
TECHNICAL CATALOG

SACE Emax 2/ML

Shockproof circuit breakers



SACE Emax 2/ML

Consultation guide



Chapter 1

Main characteristics

Introduction to the ML family, distinctive features of the series, product conformity and service.



Chapter 4

Advanced features

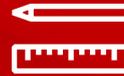
New and simple to use functionalities suitable for every kind of marine power system.



Chapter 2

The ranges

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CHAPTER 1

Main characteristics

- 02-03** **Overview of the SACE ML family**
- 04-05** **Distinctive features**
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Overview of the SACE ML family

Based on the long experience, ABB SACE is proud to offer a new family of circuit breakers for naval application and critical environment which sets a new circuit breaker benchmark for the needs of today and tomorrow.

A modern ship's operational ability is fully dependent on its onboard electrical infrastructure. Over the years, the growth in the number of electrically powered subsystems on a typical naval vessel has made this infrastructure ever more complex and extensive. It has also led to a steady increase in power requirements. These trends lead to new customer and application needs. To meet these demands, ABB has now unveiled the innovative ML family, the evolution of the ABB circuit breaker into a multifunctional platform that is able to manage the next generation of electrical plants such as microgrids.

For over 50 years, ABB SACE has been building shockproof equipment for navies around the world. The considerable installed base of the company's products on ships of the world's main navies underlines the reliability of ABB SACE electrical equipment. Since the 1950s, the company has been manufacturing circuit breakers with special features not available on the same series of equipment destined for general use.





Distinctive features

SACE ML series is the ABB low voltage circuit breakers available from 400 A up to 6300 A and with the ability to efficiently and simply control electrical navy installations – from the traditional to the more complex with the highest availability and continuity of service.

The circuit breakers of the ML series have been realized with opportune changes of the standard version with the purpose to guarantee the operations also in presence of critical environmental conditions.

The low-voltage electrical distribution plants inside the modern ship are driven by these following growing needs:

- Ensure **service continuity** by minimizing the time needed to identify and isolate faults
- Guarantee **space optimization**
- Optimize energy efficiency **maintaining the performance**
- **Safety** and **ease** of use

Reliability and service continuity

ABB SACE ML circuit breakers are the most advanced and complete solution for ensuring service continuity.

With redundant actuators and built in communication modules, ABB ML circuit breakers take electrical system reliability to new levels.

ABB's solution is the only one that uses both a communication bus and electrical connections to prevent, detect and isolate electrical faults. Its unique "digital zone selectivity" function, identifies the fault zone faster and isolate it reducing the stress in the remaining active zone. As a result, the electrical protection is more robust and costly shutdowns are more effectively prevented. Moreover ML series features enhancements to the standard circuit breaker that guarantees operation under stressful conditions:

- **Shock resistance up to 20g (IEC 60068-2-27)**
- High temperatures and humidity range in a saline atmosphere; ML circuit breakers can be used in ambient conditions where air temperature varies between **-25 °C and +70 °C (-13 °F and +158 °F)**
- Presence of vibrations that are persistent and have a high amplitude in specific frequency ranges



Dimension and weight optimization

SACE ML series offers maximum protection, best efficiency and it is the ABB low voltage circuit breakers available from 400 A up to 6300 A. The different levels of rated nominal current and breaking capacity levels have been studied to ensure optimal sizing for all ships' configurations. SACE Emax 2 /ML is the most compact circuit breaker on the market, which makes it possible to reduce the size of switchboards up to 30%. SACE Emax 2 /ML offers the highest performances in the smallest space. Less space is required in the switchgear and in the metal structures. The result is less oversizing, lower weight and, therefore, higher saving related to space optimization. SACE ML series makes it possible to standardize the circuit breaker support structures, considerably simplifying construction of the switchboards themselves. All trip units are easily interchangeable and all communication units can be installed directly on the terminal box with a few simple operations, making the complex system ready for a new digital experience.

Performance

Next-generation ships will use more advanced microgrid technologies to overcome current power distribution challenges. Electrical distribution on a ship is an islanded microgrid, connecting multiple power generators and energy storage systems, that manages directional power flows. By using smart technologies to protect, connect and control the electrical system, ships can operate more efficiently and productively. ML low-voltage circuit breaker is the industry's first smart circuit breaker. Its embedded connectivity and load management software provides a comprehensive energy management solution. The load profile optimization functions of ML circuit breaker reduce CO₂ emissions and fuel costs. The innovative circuit breaker safeguards a ship's mission-critical loads and generators, using advanced adaptive protection to maximize productivity under all conditions.

Safety and ease of use

The ML range is available in fixed and withdrawable versions, with double insulation between the front of the switchgear and the live parts to ensure operation in complete safety. All essential information is available in front shield and enables immediate identification of the status of the circuit breaker: open, closed, ready to close, charged and discharged springs. Maintenance is simple and safe. Thanks to the new front shield design, the main accessories can be installed without completely removing it. As a further guarantee of safety, the shutters of the fixed part can be locked from the front when the circuit breaker mobile part is removed. The shutters of the upper terminals are independent of those of the lower terminals to facilitate checking and maintenance operations. The protection trip units are equipped with a large display which enables safe and intuitive operation. Furthermore the trip units can be programmed and consulted from a tablet, smart phone or portable PC via the Ekip Connect application some the advanced functionalities can be easily programmed thanks to predefined logic templates.

Product conformity

Quality, Sustainability and Customer Satisfaction have always been ABB's major commitment.

Resistance to shock and vibration

The ML circuit breakers are unaffected by vibrations generated mechanically or due to electromagnetic effects, in compliance with the IEC 60068-2-6 Standards and the RINA MIL regulations. Moreover ML circuit breaker are compliant with the following International SHOCK standard:

- IEC 60068-2-27 (20g-11ms)

Approvals and certifications

ABB ML circuit breakers and their accessories conform to the international IEC 60947, EN 60947 (harmonized in 30 CENELEC countries), CEI EN 60947 and IEC 61000 Standards and comply with the following EC directives:

- "Low Voltage Directives" (LVD) no. 2006/95/EC
- "Electromagnetic Compatibility Directive" (EMC) no. 2004/108/EC.

Certification of conformity with the above-mentioned product Standards is carried out in compliance with the European EN 45011 Standard, by the Italian certification body ACAE (Association for the Certification of Electrical Equipment), which is recognized by the European organization LOVAG (Low Voltage Agreement Group), and by the Swedish Intertek SEMKO certification organization Intertek Semko which is recognized by the international organization IECCE.

Product conformity

The involvement of all company departments and organization of processes have led the company to develop, implement and certify management systems in compliance with international Standards:

- ISO 9001 for quality management
- IRIS for the quality of supplies in the railway sector (International Railway Industry Standards)
- ISO 14001 for environmental management
- OHSAS 18001 for the management of the health and safety of employees in the workplace
- SA 8000 for the management of social responsibility.



