Technical catalogue - Edition 2015.03

Formula AIR
New low voltage air circuit-breakers

Power and productivity
for a better world™

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Formula AIR
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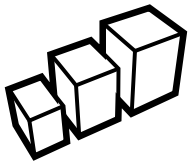

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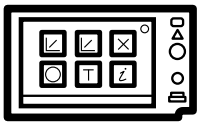

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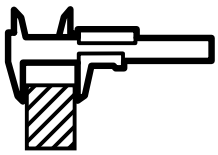

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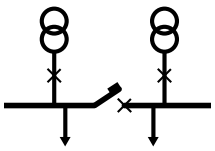

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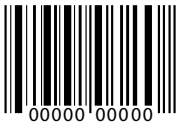


Chapter 8
Ordering codes
Ordering codes with configuration examples.

Formula AIR
Simplicity and safety, up to 65kA

FA2

FA4

Protecting your electrical installation has never been easier thanks to Formula AIR. This is the new line of low-voltage automatic circuit-breakers and switch-disconnectors.
Easy to order, use and install, the Formula AIR series offers all of the standard performance levels, quality and reliability you would expect from ABB technology.

Formula AIR is an ideal solution for main installation requirements, from distribution switchboards to onboard compartments.

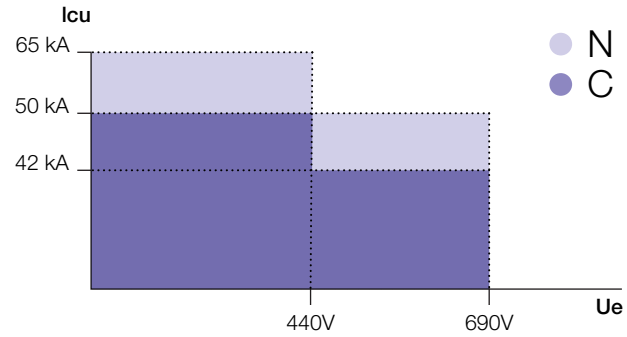
This comprehensive range offers the most suitable solution for each specific set of requirements. Easy to use Formula AIR products are also easy to order.

The performance levels you need

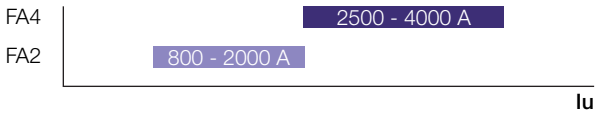
The automatic circuit-breakers are available in just two frame sizes up to 4000A, with short-circuit performance levels up to 65kA. They are equipped with the new Ek 1 and Ek 2 trip units, which guarantee maximum flexibility because they are interchangeable and common to both frames.

Ek 1. Enables rapid and accurate setting of the protections with the use of dip switches. This is the most appropriate solution for common applications.

Ek 2. Enables simple and intuitive navigation thanks to the graphical user interface of the LCD screen.
Thanks to the real-time current display and options for 10 languages there will be no more wasted time or uncertainty while setting the circuit-breaker.



1. Short circuit level

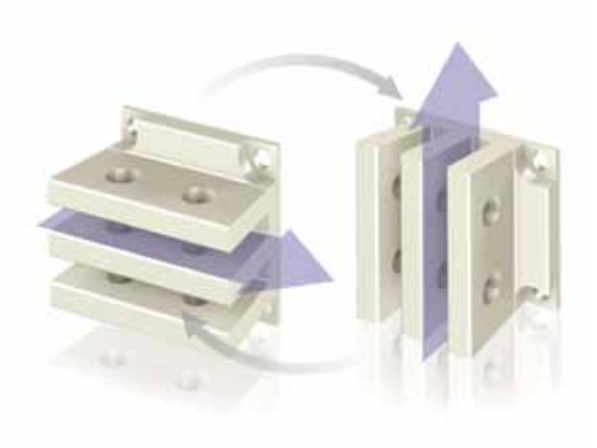


2. Current capacity

The simplicity you are looking for

The installation of Formula AIR and its accessories is simple, quick and safe. The accessories, pre-cabled and common to both frames, allow for rapid mounting and a significant reduction in warehouse stock.

The innovative design guarantees flexibility in the installation of the circuit-breaker and permits last-minute changes.
It is actually possible to change, on site, the orientation of the rear terminals from horizontal to vertical or vice versa. If you need a switchboard with more compact dimensions, front terminals are available.



The safety you would expect

The supervision of the electrical installation is essential. For this reason, Formula AIR allows you to directly monitor the main electrical parameters from the front of the circuit-breaker. The Ek 2 trip unit features a large screen that displays clear and complete information. Formula AIR also ensures the safety of maintenance personnel. When removing the main cover of the breaker, the only accessible section is the area meant for accessories; this ensures segregation from the operating mechanism.

The quality of Formula AIR is guaranteed by ABB, a leader in the development of low-voltage circuit-breakers, with decades of international experience in the sector. Moreover, ABB's global network offers prompt and efficient support.

For your installations, choose the quality, reliability and experience of ABB.

The Ranges

Formula AIR automatic circuit-breakers 1/2

Formula AIR switch-disconnectors 1/3

Formula AIR automatic circuit-breakers

Common data		
Rated service voltage Ue	[V]	690
Rated insulation voltage Ui	[V]	1000
Rated impulse withstand voltage Uimp	[kV]	12
Frequency	[Hz]	50 - 60
Number of poles		3- 4
Version		Fixed - Withdrawable
Operating temperature		-25°C....+70°C
Storage temperature		-40°C....+70°C

Formula AIR			FA2		FA4	
Performance levels			**C**	**N**	**C**	**N**
Max rated uninterrupted current at 40°C - Iu		[A]	800	800	2500	2500
		[A]	1000	1000	3200	3200
		[A]	1250	1250	4000	4000
		[A]	1600	1600		
		[A]	2000	2000		
Neutral pole current-carrying capacity for 4 poles breakers		[%Iu]	100	100	100	100
Rated ultimate breaking capacity under short circuit - Icu	@400-415V	[kA]	50	65	50	65
	@440V	[kA]	50	65	50	65
	@500-525V	[kA]	42	50	42	50
	@690V	[kA]	42	50	42	50
Rated service breaking capacity under short-circuit - Ics		[%Icu]	100	100	100	100
Rated short time withstand current - Icw	(1s) @440V	[kA]	50	65	50	65
	(1s) @690V	[kA]	42	50	42	50
	(3s)	[kA]	25	36	25	36
Rated making capacity under short-circuit (peak value) - Icm	440 V	[kA]	105	145	105	145
	690 V	[kA]	88	105	88	105
Utilization category (according to IEC 60947-2)			B	B	B	B
Operating times		[ms]	40	40	40	40
Dimensions	H - Fixed/Withdrawable	[mm]	371/425		371/425	
	D - Fixed/Withdrawable	[mm]	270/383		270/383	
	W - Fixed 3p/4p	[mm]	276/317		384/510	
	W - Withdrawable 3p/4p	[mm]	317/407		425/551	
Weights (CB with trip unit and current sensor)	Fixed 3p/4p	kg	41/53		56/70	
	Withdrawable 3p/4p (fixed part included)	kg	54/99		110/136	

Formula AIR			FA2	FA4	
Mechanical life with regular ordinary maintenance		[Iu]	≤ 2000	≤ 3200	≤ 4000
		[No. cycles x 1000]	20	20	15
	Frequency	[Oper./Hour]	60	60	60
Electrical life with regular ordinary maintenance	440 V	[No. cycles x 1000]	6	5	5
	690 V	[No. cycles x 1000]	4	2.5	2.5
	Frequency	[Cycles/Hour]	30	20	20

Formula AIR switch-disconnectors

Switch-disconnectors, identified with the abbreviation "/MS", are devices that satisfy the isolating specifications provided by the IEC 60947-3 Standard. The switch-disconnectors are derived from the corresponding automatic circuit-breakers, and they have the same dimensions and accessory options. This version differs from the automatic circuit-breakers only because of the absence of protection trip units.
The device, when in the open position, guarantees an isolating distance between the main contacts of the circuit-breaker that is sufficient to ensure that the installation downstream is not live.
Furthermore the switch-disconnectors, if used with an external protection relay with maximum delay of 500ms, enable a breaking capacity at a maximum rated operating voltage (Ue) equal to the value of rated short-time withstand current (Icw) for one second.

Common data		
Rated service voltage Ue	[V]	690
Rated insulation voltage Ui	[V]	1000
Rated impulse withstand voltage Uimp	[kV]	12
Frequency	[Hz]	50 - 60
Number of poles		3- 4
Version		Fixed - Withdrawable
Operating temperature		-25°C....+70°C
Storage temperature		-40°C....+70°C

Formula AIR			FA2		FA4	
Performance levels			**C/MS**	**N/MS**	**C/MS**	**N/MS**
Max rated uninterrupted current at 40°C - Iu		[A]	800	800	2500	2500
		[A]	1000	1000	3200	3200
		[A]	1250	1250	4000	4000
		[A]	1600	1600		
		[A]	2000	2000		
Neutral pole current-carrying capacity for 4 poles breakers		[%Iu]	100	100	100	100
Rated short time withstand current - Icw	(1s) @440V	[kA]	50	65	50	65
	(1s) @690V	[kA]	42	50	42	50
	(3s)	[kA]	25	36	25	36
Category			AC23	AC23	AC23	AC23
Dimensions	H - Fixed/Withdrawable	[mm]	371/425		371/425	
	D - Fixed/Withdrawable	[mm]	270/383		270/383	
	W - Fixed 3p/4p	[mm]	276/317		384/510	
	W - Withdrawable 3p/4p	[mm]	317/407		425/551	

Formula AIR			FA2	FA4	
Mechanical life with regular ordinary maintenance		[Iu]	≤ 2000	≤ 3200	≤ 4000
		[No. cycles x 1000]	20	20	15
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Electrical life with regular ordinary maintenance	440 V	[No. cycles x 1000]	6	5	5
	690 V	[No. cycles x 1000]	4	2.5	2.5
	Frequency	[Cycles/Hour]	30	20	20

Protection trip units

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Protection trip units

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Protection trip units
Introduction

2

Formula AIR automatic circuit-breakers are equipped with the new trip units for protection and measurements. All Formula AIR circuit-breakers are equipped with protection trip units that are interchangeable from the front with just a few, simple operations by the customer.

The range offers two different types of protection trip unit, according to the different types of requirements.
The table below shows the family offering:

	Protection of current	Measurement of current	Measurement of voltage, energy and power
Ek 1	•	–	–
Ek 2	•	•	with Ek Measuring

All protection trip units of the Formula AIR family are self-powered by current that pass through the circuit-breaker.
They guarantee excellent reliability due to a system of self-control of internal connections.

The interchangeability of the trip units enables personalization of the functions available, even during commissioning or when the circuit-breaker has already been installed. In particular, Ek consists of:
– **Protection trip unit**, available with different interfaces and versions that range from basic to more complete.
– **Ek Measuring Module**, connected internally to Formula AIR, performs voltage, power and energy measurements with high accuracy without requiring any external connection or voltage transformer.
– **Interchangeable rating plug** enables all protection thresholds to be adjusted according to the rated current, increasing flexibility for the customer. It is useful in installations that are prepared for future development or in cases in which the power supplied may be limited temporarily.

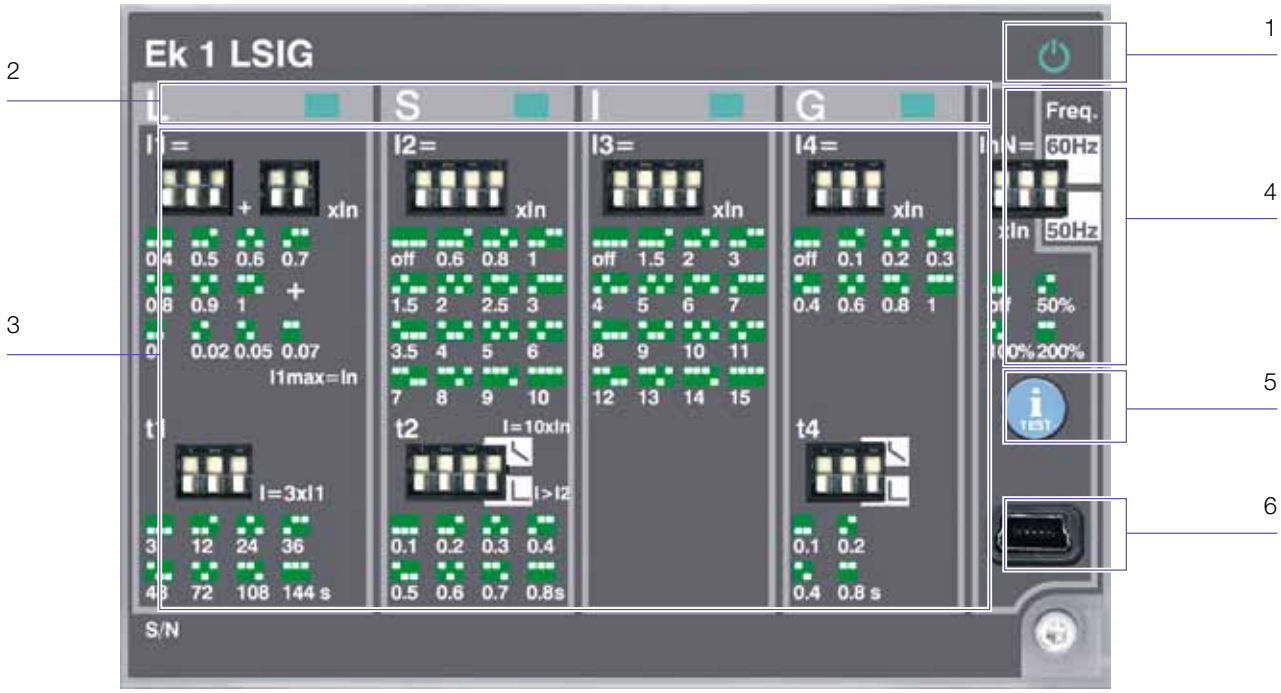
Protection trip units
Ek 1

Characteristics

Ek 1 is the new protection trip unit of the Formula AIR family for all applications in which high accuracy and reliable protection against overcurrent are required. Ek 1 offers a complete set of standard protection functions. Dedicated LEDs allow the fault that caused tripping to be determined.

The unit is available in the following versions:

- **Ek 1 LI**
- **Ek 1 LSI**
- **Ek 1 LSIG**



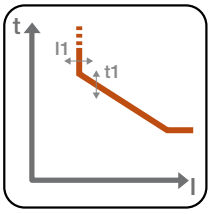
Key:

1. Power-on LED for signalling correct operation (watchdog)
2. LEDs for alarm signalling of L, S, I and G protection functions and diagnostics
3. Dip switches for setting the protection functions
4. Dip switches for setting the network frequency and neutral protection device
5. Pushbutton for test and for indicating the cause of tripping
6. Test and programming connector

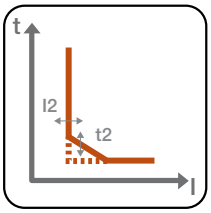
Protection trip units
Ek 1

Protection functions

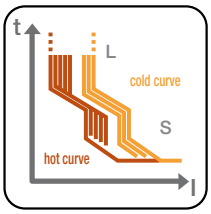
Ek 1 offers overcurrent protection functions and, in the event of tripping, controls the opening of the circuit-breaker, preventing it from closing again unless it has been reset by the operator (lockout device – code ANSI 86).



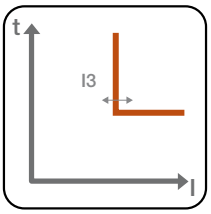
Overload (L - ANSI 49): available with 25 current thresholds and 8 curves, it provides effective protection of all systems. A pre-alarm warning is also available on reaching 90% of the threshold set.



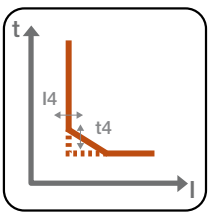
Time-delayed overcurrent (S - ANSI 51 & 50TD): with constant tripping time (t = k), or with constant specific let-through energy (t = k/I²), it provides 15 current thresholds and 8 curves, for fine adjustment. The function can be excluded by setting the dip switch combination to “OFF”.



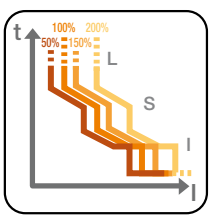
Thermal memory: for L and S protection functions, this is used to protect components, such as transformers, from overheating following an overload. The function, which can be enabled by the Ekip Connect software, adjusts the protection tripping time according to the length of time that has elapsed since the first overload, taking into account the amount of heat generated.



Instantaneous overcurrent (I - ANSI 50): with tripping curve without intentional delay, it offers 15 tripping thresholds and can be excluded by setting the dip switch combination to “OFF”.



Earth fault (G - ANSI 51N & 50NTD): with tripping time independent of current (t = k) or constant specific let-through energy (t = k/I²). The function can be excluded by setting the dip switch combination to “OFF”.



Neutral protection: available at 50%, 100% or 200% of the phase currents, or disabled, it is applied to the overcurrent protections L, S and I.

Measurements

The Ek 1 unit measures phase and neutral current with great accuracy: 1.5% including the current transformers in the 0.2 ... 1.2 In range.
Ek 1 also records the characteristics of the circuit-breaker, to enable a rapid analysis in the event of maintenance. All values stored can be displayed on a PC, through the free software Ekip Connect.

– Maximum and average current values per phase;
– Date, time, fault current per phase and type of protection tripped over the last 30 trips;
– Date, time and type of operation of the last 200 events (for example: opening/closing of circuit-breaker, pre-alarms, editing settings);
– Number of mechanical and electric operations of the circuit-breaker;
– Total operating time;
– Contact wear;
– Date and time of the last maintenance carried out, in addition to the estimate of the next maintenance required;
– Circuit-breaker identifying data: type, serial number, firmware version, name of the device as assigned by the user.

Watchdog

All the protection trip units of the Formula AIR family ensure high reliability owing to an electronic circuit that periodically controls the continuity of the internal connections, such as trip coil, rating plug and each current sensor (Ansi 74). In the event of a malfunction, the LEDs indicate the corresponding alarm to enable the fault to be identified rapidly.

User interface

Ek 1 offers a great variety of thresholds and trip times, the protections can be set by dip-switches. Up to 5 LEDs are also available (depending on the version) to indicate correct operation or alarms. The interface always enables the status of the installation to be identified clearly and quickly: correct operation (green LED), overcurrent pre-alarms or alarms, presence of self-control functions alarms, maintenance interval expired, indication of tripped protection after a fault.

The protection tripped indication is activated by pressing the iTest key, and operates without the need of an external power supply because a battery is installed inside the unit.

Test function

The test port on the front of the protection trip unit can be used to run the circuit-breaker tests by connecting one of the following devices:

– Ekip TT to run the trip test, the LEDs test and check absence of alarms detected by the watchdog function;
– Ekip T&P to permit not only the trip test and LEDs test but also to run the test of the individual protection functions and save the relative report;
– ITest key that is pressed to run the battery test when the circuit-breaker is disconnected.

Supply

The Ek 1 protection trip unit does not require an external supply for the protection functions or for the alarm indication functions because it is self-supplied by the current sensors installed on the circuit-breaker. A three-phase 100A current suffices to activate the LED indications.
The Ek Supply module enables an auxiliary supply to be easily connected and is able to receive both a direct current supply and an alternating current (110-240V AC/DC) to activate additional functions such as:

– G protection at values below 100A or below 0.2 In;
– recording the number of operations.

The trip unit can also be supplied by means of a galvanically isolated 24V DC auxiliary voltage.

Protection trip units
Ek 2

Characteristics

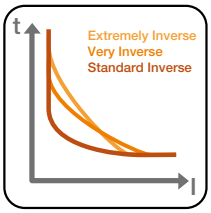
Ek 2 is the new protection trip unit for Formula AIR that provides a complete series of protections and high accuracy measurements of all electric parameters.
The simple and intuitive interface enables the operator to access all the information and settings rapidly and easily by minimizing installation and commissioning time.

The unit is available in the versions:
- **Ek 2 LSI**
- **Ek 2 LSIG**

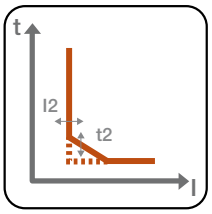
Key:
1. Wide LCD display
2. Power-on LED to indicate correct operation (watchdog)
3. Pre-alarm LED
4. Alarm LED
5. Home pushbutton to return to home page
6. Pushbutton for test and indicating cause of trip
7. Test and programming connector
8. Up pushbutton
9. Enter pushbutton
10. Down pushbutton
11 ESC pushbutton

Protection functions

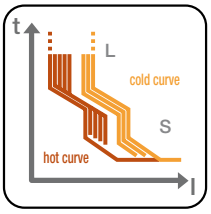
Ekip Touch enables all the protection functions to be set with a few simple steps directly from the wide touchscreen display. If the circuit breaker is tripped it must be reset manually or electrically by the operator (lockout relay – code ANSI 86).



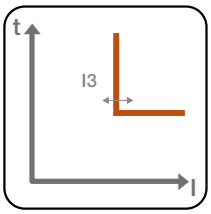
Overload (L - ANSI 49): with inverse long-time delay trip of the type t = k/I^2.
Thresholds and tripping time can be fine tuned directly from the display with a very high precision.
A pre-alarm threshold can be set, before the protection causes a trip. The settable pre-alarm indicates the set threshold is reached before the protection is tripped.



Time-delayed overcurrent (S - ANSI 51 & 50TD): with constant trip time (t = k), or constant specific let-through energy (t = k/I^2).

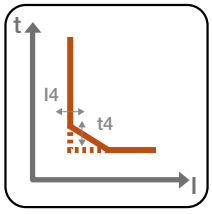


Thermal memory: for protections L and S it is used to protect the components, such as transformers, against overheating following overloads. The protection adjusts the trip time of the protection according to how much time has elapsed after the first overload, taking account of the overheating caused.

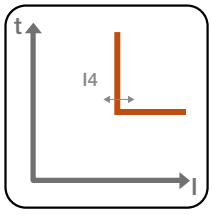


Instantaneous overcurrent (I - ANSI 50): with trip curve without intentional delay.

Closing on short-circuit (MCR): the protection uses the same algorithm of the protection I, limiting operation to a settable time window from the closing of the circuit-breaker. The protection can be disabled, also alternatively to protection I. The function is active with an auxiliary supply.

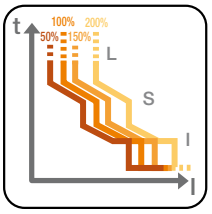


Earth fault (G - ANSI 51N & 50NTD): with trip time independent of the current (t = k) or with constant specific let-through energy (t = k/I^2). A pre-alarm indication is also available when 90% of the threshold is reached to activate corrective measures before the protection is tripped. The function also enables the trip to be excluded so that only the alarm is indicated, for use in installations where continuity of service is an essential requirement.

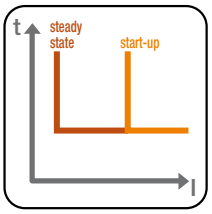


Instantaneous Earth Fault (G-ANSI 50N): with trip curve without instantaneous delay.

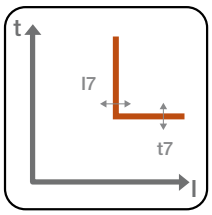
Protection trip units
Ek 2



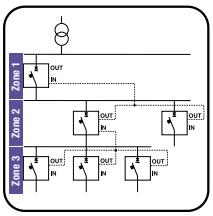
Neutral protection: available at 50%, 100%, 150% or 200% of the phase currents, or disabled, it is applied to the overcurrent protections L, S and I.



