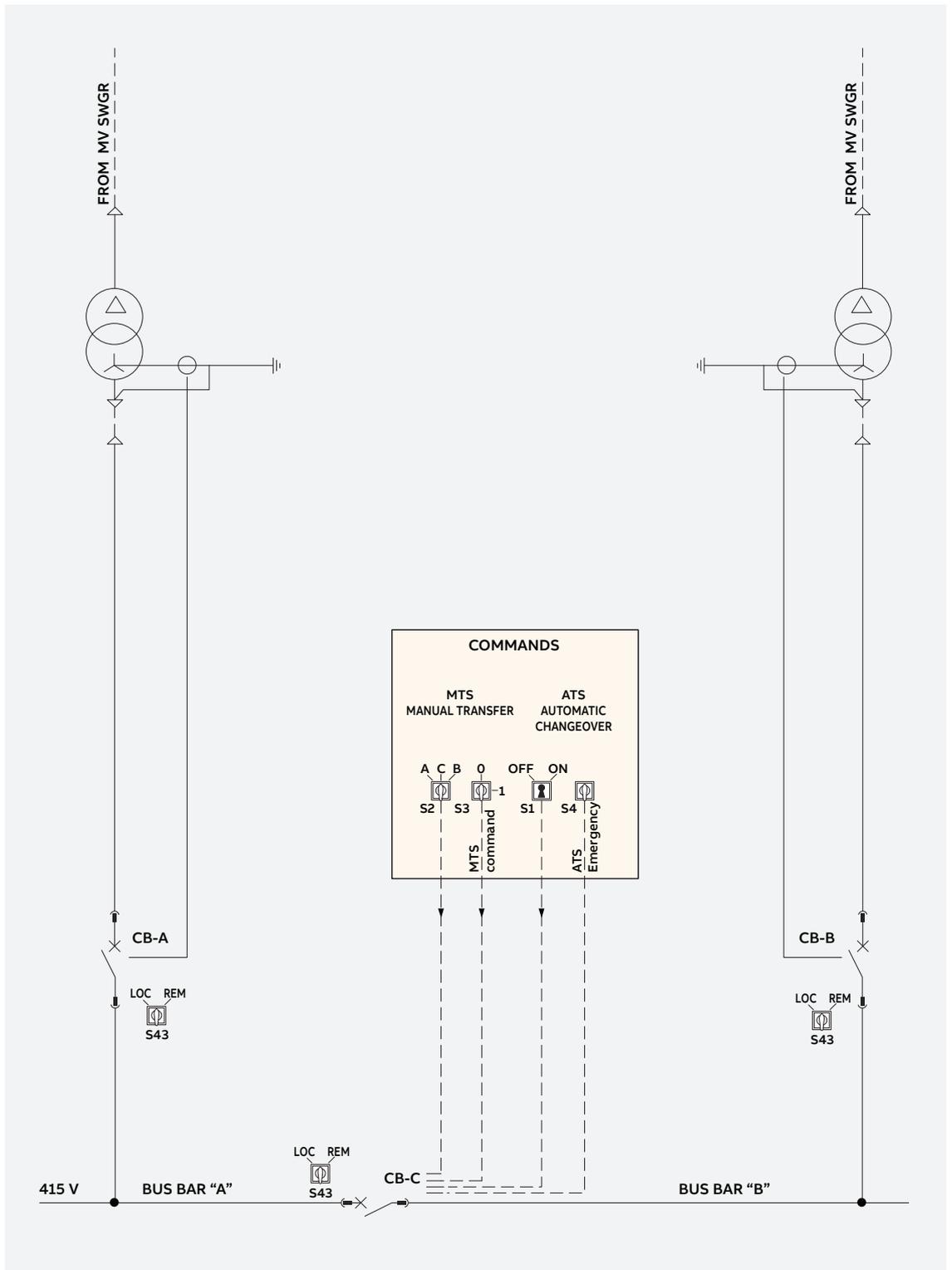


This communication is physically achieved via an Ethernet cable or similar. However, even with an architecture based on IEC 61850, many external devices are still needed to manage the complexity of the system.

Select the ABB Embedded ATS solution to master this complexity by harnessing the power of intelli-

gent SACE circuit-breakers together with Ekip Connect 3 software commissioning tool.

With Emax 2 and Tmax XT you can integrate measures, protections and communication between the devices and to the network. See picture below.



General introduction

Emax 2 and Tmax XT compactness

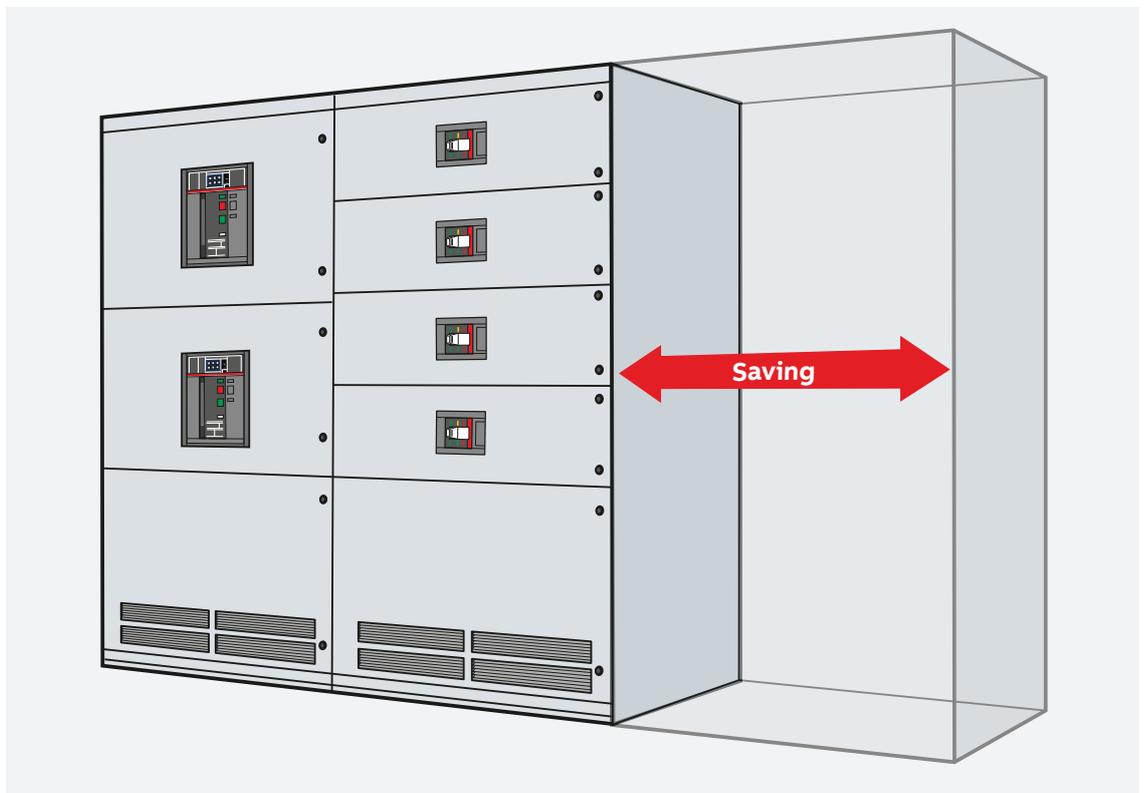
SACE Emax 2 and Tmax XT are the most compact circuit-breakers in the market by offering a lot of functionalities:

- Breaker
- Human-Machine Interface
- Advanced protection functions
- Measurement (including the transformers)
- Interlocking communication (horizontal) be-

tween devices

- Communication to the supervision system (SCADA)
- Communication to a cloud energy monitoring platform

The Embedded ATS solution is as compact as the Emax 2 and Tmax XT is. Nothing needs to be added.



Top-rate reliability

Now, let's think to a complex switchboard, with many different devices connected. What to do if one element is damaged or one cable is disconnected? See Fig. A.

Emax 2 and Tmax XT compactness does not preclude top-rate reliability. All the Ekip protection

trip units ensure high reliability by using an electronic circuit that periodically checks the continuity of the internal connections (trip coil, rating plug and current sensors). In the event of a malfunction, the LEDs indicate the corresponding -removable - alarm to enable the fault to be rapidly identified and rectified. See Fig. B and C.

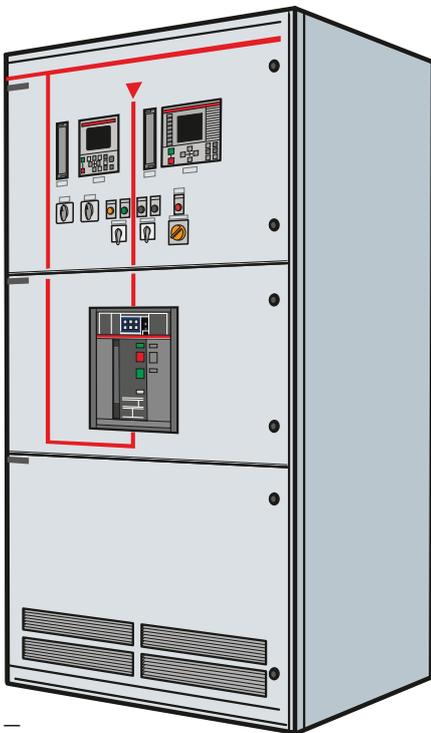


Fig. A
Traditional system:
- Switch disconnector
- External protection units
- Voltage sensors
- Amperometric transformer
- HMI
- Cabling
- Rotary selectors
- Pushbuttons