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The ABB SACE testing laboratory, accredited by ACCREDIA in compliance with ISO/IEC 17025 Standard, provides both ABB and external customers with a qualified service for performing certification tests on devices and electric equipment of low and medium voltage in accordance with the relevant product Standards.

Thanks to the implementation of systems and their integration (Integrated Management System), ABB SACE, with a view to continuous improvement, has implemented processes with a focus on:

- quality, preventing defects and faults along the entire supply chain

- environment, reviewing production processes in terms of ecology and waste reduction, rationalizing the consumption of raw materials and energy, preventing pollution, containing noise emissions and reducing the quantity of rejects in the production processes
- health and safety of employees, offering a healthy and safe workplace in all of the various stages of work with a “zero accident objective”
- social responsibility, guaranteeing the respect of human rights and the absence of any discrimination throughout the supply chain, and offering a favourable and transparent working atmosphere.

A further commitment aimed at safeguarding the environment has been achieved by assessing products' life cycles (LCA, Life Cycle Assessment): this includes the assessment and improvement of the environmental performance of products from the engineering stage throughout their entire life cycle. The materials, processes and packaging used are chosen with a view to optimising the actual environmental impact of each product, including its energy efficiency and recyclability.





CHAPTER 2

The ranges

10-10	Product selection
11-12	Emax 2 E2.2/ML
13-14	Emax 2 E4.2/ML
15-16	Emax 2 E6.2/ML

Product selection



Breaker type	E2.2/ML	E4.2/ML	E6.2/ML
Rated Current [A]	800 - 2500	2000 - 4000	4000 - 6300
Rated service voltage (Ue)	690 Vac	690 Vac	690 Vac
Rated ultimate short-circuit breaking capacity (Icu) at Ue [kA]	66 - 85	66 - 100	100
Trip unit	Electronic	Electronic	Electronic
International standard	IEC 60068-2-27	IEC 60068-2-27	IEC 60068-2-27
Shock resistance	20g 11ms	20g 11ms	20g 11ms
Page	22	24	26

Emax 2 E2.2/ML

Emax 2 E2.2/ML is available in **withdrawable** version

Common data	
Rated uninterrupted current, Iu	[A] 800/1250/1600/2000/2500
Number of poles	3
Rated service voltage, Ue AC 50-60Hz	[V] 690
Rated impulse withstand voltage, Uimp	[kV] 12
Rated insulation voltage, Ui	[V] 1000



Version	Circuit-breakers			Switch-disconnectors		
	N	S	H	N/MS	H/MS	
Rated ultimate short-circuit breaking capacity						
Icu AC 50-60 Hz 440 V	[kA]	66	85	100	-	-
Icu AC 50-60 Hz 690 V	[kA]	66	66	85	-	-
Rated service short-circuit breaking capacity						
Ics AC 50-60 Hz 690 V	[kA]	100%	100%	100%	-	-
Rated service short-circuit making capacity						
Icm AC 50-60 Hz 440 V	[kA]	145	187	220	145	187
Icm AC 50-60 Hz 690 V	[kA]	145	145	187	145	187
Rated short-time withstand current						
Icw (1s)	[kA]	66	66	85	66	85
Reference Standard		IEC 60947-2 Utilization category B			IEC 60947-3 Utilization category AC-23A	

Dimensions	
W [mm]	317
D [mm]	383
H [mm]	425
Weight Including fixed part [kg]	84

SACE EMAX 2 / ML		E2.2		
Mechanical and electrical life with regular ordinary maintenance prescribed by the manufacturer				
	[Iu]	<1600	2000	2500
	[No. cycles x 1000]	25	25	20
Frequency	[Oper./Hour]	60	60	60
Electrical life				
440 V	[No. cycles x 1000]	15	10	8
690 V	[No. cycles x 1000]	15	8	7
Frequency	[Oper./Hour]	30	30	30

Emax 2 E2.2/ML



Trip units	Ekip Touch	Ekip Hi-Touch	Ekip G Touch	Ekip G Hi-Touch
	pag. 46	pag. 47	pag. 48	pag. 49

- Standard accessory for mobile part
- Accessory on request for mobile part
- ▲ Standard accessory for fixed part
- △ Accessory on request for fixed part
- * Only closing release YC

	Automatic circuit-breaker E2.2	Switch disconnecter E2.2
Signalling		
Standard open/closed auxiliary contacts - AUX 4Q	●●	○
Open/closed auxiliary contacts - AUX 6Q	○	○
Auxiliary position contacts - AUP	△	△
Ready to close signalling contact - RTC	○	○
TU Reset mechanical signalling of the tripping of protection trip unit - TU Reset	●●	-
Contact signalling tripping of Ekip protection trip unit - S51	●●	-
Contact signalling loaded springs - S33 M/2 (supplied with Motor)	○	○
Control		
Opening and closing release - YO/YC	○	○
Second opening and closing release - YO2/YC2	○	○
Undervoltage release - YU	○	○
Electronic time-delay device for undervoltage release - UVD	○	○
Motor - M	○	○
Remote reset - YR	○	-
Opening and closing release test unit - YO/YC Test Unit	△	△
Safety		
Key lock in open position - KLC	○	○
Key lock in racked-in / test / racked-out position - KLP	○	○
Mechanical operation counter - MOC	○	○
Protection devices		
Protection device for opening and closing pushbuttons - PBC	○	○
IP30 Protection	▲	▲
IP54 Protection	△	△
Terminal covers - HTC/LTC	-	-
Separators - PB	△	△
Connections		
Orientable rear terminal - HR/VR	▲	▲
Front terminal - F	△	△
Other configurations	△	△

These are all standard supply accessories.

Emax 2 E4.2/ML

Emax 2 E4.2/ML is available in **withdrawable** version

Common data	
Rated uninterrupted current, I _u	[A] 2000/2500/3200/4000
Number of poles	3
Rated service voltage, U _e AC 50-60Hz	[V] 690
Rated impulse withstand voltage, U _{imp}	[kV] 12
Rated insulation voltage, U _i	[V] 1000



Version	Circuit-breakers			Switch-disconnectors			
	N	H	V	N/MS	H/MS	V/MS	
Rated ultimate short-circuit breaking capacity							
I _{cu} AC 50-60 Hz 440 V	[kA]	66	100	150	-	-	-
I _{cu} AC 50-60 Hz 690 V	[kA]	66	85	100	-	-	-
Rated service short-circuit breaking capacity							
I _{cs} AC 50-60 Hz 690 V	[kA]	100%	100%	100% ⁽²⁾	-	-	-
Rated service short-circuit making capacity							
I _{cm} AC 50-60 Hz 440 V	[kA]	145	220	330	145	187	220
I _{cm} AC 50-60 Hz 690 V	[kA]	145	187	220	145	187	220
Rated short-time withstand current							
I _{cw} (1s)	[kA]	65	85	100	65	85	100
Reference Standard		IEC 60947-2 Utilization category B			IEC 60947-3 Utilization category AC-23A		