Start-up function: enables protections S, I and G to operate with higher trip thresholds during the starting phase, avoiding untimely trips due to high inrush currents of certain loads (motors, transformers, lamps). The starting phase lasts 100 ms to 30 s and is recognized automatically by the trip unit:
– at the closing of the circuit-breaker with a self-supplied trip unit;
– when the peak value of the maximum current exceeds the set threshold (0.1…10 x In) with an externally supplied trip unit; a new start-up is possible after the current falls below the threshold.



Current unbalance (IU – ANSI 46): with constant trip time (t = k), protects from an unbalance between the currents of the single phases protected by the circuit-breaker.



Zone selectivity for S and G protection (ANSI 68): can be used to minimize circuit-breaker trip times closer to the fault. The protection is provided by connecting all the zone selectivity outputs of the trip units belonging to the same zone and taking this signal to the trip unit input that is immediately upstream. Each circuit-breaker that detects a fault reports it to the circuit-breaker upstream; the circuit-breaker thus detects the fault but does not receive any communication from those downstream and opens without waiting for the set delay to elapse. It is possible to enable zone selectivity if the fixed-time curve has been selected and the auxiliary supply is present.

Current thresholds: this function enables the realization of four independent thresholds to be indicated in order to enable corrective action implementation before the overload L protection trips the circuit-breaker.

Measurements

Measurements and meters

Bar graphs that show the currents of the three phases and of neutral (with 1,5% accuracy in the 0.2 to 1.2 In range) on a 0-125% In scale in addition to the numeric value of the most loaded phase can be selected as the default page. The bar graphs are yellow in the event of a pre-alarm and red in the event of an overload to enable an irregular condition to be identified immediately.
Where applicable, the measurement of the earth fault current is shown on a dedicated page. The ammeter can operate both in self-supplied mode and with auxiliary voltage. In the latter case, the display always has back lighting and the ammeter is also active at currents below 100A.

Adding the Ek Measuring to Ek 2 enables to measure the values of:
– Voltage: phase-phase, phase-neutral (accuracy 0.5%);
– Power: active, reactive, apparent (accuracy 2%);
– Energy: active, reactive, apparent (accuracy 2%);
– Frequency (accuracy 0.2%);
– Power factor by phase and total;
– Peak factor.

Maximum values and values register

The Ek 2 unit is able to supply the measurement trend of certain parameters over a settable period of time such as: average power, maximum power, maximum and minimum current, maximum and minimum voltage. The values of the last 24 time intervals are recorded in the unit with a relative timestamp and can be consulted directly from the display or remotely using one of the available communication protocols. The communication can also be used to synchronize the recording time interval.

Data logger

Ek 2 is always supplied with the exclusive Data Logger (register) function that stores with high sampling frequency the instantaneous values of all the measurements in two memory buffer registers. The data can be easily downloaded by the Ekip Connect unit and transferred to any personal computer. This enables the current and voltage waveforms to be analyzed for rapid fault analysis. The function continuously stores and stops recording, with a selectable delay, whenever the event set by the user occurs (e.g. trip or alarm). In this manner, it is possible to analyze the complete evolution of the fault: from the start to its complete elimination.

Information on trip and opening data

If a trip occurs, Ek 2 stores all the information that is required for rapid identification and elimination of the causes:
– Protection tripped
– Opening data (current, voltage or frequency)
– Time-stamping (data, time and consecutive opening number)

If the iTest key is pressed, the trip unit displays all these data directly on the display. No auxiliary supply is required. The information is also available to the user with the circuit-breaker open or without current flow, due to the battery installed inside the unit.

Protection trip units
Ek 2

Maintenance indicators

A complete set of information about the circuit-breaker and its operation is available for effective fault analysis and preventive scheduling of maintenance. All the information can be seen from the display or from a PC using a communication unit. In particular:

– Date, time, fault current by phase and type of protection tripped over the last 30 trips;
– Date, time and type of operation of the last 200 events (example: opening/closing of circuit-breaker, pre-alarms, editing of settings, ect.);
– Number of operations of the circuit-breaker: divided into mechanical operations (no current), electrical operations (with current) and protection function (trip);
– Contact wear estimated in function of the number and type of openings;
– Total operating time of the circuit-breaker with circulating current;
– Date and time of the last maintenance session, scheduling of the next maintenance session;
– Circuit-breaker identifying data: type, serial number, firmware version, device name assigned by the user.

All the information can be viewed directly from the display and from a PC using the front port of the trip unit.

Watchdog

All of the trip units in the Formula AIR family ensure high reliability because of an electronic circuit that periodically controls continuity of the internal connections, such as trip coil, rating plug and each current sensor (Ansi 74). In the event of an alarm, a message is shown on the display, and if it is set during the installation phase, the trip unit can command the opening of the circuit-breaker. If a protection function intervenes, Ek 2 always checks that the circuit-breaker has been opened by auxiliary contacts that indicate the position of the main contacts. Otherwise, Ek 2 indicates an alarm (ANSI BF code - Breaker Failure) to be used to command the opening of the circuit-breaker located upstream.
Ek 2 also contains self-protection that preserves the correct operation of the unit against abnormal temperatures (T) inside the protection trip unit. The user disposes of the following indications:

– “Warning” LED for temperature below -20 °C or above +70 °C, at which the trip unit operates correctly with the display switched off
– “Alarm” LED for temperature outside the operating range, at which the trip unit commands the opening of the circuit-breaker (if set during the configuration phase).

User interface

All operations with Ek 2 are simple and intuitive thanks to the wide LCD display. For example, all the main information is listed on one page, thus enabling the state of the installation to be identified rapidly: maximum current, maximum voltage, active, reactive, apparent power and energy. In addition, the use of Ek 2 is further simplified by the possibility of scrolling through the menu and reading the alarms in one of the languages that can be set directly from the display: Italian, English, German, French, Spanish, Chinese, Russian, Turkish, Portuguese and Thai.
The home pushbutton enables you to return, at any moment, to the main page and the iTest key enables the information to be viewed after a circuit-breaker trip and test.
As in the previous generation of trip units, a password system is used to manage “Read” or “Edit” modes. The default password, 00001, can be edited by the user.
The protection parameters (curve and trip thresholds) are settable in “Edit” mode whereas it is always possible to consult the information in “Read” mode.

On the front of the trip unit there are also two LEDs: a pre-alarm LED (square yellow LED) and an alarm LED (red triangular LED); a message on the display always accompanies the flashing of the LEDs for clear identification of the type of event. The list of all the alarms active at that moment can be viewed by simply pushing the iTest button.

Ek 2 is also supplied with a front port that permits a temporary connection to devices for test, supply or communication (for example Ekip T&P).

Test function

For circuit-breaker testing it is possible to use the test port and the iTest key positioned on the front of the protection trip unit. The available functions are:

– trip test, test of the display and of the LEDs and check of absence of alarms detected by the watchdog function using Ekip TT (always supplied with Ek 2);
– test of the single protection functions and saving of the report, in addition to the trip test and test of the display, using Ekip T&P;
– test of the battery with the circuit-breaker switched off by pressing the iTest key.

Supply

The Ek 2 protection trip unit is self-supplied by the current sensors and does not require an external supply for the basic protection functions or for the alarm indication functions. All protection settings are stored in a non-volatile memory that maintains the information, even without a power supply. To activate the indication functions the ammeter and the display, a 100A three-phase current suffices.
An auxiliary supply can easily be connected. The Ek Supply module can be connected to supplies of both direct current and alternating current to activate additional functions such as:

– using the unit with circuit-breaker open;
– recording the number of operations;
– G protection with values below 100A or below 0.2 In;
– zone selectivity;
– MCR protection functions.

The Ek Supply module allows the cartridge modules to be used in the terminal box area. Otherwise, the trip unit can be supplied by means of a galvanically isolated 24V DC auxiliary voltage.

The Ek 2 protection trip unit is also supplied with a battery that enables the cause of the fault to be indicated after a trip, without a time limit. In addition, the battery enables date and time to be updated, thus ensuring the chronology of the events. When Ek 2 is operating, it uses an internal control circuit to indicate automatically that the battery is flat. On the other hand, when the unit is switched off the battery test can be run by simply pressing the iTest key.

Technical characteristics
Protection functions

ABB Code	ANSI/IEEE C37.2 Code	Function	Threshold
L	49	Overload protection	I1 = 0.4 - 0.42 - 0.45 - 0.47 - 0.5 - 0.52 - 0.55 - 0.57 - 0.6 - 0.62 - 0.65 - 0.67 - 0.7 - 0.72 - 0.75 - 0.77 - 0.8 - 0.82 - 0.85 - 0.87 - 0.9 - 0.92 - 0.95 - 0.97 - 1 x In
		Thermal memory	
		Tolerance	tripping between 1.05 and 1.2 x I1
S	51	Short-circuit selective protection	I2 = 0.6 - 0.8 - 1 - 1.5 - 2 - 2.5 - 3 - 3.5 - 4 - 5 - 6 - 7 - 8 - 9 - 10 x In
		Tolerance	± 7% If ≤ 6 x In ± 10% If > 6 x In
		Short-circuit selective protection	I2 = 0.6 - 0.8 - 1 - 1.5 - 2 - 2.5 - 3 - 3.5 - 4 - 5 - 6 - 7 - 8 - 9 - 10 x In
		Thermal memory	
		Tolerance	± 7% If ≤ 6 x In ± 10% If > 6 x In
I	50	Short-circuit instantaneous protection	I3= 1.5 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 x In
		Tolerance	± 10%
G	51N	Earth fault protection	I4(1) = 0.1 - 0.2 - 0.3 - 0.4 - 0.6 - 0.8 - 1 x In
		Tolerance	± 7%
		Earth fault protection	I4(1) = 0.1 - 0.2 - 0.3 - 0.4 - 0.6 - 0.8 - 1 x In
		Tolerance	± 7%

(1) G protection below 100A or below 0.2 In available with auxiliary supply
(2) The minimum trip time is 1s, regardless of the type of curve set (self-protection)

The tollerances above apply to trip units already powered by the main circuit with current flowing in at least two-phases or an auxiliary power supply. In all other cases the following tollerance values apply

ABB Code	Trip threshold	Trip time
L	Trip between 1.05 and 1.2 x I1	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
G	± 15%	± 20%

	Trip time	Excludibility	Pre Alarm	Trip curve	Ek 1
	with I = 3 I1, t1 = 3 - 12 - 24 - 36 - 48 - 72 - 108 - 144 s (2)	No	50 ... 90 I1 Step 1%	t = k / I²	●
		Yes			●
	± 10% If ≤ 6 x In ± 20% If > 6 x In				
	t2 = 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.6 - 0.7 - 0.8s	Yes	No	t = k	●
	The better of the two data: ± 10% or ± 40 ms				
	with I = 10 In, t2 = 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.6 - 0.7 - 0.8s	Yes	No	t = k / I²	●
		Yes	No		
	± 15% If ≤ 6 x In ± 20% If > 6 x In				
	Instantaneous	Yes	No	t = k	●
	≤ 30 ms				
	t4 = 0.1 - 0.2 - 0.4 - 0.8s	Yes	No	t = k	●
	The better of the two data: ± 10% or ± 40 ms				
	t4 = 0.1 - 0.2 - 0.4 - 0.8s	Yes	No	t = k / I²	●
	± 15%				

Technical characteristics
Protection functions

ABB Code	ANSI Code	Function	Thereshold	Threshold step	Tripping time	Time Step
L	49	Overload Protection	I1 = 0.4…1 x In	0.001 x In	with I = 3 I1, t1 = 3...144 s	1s
		Thermal Memory				
		Tolerance	tripping between 1.05 and 1.2 x I1		± 10% I ≤ 6 x In ± 20% I > 6 x In	
S	50TD	Time-delayed overcurrent protection	I2 = 0.6...10 x In	0.1 x In	t2 = 0.05...0.8s	0.01s
	68	Zone selectivity			t2sel = 0.04…0.2s	0.01s
		Start up	Activation: 0.6…10 x In	0.1 x In	Range: 0.1…30s	0.01s
		Tolerance	± 7% I ≤ 6 x In ± 10% I > 6 x In		The better of the two data: ± 10% or ± 40 ms	
	51	Time-delayed overcurrent protection	I2 = 0.6...10 x In	0.1 x In	with I = 10 In, t2 = 0.05...0.8s	0.01s
		Thermal Memory				
		Tolerance	± 7% I ≤ 6 x In ± 10% I > 6 x In		± 15% I ≤ 6 x In ± 20% I > 6 x In	
I	50	Istantaneous overcurrent protection	I3= 1.5...15 x In	0.1 x In	Instantaneous	-
		Start up	Activation: 1.5…15 x In	0.1 x In	Range: 0.1…30s	0.01s
		Tolerance	± 10%		≤ 30 ms	
MCR		Closing on short-circuit protection	I3= 1.5...15 x In	0.1 x In	Instantaneous Activation range: 40…500ms	0.01s
		Tolerance	± 10%		≤ 30 ms	
G	50N/50N TD	Earth fault protection	I4[1] = Inst, 0.1...1 x In	0.001 x In	with I > I4, t4 = 0.1…1s	0.05s
	68	Zone selectivity			t4sel = 0.04…0,2s	0.01s
		Start up	Activation: 0.2…10 x In	0.2 x In	range: 0.1…30s	0.01s
		Tolerance	± 7%		The better of the two data: ± 10% or ± 40 ms	
	51N	Earth fault protection	I4[1] = 0.1...1 x In	0.01 x In	with I = 4 In, t4 = 0.1…1s	0.05s
		Tolerance	± 7%		± 15%	
IU	46	Current unbalance protection	I6 = 2…90% In unbalance	1%In	t6 = 0.5…60s	0.5s
		Tolerance	± 10%		The better of the two data: ± 10% or ± 40 ms	

ABB Code	Trip threshold	Trip time
L	Trip between 1.05 and 1.2 x I1	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
G	± 15%	± 20%
Other protection	± 15%	± 20%

	Excludibility	Excludibility trip	Pre-allarm	Trip curve	Ek 2
	no	no	50...90% I1	t = k / I^2	●
	yes				●
	yes	yes	no	t = k	●
	yes				●
	yes				●
	yes	yes	no	t = k / I^2	●
	yes				●
	yes	no	no	t = k	●
	yes				●
	yes	no	no	t = k	●
	yes	yes	90% I4	t = k	●
	yes				●
	yes				●
	yes	yes	90% I4	t = k / I^2	●
	yes	yes	no	t = k	●

Technical characteristics
Measurement functions

Instantaneous measurements		**Parameters**
Currents (RMS)	[A]	L1, L2, L3, Ne
Earth fault current (RMS)	[A]	Ig
Phase-phase voltage (RMS)	[V]	U12, U23, U31
Phase-neutral voltage (RMS)	[V]	U1, U2, U3
Phase sequence		
Frequency	[Hz]	f
Active power	[kW]	P1, P2, P3, Ptot
Reactive power	[kVAR]	Q1, Q2, Q3, Qtot
Apparent power	[KVA]	S1, S2, S3, Stot
Power factor		PF total
Peak factor		L1, L2, L3, Ne
Counters recorded from installation or from the last reset		**Parameters**
Active energy	[kWh]	Ep total, Ep positive, Ep negative
Reactive energy	[kVARh]	Eq total, Ep positive, Ep negative
Apparent energy	[KVAh]	Es total
Record of values: of the parameter for each interval with time-stamping		**Parameters**
Current: minimum and maximum	[A]	I Min, I Max
Phase-phase voltage: minimum and maximum	[V]	U Min, U max
Active power: average and maximum	[kW]	P Mean, P Max
Reactive power: average and maximum	[kVAR]	Q Mean, Q Max
Apparent power: average and maximum	[KVA]	S Mean, S Max
Data logger: record of high sampling rate parameters		**Parameters**
Currents	[A]	L1, L2, L3, Ne, Ig
Voltages	[V]	U12, U23, U31
Sampling rate	[Hz]	1200-9600
Maximum recording duration	[s]	18
Recording stop delay	[s]	0-10s
Number of registers	[no]	2 independent
Information on trip and opening data: after a fault without auxiliary supply		**Parameters**
Type of protection tripped		eg. L, S, I, G, UV, OV
Fault values per phase	[A/V/Hz w/VAR]	eg. I1, I2, I3, neutral for S protection V12, V23, V32 for UV protection
Time-stamping		Date, time and progressive number
Maintenance indicators		**Parameters**
Information on last 30 trips		Type of protection, fault values and time-stamping
Information on last 200 events		Type of event, time-stamping
Number of mechanical operations (1)	[no]	Can be associated to alarm
Total number of trips	[no]	
Total operating time	[h]	
Wear of contacts	[%]	Prealarm >80%; Alarm = 100%
Date of maintenance operations performed		Last
Indication of maintenance operation needed		
Circuit-breaker I.D.		Type of circuit-breaker, assigned device name, serial number
Self-diagnosis		**Parameters**
Check of continuity of internal connnections		Alarm due to disconnection: rating plug, sensors, trip coil
Failure of circuit-breaker to open (ANSI 50BF)		Alarm following non-tripping of protection functions
Temperature (T)		Prealarm and alarm for abnormal temperature

(1) with auxiliary supply present


	Accuracy		Ek 1	Ek 2
	1.5%		●	●
	2%		●	●
	0.5%		–	○
	0.5%		–	○
			–	○
	0.2%		–	○
	2%		–	○
	2%		–	○
	2%		–	○
	2%		–	○
			–	○
	Accuracy			
	2%		–	○
	2%		–	○
	2%		–	○
	Window	**Intervals**		
	Fixed synchronizable by remote	Duration: 5…120min Number of intervals: 24	●	●
			–	●
			–	○
			–	○
			–	○
			–	●
			–	○
			–	●
			–	●
			–	●
			–	●
			●	●
			●	●
			●	●
			●	●
			●	●
			●	●
			●	●
			●	●
			●	●
			●	●
			●	●
	Note: Opening of circuit-breaker can be set in the event of alarm		●	●
			●	●
			●	●

Key:
- ● available
- ○ available with Ek Measuring
- – not available

Accessories

Standard supply 3/2

Accessories for circuit-breakers 3/3

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Accessories
Standard supply

The new Formula AIR circuit-breakers have been designed to optimize the installation and commissioning of accessories.

Thanks to its innovative design, this new family allows to install electrical and mechanical accessories in a simple and time-efficient way.
At the same time, the operating mechanism area remains segregated and protected, providing safety for operators.

Fixed circuit-breakers and fixed parts of withdrawable circuit-breakers are provided with a functional terminal box for the auxiliary connection. The terminals can be wired first and then installed on the circuit-breaker terminal box, thereby facilitating cable connection for the operator.

The fixed versions of Formula AIR automatic circuit-breakers and switch-disconnectors are always supplied as standard with the following accessories:
- IP30 protection for switchgear door
- adjustable rear terminals mounted in HR – HR configuration
- lifting plates.

In addition, for fixed automatic circuit-breakers only:
- four standard open/closed auxiliary contacts - AUX 4Q 400V
- four terminals for auxiliary connections
- mechanical signalling of the tripping of the protection trip unit - TU Reset
- Ekip TT power supply and test unit (with Ek 2 only).

The withdrawable versions of automatic circuit-breakers and switch-disconnectors are always supplied as standard with the following accessories:
- closed circuit-breaker racked-out mechanism lock
- lever for racking in and racking out
- anti-insertion lock
- lifting plates.

In addition, for mobile part of withdrawable automatic circuit-breakers only:
- four standard open/closed auxiliary contacts - AUX 4Q 400V
- four terminals for auxiliary connections
- mechanical signalling of the tripping of the protection trip unit - TU Reset
- Ekip TT power supply and test unit (with Ek 2 only).

The fixed parts feature:
- IP30 protection for switchgear door
- anti-insertion lock
- standard shutter lock – SL
- adjustable rear terminals, mounted in HR – HR configuration.


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1SDC200505F001

Contacts

Open / closed auxiliary contacts - AUX

Formula AIR circuit-breakers can be equipped with auxiliary contacts that signal the open or closed status of the circuit-breaker. The first block of four standard contacts is always provided with the automatic circuit-breakers. The switching contacts are available in the following configurations:

Open / closed auxiliary contacts (AUX 4Q)		**FA2 - FA4**
4 auxiliary contacts	standard	•
Open / closed supplementary auxiliary contacts (AUX 6Q)		
6 auxiliary contacts	standard	•
Open / closed external supplementary auxiliary contacts (AUX 15Q)		
15 auxiliary contacts	standard	•
Maximum number of open / closed auxiliary contacts that can be installed		**25**

		Standard contact
Type		changeover contacts
Minimum load		100mA @ 24V
Breaking capacity		
DC	125V	0.3A @ 0ms
	250V	0.15A @ 0ms
AC	250V	5A @ cosφ 1
		5A @ cosφ 0.7
		5A @ cosφ 0.3
	400V	3A @ cosφ 1
		2A @ cosφ 0.7
		1A @ cosφ 0.3

Electrical diagram reference: figure 1, 81, 91

AUX 15Q is an alternative to the mechanical interlock (MI) and the DLP lock if mounted on the right side.

Accessories
Accessories for circuit-breakers

Auxiliary position contacts - AUP

When the circuit-breaker is a withdrawable version, the position of the mobile part can be signalled electrically by accessorizing the fixed part with one of the following signalling contact units:

Auxiliary position contacts (AUP)		FA2 - FA4
5 auxiliary contacts	standard	•
5 supplementary auxiliary contacts	standard	•
Maximum number of auxiliary position contacts that can be installed		**10**

		Standard contact
Type		changeover contacts
Minimum load		100mA @ 24V
Breaking capacity		
DC	125V	0.3A @ 0ms
	250V	0.15A @ 0ms
AC	250V	5A @ cosφ 1
		5A @ cosφ 0.7
		5A @ cosφ 0.3
	400V	3A @ cosφ 1
		2A @ cosφ 0.7
		1A @ cosφ 0.3

Electrical diagram reference: figure 96, 97

Ready to close signalling contact - RTC

The ready to close signalling contact – RTC – indicates that the circuit-breaker is ready to receive the closing command. The circuit-breaker is ready to close when the following conditions have been met:

- circuit-breaker open
- springs loaded
- no opening command or locks on the opening command
- circuit-breaker reset following tripping of Ek protection trip unit.

		Standard contact
Type		Switching
Minimum load		100mA @ 24V
Breaking capacity		
DC	250V	0.5A @ 0ms / 0.2A 10ms
AC	250V	3A @ cosφ 0.7

Electrical diagram reference: figure 71

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Mechanical signalling of the tripping of protection trip unit - TU Reset

The automatic circuit-breakers are always equipped with a mechanical device that signals the tripping status of the protection trip units. After the Ek trip unit has tripped due to an electrical fault, the signalling device clearly indicates the tripping status on the front of the circuit-breaker. The circuit-breaker can be reset only after the signalling pushbutton has been restored to its normal operating position. The device conforms to the Ansi 86T standard.


1SDC200685F001

Contact signalling tripping of protection trip unit S51

The contact signals the opening of the circuit-breaker after the Ek protection trip unit has tripped. The circuit-breaker can only be closed after the “TU Reset” tripped trip unit mechanical signalling pushbutton has been restored to its normal operating position.
The switching contact, which is always supplied with the standard version of the automatic circuit-breakers, is also available on request in a version for digital signals (for electrical characteristics, please refer to the RTC contact). It can also be associated with an optional accessory for resetting by remote control - YR. For electromechanical characteristics, please refer to the RTC contact.

Electrical diagram reference: figure 11

Contact signalling loaded springs – S33 M/2

This contact is always supplied with a geared motor; it remotely signals the spring status of the circuit-breaker operating mechanism.

		Standard contact
Type		changeover contacts
Minimum load		100mA @ 24V
Breaking capacity		
DC	125V	0.3A @ 0ms
	250V	0.15A @ 0ms
AC	250V	5A @ cosφ 1
		5A @ cosφ 0.7
		5A @ cosφ 0.3
	400V	3A @ cosφ 1
		2A @ cosφ 0.7
		1A @ cosφ 0.3

Electrical diagram reference: figure 12

Coils and motor

Opening and closing release- YO/YC

The opening and closing releases enable the circuit-breaker to be controlled remotely. Opening is always possible, while closing is available only when the closing springs of the operating mechanism are loaded and the circuit-breakers is ready to close. The releases operate by means of minimum impulse current duration time of 100 ms. Furthermore, they can operate in permanent service. In this case, if opening command is given by means of the opening release, the circuit-breaker can be closed by de-energizing the opening release and, after a time of at least 30 ms, by controlling the closing.