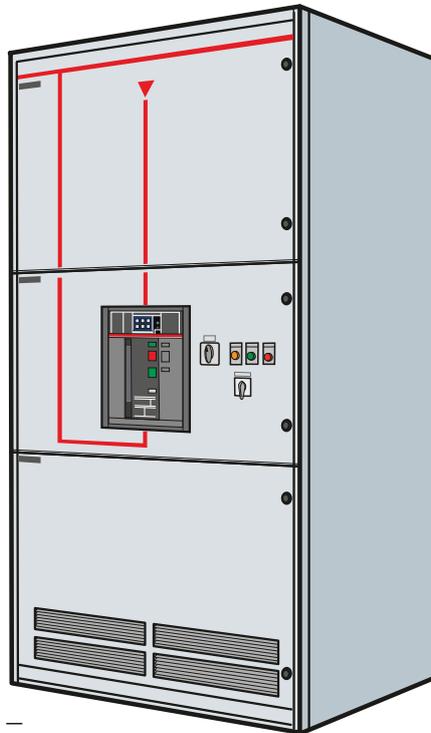


Fig. B
Emax 2 system:
- Circuit breaker
- Rotary selector
- Pushbuttons

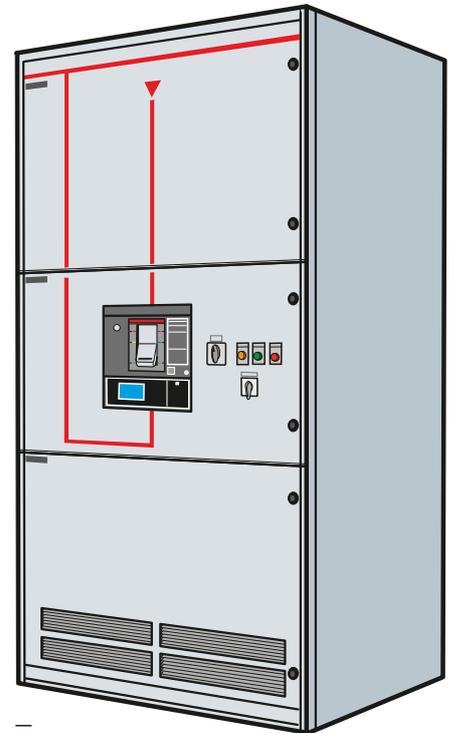
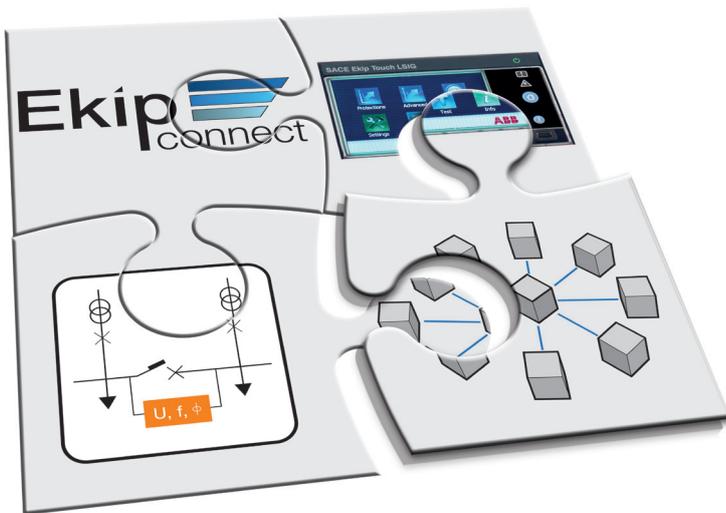


Fig. C
Tmax XT5 system:
- Circuit breaker
- Rotary selector
- Pushbuttons

How it works

ABB Embedded ATS solution is based on four main elements:

- Ekip trip units that enable logic operations
- Ekip Link
- Ekip Synchrocheck (only in case of closed transition systems)
- Ekip Connect 3 tool



Ekip trip units

The full capabilities of Embedded ATS can be exploited thanks to the Ekip Touch and Hi-Touch trip units.

These protection trip units can be easily programmed via the HMI or by using the Ekip Connect 3 software running on a laptop or mobile device (see the paragraph below).

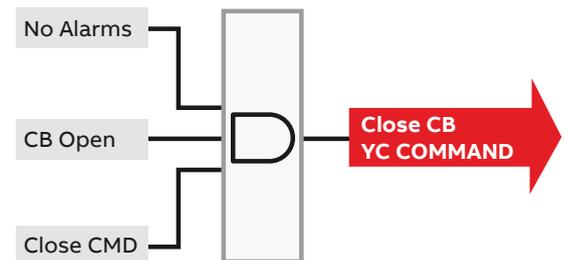
The Ekip Touch/Hi-Touch trip units measure power and energy with high accuracy and store the most recent alarms, events and measurements to prevent faults to the installation and trip effectively, when needed.

It is the access to these data that makes the Embedded ATS so powerful.

The Ekip Touch/Hi-Touch trip units (also in Generator Protection versions) have the capability of managing complex Boolean logic, rather like a PLC. Moreover, every physical, electrical and digital condition of the breaker is digitally mapped.

This means that you have at your disposal thousands of parameters and statuses that can be shared with other devices and used to monitor the entire system. You can use this capability to automate the response of the system according to any circuit breaker status or events. This is the essence of what the Embedded ATS does.

Let's show an example. Here you can see a very simple logic:



The basic elements are the input statuses (No Alarms, Circuit Breaker Open, Close Command), the Boolean AND operator and the output, which is active when all the input conditions are satisfied (AND function).

In other words, the circuit-breaker will close when it is open, with no alarms shown, and after the close command is sent. This type of logic - and the more complex ones - is exactly what the Embedded ATS can do.



Ekip Link module

Ekip Link

The computing power and logic capability of one circuit-breaker (as described above) can be extrapolated to realize a fast and powerful network of interconnected breakers that are able to exchange information each other.

This approach introduces a multiplier in terms of overall system capability that delivers unparalleled performance.

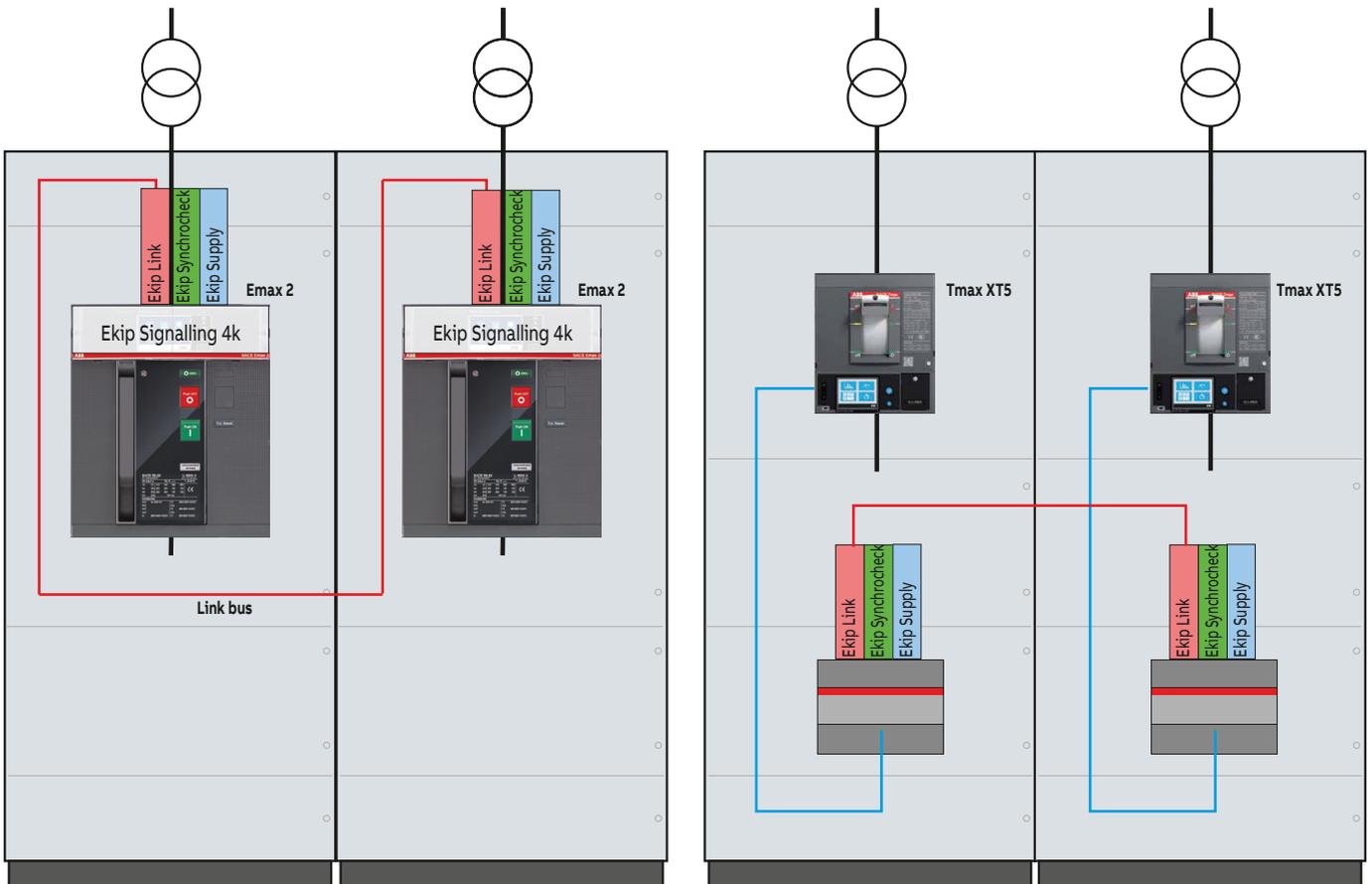
Ekip Link is the ABB tool that lets this peer-to-peer communication happen.

Ekip Link enables Emax 2 and Tmax XT circuit breakers to perform various tasks:

- Connect to the Ekip Control Panel
- Create logical selectivity
- Be part of a power controller system
- Enable horizontal communication between circuit-breakers

The horizontal communication between Emax 2 and Tmax XT circuit-breakers eliminates the need for a supervising device or master and makes data exchange - concerning, for example, status and protection interlocks between circuit breakers - direct and fast¹.

¹Another prominent method of horizontal communication is by the GOOSE messages described in the IEC 61850 standard.



How it works

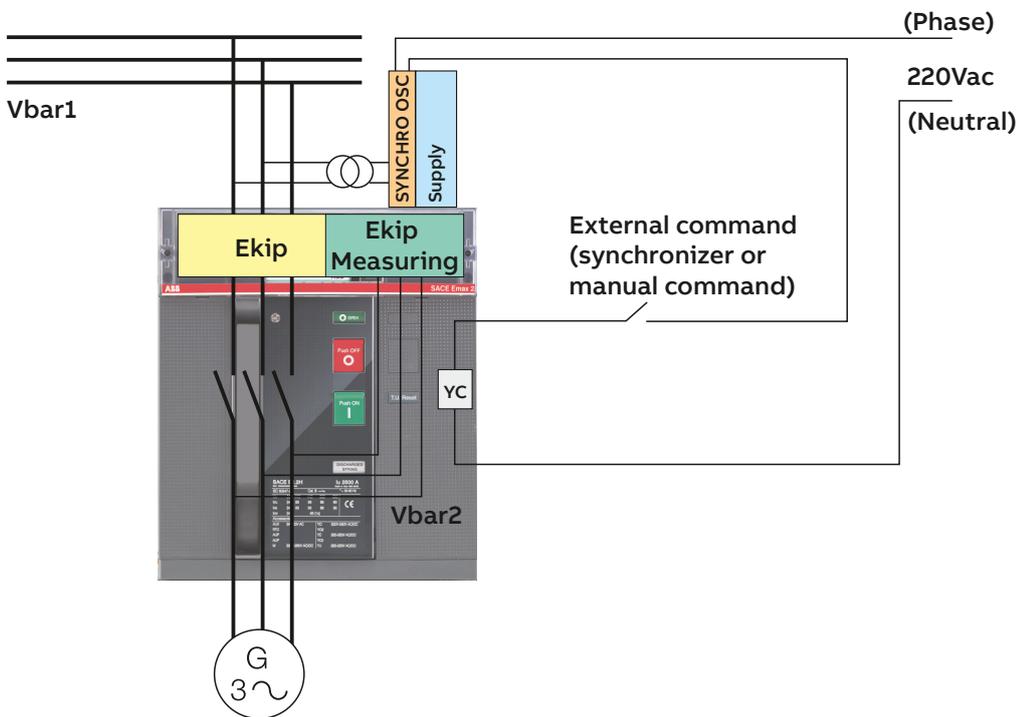
Ekip Synchrocheck (for closed transition only)

A closed transition occurs when a load is switched from one power source to another and for a short, transitional time the two power sources both supply the load, in a parallel fashion. If you want to set up what is called a closed transition ATS, then you need to install an Ekip Synchrocheck module. Conducting a closed transition is a delicate operation and many parameters must be checked and be within certain limits, before the power sources can be paralleled. The Ekip Synchrocheck module available for SACE Emax 2 and Tmax XT circuit-breakers is the accessory required to check that all the conditions for the transfer procedure are satisfied.