(2) I_{cs}: 125kA for 400V...440V voltage;

Dimensions	
W [mm]	425
D [mm]	383
H [mm]	425
Weight Including fixed part [kg]	110

SACE EMAX 2 / ML		E4.2		
Mechanical and electrical life with regular ordinary maintenance prescribed by the manufacturer				
	[I _u]	< 2500	3200	4000
	[No. cycles x 1000]	20	20	15
Frequency	[Oper./Hour]	60	60	60
Electrical life				
440 V	[No. cycles x 1000]	10	7	5
690 V	[No. cycles x 1000]	10	7	4
Frequency	[Oper./Hour]	20	20	20

Emax 2 E4.2/ML



Trip units	Ekip Touch	Ekip Hi-Touch	Ekip G Touch	Ekip G Hi-Touch
	pag. 46	pag. 47	pag. 48	pag. 49

- Standard accessory for mobile part
- Accessory on request for mobile part
- ▲ Standard accessory for fixed part
- △ Accessory on request for fixed part
- * Only closing release YC

	Automatic circuit-breaker E 4.2	Switch disconnector E 4.2
Signalling		
Standard open/closed auxiliary contacts - AUX 4Q	●●	○
Open/closed auxiliary contacts - AUX 6Q	○	○
Auxiliary position contacts - AUP	△	△
Ready to close signalling contact - RTC	○	○
TU Reset mechanical signalling of the tripping of protection trip unit - TU Reset	●●	-
Contact signalling tripping of Ekip protection trip unit - S51	●●	-
Contact signalling loaded springs - S33 M/2 (supplied with Motor)	○	○
Control		
Opening and closing release - YO/YC	○	○
Second opening and closing release - YO2/YC2	○	○
Undervoltage release - YU	○	○
Electronic time-delay device for undervoltage release - UVD	○	○
Motor - M	○	○
Remote reset - YR	○	-
Opening and closing release test unit - YO/YC Test Unit	△	△
Safety		
Key lock in open position - KLC	○	○
Key lock in racked-in / test / racked-out position - KLP	○	○
Mechanical operation counter - MOC	○	○
Protection devices		
Protection device for opening and closing pushbuttons - PBC	○	○
IP30 Protection	▲	▲
IP54 Protection	△	△
Terminal covers - HTC/LTC	-	-
Separators - PB	△	△
Connections		
Orientable rear terminal - HR/VR	▲	▲
Front terminal - F	△	△
Other configurations	△	△

These are all standard supply accessories.

Emax 2 E6.2/ML

Emax 2 E6.2/ML is available in **withdrawable** version

Common data	
Rated uninterrupted current, Iu	[A] 4000/5000/6300
Number of poles	3
Rated service voltage, Ue AC 50-60Hz	[V] 690
Rated impulse withstand voltage, Uimp	[kV] 12
Rated insulation voltage, Ui	[V] 1000



Version	Circuit-breakers		Switch-disconnectors	
	H	V	H/MS	X/MS
Rated ultimate short-circuit breaking capacity				
Icu AC 50-60 Hz 440 V	[kA] 100	150	-	-
Icu AC 50-60 Hz 690 V	[kA] 100	100	-	-
Rated service short-circuit breaking capacity				
Ics AC 50-60 Hz 690 V	[kA] 100%	100%	-	-
Rated service short-circuit making capacity				
Icm AC 50-60 Hz 440 V	[kA] 220	330	220	264
Icm AC 50-60 Hz 690 V	[kA] 220	220	220	264
Rated short-time withstand current				
Icw (1s)	[kA] 100	100	100	120
Reference Standard	IEC 60947-2 Utilization category B		IEC 60947-3 Utilization category AC-23A	

Dimensions	
W [mm]	803
D [mm]	383
H [mm]	425
Weight Including fixed part [kg]	207

	SACE EMAX 2 / ML	E6.2
Mechanical and electrical life with regular ordinary maintenance prescribed by the manufacturer		
	[Iu]	4000 6300
	[No. cycles x 1000]	12 12
Frequency	[Oper./Hour]	60 60
Electrical life		
440 V	[No. cycles x 1000]	4 2
690 V	[No. cycles x 1000]	4 2
Frequency	[Oper./Hour]	10 10

Emax 2 E6.2/ML



Trip units	Ekip Touch	Ekip Hi-Touch	Ekip G Touch	Ekip G Hi-Touch
	pag. 46	pag. 47	pag. 48	pag. 49

- Standard accessory for mobile part
- Accessory on request for mobile part
- ▲ Standard accessory for fixed part
- △ Accessory on request for fixed part
- * Only closing release YC

	Automatic circuit-breaker E 6.2	Switch disconnecter E 6.2
Signalling		
Standard open/closed auxiliary contacts - AUX 4Q	●●	○
Open/closed auxiliary contacts - AUX 6Q	○	○
Auxiliary position contacts - AUP	△	△
Ready to close signalling contact - RTC	○	○
TU Reset mechanical signalling of the tripping of protection trip unit - TU Reset	●●	-
Contact signalling tripping of Ekip protection trip unit - S51	●●	-
Contact signalling loaded springs - S33 M/2 (supplied with Motor)	○	○
Control		
Opening and closing release - YO/YC	○	○
Second opening and closing release - YO2/YC2	○	○
Undervoltage release - YU	○	○
Electronic time-delay device for undervoltage release - UVD	○	○
Motor - M	○	○
Remote reset - YR	○	-
Opening and closing release test unit - YO/YC Test Unit	△	△
Safety		
Key lock in open position - KLC	○	○
Key lock in racked-in / test / racked-out position - KLP	○	○
Mechanical operation counter - MOC	○	○
Protection devices		
Protection device for opening and closing pushbuttons - PBC	○	○
IP30 Protection	▲	▲
IP54 Protection	△	△
Terminal covers - HTC/LTC	-	-
Separators - PB	△	△
Connections		
Orientable rear terminal - HR/VR	▲	▲
Front terminal - F	△	△
Other configurations	△	△

These are all standard supply accessories.



CHAPTER 3

Trip units

18-19	Protection trip units
20-21	Ekip Touch
22-31	Protection functions

Protection trip units

SACE ML trip units are the new benchmark for the protection, measurement and control of low voltage electrical systems. The result of ABB SACE's experience and research, they make ML circuit-breaker, embedding advanced functionalities, to become an all-in-one solution for as well distribution systems and microgrid.

The protection units are divided into different families which can be suitable for distribution protection and for generator protection. The range of trip units is available with many levels of performance to satisfy simple to advanced applications.

Thanks to their simplicity of assembly, the end customer can change the type of trip unit extremely rapidly, according to their own requirements and needs. This means an increased flexibility of use of the circuit-breakers with considerable savings in terms of costs thanks to better rationalisation of stock management. The complete, flexible protection trip unit offering, which can be adapted to the actual level of protection required, is shown in the following pages.