Electrical diagram reference: figure 75, 77

Second opening release - YO2

The technical characteristics of the second opening release remain the same as those of the first opening and closing release. It is in alternative to the undervoltage release.

Electrical diagram reference: figure 72

Undervoltage release – YU

The undervoltage release opens the circuit-breaker with trip unit power supply voltages of 35-70% Un. The circuit-breaker can be closed with a trip unit power supply voltage of 85-110% Un. It can be used for safe remote tripping, for blocking closing or to control the voltage in the primary and secondary circuits. The power supply for the release is therefore obtained on the supply side of the circuit-breaker or from an independent source. Circuit-breaker closing is permitted only when the release is powered. The undervoltage release is an alternative to as second shunt trip or the anti-racking out device.

Electrical diagram reference: figure 73

General characteristics		
Power supply (Un)	**AC**	**DC**
110V…120V	•	•
220V…240V	•	•
Operating limits (IEC60947-2 standards)	YO/YO2: 70%...110% Un - YC: 85%...110% Un	
Inrush power (Ps)	300VA	300W
Continuous power (Pc)	3.5VA	3.5W
Opening time (YO/YO2)	35 ms	35 ms
Opening time (YU)	50 ms	50 ms
Closing time (YC)	50 ms	50 ms

Time-delay device for undervoltage release (UVD)

The undervoltage release can be combined with an electronic time-delay device for the circuit-breaker, allowing for delayed external tripping with adjustable preset times. Use of the delayed undervoltage trip unit is recommended to prevent tripping when the power supply network for the trip unit is subject to brief voltage drops or power supply failures. Circuit-breaker closing is inhibited when it is not powered. The time-delay device must be used with an undervoltage release with the same voltage.

General characteristics		
Power supply (UVD)	**AC**	**DC**
110-127V	•	•
220-250V	•	•
Adjustable opening time (YU + D):	0.5-1-1.5-2-3 s	

Electrical diagram reference: figure 74

Resetting remotely- YR

The reset coil YR permits remote resetting of the circuit-breaker after a release has tripped due to an overcurrent condition.
It is available for all automatic circuit-breakers, in different voltage supply:

General characteristics		
Power supply (Un)	**AC**	**DC**
110V	•	•
220V	•	•
Operating limits	90%...110% Un	

Electrical diagram reference: figure 14

Motor – M

The motor automatically loads the closing springs of the circuit-breaker. The device, which can be installed from the front, automatically reloads the springs of the operating device when they are unloaded and power is present. In the event no power is present, the springs can be manually loaded by a dedicated lever on the operating device. The motor is always supplied with the limit switch contact S33 M/2 which signals the status of the springs.

General characteristics		
Power supply (Un)	**AC**	**DC**
100V…130V	•	•
220V…250V	•	•
Operating limits (IEC60947-2 standards)	85%...110% Un	
Inrush power (Ps)	500VA	500W
Inrush time	200ms	
Continuous power (Pc)	150VA	150W
Charging time	7 sec	7 sec

Electrical diagram reference: figure 13

Accessories
Accessories for circuit-breakers

Locks

Key lock in open position - KLC

Due to these safety devices, the Formula AIR circuit-breaker can be locked in the open position. The lock can also be used during maintenance activities when the shield of the accessories area is removed. The device is available with lock with different keys – KLC-D (for only one circuit-breaker) or with the same keys – KLC-S (for several circuit-breakers). Four different key numbers are available for the KLC-S.

Padlocks - PLC

These padlock options allow the circuit-breaker to be kept open by acting directly on the mechanical operating device (opening pushbutton). Three different padlock versions are available:

– Locking device with plastic structure for up to a maximum of three padlocks of 4 mm
– Locking device with metal structure for up to a maximum of two padlocks of 8 mm
– Locking device with metal structure for one padlock of 7 mm or for padlock holders

The padlocks must be supplied by the customer. This device is an alternative to the PBC.

Key lock in racked-in / test / racked-out position - KLP

This device enables the mobile part to be locked in one of the three positions: racked-in, test and racked-out.

This device can be supplied with locks with different keys – KLP-D or with the same keys – KLP-S. Moreover, it is possible to allow locking only when in the racked-out position with a supplementary accessory.

Padlock in racked-in / test / racked-out position - PLP

This device can hold up to three padlocks of 8 mm in diameter. The structure housing the padlocks can also be used in combination with the 2 lock KLP keylock option. Furthermore, it enables the lock of the moving part in the racked-out position only by means of the supplementary lock in racked-out position.

Shutter lock – SL

When the mobile part is in the test position, the shutters of the fixed part close, maintaining the insulation distance and physically segregating the live parts of the of the cradle from the internal breaker compartment of the cradle. Using two dedicated mechanisms, the upper and lower shutters can be locked independently of one another. The shutter lock is always supplied with the fixed part of the Formula AIR circuit-breakers and locks the shutters, using a maximum of three padlocks of 4 mm, 6 mm or 8 mm.

Lock for racking-out mechanism with circuit-breaker in closed position
All Formula AIR withdrawable circuit-breakers are always supplied with a lock that prevents the mobile part from being racked in and racked out when the circuit-breaker is in the closed position. To rack in the mobile part, the circuit-breaker must be in the open position.

Lock for racking in / racking out the mobile part when the door is open - DLR
This accessory, which is mounted on the fixed part, prevents the mobile part from being racked in or out when the switchgear door is open.

Lock to prevent door opening when the circuit-breaker is in racked-in / test position - DLP
This safety device prevents the switchgear door from being opened when the mobile part of the withdrawable version of the circuit-breaker is in the racked-in or test position.
The circuit-breaker can only be racked in when the door is open, which is then closed.
This accessory can be installed on either the right-hand or left-hand side of the fixed part.
If mounted on the right side, it is an alternative to the mechanical interlock, the AUX 15Q or the DLC.

Lock to prevent door opening when the circuit-breaker is in the closed position - DLC
This prevents the compartment door from being opened when the circuit-breaker is in the closed position (and with the circuit-breaker racked in for withdrawable circuit-breakers).
It also blocks the circuit breaker from closing when the compartment door is open. DLC direct door is compatible with all mechanical interlocks and the AUX 15Q. DLC cable door is compatible with mechanical interlock type A and the AUX 15Q.

Anti-insertion lock
The withdrawable circuit-breakers are equipped with special locks that allow the mobile part to be inserted only into the corresponding fixed part.

Mechanical operation counter - MOC
The number of mechanical operations is often one of the elements that determines the frequency of ordinary maintenance operations on circuit-breakers. With this mechanical operation counter, which is always visible on the front of the circuit-breaker, the user knows how many mechanical operations the device has performed.

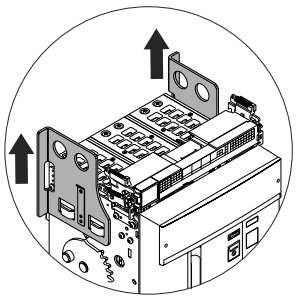
Accessories
Accessories for circuit-breakers

Protection device for opening and closing pushbuttons - PBC
This accessory is applied to the safety cover of the circuit-breaker and is available in two versions:
– Pushbutton protection device, which blocks operations on both the opening and closing pushbuttons unless the special key is used.
– Padlockable pushbutton protection device, which makes it possible to block either or both pushbuttons and lock the covers in place. It does not trip the breaker as a standard "Padlock device" would.
– PBC is an alternative to PLC padlocks.

IP30 Protection
Supplied with every circuit-breaker, the cover frame is installed on the door of the switchgear to achieve IP30 degree of protection on the front part of the circuit-breaker.

IP54 Protection
This transparent cover completely protects the front of the circuit-breaker, enabling an IP54 degree of protection to be achieved. This accessory is provided with double key lock (same or different keys).

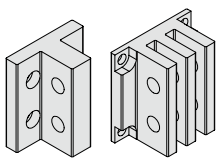
Separators - PB
These protection devices increase the insulation distance between adjacent phases.



Lifting plates
Plates for raising fixed circuit-breakers and mobile parts. Provided as standard supply.

Connections

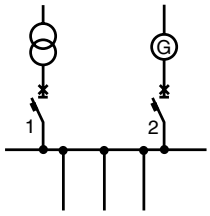
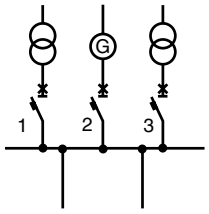
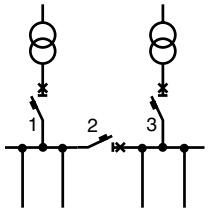
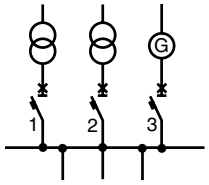
Formula AIR circuit-breakers are equipped with rear adjustable terminals. The adjustable terminals are supplied as standard in the HR – HR configuration. This configuration can be modified either from the factory or directly on site by turning the terminals by 90°.

Type		FA2	FA4	FA4
		Iu up to 2000A	Iu up to 3200A	Iu up to 4000A
Single stab design		●	●	
Multiple stab design				●

On request, Formula AIR can be provided with front terminals (F), ensuring the most compact design.

Mechanical interlocks

These interlock systems enable various opening and closing configurations to be obtained between two or three circuit-breakers. Four types of interlock configuration are available:

Types of interlock	Possible application	Logic	Circuit-breakers
Type A			
Excludes the possibility of having two circuit-breakers in the closed position at the same time.	Main line power supply and emergency power supply. 	1 2 O O I O O I	Available between circuit-breakers of different sizes and with any fixed / withdrawable version
Type B			
Permits a pair of circuit-breakers to be closed if the third is open. The latter can only be closed when the pair is open.	Two power supplies from transformers and one emergency power supply. 	1 2 3 O O O I O O O O I I O I O I O	Available with any fixed / withdrawable version
Type C			
Permits two out of three circuit-breakers to be closed at the same time.	Two half-busbars can be powered by a single transformer (bus-tie closed) or by both at the same time (bus-tie open). 	1 2 3 O O O I O O O I O O O I O I I I I O I O I	Available with any fixed / withdrawable version
Type D			
Permits one out of three interlocked circuit-breakers to be closed.	Three power supplies on the same busbar that must not operate in parallel. 	1 2 3 O O O I O O O I O O O I	Available with any fixed / withdrawable version

Accessories
Accessories for circuit-breakers

The mechanical interlocks offer multiple solutions for installation that simplify their integration into the switchgear. The interlocks can be mounted:
– vertically **VR**
– horizontally **HR**
– mixed **L**

Different types of interlocks can be supplied according to the maximum distance between two interlocked breakers:

Configuration	Type A	Type B, C, D
Horizontal	2750mm	1600mm
Vertical	1000mm	1000mm

For B, C and D types, the maximum distance between the two furthest breakers is 3200mm for horizontal configurations and 2000mm for vertical configurations (it is possible to make the mechanical interlock among three circuit-breakers disposed in “L position” by using the cables of three horizontal circuit-breakers interlock. Make sure the distance between the horizontal and vertical circuit-breakers respects the minimum and maximum values). All cables can be cut to guarantee easy installation in switchboards. Mechanical interlocks are not compatible with AUX 15Q, the lock for preventing door opening when the circuit breaker is in the closed position (DLC) or when the circuit breaker is in the racked in or test position (DLP), if mounted on the right side.

Accessories
Accessories for Ek trip units

Modules

Ek Supply

Ek Supply 110-240V AC/DC allows to supply all Ek trip units using the auxiliary power available in the switchgear. The module is mounted in the terminal box and can be installed at any time.

Electrical diagram reference: figures 31, 32

Supply	Ek Supply
Nominal voltage	110-240V AC/DC
Voltage range	105-265V AC/DC
Rated power (including modules)	10W max.
Inrush current	~10A for 5ms

Ek Measuring module

The Ek Measuring module enables the trip unit to measure the phase and neutral voltages, powers and energy.

The Ek Measuring module can be installed on the front, right housing of the Ek 2 trip units, without having to remove the trip unit itself. The voltage connections are installed by default on the lower terminals, but can be altered to the upper terminals on request.

The measuring module requires no external connection since it is connected internally to the lower or upper terminals. If necessary, the voltage outlet connection can be moved outside the circuit-breaker by using voltmetric transformers and the alternative connection positioned in the terminal box. The use of external connections is compulsory for rated voltages that are higher than 690V. The module must be disconnected for dielectric strength tests on the main busbars.

Electrical diagram reference: figures 20, 21, 23

Rating Plug

The rating plugs are field interchangeable from the front on all trip units and enable the protection thresholds to be adjusted according to the actual rated current of the system. This function is particularly advantageous in installations that may require future expansion or in cases in which the power supplied needs to be limited temporarily (e.g. mobile Gen Set).

Circuit-breaker	Rating plugs available
FA2	630-800-1000-1250-1600-2000
FA4	630-800-1000-1250-1600-2000-2500-3200-4000

Current sensor for neutral conductor outside the circuit-breaker

This is only for three-pole circuit-breakers; it enables protection of the neutral conductor to be achieved through connection to the Ek trip unit. It is supplied on request.

Electrical diagram reference: figure 27


1SDC200688F001

Testing and programming unit

Ekip TT testing and power supply unit

Ekip TT is a device that allows you to verify that the circuit-breaker trip mechanism is functioning correctly (trip test).
It also allows a trip unit not provided with auxiliary power supply to be supplied with power so that the last protection device tripped can be displayed directly on the screen or by the lighting up of corresponding LEDs.
The device can be connected to the front test connector of any Ek trip unit of Formula AIR; it is a standard supply with all Ek 2 versions.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Ekip T&P testing kit

Ekip T&P is a kit that includes different components for programming and testing the electronic protection trip units.
The kit includes:
– Ekip T&P unit;
– Ekip TT unit;
– adaptors for Emax, Emax 2 and Tmax trip units;
– USB cable to connect the T&P unit to the Ek trip units;
– installation CD for Ekip Connect and Ekip T&P interface software.
The Ekip T&P unit is easily connects from your PC (via USB) to the trip unit (via mini USB) with the cable provided.
The Ekip connect software is available free of charge on the ABB website. It is compatible with different operating systems of personal PCs (Windows XP, Windows 7, Windows Vista).
Ekip T&P unit connects the PC (via USB) with the trip unit (via mini USB). The software allows all system parameters and protection thresholds to be set rapidly in the trip units thanks to the easy and intuitive navigation pages. It is also possible to consult and download the records of events, alarms and the tripping information, thereby facilitating the identification and understanding of anomalies. Ekip connect also enables the electronic protection trip units to be tested for correct operation during the stages of commissioning and system maintenance.
As a result of advanced graphical interfaces, the user can simply select the test to perform: from simple current and voltage signals to more complex wave forms.

Installation

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Installation
Circuit-breaker

The new Formula AIR family maintains the characteristics of strength and reliability that have always distinguished the tradition of ABB air circuit-breakers.

Safety is guaranteed thanks to the double insulation of the live parts and total segregation of the phases. Furthermore, the new functional design of the Formula AIR circuit-breakers has been developed with the purpose of improving installation operations and use of the devices and accessories; making them simple, intuitive and safe.

Distinctive characteristics		Benefits
Simplicity of use and safety	- Ek protection trip units are interchangeable from front of circuit-breaker	Reduced times during the stages of: - installation - wiring - configuration - commissioning - maintenance Increased level of safety
	- Rapid configuration of the Ek trip units	
	- Electrical plug-in accessories can be installed from the front of circuit-breaker	
	- New push-in terminal box allows rapid auxiliary connections	
	- Horizontal or vertical rear connections can be modified on-site by turning 90°	
	- Accessorizing logic common to the entire family of circuit-breakers	
	- Accessory cabinet and terminal box are stamped with accessory codes for easy identification	
	- Accessories area is separated functionally from the safety area	
	- Mechanical safety locks in open position are active when the shield is removed	
	- Guided racking in and out of the mobile part	

Versions

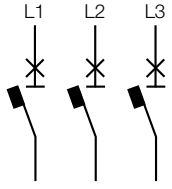
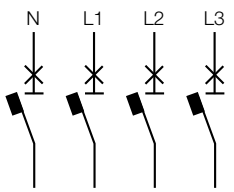
The Formula AIR circuit-breakers are available in both fixed and withdrawable versions. The withdrawable version is recommended in applications in which service continuity is a fundamental requirement. Replacement of the moving part with a new device does not require any intervention on power connections or on auxiliary connections, thus permitting reset in the shortest time possible.

The fixed version, which is connected directly to power system through the circuit-breaker terminals, is recommended in applications in which the need for space means that compact products are required without compromising the performance and possibility of fitting accessories.

Poles

Formula AIR circuit-breakers are available in three-pole and four-pole versions and can be used in all types of distribution systems. Furthermore, with the possibility of connecting the external current sensor, three-pole circuit-breakers can be used efficiently even in systems in which the neutral conductor cannot be isolated.

All frames are always provided with full-size neutral pole with rated uninterrupted current-carrying capacity identical to the phase poles.

Circuit-breaker	Three-pole	Four-pole
FA2 **FA4**		

Terminals

The integration of the circuit-breaker in the electrical system is simplified because of the connection terminals of the circuit-breakers. The terminals are designed to assist installation of connecting bars according to the change in the rated capacity of the circuit-breaker. Each terminal has been created to the standard width of busbar for that amperage and is equipped with one or three terminal stabs for easy connection to multiple bus runs that may be required for the application.
For particular installation requirements, the circuit-breakers can be equipped with different combinations of terminals for the upper and lower part.

Formula AIR circuit-breakers are equipped with rear adjustable terminals. The adjustable terminals are supplied as standard in the HR – HR configuration. This configuration can be modified either from the factory or directly on site by turning the terminals by 90°. On request, all frames can be provided with front terminals (F), ensuring the most compact design.

Degree of protection

The Formula AIR circuit-breakers guarantee the following degrees of protection:
- IP20 for circuit-breakers in fixed or withdrawable versions, excluding the terminals.
- IP30 for the front parts of the circuit-breaker when installed in switchgear with IP30 flange mounted on the door.
- IP54 for circuit-breakers equipped with optional IP54 transparent flange fixed on the door in front of the switchgear.

Power losses

To guarantee the performance of the electrical switchgear in terms of rated uninterrupted current-carrying capacity, the design of the electrical switchgear must take into consideration the power losses by the apparatus and by live parts installed.

These power losses are measured according to IEC60947 product standard, the values given in the table refer to total power for three and four pole circuit-breakers with balanced loads with a current flow equal to rated uninterrupted current "Iu" at 50/60Hz.

Circuit-breaker type		**Iu**	**800A**	**1000A**	**1250A**	**1600A**	**2000A**	**2500A**	**3200A**	**4000A**
Fixed	**FA2 C/N**	[W]	40	63	94	161	240	-	-	-
	FA4 C/N	[W]	-	-	-	-	-	272	430	565
Withdrawable	**FA2 C/N**	[W]	93	141	222	378	465	-	-	-
	FA4 C/N	[W]	-	-	-	-	-	590	750	900

Temperature derating

Under certain installation conditions, the circuit-breakers can operate at higher temperatures than the reference temperature of 40°C. In this case the current-carrying capacity of the circuit-breaker may be lower than the rated current-carrying capacity at the reference temperature: therefore the derating coefficients shown in the table must be applied. Percentage values refer to withdrawable and fixed circuit breaker. If not specified, all data refer to a copper cross section according to IEC60947.

	FA2 800		FA2 1000		FA2 1250		FA2 1600		FA2 2000	
Temperature [°C]	%	[A]	%	[A]	%	[A]	%	[A]	%	[A]
≤ **40**	100	800	100	1000	100	1250	100	1600	100	2000
45	100	800	100	1000	100	1250	100	1600	100	2000
50	100	800	100	1000	100	1250	100	1600	97	1940
55	100	800	100	1000	100	1250	100	1600	95	1900
60	100	800	100	1000	100	1250	100	1600	93	1860

	FA4 2500		FA4 3200		FA4 4000	
Temperature [°C]	%	[A]	%	[A]	%	[A]
≤ **40**	100	2500	100	3200	100	4000
45	100	2500	100	3200	100	4000
50	98	2450	97	3090	97	3870
55	96	2390	94	3020	95	3790
60	92	2290	93	2960	93	3720

Installation
Installation environment

Formula AIR circuit-breakers have been designed and tested in accordance with major international Standards to manage with maximum reliability the electrical plant. The installation requirements prescribed by the international Standards are listed below. In addition, ABB provides instructions for the use of circuit-breakers in nonstandard environments, as for example personalized maintenance program or installation solutions aimed at increasing performances and extending the lifecycle of the circuit-breaker.

Temperature

Formula AIR circuit-breakers can operate in the following environmental conditions:

	Temperature (°C)		
	Operating	**Active Display**	**Storage**
Formula AIR with Ek 1	-25°C … +70°C	-	-40°C … +70°C
Formula AIR with Ek 2	-25°C … +70°C	-25°C … +70°C	-40°C … +70°C
Formula AIR swith-disconnectors	-25°C … +70°C	-	-40°C … +70°C

Environmental conditions

The devices can be installed in industrial environments with pollution level 3, IEC60947. Formula AIR circuit-breakers also comply with:
– IEC60721-3-6 class 6C3
– IEC60721-3-3 class 3C2

Altitude

Formula AIR air circuit-breakers do not undergo changes in rated performance up to 2000 metres. Beyond this altitude, the properties of the atmosphere in terms of composition, dielectric capacitance, cooling power and pressure can vary and, therefore, the performance of the circuit-breakers is subject to derating, which can be measured by means of the variation in maximum rated service voltage and rated uninterrupted current.

Altitude		[m]	2000	3000	4000	5000
Rated service voltage - Ue	690V	[V]	690	607	538	470
Rated current		[% In]	100	98	93	90

An installation at 3000 m of a 690V AC rated service voltage can be an explicative example. The altitude, as shown in the table, may cause a derating which precludes the use of a standard automatic circuit-breaker.

Electromagnetic compatibility

The use of specific devices in industrial installations may cause electromagnetic interference in the electrical system. Formula AIR circuit-breakers have been developed and tested for electromagnetic compatibility in accordance with IEC 60947-2, Appendices J and F.

Installation
Installation in switchgear

Position

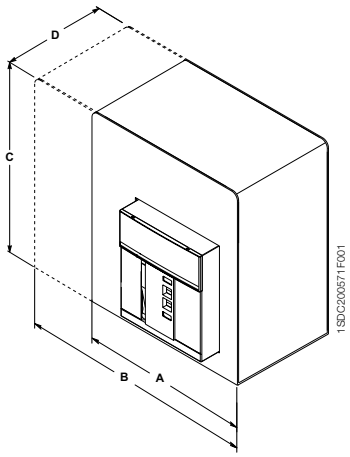
All Formula AIR circuit-breakers can be floor mounted in a vertical position inside the switchgear compartment. It is not allowed to mount any circuit-breaker in horizontal position.

Power supply

The Formula AIR circuit-breakers can be supplied, indifferently, from either the upper or lower terminals. In the event a measurement module is present, in order to make use of all information when the circuit-breaker is in the open position, the voltage sockets must be installed on the power supply side.