Fulfilling ANSI 25 protection, this module compares the angles, phases and frequencies of two voltages: one on the circuit breaker internal voltage plugs and the other on the line to be compared. When the results of the comparison match predetermined set ranges, a confirmation is generated by analog and digital contacts.

However, this is not the only function performed by the Ekip Synchrocheck. The module can also act as dead busbar detector by automatically switching from one application to the other one.

Imagine you can take all the digital information it provides and use them inside the Logic system. That's how we are able to meet the challenge of the most complex ATS systems.



Ekip Connect 3 tool

How does ABB allow to implement the Embedded ATS function in the easiest possible way?

The Ekip Connect 3 software opens the door to the Ekip electronic trip units so their functionality can be fully exploited, in an easy-to-use manner.

This commissioning tool has been created to facilitate and speed up the management of all the functions available. A simple and smart user interface and a thoughtful design of the programming processes make network configuration a breeze.

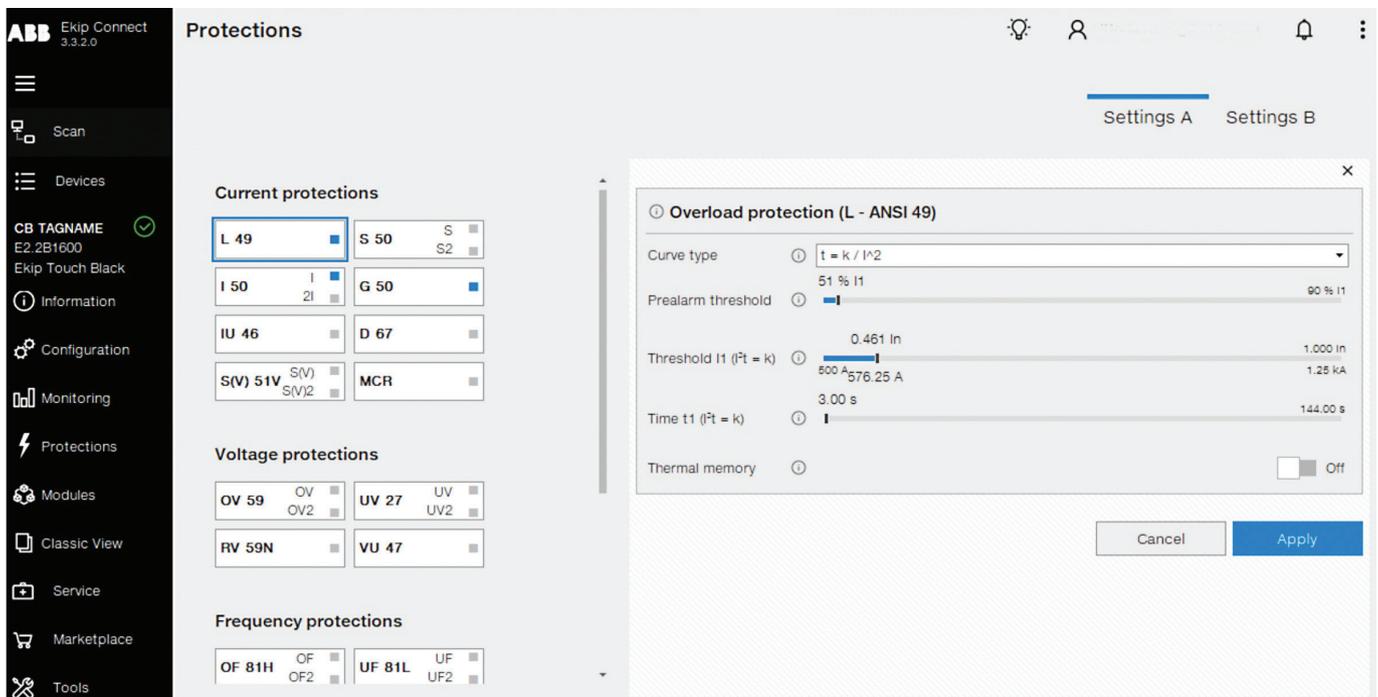
In addition, it offers measurement visualization, a freely configurable dashboard and various tools to manage information, signals, statuses and documents associated with your devices.

Inside Ekip Connect 3, the ATS software tool is a one-step wizard that allows to:

- Manage ATS projects, including the ability to save, load and share projects
- Set up projects quickly, with an intuitive interface
- Upload projects to the Ekip trip units

In this way, ABB offers a solution that is:

- Engineering-free
- Error-free
- Fast



How to buy the license and how to use it

How to buy the license

ABB circuit breakers are always upgradable with the ATS licenses thanks to ABB Ability Marketplace*. The license has to be purchased via this channel only. One license is needed to unlock the whole system, MG or MTM. You can swap the role of each authorized circuit breaker any time. You cannot substitute a breaker associated with the ATS system with a breaker not associated (eg, the Main 1 breaker needs to be changed in the switchboard, the new breaker cannot be associated automatically).

Contact ABB to break an association or to change a breaker into the system.

*please refer to the [Commissioning guideline](#) to have more information on how to install a software package

How to use it

Once you purchased the license via ABB Ability Marketplace, it will be visible in Ekip Connect 3 tool and ready to be commissioned.

Step 1: Open Ekip Connect 3

Step 2: Perform a scan of the network to find the available devices

Step 3: Enter the Tools section and follow the contextual help to configure your ATS system

Step 4: Once configured, use the lower right buttons to save the project or transfer the project to the interested circuit-breakers

It is possible to transfer the ATS project to multiple devices only in case of connection to a Modbus TCP network. Otherwise, the transfer has to be performed one single device per time using Ekip T&P or Ekip Programming. In case of single transfer, one by one, the user has to repeat the scan of the devices each time. After the scan, click again on the Tools section. The project will stay open and on hold, waiting for the next transfer command to send.

Once transferred, the project is permanently associated to the selected circuit-breakers.

To break an association, please contact ABB.

To transfer a project to the circuit-breakers, perform a Scan of the network clicking on the "Scan" section on the left column and following the procedure. After the scan the available circuit breakers will appear on the list of the ATS commissioning tool.

A progress bar will be displayed and a confirmation message will appear once operations are completed.

The screenshot shows the ABB Ekip Connect 3.3.2.0 interface. The left sidebar contains navigation options: Scan, Devices, CB TAGNAME (E2.2B1600), Information, Configuration, Monitoring, Protections, Modules, Classic View, Service, Marketplace, and Tools. The main area is titled "Embedded ATS" and shows a "New Main-Tie-Main Closed transition project". Below the title, it says "Configure set points and roles for the breakers". A schematic diagram shows two main breakers (MAIN BREAKER 1 and MAIN BREAKER 2) connected to a central bus tie (BUS TIE). The right panel is titled "MAIN BREAKER 1" and contains three sections: "1. Role set points" (with a dropdown arrow), "2. Role association" (with a dropdown arrow), and "3. Role conditions" (with a dropdown arrow). At the bottom of the interface, there are three buttons: "Start Over", "Save project", and "Transfer".

Annex A

Main-Tie-Main Closed Transition

Compatible frames:

Emax 2: E2.2, E4.2, E6.2
 Tmax XT: XT2 - XT4 - XT5

Scope

This specification describes the operating philosophy of the ATS Main-Tie-Main Closed transition system with SACE Emax 2 circuit-breakers. The system is a Main-Tie-Main. The two electrical power sources are transformers.

Glossary and acronyms

ATS	Automatic transfer switch
MTS	Manual transfer switch
CB	Circuit Breaker
Un	Nominal voltage of the system
RTC*	Ready to close
-CB-A	Circuit breaker incomer from line A
-CB-B	Circuit breaker incomer from line B
-CB-C	Circuit breaker incomer from line C
IPCS	Embedded protection and control system
HMI	Human-machine interface

* RTC not needed for XT2, XT4 and XT5.

Modes of operation and controls

Four modes of operation and control are foreseen and described in this document:

- Local control (manual)
- Remote control
- Automatic transfer switch (ATS)
- Manual transfer switch (MTS)

One of the operation modes is selected by means of one of the following switches:

- S1: ATS/MTS mode switch selector
 - A = CB-A
 - C = CB-C
 - B = CB-B
- S3: Push-button for starting manual transfer mode
- S4: Emergency latching push-button to exclude the automatic logic
- S43: Local/remote-IPCS selector (one per each circuit-breaker, it can be wired by the customer following the connection schemes in the Emax 2 installation manual)

Application limits:

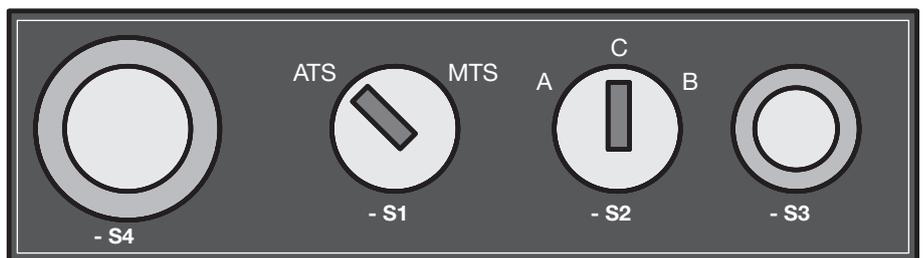
For Tmax XT family this function can be used only between same frame sizes.

For example: Accepted configuration:

CB-A: XT5 CB-B:XT5 CB-C:XT5

Not accepted configuration:

CB-A: XT2 CB-B:XT2 CB-C:XT4



Annex A

The following table shows the combination of switches/selectors/push-buttons needed to get each condition ready to operate.