SACE Emax 2 Ekip protection trip units are the new benchmark for the protection, measurement and control of low voltage electrical systems. The protection units, available in the LSI and LSI G versions, are divided into two families: Ekip for distribution protection and Ekip G for generator protection.

The Ekip trip units are designed to protect a vast range of applications, such as use with transformers, motors and drives. Ekip Dip, Ekip Touch or Ekip Hi-Touch can be selected, depending on the complexity of the system, the need to take voltage or energy measurements or to include control systems in switchgear.

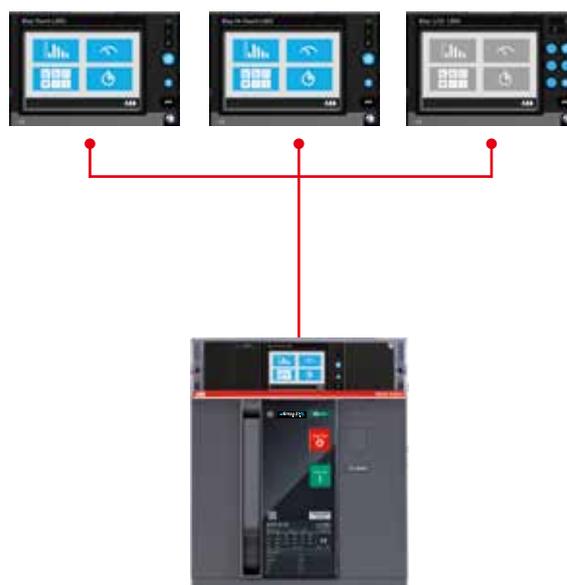
Ekip G enables the protection of generators without the use of external devices that require dedicated relays and wiring. Ekip G increases efficiency from the design stage to installation, minimizing the time needed for realization and commissioning of the system, and ensuring high levels of accuracy and reliability of all protection devices required for running generators in applications such as naval, GenSet or cogeneration. Thanks to the Network Analyzer function integrated in all Hi-Touch versions, the quality of energy in terms of harmonics, micro-interruptions or voltage dips is monitored without the need for dedicated instrumentation. This allows effective preventive and corrective action to be implemented through accurate analysis of the faults, thereby improving the efficiency of the system. Here below there is a summary of the trip units portfolio for Emax 2 ML circuit breaker.

All ML circuit-breakers are equipped with protection trip units that are interchangeable from the front with just a few, simple operations by the customer.

This enables personalization of the functions available, even during commissioning or when the circuit-breaker has already been installed. In particular, consists of:

- **Protection trip unit**, available with different interfaces and versions that range from basic to more complete; it contains a latest generation microprocessor that performs all the functions of protection and control.
- **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.

- **Main board** is the mechanical housing of the trip unit, which includes a micro-controller for measuring currents and the self-protection functions. The separation of trip units ensures excellent reliability and immunity to conducted and radiated emissions. Integrated new generation Rogowski sensors, which are sensitive to the true r.m.s. value of the current, guarantee high accuracy of both measurements and protection.



Ekip Touch

Ekip Touch is the new protection trip unit for SACE Emax 2 that provides a complete series of protections and high accuracy measurements of all electric parameters and can be integrated perfectly with the most common automation and supervision systems.

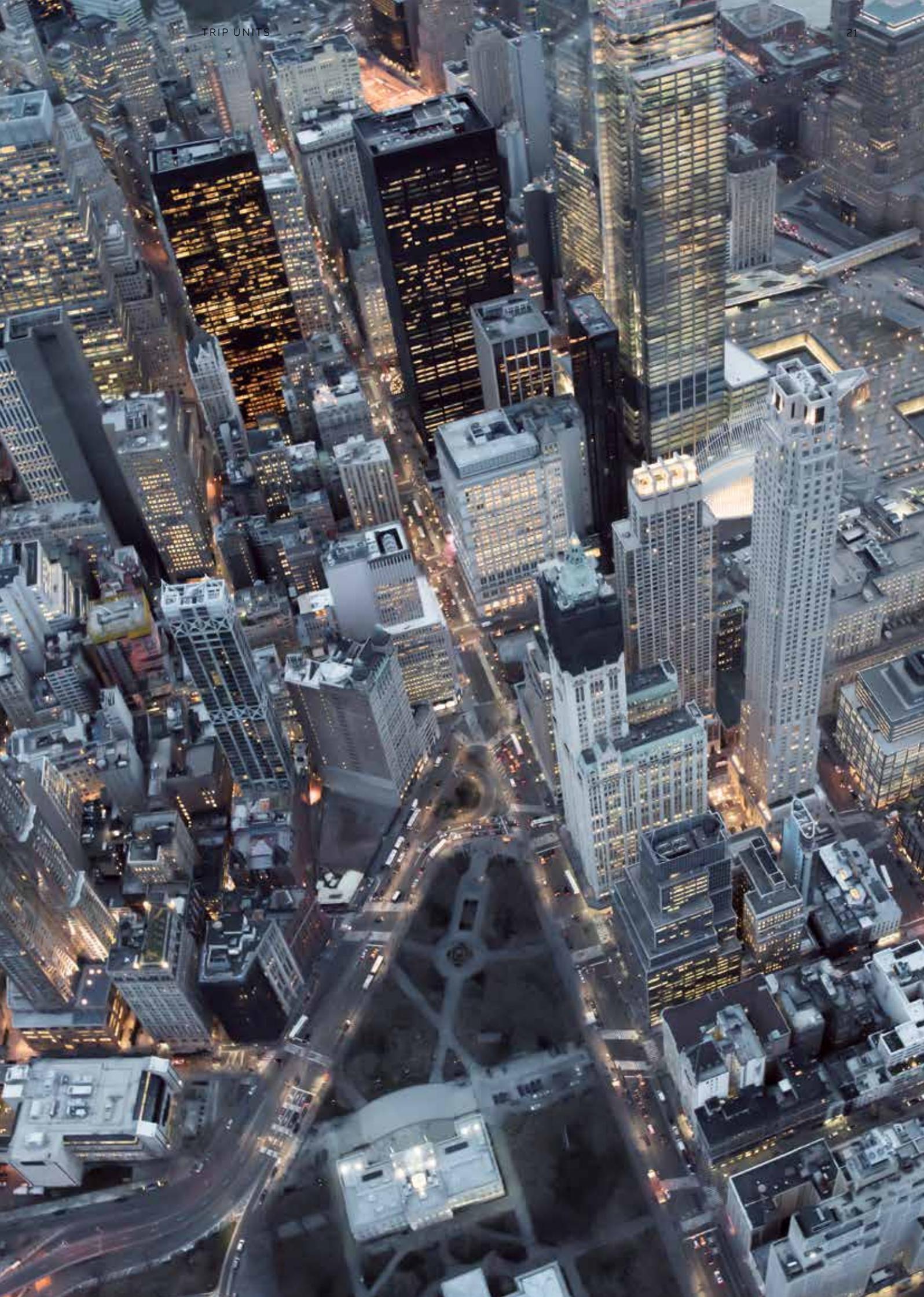
The simple and intuitive interface enables the operator to access all the information and settings rapidly and easily by minimizing installation and commissioning time.