Insulation distances and connection

The circuit-breakers can be connected to the main power system using the most common configurations and dimensions of copper bars. Installation of live parts must ensure:

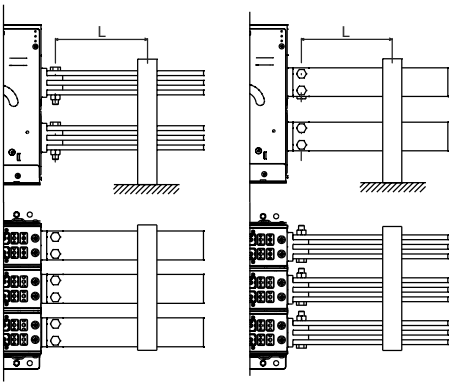


– Minimum insulation distances between the phases

Rated insulation voltage Ui	Minimum distance [mm]
1000V	14mm in accordance with IEC 61439; ABB suggests 25mm

– Insulation distance of installation cubicle

Frame	Version	A 3 poles	B 4 poles	C	D
FA2 - FA4	Fixed	500	600	500	221
FA2 - FA4	Withdrawable	500	600	500	355



– Anchorage plates

The electrodynamic force released during a short-circuit can cause high levels of mechanical stress to the devices and structures of the switchgear. To minimize this, fastening plates must be positioned near the circuit-breaker terminals. The table below indicates the distance for positioning the first anchor plate according to the type of circuit-breaker type and the short-circuit capacity:

Frame	Icu	L
FA2C - FA4C	50 kA	40 cm
FA2N - FA4N	65 kA	30 cm

– **Tightening torques**
The following table indicates the values required for connecting the circuit-breaker terminal and the connecting bars.

Terminals	FA2 - FA4
Modifiable HR/VR rear	70 Nm
Front	70 Nm

– **Segregation plates and separator plates**
The rear part of the circuit-breaker has been designed with specific slots in which insulating walls can be housed to facilitate segregation of live parts. In addition, phase separators are available as optional accessories.

Earthing connection

To achieve continuity and equal potential of earthing between the Formula AIR circuit-breaker and the protection citcuit of the switchboard, customers can connect the Formula AIR fixed circuit-breaker or the fixed part of the withdrawable circuit-breaker to the protective circuit by means of a cable with suitable cross-sectional area to fulfil the requirements of clause 10.5.2 fo the Standard IEC 61439-1.

Busbar types

The circuit-breakers, via the terminals, can be connected to the main distribution system by busbars of different types: copper, silver-plated copper and tinned aluminium when the main distribution system is made of aluminium.
The circuit-breakers can also be connected indirectly by cable-carrying bars.

Installation
Performance in switchgear

The many types of switchgear that can be created and the installation and environmental conditions can considerably influence the performance of the circuit-breaker.

General conditions:
– Switchgear degree of protection: IP31
– Switchgear dimension: 2200x800x900 (HxWxD)
– Segregation form 3
– Ambient temperature Ta (IEC61439-1): 35°C
– Withdrawable circuit-breakers
– Maximum withstand temperature for the terminal: 115°C.

The tables should be used solely as a general guideline for selecting products. Due to the extensive variety of switchgear construction shapes and conditions that can affect the behavior of the apparatus, the solution used must always be verified.

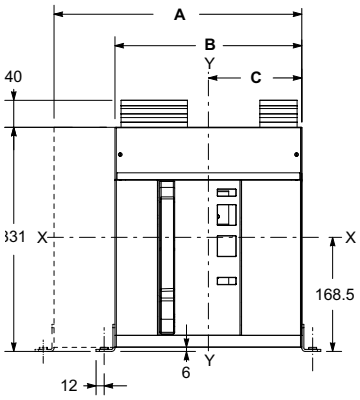
	Vertical terminals		Horizontal and frontal terminals	
Type	**Busbar section [mm²]**	**Continuous capacity [A] 35°C**	**Busbar section [mm²]**	**Continuous capacity [A] 35°C**
FA2 800	1x60x10	800	1x60x10	800
FA2 1000	1x60x10	1000	1x60x10	1000
FA2 1250	2x60x10	1250	2x60x10	1250
FA2 1600	2x60x10	1600	1x100x10	1600
FA2 2000	2x80x10	1950	3x60x10	1920
FA4 2500	2x100x10	2500	2x100x10	2500
FA4 3200	3x100x10	3150	3x100x10	3000
FA4 4000	4x100x10	3630	4x100x10	3420

Dimensions

Fixed circuit-breaker	**5/2**
FA2	5/3
FA4	5/5
Withdrawable circuit-breaker	**5/7**
FA2	5/8
FA4	5/10

Dimensions
Fixed circuit-breaker

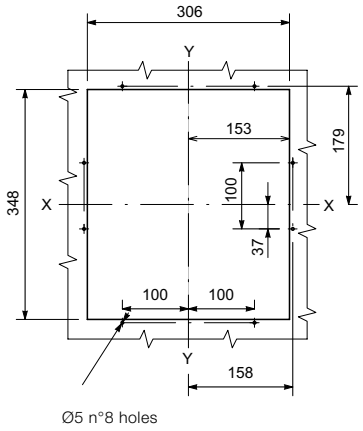
FA2-FA4



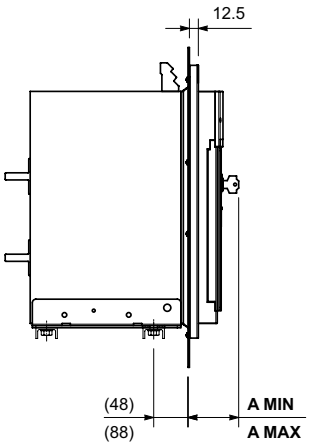
[mm]	A 4p	B 3p	C 3p	4p
FA2	366	276	138	138
FA4	510	384	192	192

Compartment door drilling

FA2-FA4

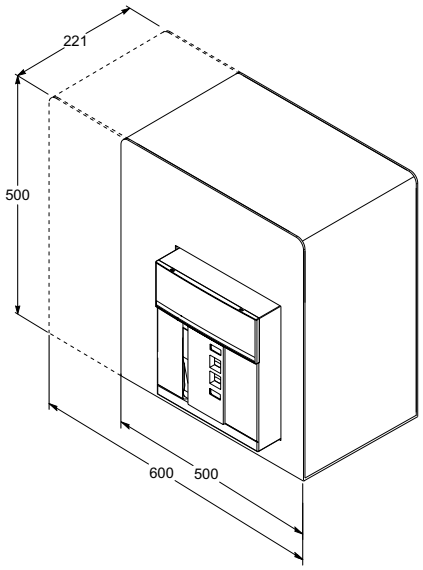


FA2-FA4

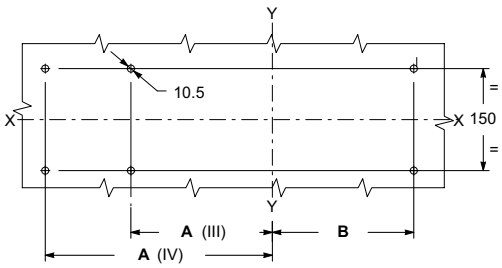


FA2-FA4		Standard
A MIN	[mm]	29,5
A MAX	[mm]	69,5

Dimensions of the compartment

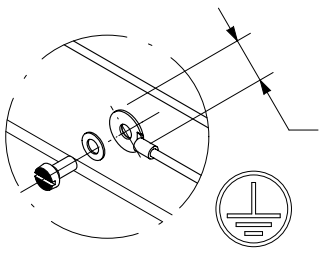


Floor fixing



[mm]	A 3p	4p	B 3p	4p
FA2	154	244	154	154
FA4	208	334	208	208

Earthing device FA2 - FA4



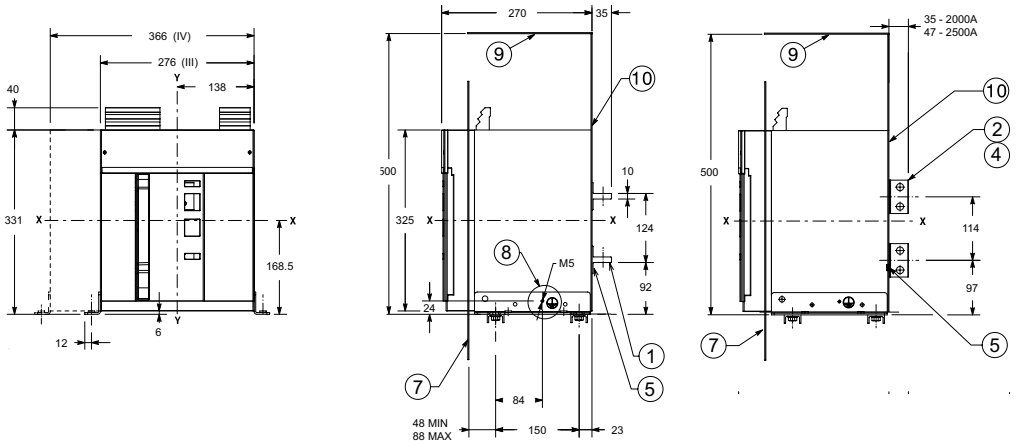
Ø 10 MAX

M5x8 screws supplied
Tightening torque 3Nm

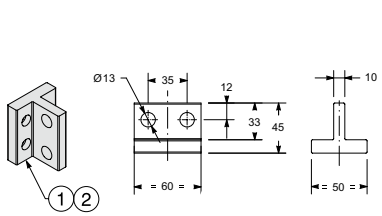
Dimensions
Fixed circuit-breaker - FA2

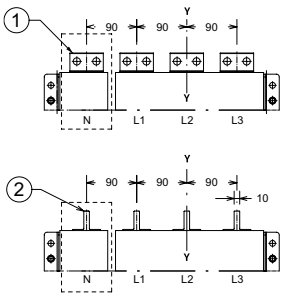
Orientable rear terminals - HR/VR

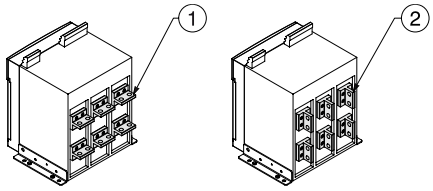
FA2



FA2





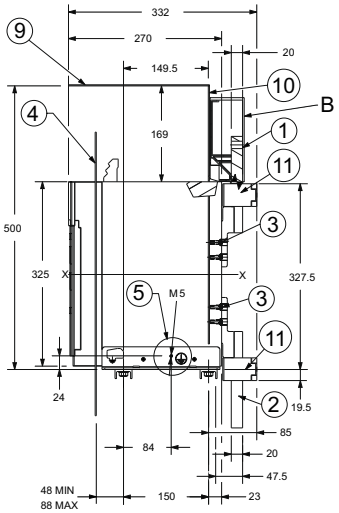


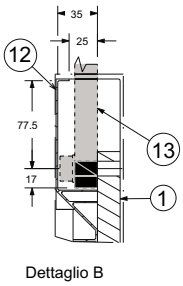
Key

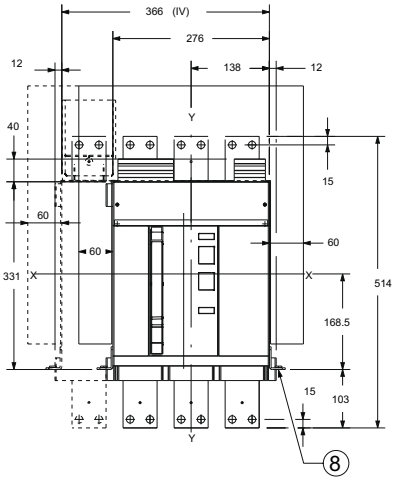
1 Horizontal terminals 2000A
2 Vertical terminals 2000A
5 Tightening torque 2000A 8.6Nm
7 Door position - Ref. page 6/2
8 Earthing device - Ref. page 6/2
9 Metallic sheet
10 Insulating sheet or insulated metallic sheet

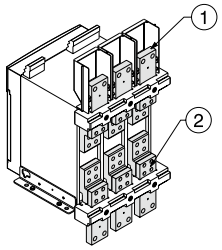
Dimensions
Fixed circuit-breaker - FA2

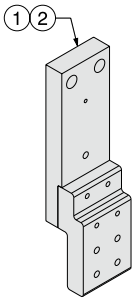
Front terminals – F

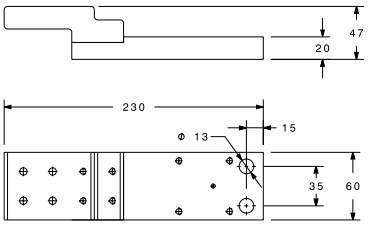


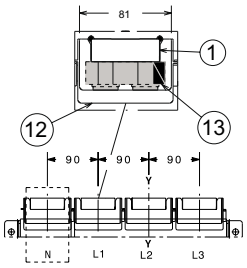


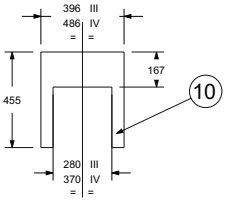












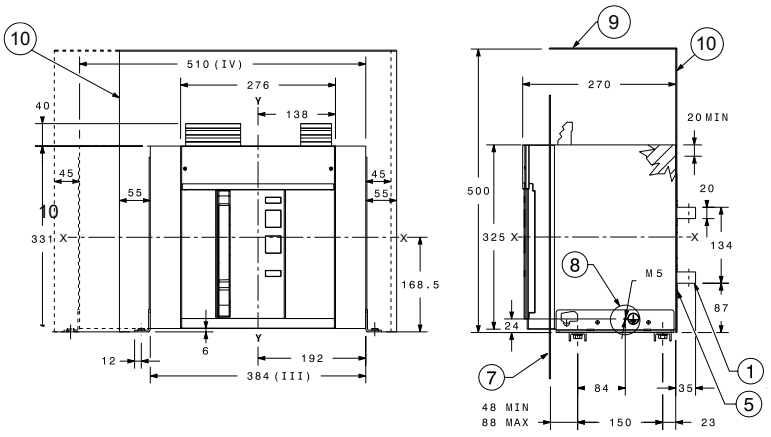
Key

1 Upper front terminals
2 Lower front terminals
3 Tightening torque 8.6Nm
4 Door position - Ref. page 6/2
5 Grounding
6 Ferrule for grounding by the costumer
7 Screw M5x8 provided Tightening torque 3Nm
8 Mounting outside feet Reccomended screws M10x25 high class
9 Metallic sheet
10 Insulating sheet or insulated metallic sheet
11 Crossbeam front terminals
12 Plastic protection
13 Customer busbar and screws (not provided)

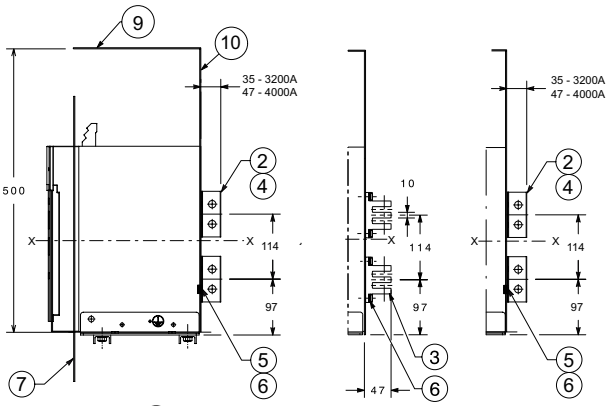
Dimensions
Fixed circuit-breaker - FA4

Orientable rear terminals - HR/VR

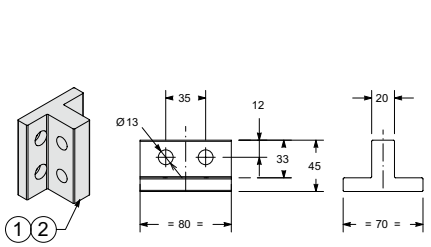
FA4 2500A-3200A

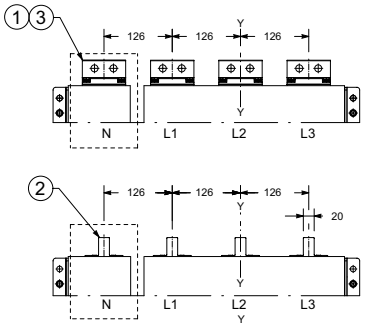


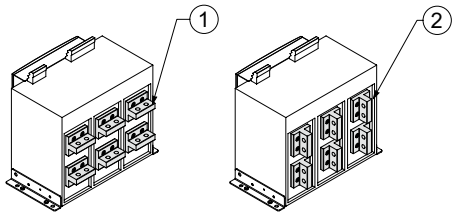
FA4 4000A



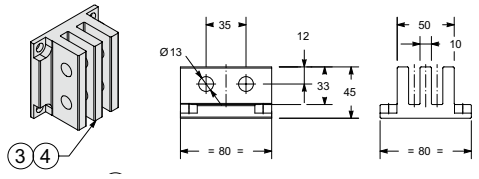
FA4 2500A-3200A

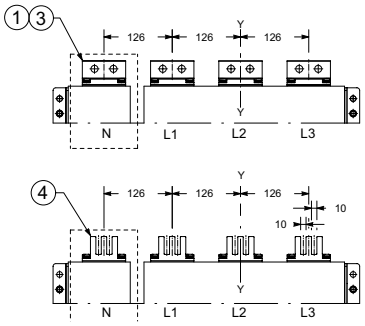


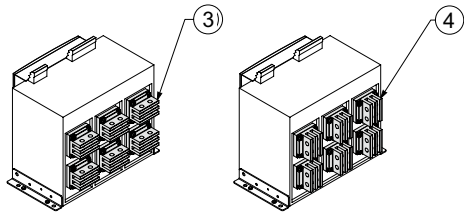




FA4 4000A





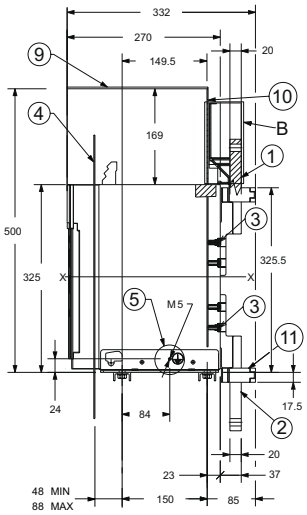


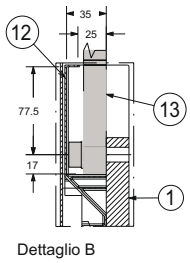
Key

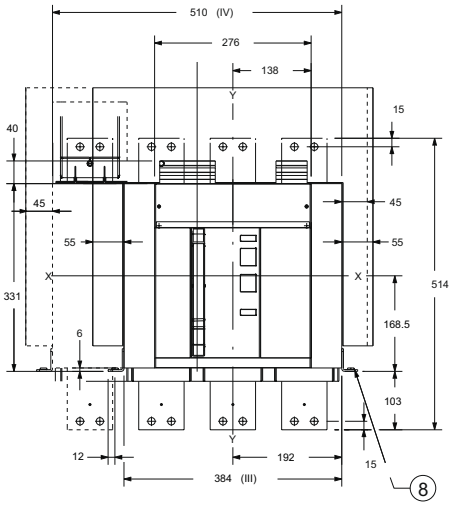
1 Horizontal terminals 3200A
2 Vertical terminals 3200A
3 Horizontal terminals 4000A
4 Vertical terminals 4000A
5 Tightening torque 3200A 20Nm
6 Tightening torque 4000A 20Nm
7 Door position - Ref. page 6/2
8 Earthing device - Ref. page 6/2
9 Metallic sheet
10 Insulating sheet or insulated metallic sheet

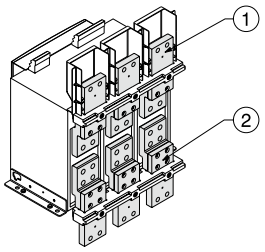
Dimensions
Fixed circuit-breaker - FA4

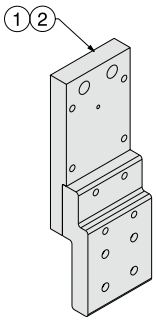
Front terminals – F

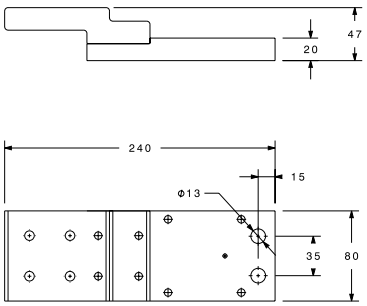


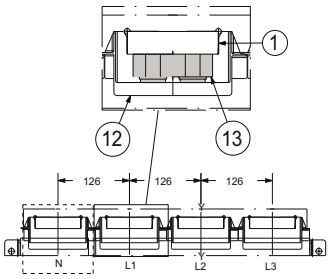


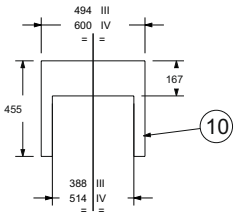










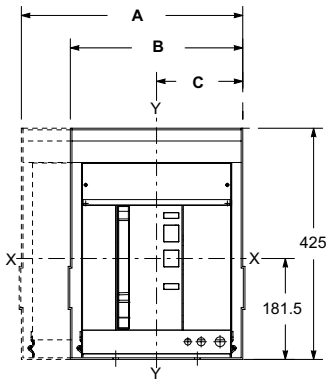


Key

1 Upper front terminals
2 Lower front terminals
3 Tightening torque 20Nm
4 Door position - Ref. page 6/2
5 Grounding
6 Ferrule for grounding by the costumer
7 Screw M5x8 provided
Tightening torque 3Nm
8 Mounting outside feet
Reccomended screws M10x25 high class
9 Metallic sheet
10 Insulating sheet or insulated metallic sheet
11 Crossbeam front terminals

Dimensions
Withdrawable circuit-breaker

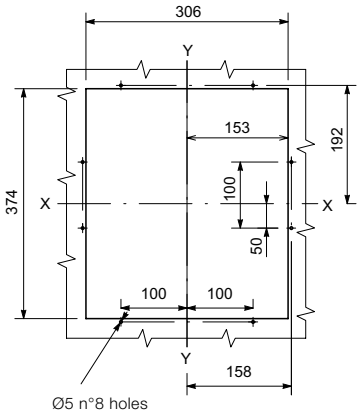
FA2-FA4



[mm]	A 4p	B 3p	C 3p	4p
FA2	407	317	158.5	158.5
FA4	551	425	212.5	212.5

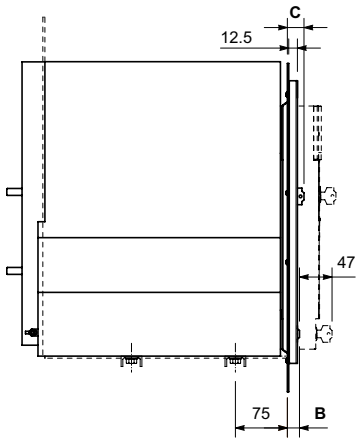
Compartment door drilling

FA2 - FA4



Distance from connected to isolated position

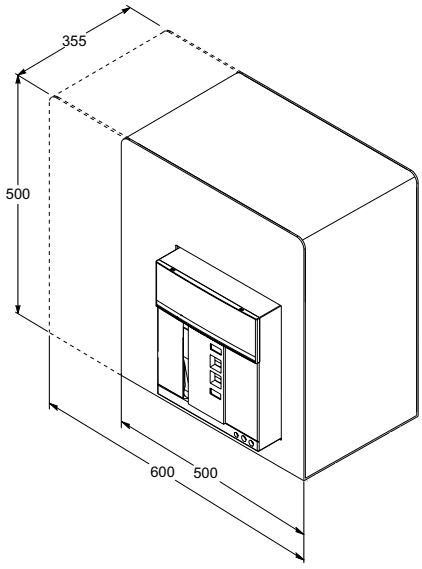
FA2 - FA4



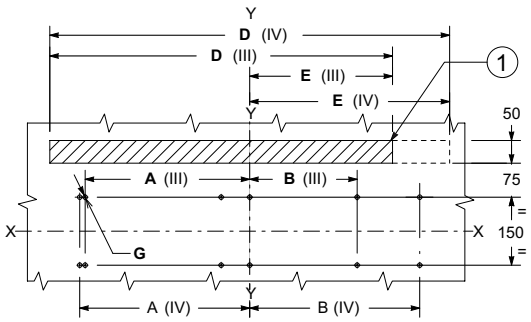
FA2-FA4		Standard
B	[mm]	22
C	[mm]	23

B refers to KLC; C refers to KLP

Dimensions of the compartment



Floor fixing

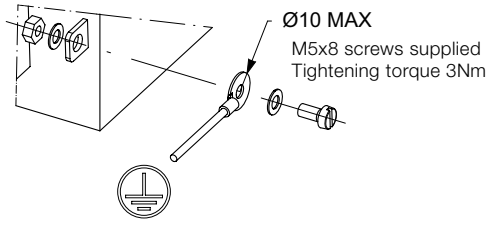


Key

1 Ventilation drilling on the switchgear

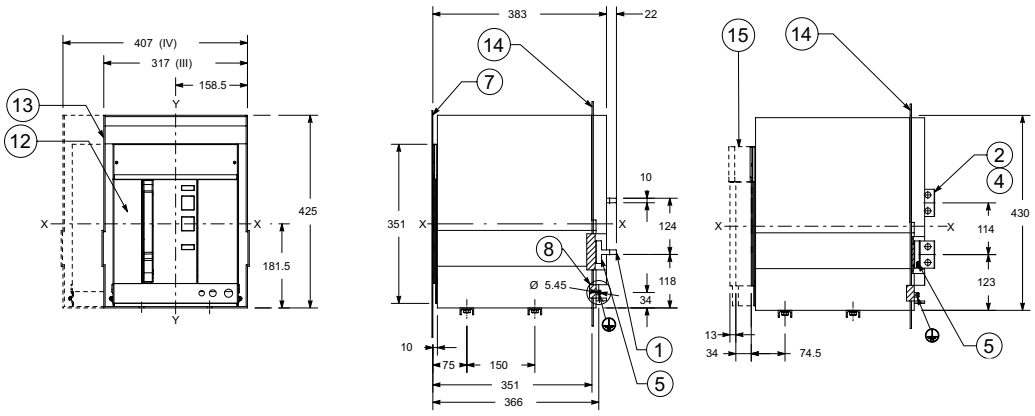
[mm]	A 3p	A 4p	B 3p	B 4p	D 3p	D 4p	E 3p	E 4p
FA2	75	175	75	75	270	360	135	135
FA4	100	225	100	100	378	504	189	189