Selector status				
	S1 (auto manual)	S2 (A-C-B)	S3 (start MTS)	S4 (logic off)
ATS	ATS	#	#	0
MTS	MTS	#	#	0
Local CB-A	#	#	#	#
Local CB-B	#	#	#	#
Local CB-C	#	#	#	#
Automation OFF	#	#	#	1
MTS-open CB-A	M	A	1	0
MTS-open CB-B	M	B	1	0
MTS-open CB-C	M	C	1	0

Selector status			
	S43 CB-A (local/ remote)	S43 CB-B (local/ remote)	S43 CB-C (local/ remote)
ATS	Remote	Remote	Remote
MTS	Remote	Remote	Remote
Local CB-A	Local	#	#
Local CB-B	#	Local	#
Local CB-C	#	#	Local
Automation OFF	Remote	Remote	Remote
MTS-open CB-A	Remote	Remote	Remote
MTS-open CB-B	Remote	Remote	Remote
MTS-open CB-C	Remote	Remote	Remote

Main switchgear working philosophy

The main switchgear configuration (see fig.2) under normal operating condition is “TT”:

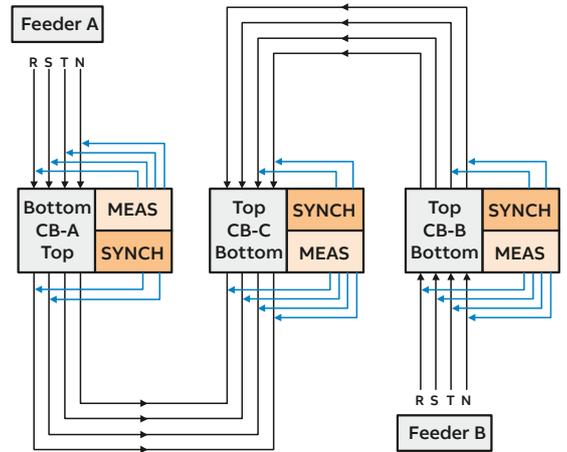
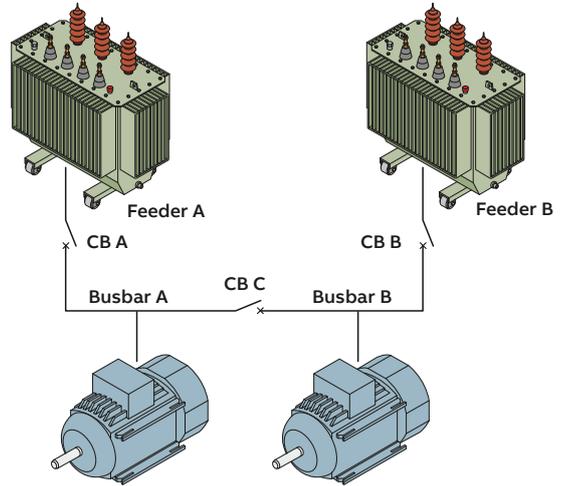
- Incomer lines from transformer (CB-A and CB-B): Close condition
- Bus-tie (CB-C): Open condition

The circuit breakers shall be manually controlled locally (switchgear) or remotely (IPCS).

ATS “break-before-make” and MTS “make-before-break” systems are provided.

The local/remote mode selection shall be done using the selector switch S43 located in each incomer or bus tie cubicle.

Figure 2 - Main switchgear configuration



Legend

- R, S, T, N: Three phases + neutral
- MEAS: Measurement module
- SYNCH: Ekip Synchrocheck
- Feeder A/B: Power sources (transformer or generator)comer or bus tie cubicle.

Note:
ABB provide the internal voltage plug connected as standard to the bottom terminals. To obtain the breaker with the voltage plugs connected to the top terminals, please use the specific extra ordering code.

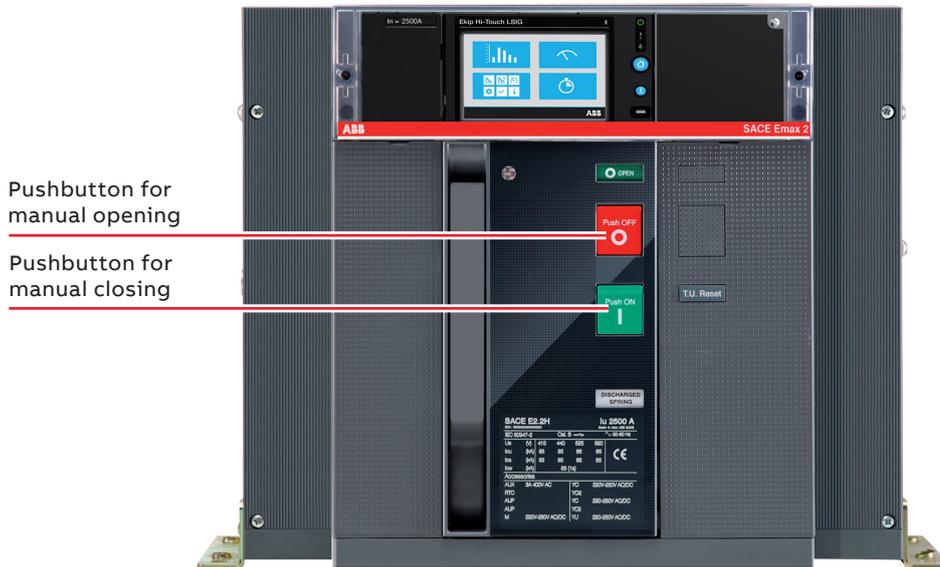
S43 - Local control

When the local/remote selector S43 is set to “Local” at each corresponding CB, opening and closing operations are permitted by using the ON or OFF push-buttons provided with every CB (see fig.3). The control is manual.

The selector excludes any automatic logic (ATS or MTS) or IPCS remote operations. In practice, the local/remote selector S43 activates the circuit breakers actuators (Ekip actuator or coils).

See the wiring diagram below for details. The system permits the closing of every circuit breaker, if done manually. No Interlock are provided in Manual operations.

Figure 3 - Emax 2 front



Pushbutton for manual opening

Pushbutton for manual closing

S43 - Remote control

CB-A / CB-B / CB-C (incomers and bus tie) IPCS controls are allowed with switch S43 in the Remote position.

The CBs can be controlled by the IPCS via the defined communication protocol.

In remote mode, the CB status can also be controlled by Ekip Connect.

If the Emergency latching push-button S4 is pushed, it is possible to open or close any circuit breaker.

It is not possible to start an MTS sequence in remote mode.

Scheme 1

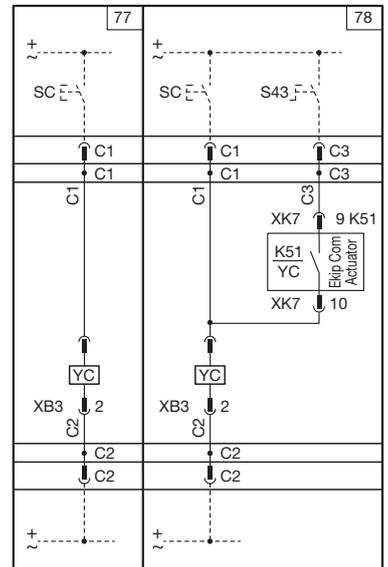
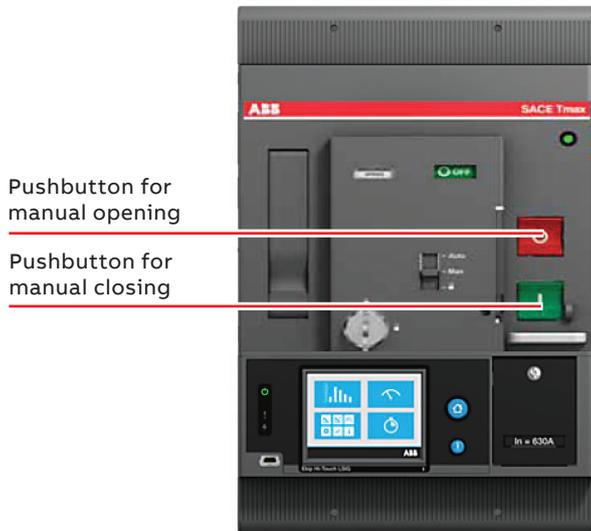
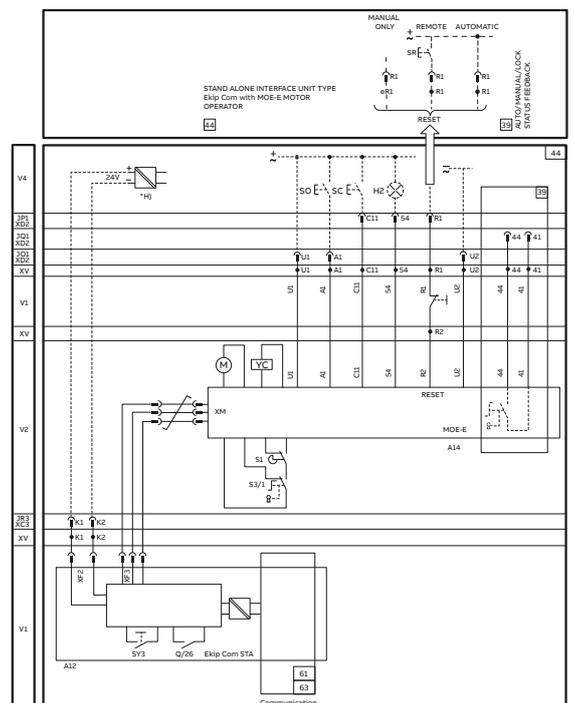


Figure 4 - Tmax XT5 MOE-E front



Pushbutton for manual opening

Pushbutton for manual closing



Annex A

S1 - Automatic Transfer Switch (ATS)

The ATS logic works as follows.

Starting from a **TT configuration** (CB-A and CB-B closed, CB-C open):

- In case of undervoltage (ANSI27) [set point] or Ekip Signalling 4K/10K Digital Input 1, 2 or 3 activated on one line (A or B), the relevant CB opens within the set time [set point].
- After the pre-set time and checking for Ready to Close (E2/XT7) or Not tripped (XT2/XT4/XT5) status, checking for dead busbar (under 10 percent of U_n), checking that no electric protection element caused the line to open, checking that the other line is available and healthy (over 90 percent of U_n), -CB-C closes.

The ATS shall operate under the following conditions:

- ATS Emergency latching push-button S4 not pressed
- Bus-tie open and RTC (not needed for XT2, XT4 and XT5)
- Other bus bar voltage level > 90 percent of U_n

The automatic changeover shall be locked in case of:

- Any protection Trip or alarm (The protections activation and settings must be carried out by the customer)
- Emergency push-button pressed

After a current protection trip of any circuit-breakers, the ATS logic is locked. The lock shall be removed by resetting the circuit-breaker locally or remotely.

When the “ATS Logic Disabled” normally closed pushbutton is pressed:

- The ATS logic is deactivated
 - The line breakers CB-A and CB-B can open for ANSI27
 - The bus-tie breaker CB-C does NOT close after the opening by ANSI27 of one line
- The MTS logic is deactivated

When the “ATS Logic Disabled” normally closed pushbutton is reset after being pressed:

- If no events occurred (ANSI27 or digital input) the ATS system is restored and ready to operate
- If one line breaker opened for ANSI27 while the pushbutton was pressed:
 - If the line voltage is still absent, the ATS system starts the bus-tie closing procedure after the preset time.
 - If the line voltage is back over 90 percent of U_n , the system keeps the previous status (line breaker open, bus tie open) and the operator shall manually restore the desired condition.