For more info about the trip unit functionalities please check the Emax 2 catalogue.

Key:

1. Wide high-resolution colour touch-screen 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





Protection functions

ABB Code	ANSI Code	Function	Threshold	Threshold step	Trip time	Time Step
L	49	Overload Protection	$I_1 = 0.4...1 \times I_n$	$0.001 \times I_n$	with $I = 3 I_1$, $t_1 = 3...144 \text{ s}$	1s
		Thermal Memory				
	Tolerance	trip between 1.05 and $1.2 \times I_1$			$\pm 10\% I \leq 6 \times I_n / \pm 20\% I > 6 \times I_n$	
	49	Overload Protection	$I_1 = 0.4...1 \times I_n$	$0.001 \times I_n$	with $I = 3 I_1$, $t_1 = 3...144 \text{ s}$ Standard inverse SI: $k=0.14 \alpha=0,02$ Very Inverse VI: $k=13.5 \alpha=1$ Extremely Inverse EI: $k=80 \alpha=2$ $t=k/I_4$: $k=80 \alpha=4$	1s
	Tolerance	trip between 1.05 and $1.2 \times I_1$			$\pm 10\% I \leq 6 \times I_n / \pm 20\% I > 6 \times I_n$	
S	50TD	Time-delayed overcurrent protection	$I_2 = 0.6...10 \times I_n$	$0.1 \times I_n$	With $I > I_2$, $t_2 = 0.05...0.8 \text{ s}$	0.01s
	68	Zone selectivity			$t_{2sel} = 0.04...0.2 \text{ s}$	0.01s
		Start up	Activation: $0.6...10 \times I_n$	$0.1 \times I_n$	Range: $0.1...30 \text{ s}$	0.01s
	Tolerance	$\pm 7\% I \leq 6 \times I_n$ $\pm 10\% I > 6 \times I_n$			The better of the two data: $\pm 10\%$ or $\pm 40 \text{ ms}$	
51	Time-delayed overcurrent protection	$I_2 = 0.6...10 \times I_n$	$0.1 \times I_n$	with $I = 10 I_n$, $t_2 = 0.05...0.8 \text{ s}$	0.01s	
	Thermal Memory					
	Tolerance	$\pm 7\% I \leq 6 \times I_n$ $\pm 10\% I > 6 \times I_n$			$\pm 15\% I \leq 6 \times I_n$ $\pm 20\% I > 6 \times I_n$	
I	50	Istantaneous overcurrent protection	$I_3 = 1.5...15 \times I_n$	$0.1 \times I_n$	With $I > I_3$, instantaneous	-
		Start up	Activation: $1.5...15 \times I_n$	$0.1 \times I_n$	Range: $0.1...30 \text{ s}$	0.01s
		Tolerance	$\pm 10\%$		$\leq 30 \text{ ms}$	
G	50N TD	Earth fault protection	$I_4^{(1)} = 0.1...1 \times I_n$	$0.001 \times I_n$	with $I > I_4$, $t_4 = \text{Instantaneous (with Vaux) } + 0.1...1 \text{ s}$	0.05s
	68	Zone selectivity			$t_{4sel} = 0.04...0,2 \text{ s}$	0.01s
		Start up	Activation: $0.2...1 \times I_n$	$0.02 \times I_n$	range: $0.1...30 \text{ s}$	0.01s
		Tolerance	$\pm 7\%$		The better of the two data: $\pm 10\%$ or $\pm 40 \text{ ms}$ or 50 ms with $t_4 = \text{instantaneous}$	
	51N	Earth fault protection	$I_4^{(1)} = 0.1...1 \times I_n$	$0.001 \times I_n$	with $I = 4 I_n$, $t_4 = 0.1...1 \text{ s}$	0.05s
		Tolerance	$\pm 7\%$		$\pm 15\%$	
IU	46	Current unbalance protection	$I_6 = 2...90\% I_n$ unbalance	$1\% I_n$	with unbalance $> I_6$, $t_6 = 0.5...60 \text{ s}$	0.5s
		Tolerance	$\pm 10\%$		The better of the two data: $\pm 10\%$ or $\pm 40 \text{ ms}$ (for $t < 5 \text{ s}$) / $\pm 100 \text{ ms}$ (for $t \geq 5 \text{ s}$)	
2I	50	Programmable instantaneous overcurrent protection	$I_{31} = 1.5...15 \times I_n$	$0.1 \times I_n$	with $I > I_{31}$, instantaneous	
		Tolerance	$\pm 10\%$		$\leq 30 \text{ ms}$	
MCR		Closing on short-circuit protection	$I_3 = 1.5...15 \times I_n$	$0.1 \times I_n$	With $I > I_3$, instantaneous Monitor time range: $40...500 \text{ ms}$	0.01s
		Tolerance	$\pm 10\%$		$\leq 30 \text{ ms}$	
Gext	50G TD	Earth fault protection	$I_{41}^{(1)} = 0.1...1 \times I_n$ Toroid	$0.001 \times I_n$ Toroid	with $I > I_{41}$, $t_{41} = 0.1...1 \text{ s}$	0.05s
	68	Zone selectivity			$t_{41sel} = 0.04...0,2 \text{ s}$	0.01s
		Start up	Activation: $0.1...1 \times I_n$	$0.02 \times I_n$	range: $0.1...30 \text{ s}$	0.01s
		Tolerance	$\pm 7\%$		The better of the two data: $\pm 10\%$ or $\pm 40 \text{ ms}$	
	51G	Earth fault protection	$I_{41}^{(1)} = 0.1...1 \times I_n$	$0.001 \times I_n$	with $I = 4 I_n$, $t_{41} = 0.1...1 \text{ s}$	0.05s
	Tolerance	$\pm 7\%$		$\pm 15\%$		
Rc	64 50N TD	Residual current protection	$I_{\Delta n} = 3 - 5 - 7 - 10 - 20 - 30 \text{ A}$		with $I > I_{\Delta n}$, $t_{\Delta n} = 0.06 - 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.8 \text{ s}$	
	87N	Differential ground fault protection			$140 \text{ ms} @ 0.06 \text{ s}$ (max trip time) $950 \text{ ms} @ 0.80 \text{ s}$ (max trip time)	
	Tolerance	$- 20\% \div 0\%$				
UV	27	Undervoltage Protection	$U_8 = 0.5...0.98 \times U_n$	$0.001 \times U_n$	with $U < U_8$, $t_8 = 0.05...120 \text{ s}$	0.01s
		Tolerance	$\pm 2\%$		The better of the two data: $\pm 10\%$ or $\pm 40 \text{ ms}$ (for $t < 5 \text{ s}$) / $\pm 100 \text{ ms}$ (for $t \geq 5 \text{ s}$)	
OV	59	Overvoltage protection	$U_9 = 1.02...1.5 \times U_n$	$0.001 \times U_n$	with $U > U_9$, $t_9 = 0.05...120 \text{ s}$	0.01s
		Tolerance	$\pm 2\%$		The better of the two data: $\pm 10\%$ or $\pm 40 \text{ ms}$ (for $t < 5 \text{ s}$) / $\pm 100 \text{ ms}$ (for $t \geq 5 \text{ s}$)	