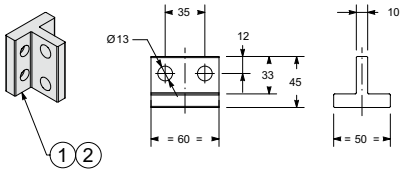
Earthing device FA2 - FA4

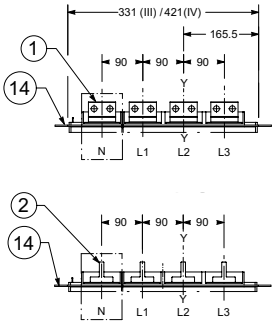


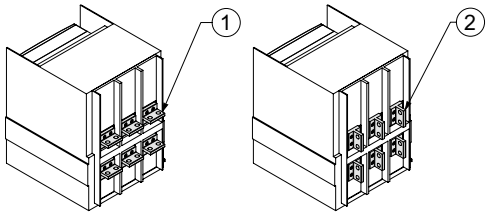
Dimensions
Withdrawable circuit-breaker - FA2

Rear orientable terminals - HR/VR





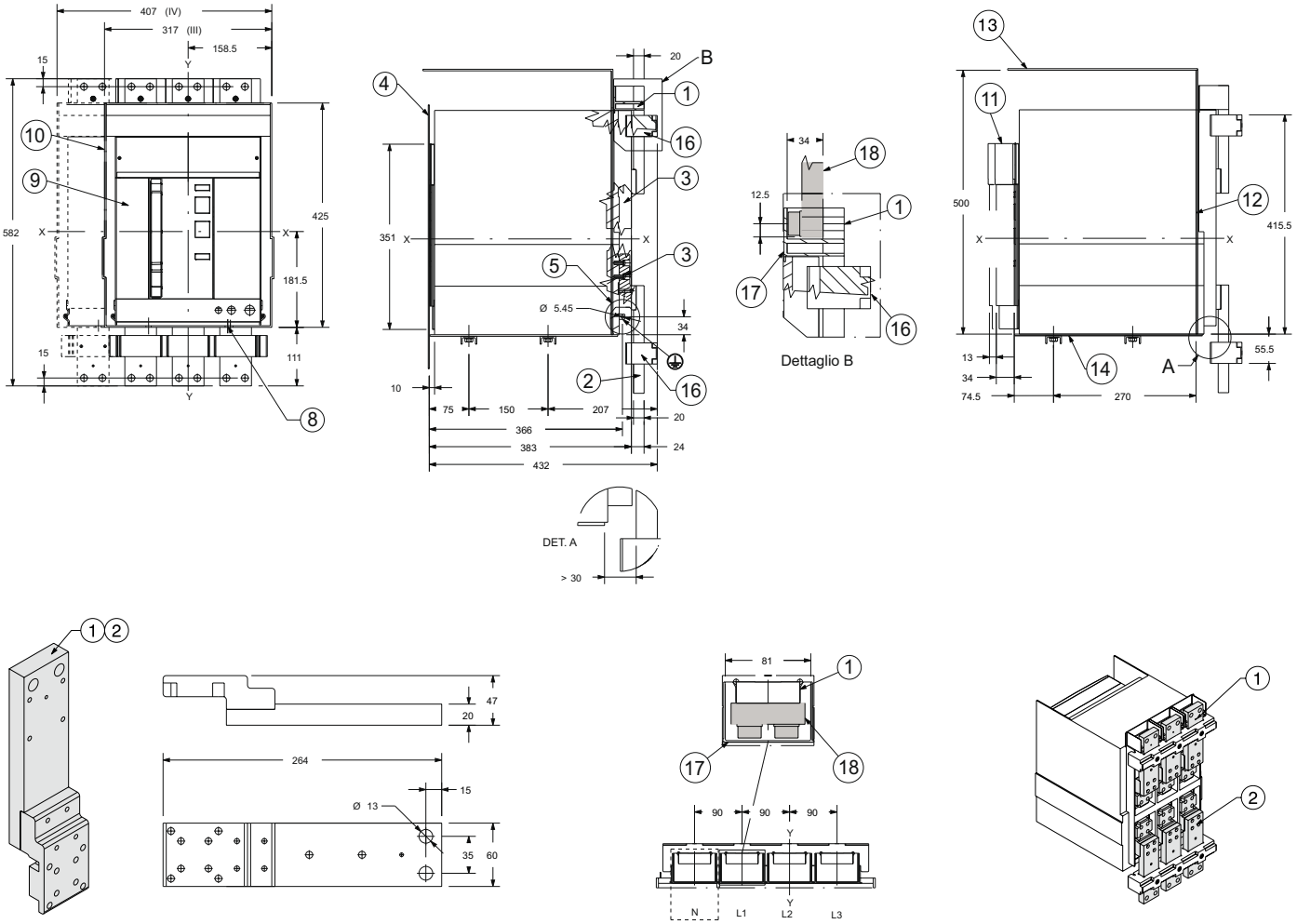




Key

1 Horizontal terminals 2000A
2 Vertical terminals 2000A
5 Tightening torque 2000A 8.6Nm
7 Door position - Ref. page 6/7
8 Earthing device
12 Mobile part
13 Fixed part
14 Segregation (where envisaged)
15 Distance from connected for testing to isolated

Front terminals – F



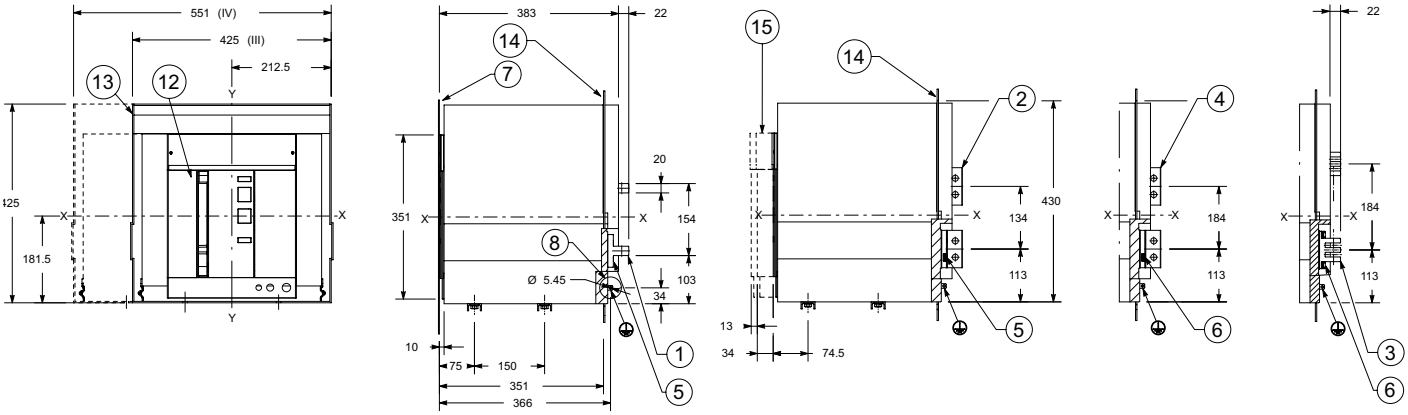
Key

1 Upper front terminals
2 Lower front terminals
3 Tightening torque 8.6Nm
4 Door position - Ref. page 6/2
5 Grounding
6 Ferrule for grounding by the costumer
7 Screw M5x8 provided Tightening torque 3Nm
8 Mounting outside feet Reccomended screws M10x25 high class
9 Moving part
10 Fixed part
11 Crossbeam front terminals
11 Connected, test, disconnected distances
12 Insulating sheet or insulated metallic sheet
13 Roof insulation or insulated metal
14 Fixing plate
16 Crossbeam front terminal
17 Plastic protection
18 Customer busbar and screws (not provided)

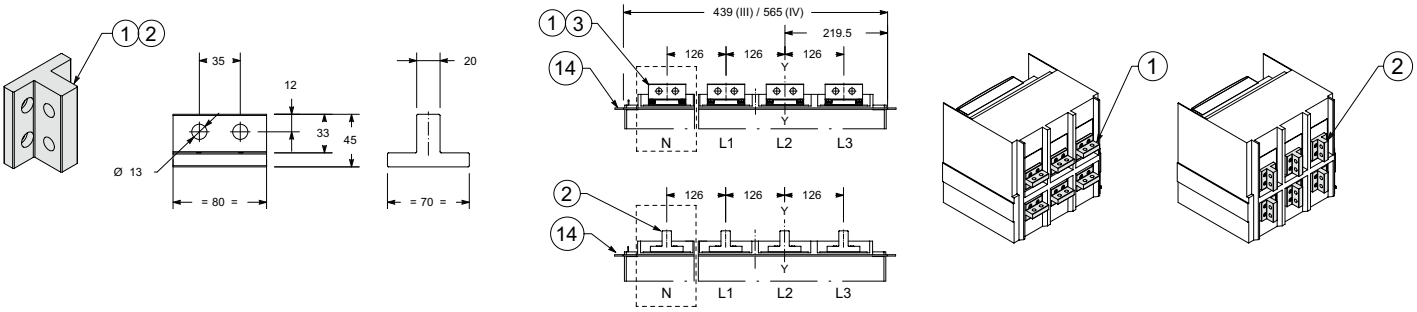
Dimensions
Withdrawable circuit-breaker - FA4

Rear orientable terminals - HR/VR

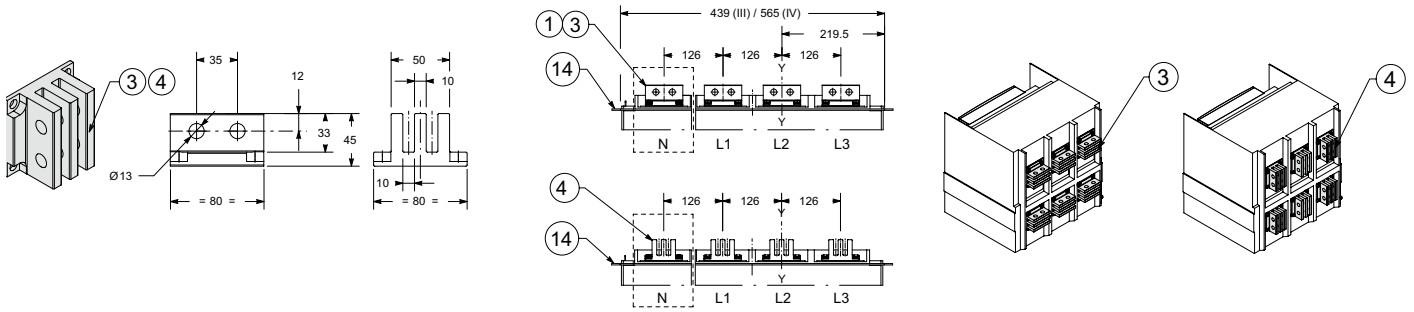
FA4 2500A-3200A **FA4 4000A**



FA4 2500A-3200A



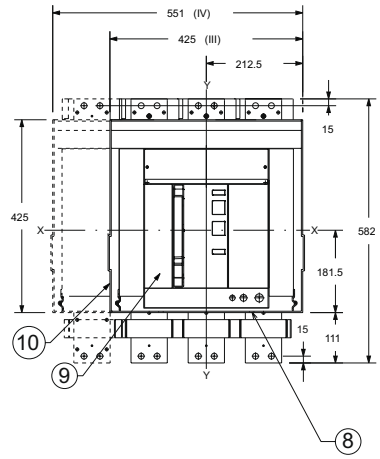
FA4 4000A

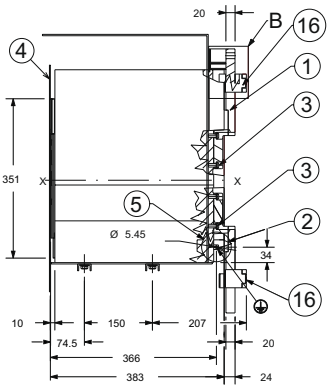


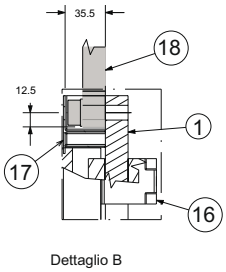
Key

1 Horizontal terminals 2500A - 3200A
2 Vertical terminals 2500A - 3200A
3 Horizontal terminals 4000A
4 Vertical terminals 4000A
5 Tightening torque 2500A - 3200A 20Nm
6 Tightening torque 4000A 20Nm
7 Door position - Ref. page 6/7
8 Earthing device
12 Mobile part
13 Fixed part
14 Segregation (where envisaged)
15 Distance from connected for testing to isolated

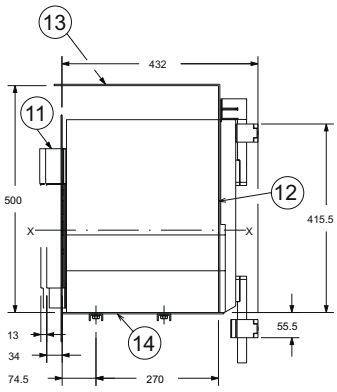
Front terminals – F

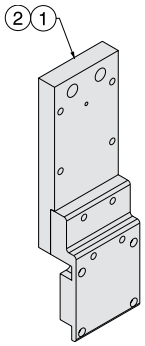


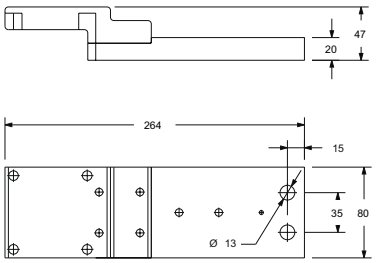


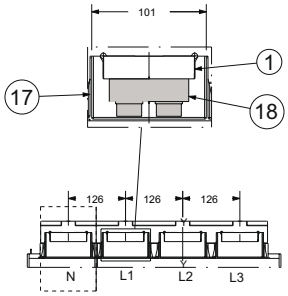


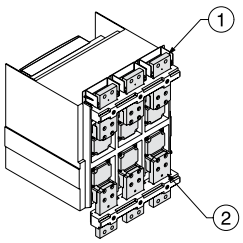
Dettaglio B











Key

1 Upper front terminals
2 Lower front terminals
3 Tightening torque 20Nm
4 Door position - Ref. page 6/2
5 Grounding
6 Ferrule for grounding by the costumer
7 Screw M5x8 provided Tightening torque 3Nm
8 Mounting fixed part Reccomended screws M8x25 high class
9 Moving part
10 Fixed part
11 Crossbeam front terminals
11 Connected, test, disconnected distances
12 Insulating sheet or insulated metallic sheet
13 Roof insulation or insulated metal
14 Fixing plate
16 Crossbeam front terminal
17 Plastic protection
18 Customer busbar and screws (not provided)

Electrical diagrams

Reading information 6/2

Circuit-breakers 6/5

Terminal box 6/6

Electrical accessories 6/7

Electrical diagrams
Reading information

Operating state shown
The diagram is shown in the following conditions:
- withdrawable version circuit-breaker, open and racked-in
- with de-energized circuits
- trip units not tripped
- motor operator with unloaded springs.

Versions
The diagram shows a withdrawable version circuit-breaker, but it is also valid for fixed version circuit-breakers.

Fixed version
The control circuits are included between the XV terminals (the X connector is not supplied).

Withdrawable version
The control circuits are included between the poles of the X connector (the XV terminal box is not supplied).

Description of figures
1) Supplementary open/closed auxiliary contacts of the circuit-breaker - AUX 6Q (6 Form C)
11) Trip signalling contact (S51)
12) Contact for signalling position of loaded springs - S33 M/2
13) Motor for loading closing springs- M
14) Remote reset - YR
20) Ek Measuring with voltage socket inside the four pole circuit-breaker
21) Ek Measuring with voltage sockets inside the three-pole circuit-breaker and connection for external neutral
23) Ek Measuring with external voltage socket
26) Zone selectivity
27) Current sensor input on external neutral (only for 3-pole circuit-breakers)
31) Direct auxiliary supply 24V DC and local bus
32) Auxiliary supply through module 110-240V AC/DC and local bus
71) Ready to close contact - RTC
72) Second opening coil - YO2
73) Undervoltage coil - YU
74) Undervoltage coil with external time-lag device - YU, D
75) First opening coil - YO
77) First closing coil - YC
81) Open/closed auxiliary contacts of circuit-breaker - AUX 4Q (4 Form C)
91) External supplementary open/closed auxiliary contacts of circuit-breaker - AUX 15Q (15 Form C)
96) Auxiliary position contacts
97) Supplementary auxiliary position contacts - AUP

Key

*	= See the note indicated by the letter
A1	= Applications located on the mobile part of the circuit-breaker
A3	= Applications located on the fixed part of the circuit-breaker
A4	= Indicative devices and connections for control and signalling, outside the circuit-breaker
D	= Electronic time-lag device of YU undervoltage coil, outside the circuit-breaker
F1	= Time-delayed trip fuse
GZi	= Zone selectivity input for G protection
GZo	= Zone selectivity output for G protection
K51	= Electronic overcurrent protection trip unit of the types: Ek 1 and Ek 2
K51/MEAS	= Measurement module
K51/SUPPLY	= Optional auxiliary supply module (110-220VAC/DC)
Q	= Circuit-breaker
Q/1...Q/25	= Auxiliary open/close contacts of circuit-breaker
Q/26...Q/27	= Auxiliary open/close contacts used internally by the trip unit
RTC	= Contact for signalling circuit-breaker is ready to close
S33M/1…2	= Limit contacts of spring loading motor
S51	= Trip signalling contact
S75E/1…4	= Contacts for signalling circuit-breaker in racked-out position (provided only with withdrawable version)
S75I/1…4	= Contacts for signalling circuit-breaker in racked-in position (provided only with withdrawable version)
S75T/1…2	= Contact for signalling circuit-breaker in test position (provided only with withdrawable version)
SC	= Pushbutton or contact for closing the circuit-breaker
SO	= Pushbutton or contact for immediate opening of the circuit-breaker
SO1	= Pushbutton or contact for opening the circuit-breaker with time-delayed trip
SR	= Pushbutton or contact for electrical resetting of S51 trip contact
SZi	= Input for zone selectivity for S protection
SZo	= Output for zone selectivity for S protection
TI/L1	= Current transformer phase L1
TI/L2	= Current transformer phase L2
TI/L3	= Current transformer phase L3
TI/N	= Current transformer on neutral
TU1…TU2	= Insulation voltage transformer (outside circuit-breaker)
Uaux	= Auxiliary supply voltage
UI/L1	= Current sensor phase L1
UI/L2	= Current sensor phase L2
UI/L3	= Current sensor on phase L3
UI/N	= Current sensor on neutral
W2	= Serial interface with internal bus (local bus)
X	= Delivery connector for auxiliary circuits for withdrawable version of circuit-breaker
XB1...XB7	= Connectors for circuit-breaker applications
XF	= Delivery terminal board for position contacts of withdrawable version of circuit-breaker
XK1…XK3	= Connectors for auxiliary circuits of the Ek protection trip unit
XV	= Delivery terminal box for auxiliary circuits of fixed version circuit-breaker
YC	= Closing coil
YO	= Opening coil
YO1	= Opening coil for overcurrent
YO2	= Second opening coil
YR	= Coil for electrical resetting of trip contact S51
YU	= Undervoltage coil

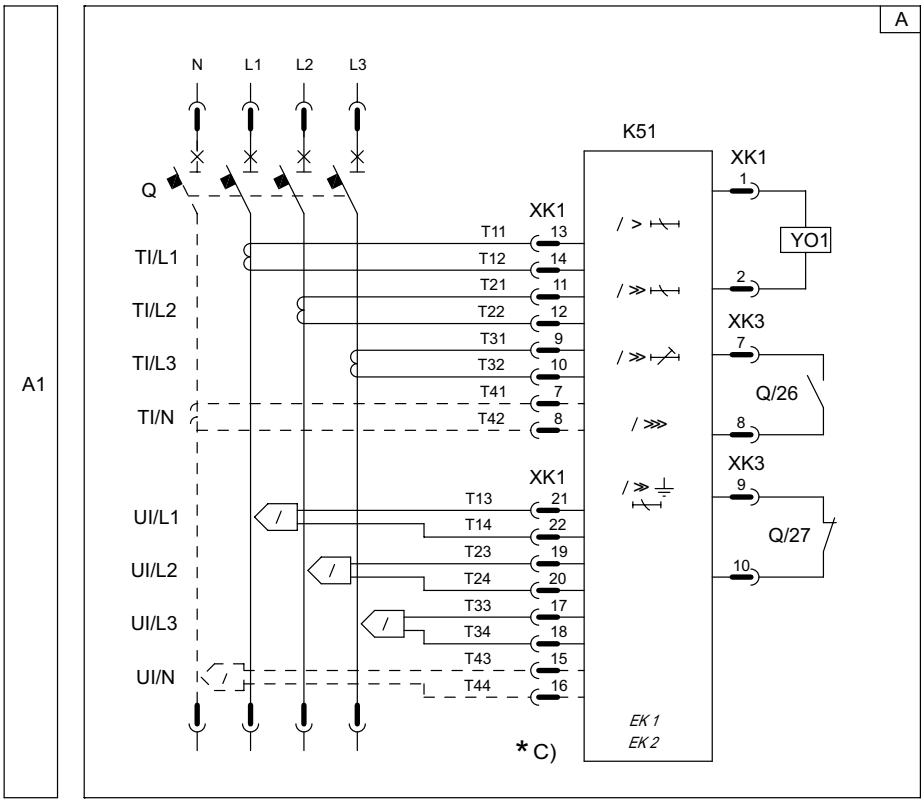
Electrical diagrams
Reading information

Notes

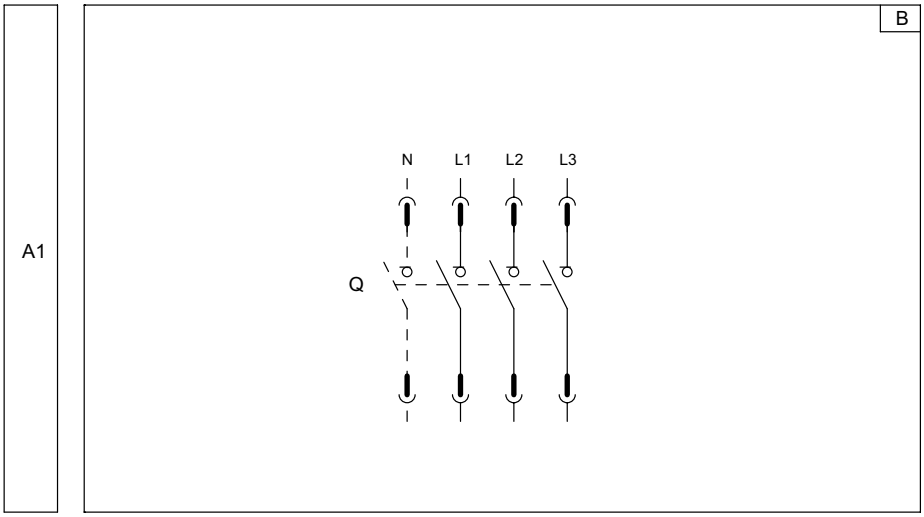
A) Always supplied with motor for loading closing springs in Fig. 13.
B) Obligatory voltage transformer in the case of external sockets. Obligatory external sockets for systems with rated voltage greater than 690V.
C) The connections between the terminal box and external neutral sensor must be made with the 2m cable provided.
D) The auxiliary voltage Uaux. enables activation of all the functions of the Ek electronic protection trip units. Since an earth insulated Uaux was requested, it is necessary to use “galvanically separated convertors” which comply with the standards IEC 60950 or equivalent, which guarantee a common mode current or leakage current (refer to IEC 478/1, CEI 22/3) no greater than 3.5mA, IEC 60364-41 and CEI 64-8.