Starting from an **L configuration** (CB-A and CB-C closed, CB-B open / CB-B and CB-C closed, CB-A open)

- In the case of undervoltage (ANSI27) on the healthy line, the relevant breaker and the bus-tie open. The system shall be manually restored.
- In the case of return of voltage (over 90 percent of U_n) on the previously faulty line, the system is locked. The operator shall activate the MTS operating mode to change the status of the system.

If the ATS system is working properly, the CB-A 4K/10K Output 1 is lit. You can connect the output to a switchboard signalling system or you can communicate the contact status to the IPCS.

S1 - Manual Transfer Switch (MTS)

MTS mode can:

- Restore the normal operating condition (TT) without loss of supply after an ATS operation
- Transfer the load from one transformer to another without loss of supply
- Change the system configuration from TT to L without loss of supply

The ANSI25 Syncrocheck function prevents the paralleling of out-of-synch sources.

The "A-C-B" selector S2 has three positions. Each position acts as follow:

- Position A : CB-C or CB-B will close and CB-A will open;
- Position C: CB-A or CB-B will close and CB-C will open;
- Position B: CB-A or CB-C will close and CB-B will open;

The manual transfer shall be locked in case of:

- Emergency push-button S4 pressed
- The two power sources are out of sync as stated by ANSI25

- ANSI27 alarm on closing breaker
- Closing breaker not RTC/Not tripped
- Any alarm or timing protection on the opening line
- Any Loc/Rem selector on local

The manual transfer will happen if the operator follows the sequence:

1. Select the "Manual" mode with the "Auto/Manual" Switch S1
2. Select which breaker shall open with the "A-C-B" Selector S2
3. Press the "Open" pushbutton S3

And if:

- The two power sources are in sync as stated by the ANSI25
- There is no ANSI27 alarm on closing breaker
- The closing breaker is RTC/Not tripped
- There is no alarm or timing protection on the opening line
- All Local/Remote selectors are on Remote

Available setting points

CB-A

Name	Description	Threshold	Step
Set point A	Opening time after a voltage drop below the ANSI27 threshold	[0 s...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	$U8=0.5...0.98xUn$	0.001xUn

UV setting available at the "Protection" section of Ekip Connect 3.

CB-B

Name	Description	Threshold	Step
Set point A	Opening time after a voltage drop below the ANSI27 threshold	[0 s...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	$U8=0.5...0.98xUn$	0.001xUn

UV setting available at the "Protection" section of Ekip Connect 3.

Fixed settings

Synchrocheck	ΔU threshold	Voltage difference	10%
	Δf threshold	Frequency difference	0.2 Hz
	$\Delta \varphi$ threshold	Phase angle difference	10°
	Dead busbar Threshold		0.1 x Un
	Live busbar threshold		0.8 x Un
	Synchro voltage	Reference voltage for the synchronism check	U12
	Synchro Primary voltage		400 V
	Synchro Secondary voltage		100 V

SOS Opening Sequence: C - A - B

Annex A

Breakers configuration

The Embedded ATS function is suitable for E2.2, E4.2 and E6.2 circuit-breakers equipped with the following accessories:

Description	Ordering code
Ekip Hi-Touch or Ekip Touch + Measuring Package + Voltage Protection Package	Depends on Breaker Type
Ekip Supply	Depends on Aux Voltage
Ekip Link	1SDA074163R1
Ekip Synchrocheck	1SDA074183R1
Ekip Signalling 4K	1SDA074170R1
Ekip Com Actuator	1SDA074166R1
Spring Charger Motor	Depends on Aux Voltage
YO	Depends on Aux Voltage
YC	Depends on Aux Voltage

For Tmax XT the circuit breakers involved shall be XT2 / XT4 / XT5. Each single circuit breaker (CB-A, CB-B, CB-C) must be equipped as following:

Description
Ekip Hi-Touch or Touch + Measuring package enabled
MOE-E
YO (XT5) or SOR (XT2-XT4)
Ekip Cartridge (4 slot)
Ekip Supply
Ekip Com Link
Ekip Synchrocheck
Ekip Signalling 10K

Wiring diagrams

For Emax 2 and Tmax XT wiring diagram refer to the following material available on ABB Library (<https://library.abb.com/>):

- XT2-XT4: [1SDM000026A1001](https://library.abb.com/1SDM000026A1001)
- XT5: [1SDM000025A1001](https://library.abb.com/1SDM000025A1001)
- Emax 2: [1SDM000010A1001](https://library.abb.com/1SDM000010A1001)

Compatibility

The Embedded ATS tool is compatible with all the Emax 2 electronic trip units starting from version v02.20.08 of the Ekip Mainboard firmware.

To check the firmware version of your device you can:

- 1) Use the "Information" section of Ekip Connect 3, Nominal Data field
- 2) Press the "i" button on the front of the trip unit until the page "Protection Unit" appears.

Notes

Between the external contacts of the circuit-breaker and the inputs of the Ekip Synchrocheck module, an insulation transformer must be always installed (see the technical details in the table below).

Characteristics	Description
Mechanical	<ul style="list-style-type: none"> - Mounting: EN 50022 DIN43880 guide - Material: self-extinguishing thermoplastic - Protection class: IP30 - Electrostatic protection: with screen to be connected to earth
Electrical	<ul style="list-style-type: none"> - Precision class: ≤ 0.5 - Performance: ≥ 5 VA - Overload: 20 % permanent - Insulations: 4 kV between inputs and outputs, 4 kV between screen and outputs - 4 kV between screen and inputs - Frequency: 45...66 Hz

The standard fixed settings of the module are:

- Primary voltage 400 V
- Secondary voltage 100 V

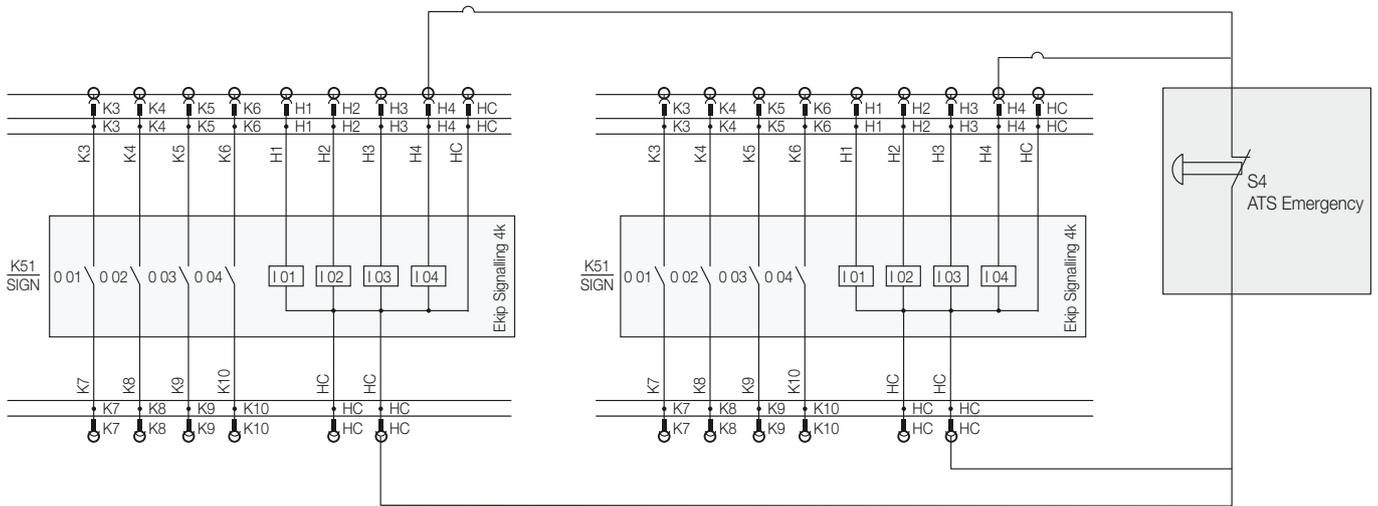
For further information about the Ekip Synchrocheck module, please refer to the Emax 2/ Tmax XT instruction manual.



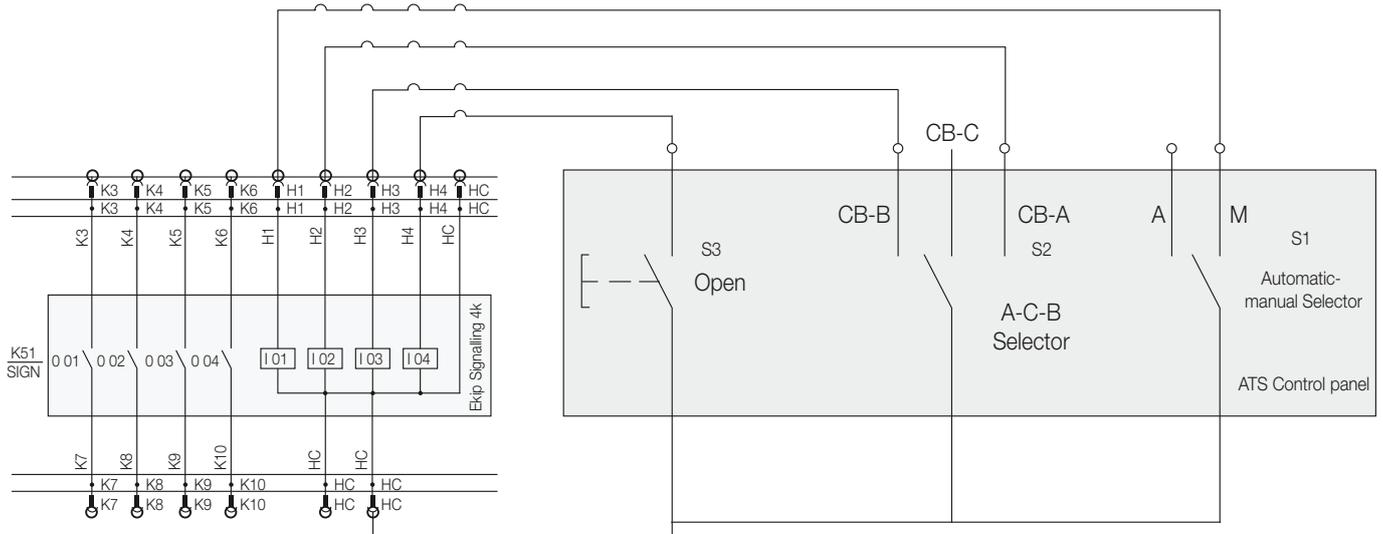
Watch video on Embedded ATS Main tie Main