Excludibility	Excludibility trip	Pre-alarm	Trip curve	Ekip Touch	Ekip Hi-Touch	Ekip G Touch	Ekip G Hi-Touch
yes, with rating plug L=off	no	50...90% I1, step 1%	$t = k / I^2$	●	●	●	●
yes				●	●	●	●
yes, with rating plug L=off	no	50...90% I1, step 1%	$t = \frac{k t1}{\left(\frac{if}{If}\right)^{\alpha-1}}$	●	●	●	●
yes	yes	no	$t = k$	●	●	●	●
yes				●	●	●	●
yes				●	●	●	●
yes	yes	no	$t = k / I^2$	●	●	●	●
yes				●	●	●	●
yes	no	no	$t = k$	●	●	●	●
yes				●	●	●	●
yes	yes	50...90% I4, step 1%	$t = k$	●	●	●	●
yes				●	●	●	●
yes				●	●	●	●
yes	yes	50...90% I4, step 1%	$t = k / I^2$	●	●	●	●
yes	yes	no	$t = k$	●	●	●	●
yes	no	no	$t = k$	●	●	●	●
yes	no	no	$t = k$	●	●	●	●
yes	yes	50...90% I41, step 1%	$t = k$	●	●	●	●
yes				●	●	●	●
yes				●	●	●	●
yes	yes	50...90% I41, step 1%	$t = k / I^2$	●	●	●	●
Attivabile with rating plug Rc	no	no	$t = k$	●	●	●	●
yes	yes	no	$t = k$	○	●	●	●
yes	yes	no	$t = k$	○	●	●	●

Protection functions

ABB Code	ANSI Code	Function	Threshold	Threshold step	Trip time	Time Step
VU	47	Voltage unbalance protection	$U14 = 2...90\% U_n$	1% U_n	with unbalance > $U14$, $t14 = 0.5...60s$	0.5s
		Tolerance	$\pm 5\%$		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	
UF	81L	Underfrequency protection	$f12 = 0.9...0.999 \times f_n$	$0.001 \times f_n$	with $f < f12$, $t12 = 0.15...300s$	0.01s
		Tolerance	$\pm 1\%$ (with $f_n \pm 2\%$)		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	
OF	81H	Overfrequency protection	$f13 = 1.001...1.1 \times f_n$	$0.001 \times f_n$	with $f > f13$, $t13 = 0.15...300s$	0.01s
		Tolerance	$\pm 1\%$ (with $f_n \pm 2\%$)		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	
RP	32R	Reverse active power protection	$P11 = -1...-0.05 S_n$	$0.001 S_n$	with $P > P11$, $t11 = 0.5...100s$	0.1s
		Tolerance	$\pm 10\%$		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	
ABB: Cyclical direction	47	Cyclical direction of the phases	1-2-3 or 3-2-1			
ABB: Power factor	78	3phase Power factor	$PF3 = 0.5...0.95$	0.01		
LC1/2 Iw1/2		Current threshold	$LC1 = 50\%...100\% I1$ $LC2 = 50\%...100\% I1$ $Iw1 = 0.1...10 I_n$ $Iw2 = 0.1...10 I_n$ Activation: up/down	1% 1% $0.01 \times I_n$		
		Tolerance	$\pm 10\%$			
S2	50TD	Time-delayed overcurrent protection	$I5 = 0.6...10 \times I_n$	$0.1 \times I_n$	With $I > I5$, $t5 = 0.05...0.8s$	0.01s
		Zone selectivity			$t5sel = 0.04...0.2s$	0.01s
		Start up	Activation: $0.6...10 \times I_n$	$0.1 \times I_n$	Range: $0.1...30s$	0.01s
		Tolerance	$\pm 7\% I \leq 6 \times I_n$ $\pm 10\% I > 6 \times I_n$		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$	
D	67	Directional overcurrent protection (forward &/or backward)	$I7 = 0.6...10 \times I_n$	$0.1 \times I_n$	with $I > I7$, $t7 = 0.1...0.8s$	0.01s
		Zone selectivity			$t7sel = 0.1...0.8s$	0.01s
		Start up (forward &/or backward)	Activation: $0.6...10 \times I_n$	$0.1 \times I_n$	Range: $0.1...30s$	0.01s
		Trip direction	forward &/or backward			
		Minimum angle direction (°)	3.6, 7.2, 10.8, 14.5, 18.2, 22, 25.9, 30, 34.2, 38.7, 43.4, 48.6, 54.3, 61, 69.6			
		Tolerance	$\pm 7\% I \leq 6 \times I_n$ $\pm 10\% I > 6 \times I_n$		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$	
UV2	27	Undervoltage Protection	$U15 = 0.5...0.98 \times U_n$	$0.001 \times U_n$	with $U < U15$, $t15 = 0.05...120s$	0.01s
		Tolerance	$\pm 2\%$		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	
OV2	59	Overvoltage protection	$U16 = 1.02...1.5 \times U_n$	$0.001 \times U_n$	with $U > U16$, $t16 = 0.05...120s$	0.01s
		Tolerance	$\pm 2\%$		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	
UF2	81L	Underfrequency protection	$f17 = 0.9...0.999 \times f_n$	$0.001 \times f_n$	with $f < f17$, $t17 = 0.15...300s$	0.01s
		Tolerance	$\pm 1\%$ (with $f_n \pm 2\%$)		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	
OF2	81H	Overfrequency protection	$f18 = 1.001...1.1 \times f_n$	$0.001 \times f_n$	with $f > f18$, $t18 = 0.15...300s$	0.01s
		Tolerance	$\pm 1\%$ (with $f_n \pm 2\%$)		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	
S(V)	51V	Voltage controlled overcurrent protection	$I20 = 0.6...10 \times I_n$	$0.1 \times I_n$	With $I > I20$, $t20 = 0.05...30s$	0.01s
		Step mode	$U1 = 0.2...1 \times U_n$	$0.01 \times U_n$		
			$Ks = 0.1...1$	0.01		
		Linear mode	$U1 = 0.2...1 \times U_n$	$0.01 \times U_n$		
			$U_h = 0.2...1 \times U_n$	$0.01 \times U_n$		
			$Ks = 0.1...1$	0.01		
		Tolerance	$\pm 10\%$		The better of the two data: $\pm 10\%$ or $\pm 40\text{ ms}$ (for $t < 5s$) / $\pm 100\text{ ms}$ (for $t \geq 5s$)	