Electrical diagrams
Circuit-breakers (IEC60617 standards)

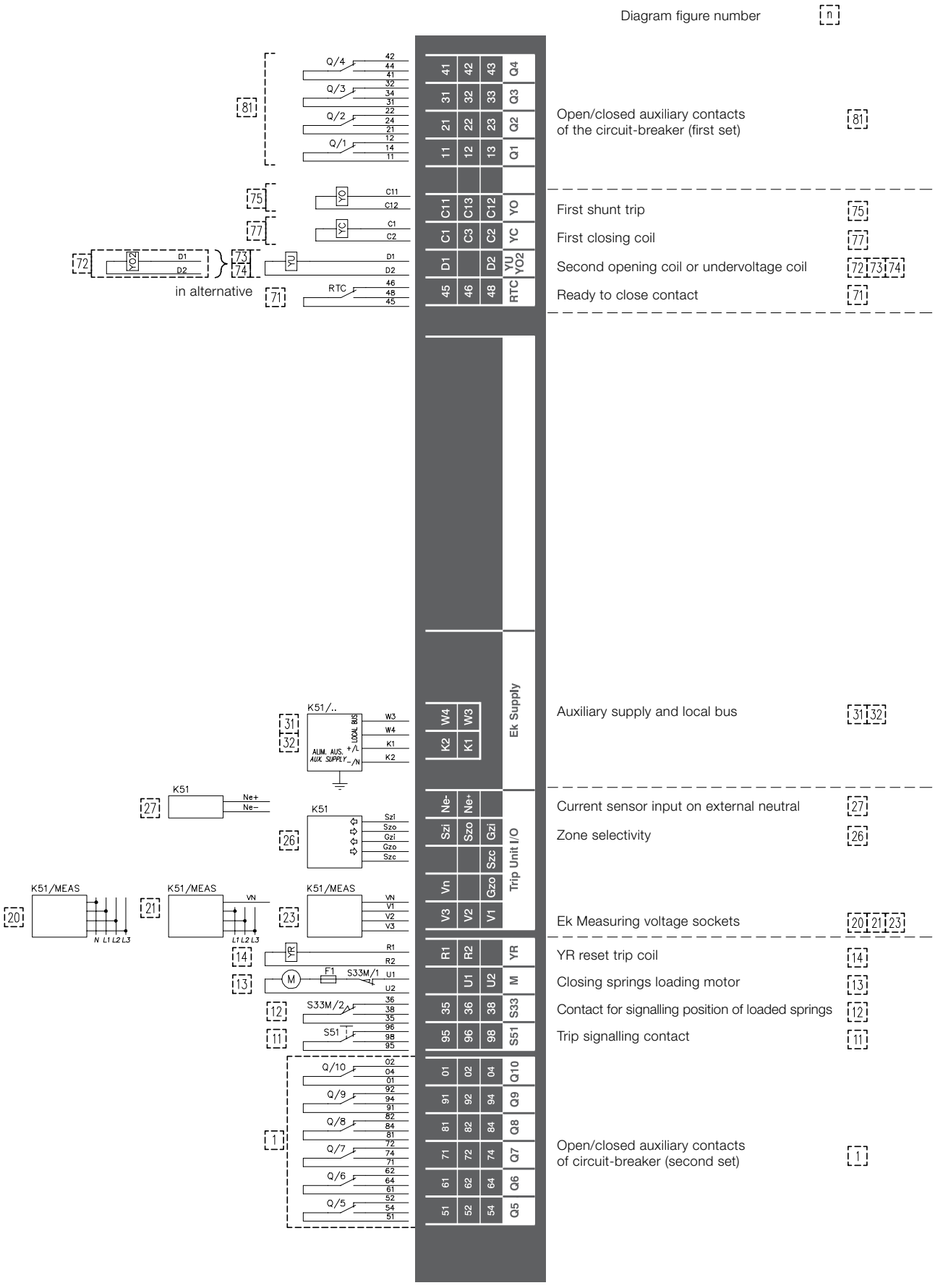
3-pole or 4-pole circuit-breaker



3-pole or 4-pole switch-disconnector

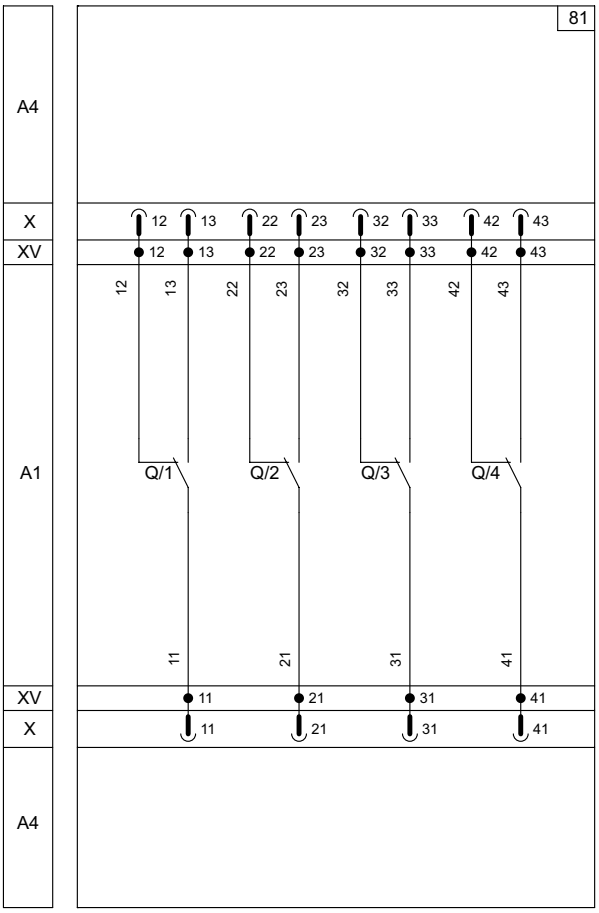


Electrical diagrams
Terminal box

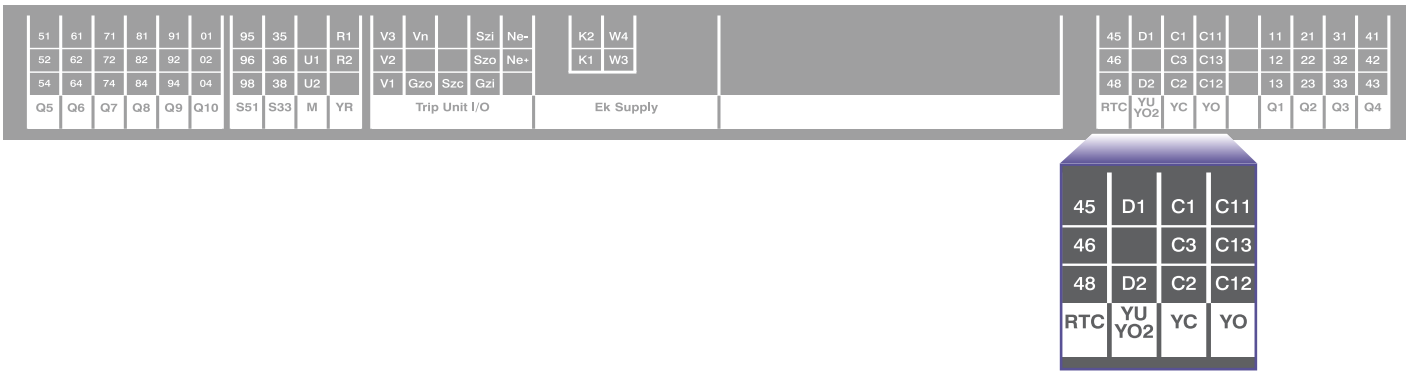


Electrical diagrams
Electrical accessories

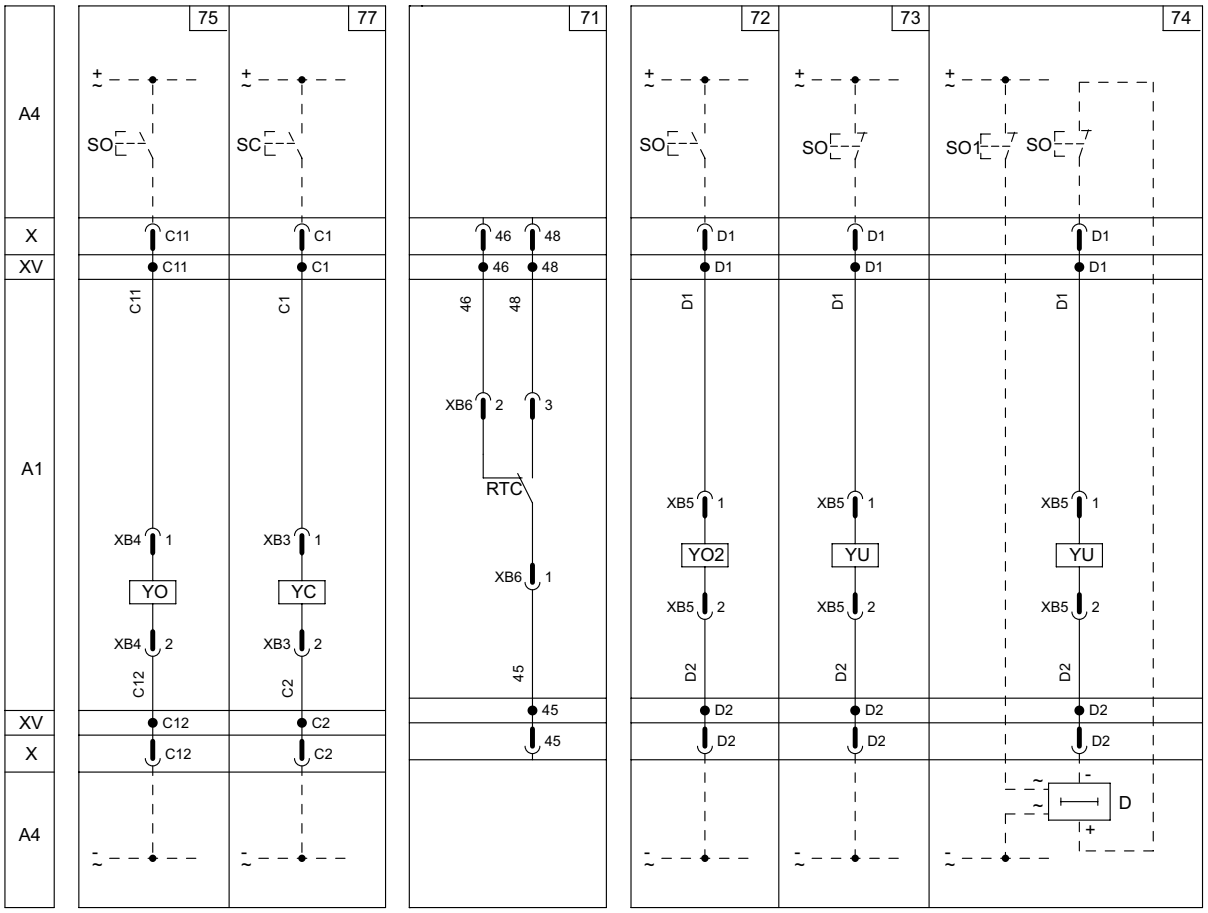
81) Open/closed auxiliary contacts of circuit-breaker - AUX 4Q (4 Form C)



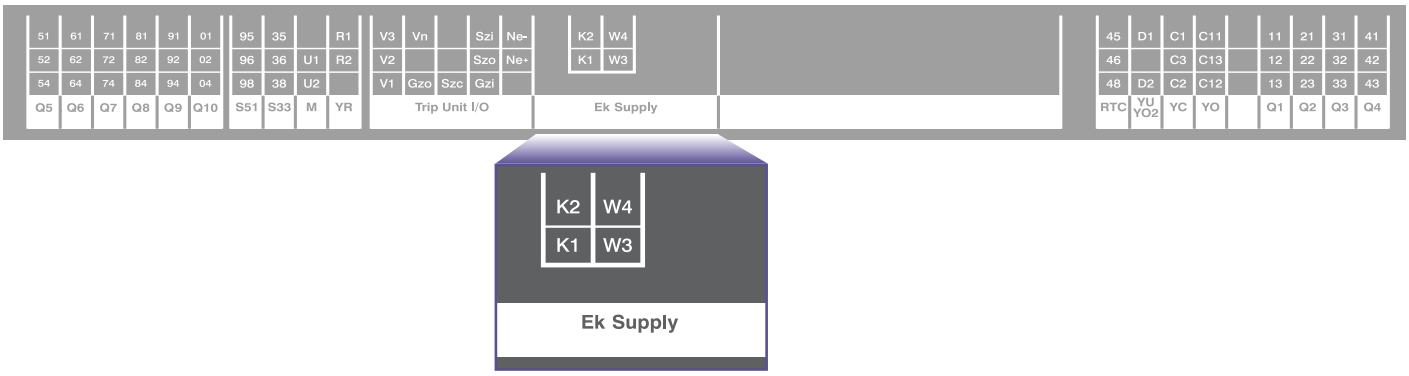
Electrical diagrams
Electrical accessories



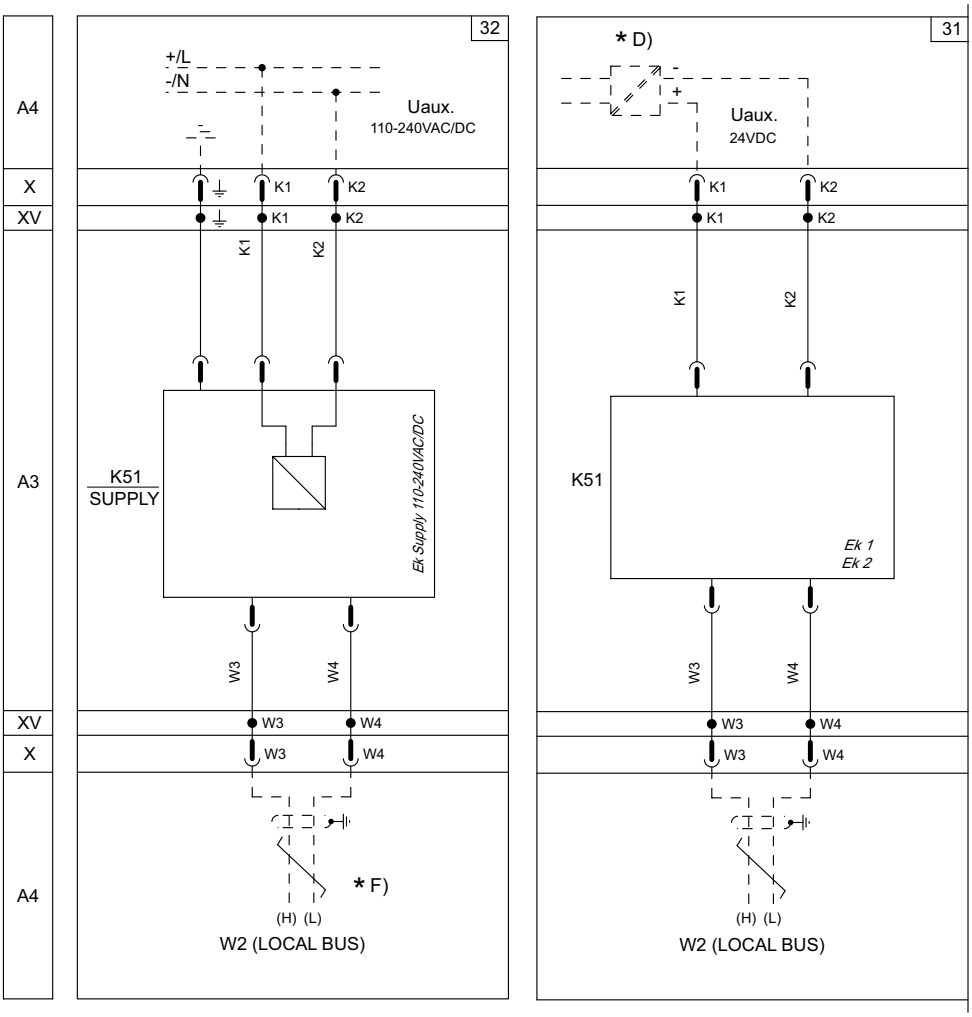
75) First opening coil - YO
77) First closing coil - YC
71) Ready to close signalling contact - RTC
72) Second opening coil - YO2
73) Undervoltage coil - YU
74) Undervoltage coil with external time-lag device - YU, D



72-73-74 as an alternative to each other

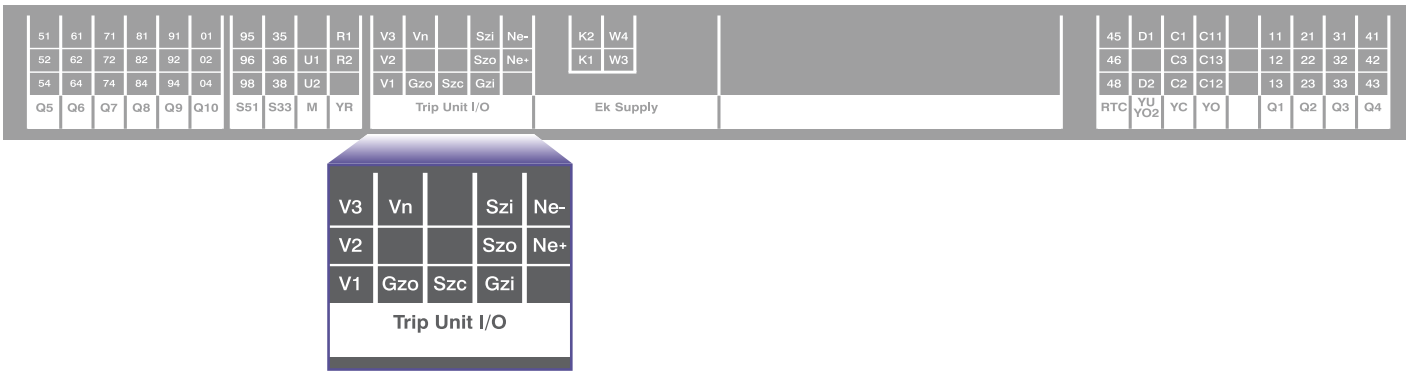


32) Auxiliary supply through module 110-240V AC/DC - Ek Supply
31) Direct auxiliary supply 24V DC and local bus

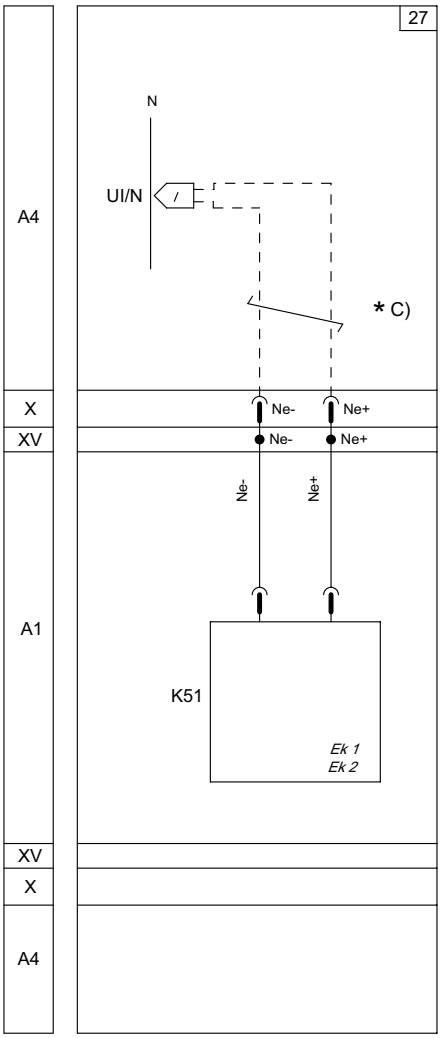


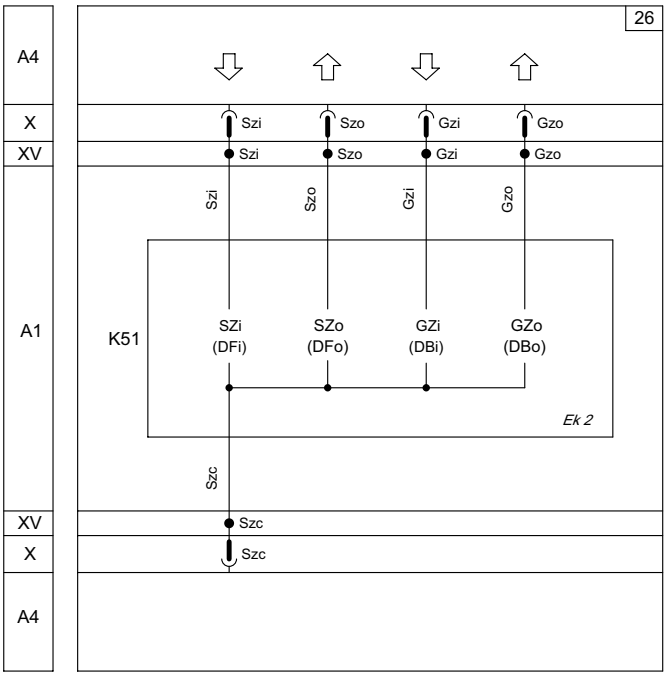
31-32 as an alternative to each other

Electrical diagrams
Electrical accessories

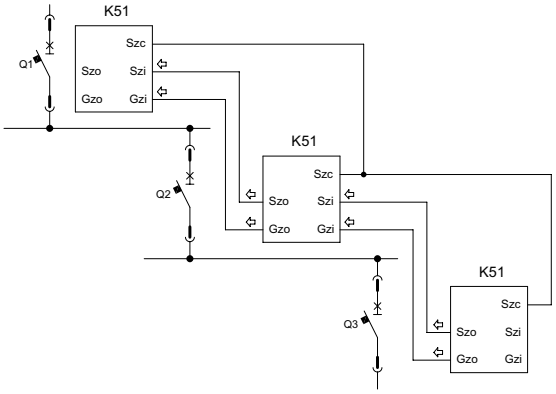


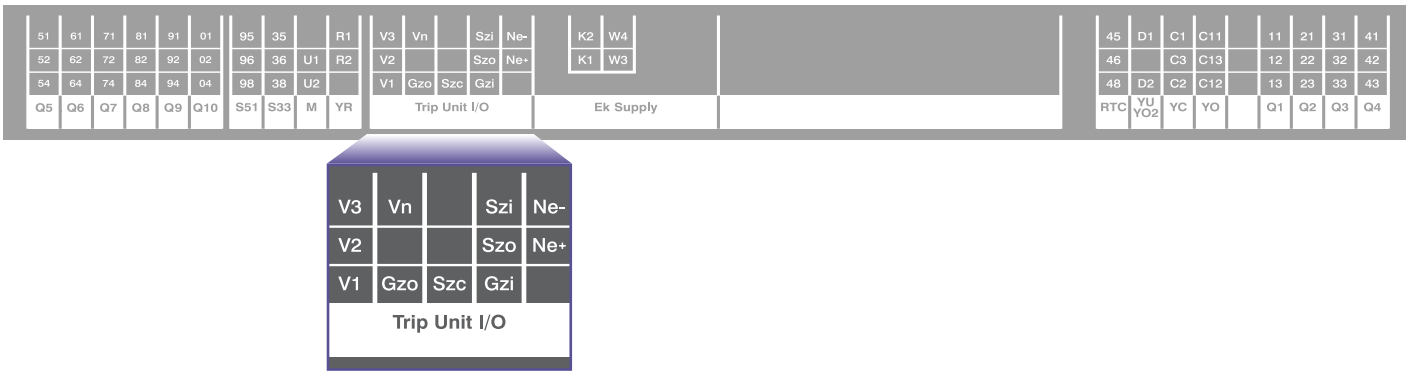
27) Current sensor input on external neutral (only for 3-pole circuit-breakers)
26) Zone selectivity