Electrical diagrams

—
Ekip Signalling 4K CB-A / CB-B



—
Ekip Signalling 4K CB-C



Please note that the following accessories are not compatible with the Emax 2 and Tmax XT Embedded ATS Main-Tie-Main logic:

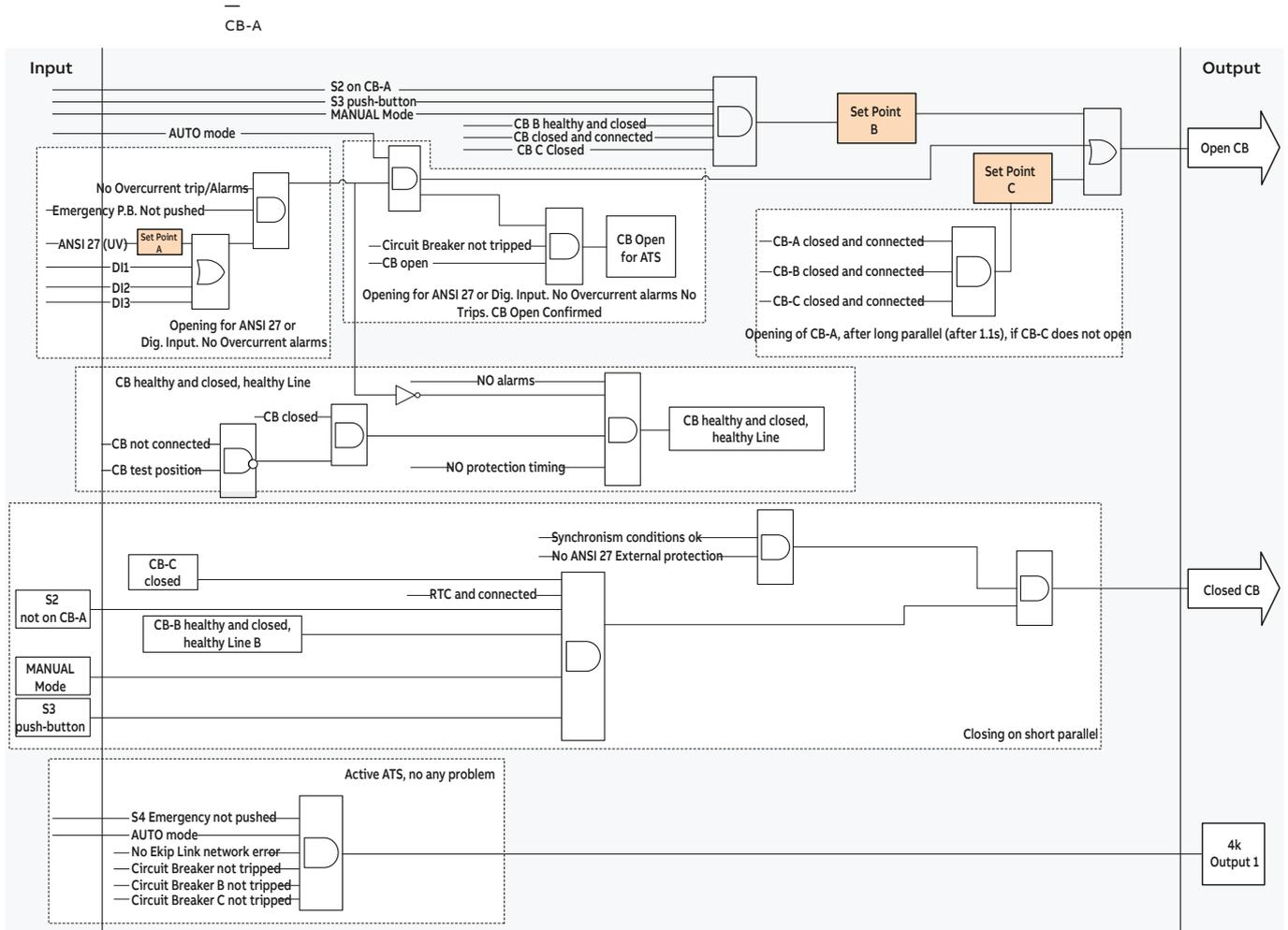
- CB-A: 10k-1, 10k-2
- CB-B: 10k-1, 10k-2
- CB-C: 10k-1

Also, the following settings cannot be modified if you have in place the Embedded ATS Main-Tie-Main logic:

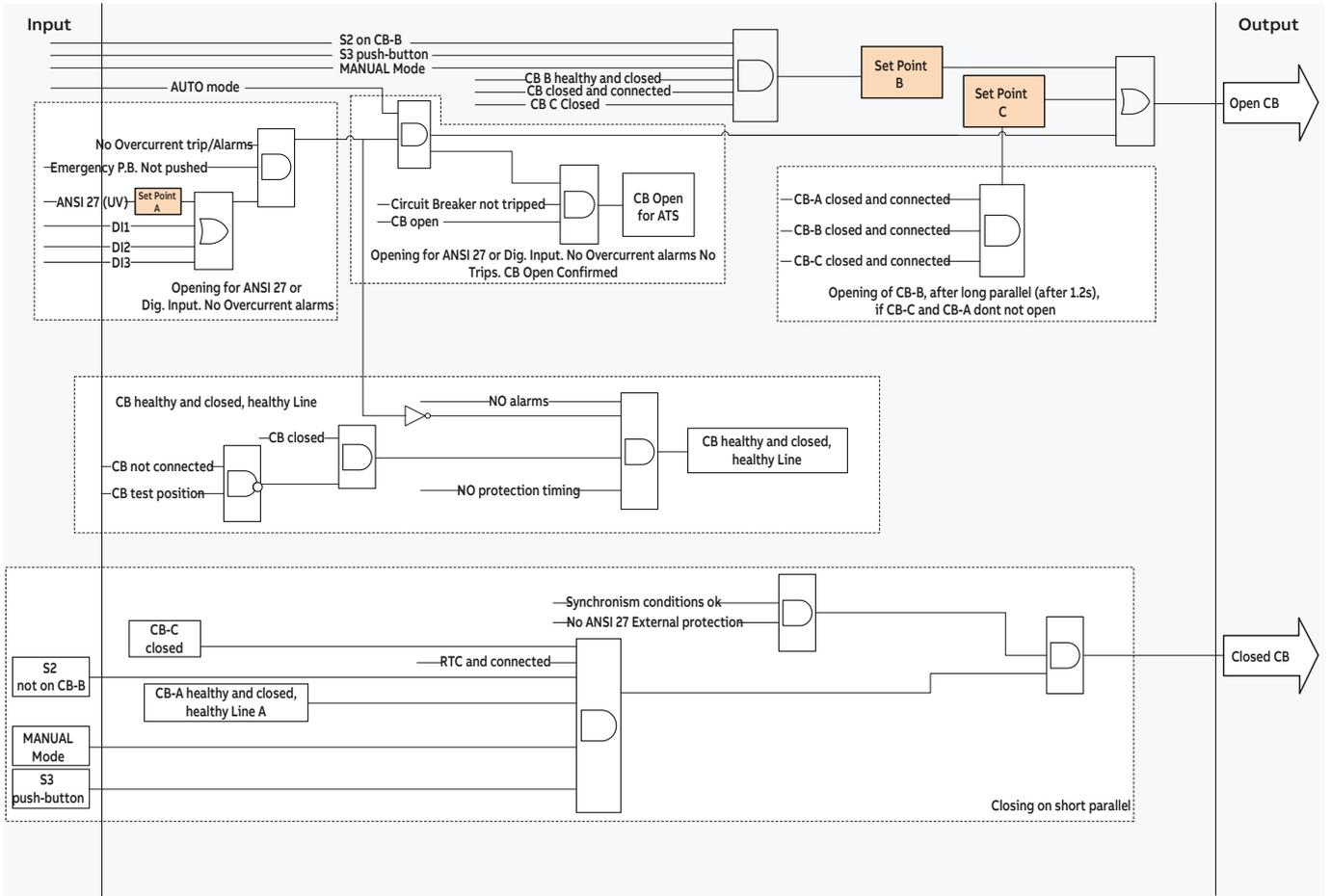
- Programmable status
- Function: YO command, YC command, external trip
- Signal reset
- Ekip Link functionalities
- Voltage and frequency stability
- Ekip Syncrocheck setting
- 4k settings (already used by the logic itself)

Annex A

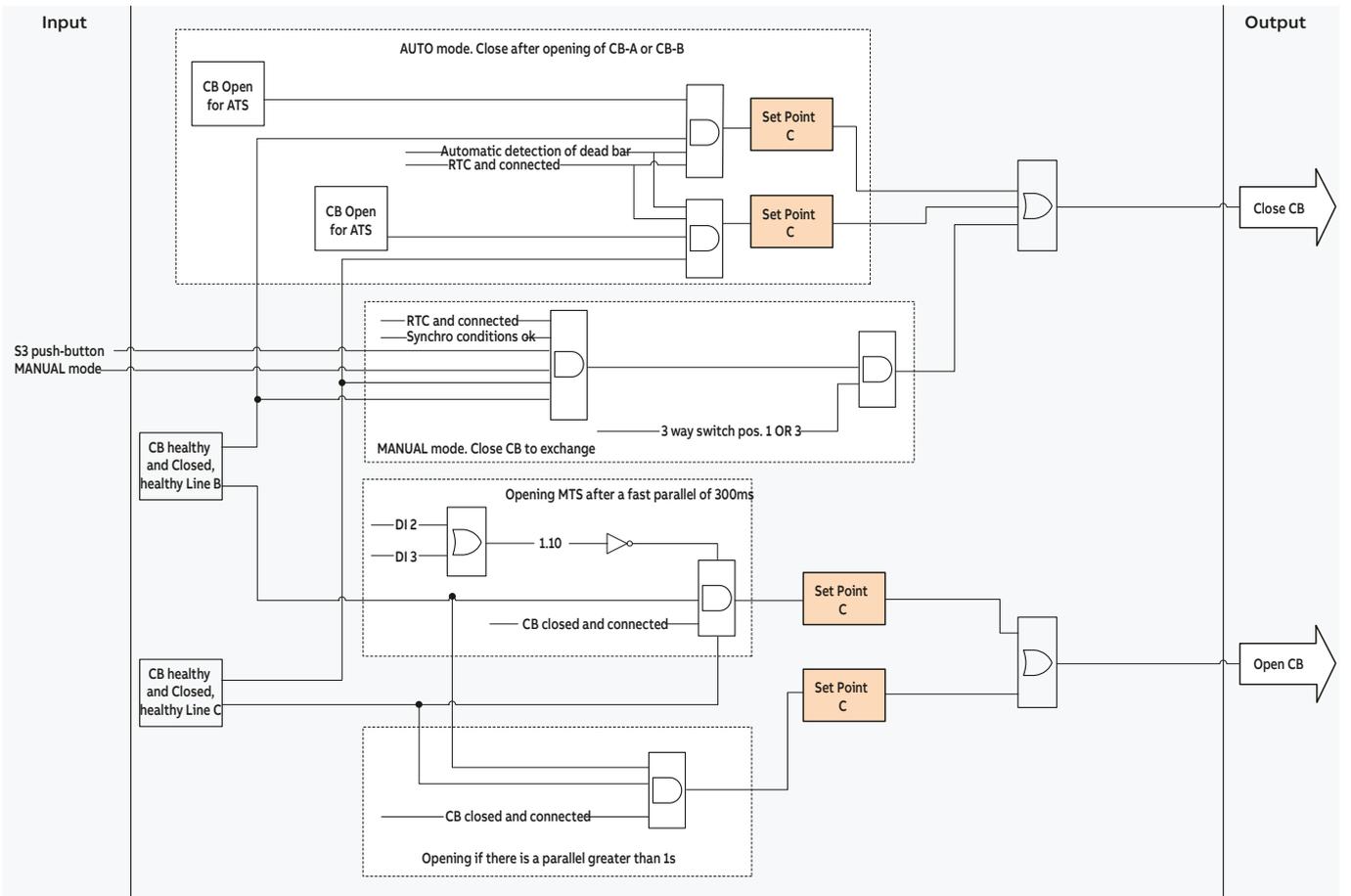
Logic diagrams



—
CB-B



—
CB-C



Annex B

Main-Gen Open Transition

Compatible frames:

Emax 2: E1.2 - E2.2 - E4.2 - E6.2
 Tmax XT: XT2 - XT4 - XT5 - XT7M

Scope

This specification describes the operating philosophy of the ATS Main-Gen Open transition system with SACE Emax 2 circuit-breakers. The device monitors the voltage of the main line and generator line and reacts to the following faults:

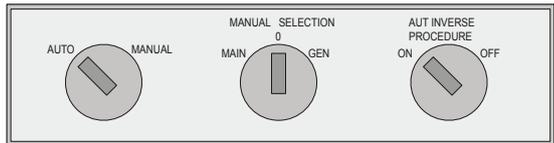
Glossary and acronyms

ATS	Automatic transfer switch
CB	Circuit Breaker
Un	Nominal voltage of the system
RTC	Ready to close
CB-A	Circuit breaker incomer from line A
CB-B	Circuit breaker incomer from Generator
HMI	Human-machine interface

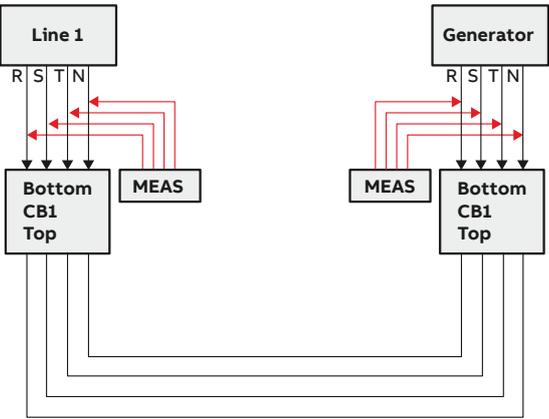
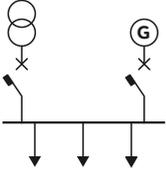
- Maximum and minimum voltage
 - Maximum and minimum frequency
 - Modes of operation and controls
- There are three mode of operation available:
- Automatic with inverse procedure
 - Automatic without inverse procedure
 - Manual

Switches mounted on the panel door (installed by the customer) do the operation mode selection:

- Auto/Manual selector switch
- Manual selection switch
- Inverse procedure selector switch



Application Layout



Legend
 R, S, T, N: 3phases+neutral
 MEAS: Measurement module
 Line 1/Generator: Power sources (Transformer or generator)

Application Limits

- Un = Up to 1150 V
- AUX = 24-240 V
- In = 100-6300 A
- Frequency = 50-60 Hz
- Three-phase with or without neutral

Moreover, for Tmax XT family this function can be used only between same frame sizes.

For example:
 Accepted configuration: CB-A: XT4 CB-B:XT4
 Not accepted configuration: CB-A: XT4 CB-B:XT5

Application Description

1. Auto mode

In case of main line failure, the system starts up the emergency generator and, as soon as power on the generator side is available, the system starts the automatic switching procedure according to TS and TCE times.

When the voltage on the main line comes back, two different behaviors can take place:

- 1) If the system is set to "Automatic switching without inverse procedure", the system locks in the current configuration (CB1 OPEN, CB2 CLOSED, generator running)
- 2) If the system is set to "Automatic switching with inverse procedure", the system will go back to the original configuration (CB1 CLOSED and CB2 OPEN) with a "Break-Before-Make" switching, according to the set times. Once the transition is completed, the generator switches off.

2. Manual mode

In manual mode, the system can be manually configured running under transformer or under generator.

In case of any protection trip or alarm, the iTTEST button must be pressed to reset the message.

Please note that the following accessories are not compatible with the Embedded ATS Main - Gen logic:

- RELT 2k-3
- 10k-3

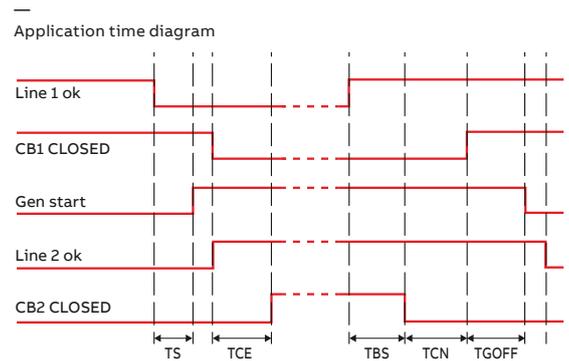
Also, the following settings cannot be modified if you have in place the Embedded ATS Main - Gen logic:

- Programmable status
- Function: YO command, YC command, external trip
- Signal reset
- Ekip Link functionalities
- Voltage and frequency stability
- 2k-1 settings (already used by the logic itself)

Legend

TS	Generator start delay, after detection of fault in mains (generator in use)
TCE	Closing delay of CB2 of line LN2
TBS	Opening delay of emergency line CB, after detection of stabilized voltage on main line
TCN	Closing delay of CB1 of line LN1
TGOFF	Generator switching off delay, after closure of main line LN1 CB
TL	Delay in activation of outlet DO7, after detection of the fault on both lines LN1 and LN2

Time Diagrams



Special cases:

- If LN1 returns to normal and it is stabilized before LN2 is normal the sequence interrupts and the generator must be turned off
- If LN1 returns to normal and it is stabilized during TCE, the sequence is completed
- If LN1 disappears during TBS, the sequence interrupts
- If LN1 disappears during TCN, the switchboard starts TS running in order to re-enter on LN2

Annex B

System settings

The system settings can be adjusted through the Ekip Connect 3 commissioning tool.

—
Description of time delays

Time delays	Description	Value	Default
TS Delay	Generator start delay after detection of a fault in the mains	0...30s Step 1s	0 s
TBS Delay	Opening delay of emergency line CB	0...100s, Step 1s	0 s
TCE Delay	Closing delay of line LN2 CB2	0...60s Step 1s	0 s
TCN Delay	Closing delay of CB1 of line LN1	0...60s Step 1s	0 s
TGOFF Delay	Generator switching off delay after closure of line LN1 CB1	0...100s Step 1s	0 s
TL Delay	Delay in activation of outlet DO7, after detection of the fault on both lines LN1 and LN2	0...60s Step 1s	0 s
Min/max voltage threshold	The voltage threshold at which the ATS starts the transfer procedure when in AUTO mode	-30% ... -5%, +5% ... +30%, Step ± 1%	-10% +10%
Min/max frequency threshold	The frequency threshold at which the ATS starts the transfer procedure when in AUTO mode	-10% ... -1%, +1% ... +10%, Step ± 1%	-2% +2%

Breakers configuration

The Embedded ATS Main-Gen Open Transition is available for all the SACE Emax 2 frames, fixed or withdrawable, 3 poles or 4 poles.

Each breaker must be equipped with the following listed accessories.

Description	Ordering Code
Ekip Hi-Touch or Ekip Touch + Measuring Package	Depends on Breaker Type
Ekip Supply	Depends on Aux Voltage
Ekip Link	1SDA074163R1
Ekip Signalling 2K	1SDA074167R1
Ekip Com Actuator	1SDA074166R1
Spring Charger Motor	Depends on Aux Voltage
YO	Depends on Aux Voltage
YC	Depends on Aux Voltage

For Tmax XT, each single circuit breaker (CB-A and CB-B) must be equipped as following:

Description
Ekip Hi-Touch or Touch + Measuring package enabled
MOE-E
Ekip Cartridge (4 slot) - Only for XT2, XT4 and XT5
Ekip Supply
Ekip Com Link
Ekip 2K

The Ekip Connect 3 commissioning tool for ATS checks the correct configuration of the circuit breakers. The commissioning succeeds only if the configurations are correct.

Mechanical Interlock

We strongly recommend to install a mechanical interlock between the breakers.

Please refer to the Emax 2 catalogue to order the right interlock.

Compatibility

The Embedded ATS Main-Gen Open Transition is compatible with all the Tmax XT electronic trip unit. For Emax 2 it is compatible with the following firmware versions.

Mainboard	02.22.37
Ekip Touch	02.22.34
Link	02.40

- To check the firmware version you can do one of the following:
- 1) Use the "Information" section of Ekip Connect 3, Nominal Data field
 - 2) Press the "i" button on the front of the trip unit until the page "Protection Unit" appears



Ekip Signalling 2K

The Ekip Signalling 2K is a signalling accessory module equipped with:

- Two digital inputs and two contacts for output signals
- A power status LED and four signalling LEDs (one LED for every input/output).

On each circuit-breaker, a maximum of two Ekip Signalling 2K modules can be installed.

These modules only differ in naming and wiring diagrams. The technical characteristics and manner of installation are in common.

The Ekip Signalling 2K modules always require the presence of an Ekip Supply module in the first slot of the circuit-breaker terminal box.