Excludibility	Excludibility trip	Pre-alarm	Trip curve	Ekip Touch	Ekip Hi-Touch	Ekip G Touch	Ekip G Hi-Touch
yes	yes	no	t = k	○	●	●	●
yes	yes	no	t = k	○	●	●	●
yes	yes	no	t = k	○	●	●	●
yes	yes	no	t = k	○	●	●	●
yes	only signalling	no	-	○	●	●	●
yes	only signalling	no	-	○	●	●	●
yes	only signalling	no	-	●	●	●	●
yes	yes	no	t = k		●		●
yes	yes				●		●
yes					●		●
yes	yes	no	t = k		●		●
yes					●		●
yes					●		●
yes	yes	no	t = k		●		●
yes	yes	no	t = k		●		●
yes	yes	no	t = k		●		●
yes	yes	no	t = k			●	●
						●	●
						●	●
						●	●

Table continued on next page

Protection functions

ABB Code	ANSI Code	Function	Threshold	Threshold step	Tripping time	Time Step	
RV	59N	Residual overvoltage protection Tolerance	$U_{22} = 0.05...0.5 \times U_n$ $\pm 5\%$	$0.001 \times U_n$	with $U > U_{22}$, $t_{22} = 0.5...120s$ The better of the two data: $\pm 10\%$ or $\pm 40 ms$ (for $t < 5s$) / $\pm 100 ms$ (for $t \geq 5s$)	0.01s	
OP	32OF	Active overpower protection Tolerance	$P_{26} = 0.4...2 S_n$ $\pm 10\%$	$0.001 S_n$	with $P > P_{26}$, $t_{26} = 0.5...100s$ The better of the two data: $\pm 10\%$ or $\pm 40 ms$ (for $t < 5s$) / $\pm 100 ms$ (for $t \geq 5s$)	0.5s	
OQ	32OF	Reactive overpower protection Tolerance	$Q_{27} = 0.4...2 S_n$ $\pm 10\%$	$0.001 S_n$	with $Q > Q_{27}$, $t_{27} = 0.5...100s$ The better of the two data: $\pm 10\%$ or $\pm 40 ms$ (for $t < 5s$) / $\pm 100 ms$ (for $t \geq 5s$)	0.5s	
UP	32LF	Active underpower protection Start up Tolerance	$P_{23} = 0.1...1 \times S_n$ $\pm 10\%$	$0.001 \times S_n$	with $P < P_{23}$, $t_{23} = 0.5...100s$ range: $0.1...30s$ The better of the two data: $\pm 10\%$ or $\pm 40 ms$ (for $t < 5s$) / $\pm 100 ms$ (for $t \geq 5s$)	0.5s 0.01s	
RQ	40/32R	Loss of field or reverse reactive power protection	$Q_{24} = -1...-0.1 S_n$ $K_{q2} = -2...2$	$0.001 S_n$ 0.01	with $Q > Q_{24}$, $t_{24} = 0.5...100s$	0.1s	
		Loss of field or reverse reactive power protection	$Q_{25} = -1...-0.1 S_n$ $K_{q2} = -2...2$	$0.001 S_n$ 0.01	with $Q > Q_{25}$, $t_{25} = 0.5...100s$	0.5s	
		Voltage minimum threshold	$V_{min.} = 0.5...1.2$	0.01			
		Tolerance	$\pm 10\%$		The better of the two data: $\pm 10\%$ or $\pm 40 ms$ (for $t < 5s$) / $\pm 100 ms$ (for $t \geq 5s$)		
S2(V)	51V	Voltage controlled overcurrent protection	$I_{21} = 0.6...10 \times I_n$	$0.1 \times I_n$	With $I > I_{21}$, $t_{21} = 0.05...30s$	0.01s	
		Step mode	$UI_{21} = 0.2...1 \times U_n$ $K_{s2} = 0.1...1$	$0.01 \times U_n$ 0.01			
		Linear mode	$UI_{21} = 0.2...1 \times U_n$ $Uh_{21} = 0.2...1 \times U_n$ $K_{s2} = 0.1...1$	$0.01 \times U_n$ $0.01 \times U_n$ 0.01			
		Tolerance	$\pm 10\%$		The better of the two data: $\pm 10\%$ or $\pm 40 ms$ (for $t < 5s$) / $\pm 100 ms$ (for $t \geq 5s$)		
ROCOF	81R	Rate of change of frequency protection	$f_{28} = 0.4...10 Hz/s$	$0.2 Hz/s$	with $f > f_{28}$, $t_{28} = 0.5...10s$	0.01s	
		Trip direction	up &/or down				
		Tolerance	$\pm 5\%$		The better of the two data: $\pm 20\%$ or $\pm 200 ms$		
Synchro-check SC	25	Synchrocheck (Live busbars)	$U_{live} = 0.5...1.1 U_n$ $\Delta U = 0.02...0.12 U_n$ $\Delta f = 0.1...1 Hz$ $\Delta \Phi = 5...50^\circ \text{ elt}$	$0.001 U_n$ $0.001 U_n$ $0.1 Hz$ 5° elt	Stability voltage time for live state = $100...30000ms$ Minimum matching Time = $100...3000ms$	$0.001 s$ $0.01 s$	
		Tolerance	$\pm 10\%$				
		Synchrocheck (Live,Dead busbars)	$U_{live} = 0.5...1.1 U_n$ $U_{dead} = 0.02...0.2 U_n$	$0.001 U_n$ $0.001 U_n$	$t_{ref} = 0.1...30s$	0.1s	
		Frequency check off					
		Phase check off					
		Dead bar configuration	Reverse/standard				
		Primary voltage	100...1150	100, 115, 120, 190, 208, 220, 230, 240, 277, 347, 380, 400, 415, 440, 480, 500, 550, 600, 660, 690, 910, 950, 1000, 1150			
		Secondary voltage	100...120	100, 110, 115, 120			
Tolerance	$\pm 10\%$						

(1) With Vaux all thresholds are available. Without Vaux minimum threshold is limited to: $0.3I_n$ (with $I_n = 100A$), $0.25I_n$ (with $I_n = 400A$) or $0.2I_n$ (for all other ratings)
The tolerances 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 tolerance values apply:

ABB Code	Trip threshold	Trip time
L	Trip between 1.05 and $1.2 \times I_1$	$\pm 20\%$
S	$\pm 10\%$	$\pm 20\%$
I	$\pm 15\%$	$\leq 60ms$
G	$\pm 15\%$	$\pm 20\%$
Other protection	$\pm 15\%$	$\pm 20\%$