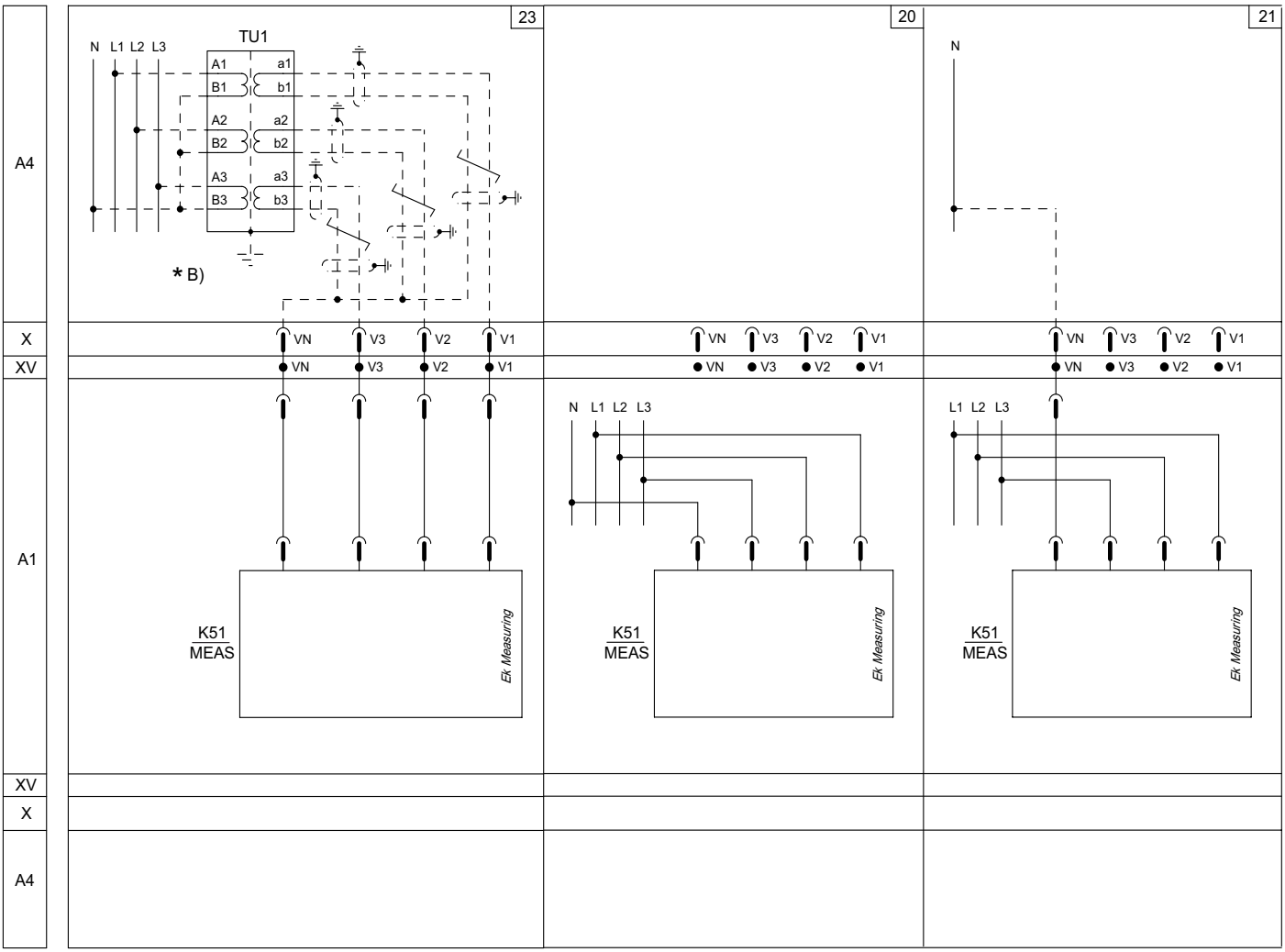


Example for application diagram (among 3 circuit-breakers)



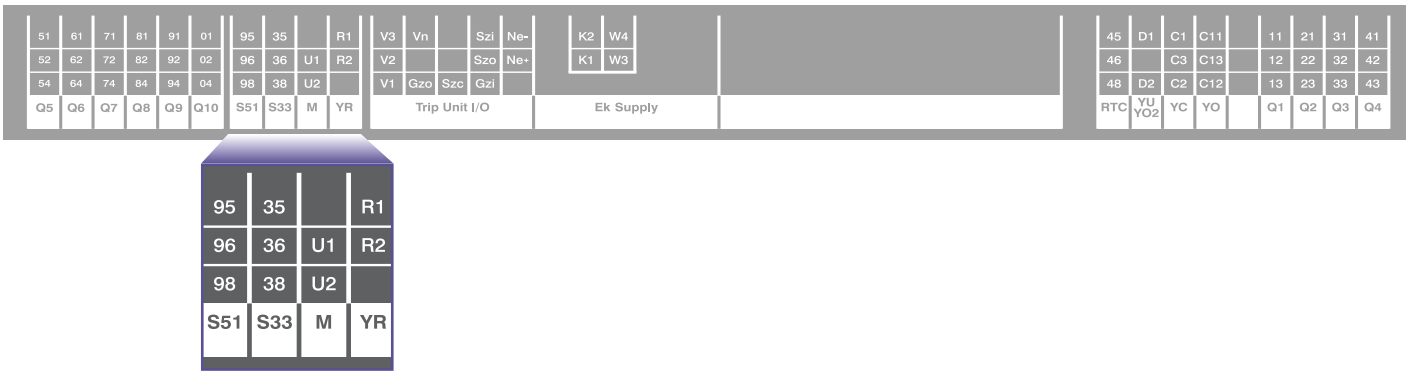


23) Ekip Measuring with external voltage socket
20) Ekip Measuring with voltage socket inside the four pole circuit-breaker
21) Ekip Measuring with voltage sockets inside the three-pole circuit-breaker and connection to the external neutral

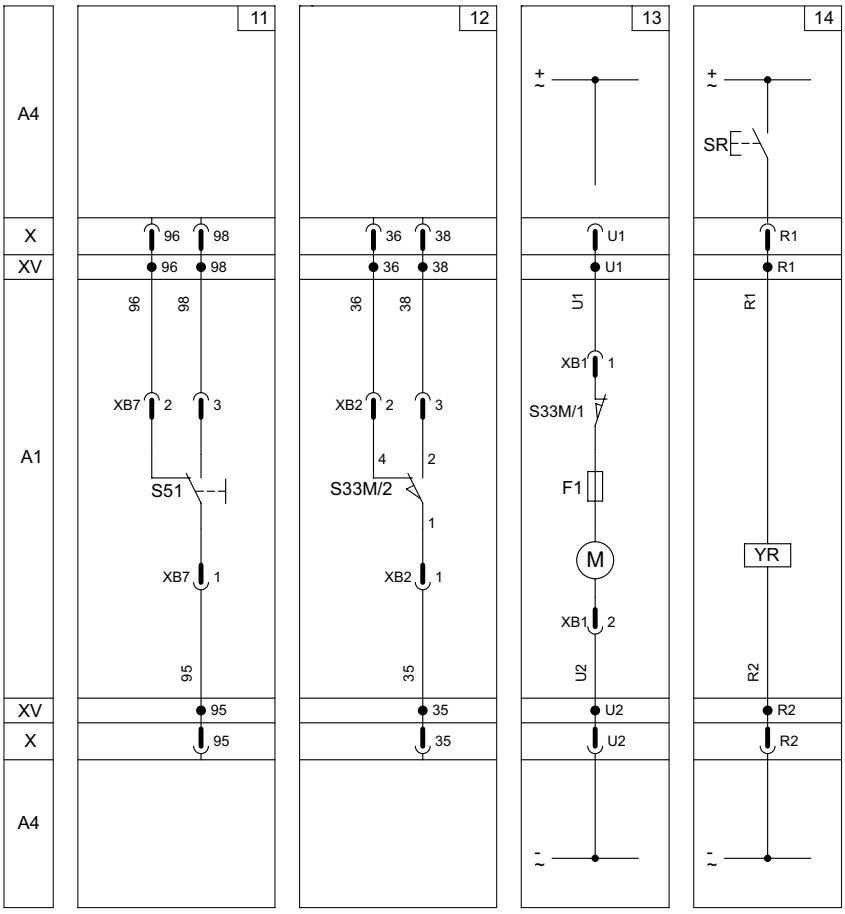


20-21-23 as an alternative to each other

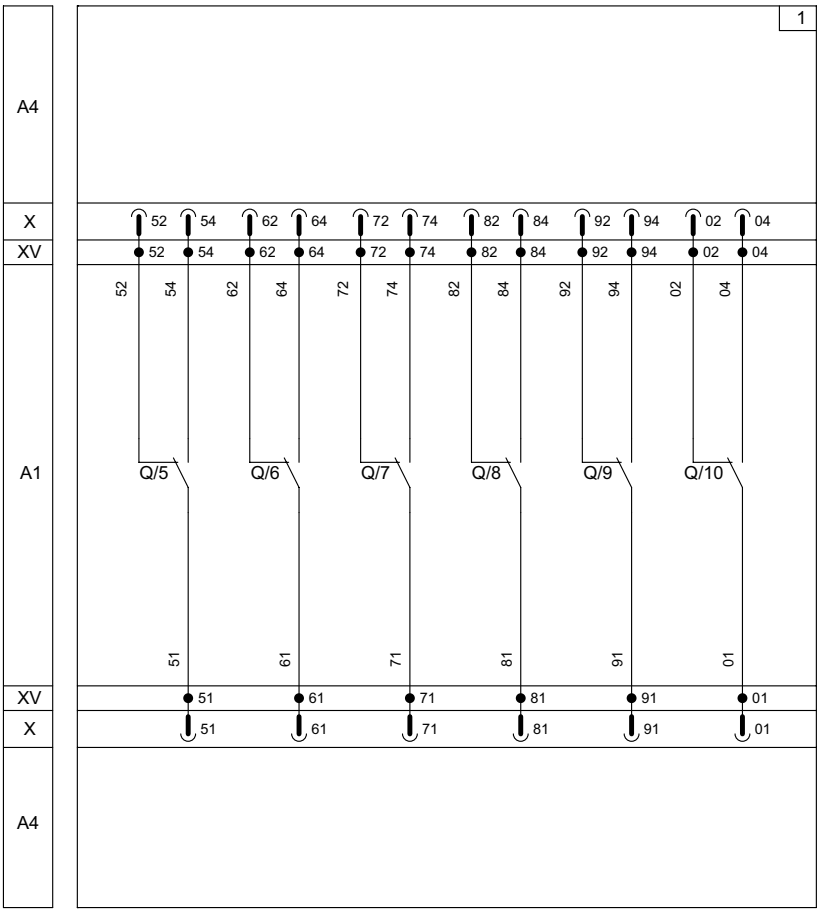
Electrical diagrams
Electrical accessories



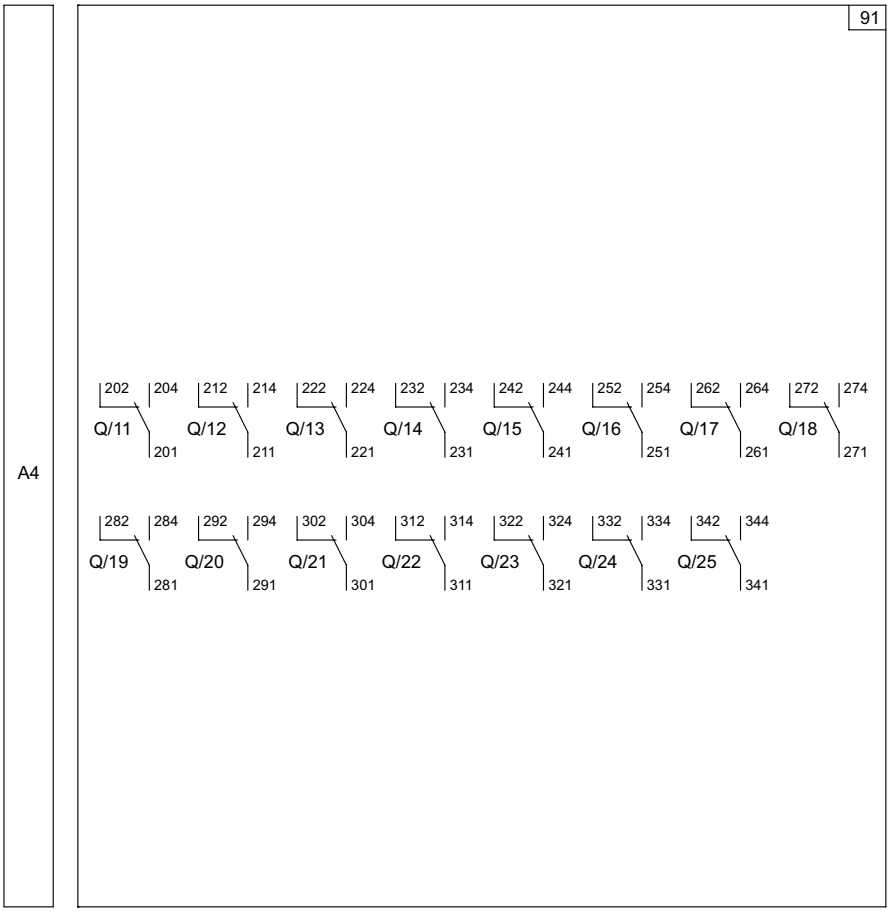
11) Trip signalling contact - S51
12) Contact for signalling position of loaded springs - S33 M/2
13) Motor for loading closing springs - M
14) Trip contact reset coil – YR



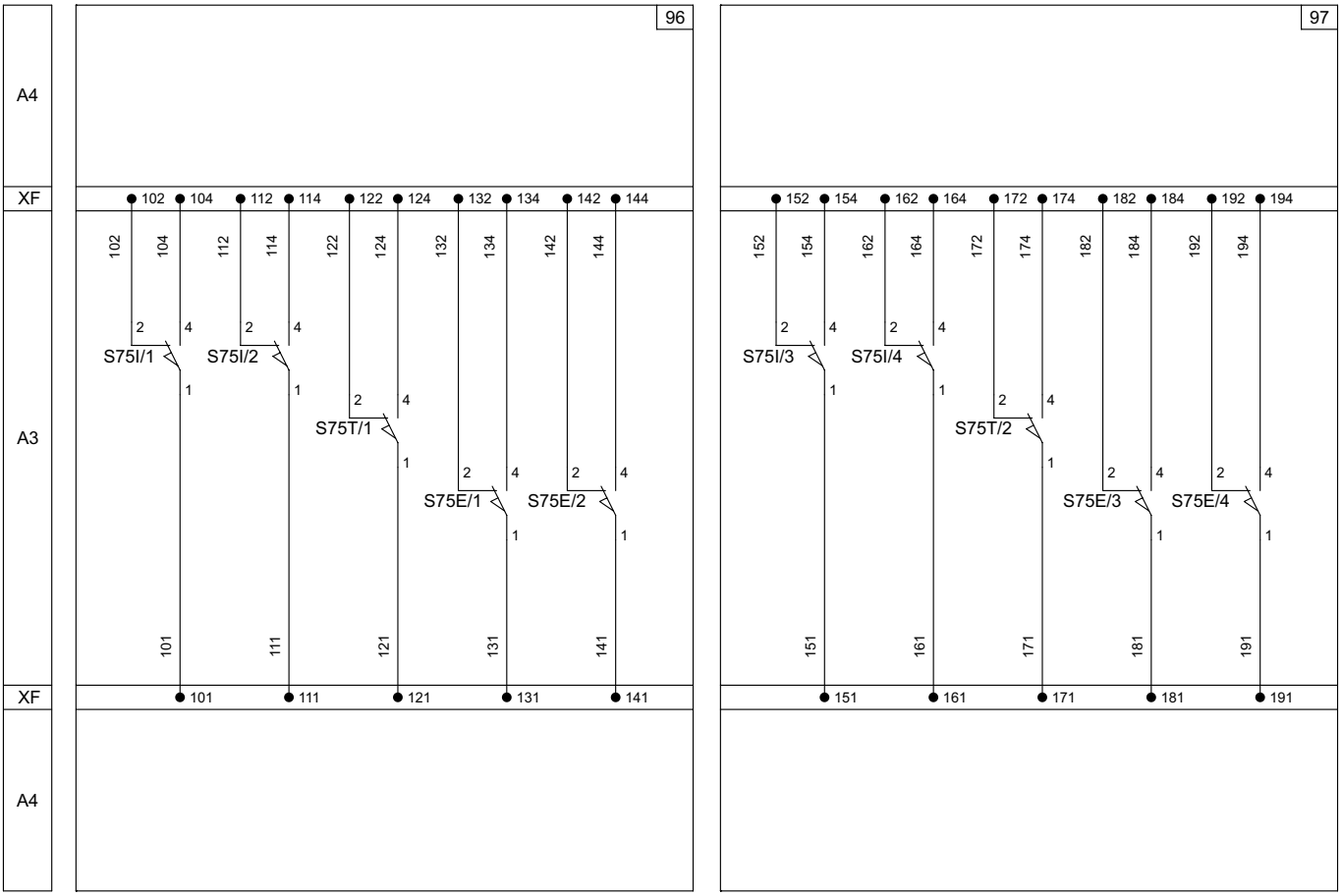
1) Supplementary open/closed auxiliary contacts of the circuit-breaker - AUX 6Q (6 Form C)



91) Supplementary open/closed auxiliary contacts outside the circuit-breaker - AUX 15Q (15 Form C)



96) Auxiliary position contacts - AUP
97) Supplementary auxiliary position contacts - AUP



Only for circuit-breakers FA2, FA4 in withdrawable version

Ordering codes

Instructions for ordering

Ordering examples 7/2

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Automatic circuit-breakers 7/6

Switch-disconnectors 7/7

Fixed parts 7/8

Accessories

Electrical accessories 7/9

Mechanical accessories 7/11

Mechanical interlocks 7/13

Modules 7/14

Terminals 7/15

Instructions for ordering
Ordering examples

Standard version Formula AIR series circuit-breakers are identified by means of commercial codes that can be accessorized. Please not that, for automatic circuit breakers, the breaking unit must be ordered together with a trip unit (Ek 1 or Ek 2), as shown in the examples below.
Step 1: [mandatory] select the breaking part of the automatic circuit-breaker
Step 2: [mandatory] select the trip unit type and version
Step 3: [optional] select mechanical and/or electrical accessories for the circuit-breaker

For fixed parts:
Step 1: select the fixed part
Step 2: [optional] select mechanical and/or electrical accessories for the fixed part

Ordering examples

– **Terminal kit codes** (other than standard supply) for fixed circuit-breaker or for fixed part of withdrawable circuit-breaker.
The codes refer to 3 or 4 pieces (for mounting on top or bottom terminals).
To convert a complete circuit-breaker, 1 kit for upper terminals and 1 kit for lower terminals must be specified in the order.

Example no. 1

FA2C 3 poles fixed with vertica rear terminals (VR)	
1SDA080383R1	FA2C 2000 3p FHR
1SDA080516R1	Ek 2 LSI
1SDA080611R1	Kit VR Up FA2 Iu=2000 3pcs INST
1SDA080612R1	Kit VR Up FA2 Iu=2000 4pcs INST

Example no. 2

FA4N 4 poles fixed with upper vertical rear terminals (VR) and lower front terminals (F)	
1SDA080410R1	FA4N 4000 4p FHR
1SDA080517R1	Ek 2 LSIG
1SDA080620R1	Kit VR Up FA4 Iu=4000 4pcs INST
1SDA080638R1	Kit F Low FA4 F 4pcs INST

Example no. 3

FA2 3 poles fixed part with upper front terminals (F) and rear bottom adjustable horizontal (HR) terminals (standard supply)	
1SDA080507R1	FA2 W FP Iu=2000 HR HR
1SDA080623R1	Kit F Up FA2 W FP 3pcs INST

– **Rating Plug for lower values than rated current.**
Rating plug installed on the circuit-breaker enables to obtain lower current values than rated current.

Example no. 4

FA4N 3200A 3 poles fixed In=2500A	
1SDA080393R1	FA4N 3200 3p FHR
1SDA080609R1	Rating Plug 2500 FA4 INST

– **Ordering for Ek modules.**

Example no. 5

FA2C 3 poles fixed with modules: Ek Supply and Ek Measuring	
1SDA080382R1	FA2C 1600 3p FHR
1SDA080517R1	Ek 2 LSIG
1SDA080584R1	Ek Supply 110-240VAC/DC
1SDA080587R1	Ek Measuring FA2

– Ordering for electrical accessories.

All the accessories and auxiliary contacts are available. In particular, up to 3 coils can be ordered.

Example no. 6

FA4C 3 poles withdrawable with accessories: opening release, closing release, undervoltage release and motor for automatic charging of the springs	
1SDA080421R1	FA4C 2500 3p WMP
1SDA080516R1	Ek 2 LSI
1SDA080519R1	YO FA2-FA4 220-240 Vac/dc
1SDA080521R1	YC FA2-FA4 220-240 Vac/dc
1SDA080523R1	YU FA2-FA4 220-240 Vac/dc
1SDA080525R1	M FA2-FA4 220-250 Vac/dc

– Ordering for locks.

Example no. 7

FA2N 4 poles withdrawable with key lock in open position (KLP) and padlock in racked-in / test / racked-out position (PLP)	
1SDA080436R1	FA2N 2000 4p WMP
1SDA080514R1	Ek 1 LSI
1SDA080541R1	KLC-D Key lock open FA2-FA4
1SDA080557R1	PLP Position padlock D=4/6/8mmFA2-FA4

Instructions for ordering
Ordering examples

– Ordering for mechanical Interlocks.