Watch video on Embedded
ATS Main Gen

Electrical characteristics

Component	Characteristics
Output contacts	<ul style="list-style-type: none"> • Maximum switching power: 1250 VA • Maximum switching voltage: 150 V DC / 250 V • Breaking power: 2 A @ 30 V DC, 0.8 A @ 50 V DC, 0.2 A @ 150 V DC, 4A @ 250 V AC • Dielectric strength between open contacts: 1000 V AC (1 minute @ 50 Hz) • Dielectric strength between each contact and coil: 1000 V AC (1 minute @ 50 Hz)

ATS System Outputs

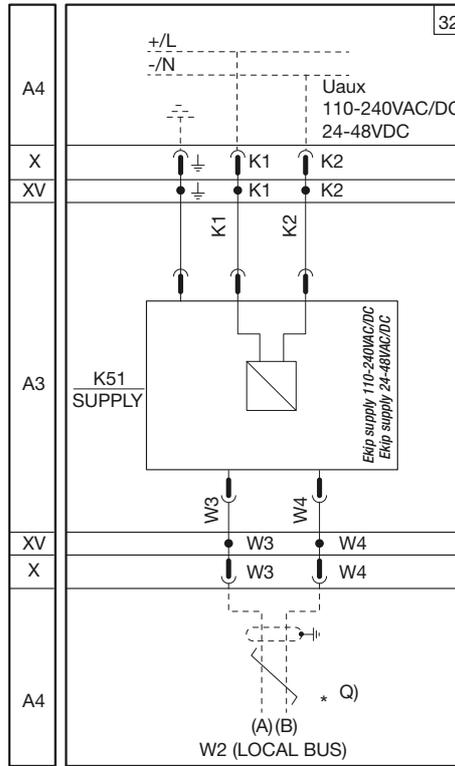
Circuit Breaker	Contact	Type	Meaning
CB-A (Line CB)	2K-O11	NO	ATS Ready (Circuit breakers not tripped. No Ekip Link Errors. No internal or hardware errors. Auto mode ON. Circuit breakers connected)
CB-A (Line CB)	2K-O12	NO	Alarm (Circuit breakers command failed. Protection releases tripped. Ekip Link Errors. Internal or hardware errors.)
CB-B (Generator CB)	2K-O11	NO	Generator Start
CB-B (Generator CB)	2K-O12	NO	DO7 Alarm (Line and generator voltages missing for a TL Time)

Annex B

Electrical diagrams

The Ekip Supply module must be continuously feded, also during the transfer phase.
 You can order a low voltage Ekip Supply (24-48V), or any voltage which fits, and supply it from the engine starting battery.

Alternatively, an isolated secondary circuit (UPS) must be provided.



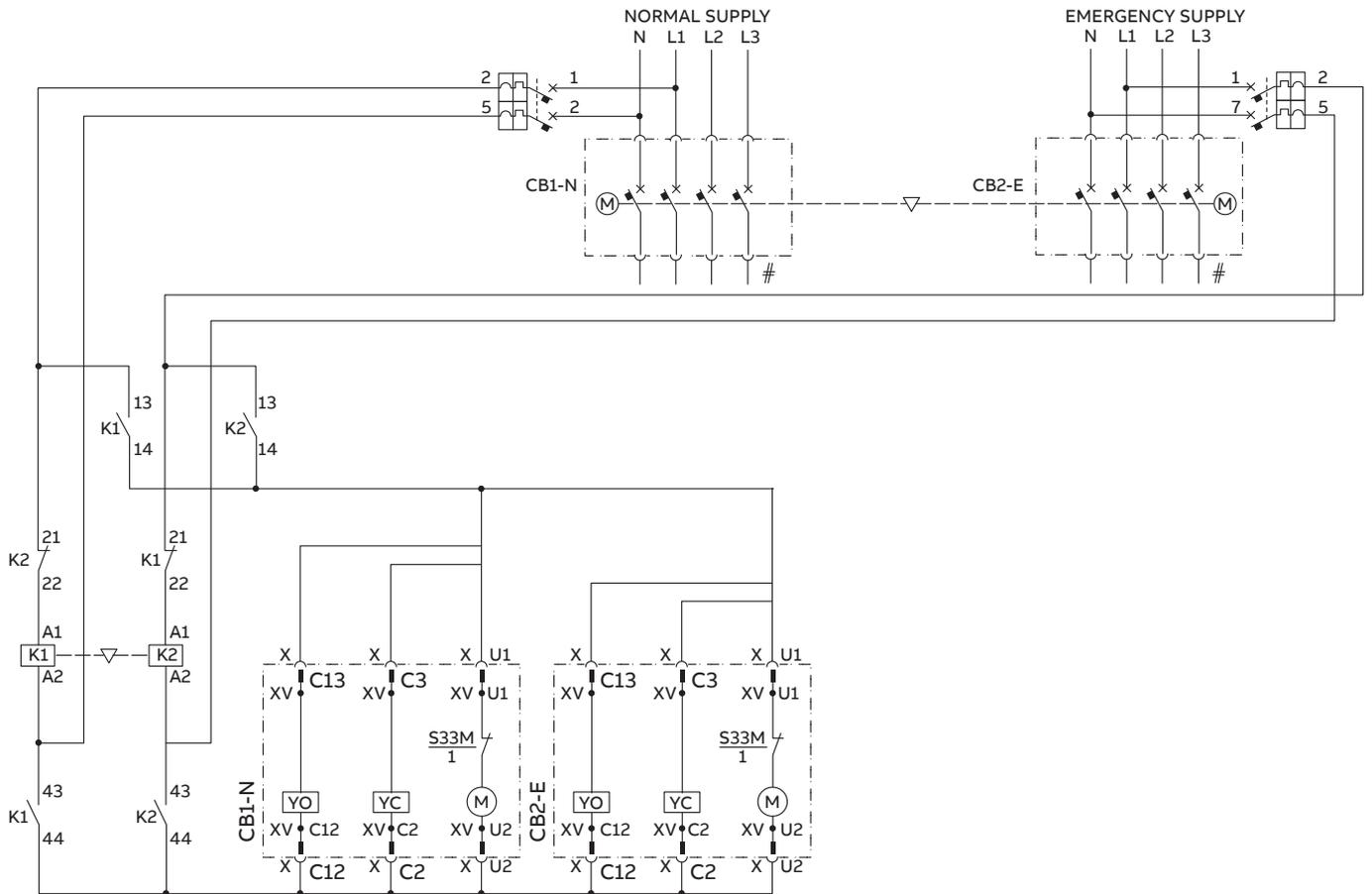
*A); *I)

Notes

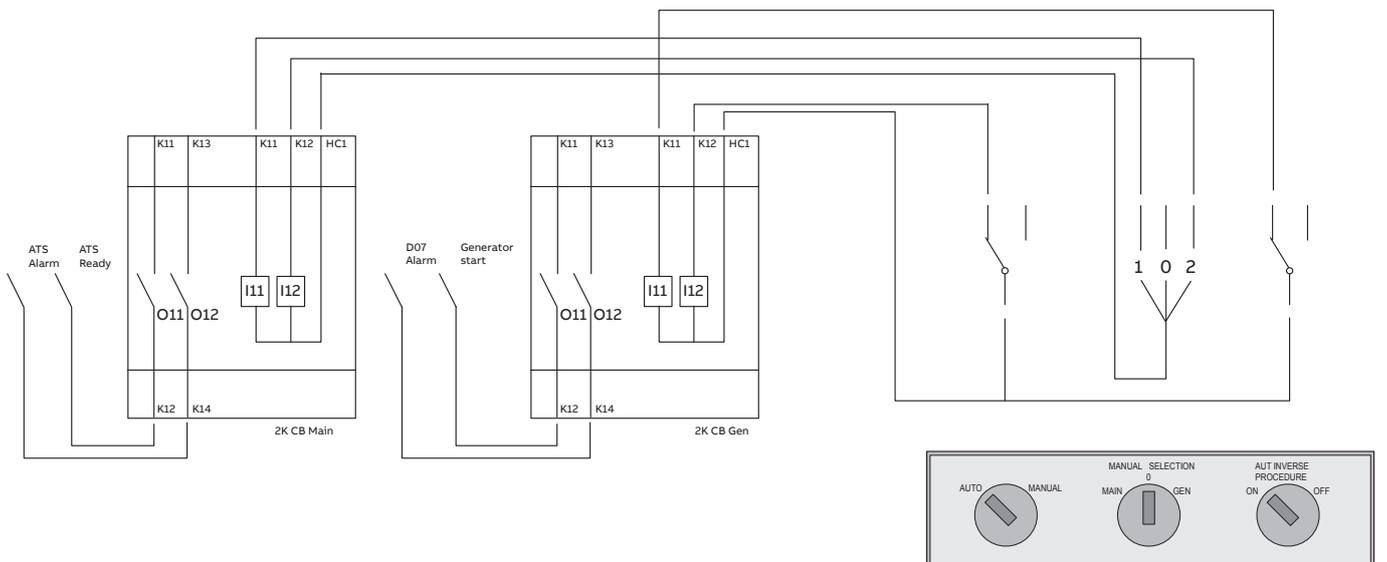
For external wiring, AWG 22-16 cables with a maximum external diameter Of 1.4 mm must be used.

For further information, please refer to the document 1SDM000091R0001.

Auxiliaries



Controls, alarms and generator start



Wiring diagrams

For Emax 2 and Tmax XT wiring diagram refer to the following material available on ABB Library (<https://library.abb.com/>):

- XT2-XT4: [1SDM000024A1001](#)
- XT5: [1SDM000023A1001](#)
- XT7 and Emax 2: [1SDM000009A1001](#)

Annex C

Embedded ATS: Grey vs Black trip units

With the introduction of the new electronics, SACE Emax 2 circuit-breakers are provided with the new Black trip units.

Classic grey platform



New black Platform



The Embedded ATS function is suitable for both the old (Grey) and new (Black) trip units. However, an ATS license must be associated to circuit-breakers with the same type of electronics. No mixes are allowed between Grey and Black Platforms within the same ATS project.

The Embedded ATS characteristics remain the same. The only differences concern product configuration and accessories, as shown in the following tables.

Main-Tie-Main Closed Transition

Grey Platform
Ekip Hi-Touch or Ekip Touch + Measuring Pro
Ekip Supply
Ekip Link
Ekip Synchrocheck
Ekip Signalling 4K
Ekip Com Actuator
Spring Charger Motor
YO
YC

Black Platform
Ekip Hi-Touch or Ekip Touch + Measuring Package + Voltage Protection Package ^(*)
Ekip Supply
Ekip Link
Ekip Synchrocheck
Ekip Signalling 4K
Ekip Com Actuator
Spring Charger Motor
YO
YC

^(*) To activate UV Protection. In case of Ekip G trip units, no SW packages are needed.

Main-Gen Open Transition

Grey Platform
Ekip Hi-Touch or Ekip Touch + Measuring (or higher)
Ekip Supply
Ekip Link
Ekip Signalling 2K
Ekip Com Actuator
Spring Charger Motor
YO
YC

Black Platform
Ekip Hi-Touch or Ekip Touch + Measuring Package ^(*)
Ekip Supply
Ekip Link
Ekip Signalling 2K
Ekip Com Actuator
Spring Charger Motor
YO
YC

^(*) In case of Ekip G trip units, no SW packages are needed.

The ordering codes for ATS licenses are the same, with no distinctions between Grey and Black trip units:

- 1SDA082886R1 for ATS Main-Tie-Main Closed Transition
- 1SDA082889R1 for ATS Main-Gen Open Transition

For further details, please refer to the Emax 2 technical catalogue.

—

ABB S.p.A.**L.V. Breakers**

Via Pescaria, 5

24123 Bergamo - Italy

Tel.: +39 035 395 111

Fax: +39 035 395306-433

www.abb.com