Interlocks have several strategy configuration, suitable for fixed circuit-breakers and withdrawable circuit-breakers.
Each configuration requires different groups:

- **Cables**, select one kit for strategy A / B / C / D. The cables must be ordered on fixed circuit-breaker or fixed part of withdrawable circuit-breaker.
- **Lever**, select one kit for each fixed circuit-breaker or mobile part of withdrawable ciruit-breaker.
- **Support**, select one kit for each fixed circuit-breaker or fixed part of withdrawable ciruit-breaker. This support is mounted on the external right side of the circuit-breaker or fixed part.

Example no. 8

Interlock between two fixed circuit breakers: FA2 and FA4	
FA2 fixed CB	**FA4 fixed CB**
Cables [Group 1]: 1 item	Lever [Group 2]: 1 item
Lever [Group 2]: 1 item	Support [Group 3]: 1 item
Support [Group 3]: 1 item	

Example no. 9

Interlock between three fixed circuit breakers: two FA2 and one FA4		
FA2 fixed CB	**FA2 fixed CB**	**FA4 fixed CB**
Cables [Group 1]: 1 item	Lever [Group 2]: 1 item	Lever [Group 2]: 1 item
Lever [Group 2]: 1 item	Support [Group 3]: 1 item	Support [Group 3]: 1 item
Support [Group 3]: 1 item		

Example no. 10

Interlock between two withdrawable circuit breakers: FA2 and FA4	
FA2 mobile part	**FA4 mobile part**
Lever [Group 2]: 1 item	Lever [Group 2]: 1 item
+	**+**
FA2 fixed Part	**FA4 fixed Part**
Cables [Group 1]: 1 item	Support [Group 3]: 1 item
Support [Group 3]: 1 item	

Example no. 11

Interlock between three withdrawable circuit breakers: two FA2 and one FA4		
FA2 mobile part	**FA2 mobile part**	**FA4 mobile part**
Lever [Group 2]: 1 item	Lever [Group 2]: 1 item	Lever [Group 2]: 1 item
+	+	+
FA2 fixed Part	**FA2 fixed Part**	**FA4 fixed Part**
Cables [Group 1]: 1 item	Support [Group 3]: 1 item	Support [Group 3]: 1 item
Support [Group 3]: 1 item		

Abbreviations used for the description of the product

Versions and terminals

F	Fixed circuit-breaker
W	Withdrawable circuit-breaker
MP	Mobile part of withdrawable circuit-breaker
FP	Fixed part of withdrawable circuit-breaker
Iu	Rated uninterrupted current
In	Rated current of the rating plug
Icu	Rated ultimate short-circuit breaking capacity
Icw	Rated short-time withstand current
/MS	Switch-disconnector
HR VR	Rear orientable terminals
F	Front terminals

Protection trip units and functions

Ek 1	Protection trip unit for power distribution
Ek 2	Measurement and protection trip unit for power distribution
L	Overload protection
S	Protection against selective short circuit
I	Protection against instantaneous short circuit
G	Earth fault protection

Automatic circuit-breakers

Fixed version

Formula AIR FA2 - FA4, adjustable rear terminals (HR - HR)

Size	Iu	Icu (440 V)	Icw 1s (440V)	Type	3 Poles		4 Poles	
					Code		Code	
FA2C	800	50	50	FA2C 800	1SDA080379R1		1SDA080395R1	
	1000	50	50	FA2C 1000	1SDA080380R1		1SDA080396R1	
	1250	50	50	FA2C 1250	1SDA080381R1		1SDA080397R1	
	1600	50	50	FA2C 1600	1SDA080382R1		1SDA080398R1	
	2000	50	50	FA2C 2000	1SDA080383R1		1SDA080399R1	
FA2N	800	65	65	FA2N 800	1SDA080384R1		1SDA080400R1	
	1000	65	65	FA2N 1000	1SDA080385R1		1SDA080401R1	
	1250	65	65	FA2N 1250	1SDA080386R1		1SDA080402R1	
	1600	65	65	FA2N 1600	1SDA080387R1		1SDA080403R1	
	2000	65	65	FA2N 2000	1SDA080388R1		1SDA080404R1	
FA4C	2500	50	50	FA4C 2500	1SDA080389R1		1SDA080405R1	
	3200	50	50	FA4C 3200	1SDA080390R1		1SDA080406R1	
	4000	50	50	FA4C 4000	1SDA080391R1		1SDA080407R1	
FA4N	2500	65	65	FA4N 2500	1SDA080392R1		1SDA080408R1	
	3200	65	65	FA4N 3200	1SDA080393R1		1SDA080409R1	
	4000	65	65	FA4N 4000	1SDA080394R1		1SDA080410R1	

To be ordered together with an electronic trip unit reported below

Withdrawable version

Formula AIR FA2 - FA4, mobile part of withdrawable breaking unit (MP)

Size	Iu	Icu (440 V)	Icw 1s (440V)	Type	3 Poles		4 Poles	
					Code		Code	
FA2C	800	50	50	FA2C 800	1SDA080411R1		1SDA080427R1	
	1000	50	50	FA2C 1000	1SDA080412R1		1SDA080428R1	
	1250	50	50	FA2C 1250	1SDA080413R1		1SDA080429R1	
	1600	50	50	FA2C 1600	1SDA080414R1		1SDA080430R1	
	2000	50	50	FA2C 2000	1SDA080415R1		1SDA080431R1	
FA2N	800	65	65	FA2N 800	1SDA080416R1		1SDA080432R1	
	1000	65	65	FA2N 1000	1SDA080417R1		1SDA080433R1	
	1250	65	65	FA2N 1250	1SDA080418R1		1SDA080434R1	
	1600	65	65	FA2N 1600	1SDA080419R1		1SDA080435R1	
	2000	65	65	FA2N 2000	1SDA080420R1		1SDA080436R1	
FA4C	2500	50	50	FA4C 2500	1SDA080421R1		1SDA080437R1	
	3200	50	50	FA4C 3200	1SDA080422R1		1SDA080438R1	
	4000	50	50	FA4C 4000	1SDA080423R1		1SDA080439R1	
FA4N	2500	65	65	FA4N 2500	1SDA080424R1		1SDA080440R1	
	3200	65	65	FA4N 3200	1SDA080425R1		1SDA080441R1	
	4000	65	65	FA4N 4000	1SDA080426R1		1SDA080442R1	

To be ordered together with an electronic trip unit reported below

Ek electronic trip units

Size	Type	
		Code
FA2-FA4	Ek 1 LI	1SDA080513R1
FA2-FA4	Ek 1 LSI	1SDA080514R1
FA2-FA4	Ek 1 LSIG	1SDA080515R1
FA2-FA4	Ek 2 LSI*	1SDA080516R1
FA2-FA4	Ek 2 LSIG*	1SDA080517R1
FA2-FA4	Trip Unit Battery**	1SDA080583R1

* Ekip TT is provided as standard supply with Ek 2.
**Spare part. All trip units are already equipped with a battery.

Switch-disconnectors

Fixed version

Formula AIR FA2/MS - FA4/MS, adjustable rear terminals (HR - HR)

Size	Iu	Icu (440 V)	Icw 1s (440V)	Type	3 Poles		4 Poles	
					Code		Code	
FA2C	800	50	50	FA2C/MS 800	1SDA080443R1		1SDA080459R1	
	1000	50	50	FA2C/MS 1000	1SDA080444R1		1SDA080460R1	
	1250	50	50	FA2C/MS 1250	1SDA080445R1		1SDA080461R1	
	1600	50	50	FA2C/MS 1600	1SDA080446R1		1SDA080462R1	
	2000	50	50	FA2C/MS 2000	1SDA080447R1		1SDA080463R1	
FA2N	800	65	65	FA2N/MS 800	1SDA080448R1		1SDA080464R1	
	1000	65	65	FA2N/MS 1000	1SDA080449R1		1SDA080465R1	
	1250	65	65	FA2N/MS 1250	1SDA080450R1		1SDA080466R1	
	1600	65	65	FA2N/MS 1600	1SDA080451R1		1SDA080467R1	
	2000	65	65	FA2N/MS 2000	1SDA080452R1		1SDA080468R1	
FA4C	2500	50	50	FA4C/MS 2500	1SDA080453R1		1SDA080469R1	
	3200	50	50	FA4C/MS 3200	1SDA080454R1		1SDA080470R1	
	4000	50	50	FA4C/MS 4000	1SDA080455R1		1SDA080471R1	
FA4N	2500	65	65	FA4N/MS 2500	1SDA080456R1		1SDA080472R1	
	3200	65	65	FA4N/MS 3200	1SDA080457R1		1SDA080473R1	
	4000	65	65	FA4N/MS 4000	1SDA080458R1		1SDA080474R1	

Withdrawable version

Formula AIR FA2/MS - FA4/MS, mobile part of withdrawable breaking unit (MP)

Size	Iu	Icu (440 V)	Icw 1s (440V)	Type	3 Poles		4 Poles	
					Code		Code	
FA2C	800	50	50	FA2C/MS 800	1SDA080475R1		1SDA080491R1	
	1000	50	50	FA2C/MS 1000	1SDA080476R1		1SDA080492R1	
	1250	50	50	FA2C/MS 1250	1SDA080477R1		1SDA080493R1	
	1600	50	50	FA2C/MS 1600	1SDA080478R1		1SDA080494R1	
	2000	50	50	FA2C/MS 2000	1SDA080479R1		1SDA080495R1	
FA2N	800	65	65	FA2N/MS 800	1SDA080480R1		1SDA080496R1	
	1000	65	65	FA2N/MS 1000	1SDA080481R1		1SDA080497R1	
	1250	65	65	FA2N/MS 1250	1SDA080482R1		1SDA080498R1	
	1600	65	65	FA2N/MS 1600	1SDA080483R1		1SDA080499R1	
	2000	65	65	FA2N/MS 2000	1SDA080484R1		1SDA080500R1	
FA4C	2500	50	50	FA4C/MS 2500	1SDA080485R1		1SDA080501R1	
	3200	50	50	FA4C/MS 3200	1SDA080486R1		1SDA080502R1	
	4000	50	50	FA4C/MS 4000	1SDA080487R1		1SDA080503R1	
FA4N	2500	65	65	FA4N/MS 2500	1SDA080488R1		1SDA080504R1	
	3200	65	65	FA4N/MS 3200	1SDA080489R1		1SDA080505R1	
	4000	65	65	FA4N/MS 4000	1SDA080490R1		1SDA080506R1	

Fixed parts

Size	Performance	Iu max	Type of terminal	Type	3 Poles		4 Poles	
					Code		Code	
FA2	C, N	2000	HR - HR	FA2 W FP Iu=2000 HR HR	1SDA080507R1		1SDA080508R1	
FA4	C, N	3200	HR - HR	FA4 W FP Iu=3200 HR HR	1SDA080509R1		1SDA080510R1	
FA4	C, N	4000	HR - HR	FA4 W FP Iu=4000 HR HR	1SDA080511R1		1SDA080512R1	

Accessories
Electrical accessories

First and second opening release - YO

Size	Type	Code
FA2-FA4	YO 110-120 Vac/dc	1SDA080518R1
FA2-FA4	YO 220-240 Vac/dc	1SDA080519R1

Closing release - YC

Size	Type	Code
FA2-FA4	YC 110-120 Vac/dc	1SDA080520R1
FA2-FA4	YC 220-240 Vac/dc	1SDA080521R1

Undervoltage release - YU

Size	Type	Code
FA2-FA4	YU 110-120 Vac/dc	1SDA080522R1
FA2-FA4	YU 220-240 Vac/dc	1SDA080523R1

Electronic time-delay device for undervoltage release - UVD

Size		Type	Code
FA2-FA4	**UVD**	110..127V AC/DC	1SDA038316R1
FA2-FA4	**UVD**	220..250V AC/DC	1SDA038320R1

Remote Reset - YR

Size	Type	Code
FA2-FA4	YR 110 Vac/dc*	1SDA080529R1
FA2-FA4	YR 250 Vac/Dc*	1SDA080530R1

*when YR is used in DC, the activation must be done with a maximum impulse time of 50ms. The YR cannot be powered permanently

Motor - M

Size	Type	Code
FA2-FA4	M 100-130 Vac/dc + S33 M/2 400V	1SDA080524R1
FA2-FA4	M 220-250 Vac/dc + S33 M/2 400V	1SDA080525R1

Current sensor for neutral conductor outside the circuit-breaker

Size	Type	Code
FA2	Ext CS N FA2 2000A*	1SDA080526R1
FA4	Ext CS N FA4 2500-3200A*	1SDA080527R1
FA4	Ext CS N FA4 4000A*	1SDA080528R1

*Only as loose part

Accessories
Electrical accessories

Open/closed auxiliary contacts - AUX

Size	Type	Code	
FA2-FA4	AUX 4Q 400Vac*	1SDA080531R1	
FA2-FA4	AUX 6Q 400Vac	1SDA080532R1	
FA2-FA4	AUX 15Q 400V (for fixed/withdrawable with signalling in racked in)**	1SDA080533R1	

* standard supply with automatic circuit breakers
** not compatible with mechanical locks on compartment doors or mechanical interlocks

Auxiliary position contacts - AUP

Size	Type	Code	
FA2-FA4	AUP 5 contacts 400V - left set	1SDA080534R1	
FA2-FA4	AUP 5 contacts 400V - right set	1SDA080535R1	

Ready to close signalling contact - RTC

Size	Type	Code	
FA2-FA4	RTC 250Vac	1SDA080536R1	

Contact signalling tripping of Ek protection trip unit - S51

Size	Type	Code	
FA2-FA4	S51 250V	1SDA080538R1	

Terminals for auxiliary connection

Size	Type	Code	
FA2-FA4	Terminals terminal box 10pz	1SDA080539R1	

Accessories
Mechanical accessories

Mechanical operation counter - MOC

Size	Type	Code
FA2-FA4	MOC Mechanical Operation Counter	1SDA080540R1

Key lock in open position - KLC

Size	Type	Code
FA2-FA4	KLC-D Key lock open	1SDA080541R1
FA2-FA4	KLC-S Key lock open N.20005	1SDA080542R1
FA2-FA4	KLC-S Key lock open N.20006	1SDA080543R1
FA2-FA4	KLC-S Key lock open N.20007	1SDA080544R1
FA2-FA4	KLC-S Key lock open N.20008	1SDA080545R1
FA2-FA4	KLC-S Key lock open N.20009	1SDA080546R1

Padlocks in open position - PLC

Size	Type	Code
FA2-FA4	PLC FA2-FA4 Padlocks in open D=4mm	1SDA080547R1
FA2-FA4	PLC FA2-FA4 Padlocks in open D=7mm	1SDA080548R1
FA2-FA4	PLC FA2-FA4 Padlocks in open D=8mm	1SDA080549R1

Key lock in racked-in / test / racked-out position- KLP

Size	Type	Code
FA2-FA4	KLP-D Pos.lock	1SDA080550R1
FA2-FA4	KLP-S Pos.lock N.20005	1SDA080551R1
FA2-FA4	KLP-S Pos.lock N.20006	1SDA080552R1
FA2-FA4	KLP-S Pos.lock N.20007	1SDA080553R1
FA2-FA4	KLP-S Pos.lock N.20008	1SDA080554R1
FA2-FA4	KLP-S Pos.lock N.20009	1SDA080555R1

Accessory for supplementary lock in racked-out position

Size	Type	Code
FA2-FA4	Suppl. locks in racked-out	1SDA080556R1

Padlock in racked-in / test / racked-out position - PLP

Size	Type	Code
FA2-FA4	PLP Position padlock D=4/6/8mm	1SDA080557R1

Protection device for opening and closing pushbuttons - PBC

Size	Type	Code
FA2-FA4	PBC Prot. Pushbuttons AP/CH	1SDA080558R1
FA2-FA4	PBC Prot.Pushb. AP/CH D=4mm	1SDA080559R1
FA2-FA4	PBC Prot.Pushb. AP/CH D=7mm	1SDA080560R1
FA2-FA4	PBC Prot.Pushb. AP/CH D=8mm	1SDA080561R1

Accessories
Mechanical accessories

Lock for racking in / racking out the mobile part when the door is open - DLR

Size	Type	Code	
FA2-FA4	DLR*	1SDA080562R1	

*Only as loose part

Lock to prevent door opening when the circuit-breaker is in racked-in / test position

Size	Type	Code	
FA2-FA4	DLP*	1SDA080563R1	

*Only as loose part

Lock to prevent door opening when circuit-breaker is in closed position - DLC

Size	Type	Code	
FA2-FA4	DLC Interlock cable door	1SDA080564R1	
FA2-FA4	DLC Interlock direct door	1SDA080565R1	

To be ordered with lever for interlock [group 2] and support for interlock [1SDA080581R1]

Phase Barriers - PB

Size	Type	Code	
FA2-FA4	PB Separators 2pz F 3P	1SDA080571R1	
FA2-FA4	PB Separators 3pz F 4P	1SDA080572R1	
FA2-FA4	PB Separators 2pz W FP 3P	1SDA080573R1	
FA2-FA4	PB Separators 3pz W FP 4P	1SDA080574R1	

Circuit-breaker flange

Size	Type	Code	
FA2-FA4	IP30 Flange for fixed circuit-breaker	1SDA080566R1	
FA2-FA4	IP30 Flange for withdrawable circuit-breaker	1SDA080567R1	
FA2-FA4	IP54 Flange different keys FA2-FA4	1SDA080568R1	
FA2-FA4	IP54 Flange key No. 20005 FA2-FA4	1SDA080569R1	
FA2-FA4	Sealable trip unit cover FA2-FA4	1SDA080570R1	

Accessories
Mechanical interlocks

Cables for mechanical interlock [Group 1]

Size	Type	Code
FA2-FA4	Tipo A horizontal	1SDA080575R1
FA2-FA4	Tipo B, C, D horizontal	1SDA080576R1
FA2-FA4	Tipo A vertical	1SDA080577R1
FA2-FA4	Tipo B, C, D vertical	1SDA080578R1

Only one type of cable for each interlock. The cable must be ordered on the fixed circuit-breaker or on the fixed part of withdrawable circuit-breaker

Lever for mechanical interlock of fixed circuit-breaker or mobile part [Group 2]

Size	Type	Code
FA2	Lever for mechanical interlock FA2	1SDA080579R1
FA4	Lever for mechanical interlock FA4	1SDA080580R1

One kit for each fixed circuit-breaker or mobile part of withdrawable circuit-breaker

Support for mechanical interlock of fixed circuit-breaker or fixed part [Group 3]

Size	Type	Code
FA2-FA4	Type A / B / D	1SDA080581R1
FA2-FA4	Type C	1SDA080582R1

One kit for each fixed circuit-breaker or mobile part of withdrawable circuit-breaker

Accessories
Modules

Power supply module

Size	Type	Code
FA2-FA4	Ek Supply 110-240VAC/DC	1SDA080584R1

Trip Test Unit

Size	Type	Code
FA2-FA4	Ekip TT	1SDA080974R1

Measuring modules and options

Size	Type	Code
FA2	Ek Measuring FA2	1SDA080587R1
FA4	Ek Measuring FA4	1SDA080588R1
FA2-FA4	Arrangement for cables with lower internal voltage outlets	1SDA080589R1
FA2-FA4	Arrangement for cables with upper internal voltage outlets	1SDA080590R1
FA2-FA4	Arrangement for cables with external voltage outlets	1SDA080591R1
FA2-FA4	Upper internal installed voltage outlets	1SDA080592R1
FA2-FA4	External installed voltage outlets	1SDA080593R1

Rating plugs

Size	Type	Code (loose supply)		Code (installed)	
FA2-FA4	Rating Plug 630	1SDA080594R1		1SDA080603R1	
FA2-FA4	Rating Plug 800	1SDA080595R1		1SDA080604R1	
FA2-FA4	Rating Plug 1000	1SDA080596R1		1SDA080605R1	
FA2-FA4	Rating Plug 1250	1SDA080597R1		1SDA080606R1	
FA2-FA4	Rating Plug 1600	1SDA080598R1		1SDA080607R1	
FA2-FA4	Rating Plug 2000	1SDA080599R1		1SDA080608R1	
FA4	Rating Plug 2500	1SDA080600R1		1SDA080609R1	
FA4	Rating Plug 3200	1SDA080601R1		1SDA080610R1	
FA4	Rating Plug 4000	1SDA080602R1		-	

Accessories
Terminals

Kit for terminals - installed for fixed circuit breaker

Size	Version	Iu max	Type	3 Poles	4 Poles
				Code	Code
FA2	F	2000	Kit VR Upper	1SDA080611R1	1SDA080612R1
FA2	F	2000	Kit VR Lower	1SDA080613R1	1SDA080614R1
FA2	F	2000	Kit F Upper	1SDA080631R1	1SDA080632R1
FA2	F	2000	Kit F Lower	1SDA080633R1	1SDA080634R1
FA4	F	3200	Kit VR Upper	1SDA080615R1	1SDA080616R1
FA4	F	3200	Kit VR Lower	1SDA080617R1	1SDA080618R1
FA4	F	4000	Kit VR Upper	1SDA080619R1	1SDA080620R1
FA4	F	4000	Kit VR Lower	1SDA080621R1	1SDA080622R1
FA4	F	4000	Kit F Upper	1SDA080635R1	1SDA080636R1
FA4	F	4000	Kit F Lower	1SDA080637R1	1SDA080638R1

Kit for terminals - installed for fixed part of withdrawable circuit breaker

Size	Version	Iu max	Type	3 Poles	4 Poles
				Code	Code
FA2	F	2000	Kit VR Upper	1SDA080639R1	1SDA080640R1
FA2	F	2000	Kit VR Lower	1SDA080641R1	1SDA080642R1
FA2	F	2000	Kit F Upper	1SDA080623R1	1SDA080624R1
FA2	F	2000	Kit F Lower	1SDA080625R1	1SDA080626R1
FA4	F	3200	Kit VR Upper	1SDA080643R1	1SDA080644R1
FA4	F	3200	Kit VR Lower	1SDA080645R1	1SDA080646R1
FA4	F	4000	Kit VR Upper	1SDA080647R1	1SDA080648R1
FA4	F	4000	Kit VR Lower	1SDA080649R1	1SDA080650R1
FA4	F	4000	Kit F Upper	1SDA080627R1	1SDA080628R1
FA4	F	4000	Kit F Lower	1SDA080629R1	1SDA080630R1

Kit for terminals - loose supply for fixed circuit breaker

Size	Version	Iu max	Type	3 Poles	4 Poles
				Code	Code
FA2	F	2000	Kit Adjustable HR/VR	1SDA080651R1	1SDA080652R1
FA2	F	2000	Kit F Upper	1SDA080665R1	1SDA080666R1
FA2	F	2000	Kit F Lower	1SDA080667R1	1SDA080668R1
FA4	F	3200	Kit Adjustable HR/VR	1SDA080653R1	1SDA080654R1
FA4	F	4000	Kit Adjustable HR/VR	1SDA080655R1	1SDA080656R1
FA4	F	4000	Kit F Upper	1SDA080669R1	1SDA080670R1
FA4	F	4000	Kit F Lower	1SDA080671R1	1SDA080672R1

Kit for terminals - loose supply for fixed part of withdrawable circuit breaker

Size	Version	Iu max	Type	3 Poles	4 Poles
				Code	Code
FA2	F	2000	Kit Adjustable HR/VR	1SDA080651R1	1SDA080652R1
FA2	F	2000	Kit F Upper	1SDA080657R1	1SDA080658R1
FA2	F	2000	Kit F Lower	1SDA080659R1	1SDA080660R1
FA4	F	3200	Kit Adjustable HR/VR	1SDA080653R1	1SDA080654R1
FA4	F	4000	Kit Adjustable HR/VR	1SDA080655R1	1SDA080656R1
FA4	F	4000	Kit F Upper	1SDA080661R1	1SDA080662R1
FA4	F	4000	Kit F Lower	1SDA080663R1	1SDA080664R1

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