Excludibility	Excludibility trip	Pre-allarm	Trip curve	Ekip Touch	Ekip Hi-Touch	Ekip G Touch	Ekip G Hi-Touch
yes	yes	no	t = k			●	●
yes	yes	no	t = k			●	●
yes	yes	no	t = k			●	●
yes	yes	no	t = k			●	●
yes	yes	no	t = k			●	●
yes	yes	no	t = k			●	●
yes	yes	no	t = k				●
yes	yes	no	t = k				●
yes	yes	no	t = k				●
yes	yes	no	t = k				●
yes	yes	no	t = k				●
yes	only signalling	no	-	○ ○○	○○	○○	○○
yes	only signalling	no	-				
yes							
yes							
yes							

Key:
 - not available
 ● available
 ○ available with Ekip Measuring and Ekip Measuring Pro
 ○○ available with Ekip Synchrocheck

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	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

Network Analyzer	Parameters
Hourly average voltage value	[V] - Umin= 0.75...0.95 x Un [no] - Umax= 1.05...1.25 x Un - Events counter (nr. of events day by day in the last year plus the total events in the breaker's lifetime)
Short voltage interruptions	[no] - Umin= 0.75...0.95 x Un - Events counter (nr. of events day by day in the last year plus the total events in the breaker's lifetime)
Short voltage spikes	[no] - Umax= 1.05...1.25 x Un - Events counter (nr. of events day by day in the last year plus the total events in the breaker's lifetime)
Slow voltage sags and swells	[no] - Umin1= 0.75...0.95 x Un - Umin2= 0.75...0.95 x Un - Umin3= 0.75...0.95 x Un - Umax1= 1.05...1.25 x Un - Umax2= 1.05...1.25 x Un - Events counter (nr. of events day by day in the last year plus the total events in the breaker's lifetime)
Voltage unbalance	[V] - U neg. seq.= 0.02...0.10 x Un [no] - Events counter (nr. of events day by day in the last year plus the total events in the breaker's lifetime)
Harmonic analysis	Current and voltage: - up to 50° - Alarm THD: 5...20% - Single harmonic alarm: 3...10% plus a count of minutes the harmonic has been exceeded



	Ekip Touch	Ekip Hi-Touch	Ekip G Touch	Ekip G Hi-Touch
Precision				
1%	●	●	●	●
2%	●	●	●	●
0.5%	○	●	●	●
0.5%	○	●	●	●
	○	●	●	●
0.2%	○	●	●	●
2%	○	●	●	●
2%	○	●	●	●
2%	○	●	●	●
2%	○	●	●	●
	○	●	●	●
Precision				
2%	○	●	●	●
2%	○	●	●	●
2%	○	●	●	●
Intervals				
t = 5...120min	-	●	-	●
t <40ms	-	●	-	●
t <40ms	-	●	-	●
t = 0.02s...60s	-	●	-	●
t = 5...120min	-	●	-	●
	-	●	-	●

Measurement functions

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] 1200-2400-4800-9600
Maximum recording duration	[s] 16
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 connections	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 (OT)	Prealarm and alarm for abnormal temperature

(1) with auxiliary supply present



CHAPTER 4

Advanced functionalities

- 34-35** **Advanced features**
- 36-37** **Ekip G generator protection trip unit**
- 38-39** **Logic zone selectivity for Emax 2/ML**
- 40-40** **Load shedding**

Advanced features

A modern ship's operational ability is fully dependent on its onboard electrical infrastructure. Over the years, the growth in the number of electrically powered subsystems on a typical naval vessel has made this infrastructure ever more complex and extensive, and has led to a steady increase in power requirements.

ABB provides the first smart circuit-breaker that combine advanced protection, programmable logic, full connectivity, and comprehensive energy management in all-in-one revolutionary device. ML circuit breaker integrates the functions of Interface Protection System and Interface Device in order to check the Main Grid conditions and disconnect the User's plant whenever grid voltage and frequency are out of the ranges prescribed by the connection standard.

ML circuit breaker and its adaptive protections recognize the network change and automatically set new thresholds to guarantee protection and coordination in on-grid and off-grid conditions. Emax 2/ML is more than a circuit breaker as traditionally defined, compactness and high reliability from pre-tested functions makes Emax 2/ML highly suitable for applications in ships and marine vessels.

Emax 2/ML is an all-in-one innovative concept, in fact it is the first intelligent circuit breaker designed to protect, connect and optimize low-voltage microgrid applications. Accessories (modules) are added to the breaker to achieve all the additional functions needed.

Besides the advanced functionalities described on the following page, Emax 2 integrates in a single device the following function:

**Synchro reclosing,
Automatic Transfer Switch,
Watchdog.**

For further detail please refer to your local ABB referent.





Ekip G generator protection trip unit

ABB SACE ML family, with the new Ekip G generator protection trip unit, offers an effective and reliable solution designed for the protection of low voltage generators.

Ekip G is the new generator protection release, which has all the protection embedded and it can monitor all the key critical parameters for connecting the generator to the system. These functions, generally provided by multifunction independent relays, are now integrated into SACE ML circuit breaker to guarantee a solution that is easy to install, compact, and reliable.

The generator is one of the most delicate part of the ship's electrical system. The protections, especially those that safeguard this machine from the most heavy failures, are often redundant. Hence the protection system for a generator is complex and complicated to be calibrated and to be managed. The protections available on Ekip G are individually activated and cover a wide spectrum of onboard electrical system. They also comply with the major international regulations and standard that provide guidance on the type of protections to be used to control generators, for example in the naval field.

Ekip G is compliant with the standard IEC 60034-1 "Rotating electrical machines - Part 1: Rating and performance" of with the IEEE C37.102 "Guide for AC Generator Protection" and IEEE 242 "Protection and Coordination of Industrial and Commercial Power Systems" or requirements requested by naval standard such RINA, DNV etc. Nevertheless, the most commonly required protections according also to the indications given in the above mentioned Standards and rules are summarized in the Table below.

Protections for synchronous generators	SnG < 500kVA	500kVA < SnG < 1500kVA	SnG > 1500kVA
Protections against loss of prime mover:			
- Active power directional protection	●	●	●
Protections against overloads:			
- Overload and overcurrent	●	●	●
- Current unbalance	●	●	●
Protections against failures of the excitation system:			
- Loss of field	-	●	●
- Under/Overvoltage	●	●	●
Protections against frequency variations:			
- Under/Overfrequency	●	●	●
Protection against network loss:			
- Rate of change of frequency	-	●	●
Protection against failures of the insulation system:			
- Stator earth fault	●	●	●

The Ekip G trip unit is able to:

- monitor the frequency and voltage inside the machine whereby tripping the machine main circuit breaker would isolate the generator from the rest of the plant without eliminating the fault;
- monitor the interaction conditions between the generator and the rest of the plant and provide for the separation and protection of the two systems when the conditions for interconnection are missing.

In both cases, programmable contacts are available that can be used to determine the shutdown of the generator, of the prime mover and of excitation. Ekip G, which is supplied as standard with Ekip Measuring Pro module, is comprised of current, frequency, voltage and power protection functions specific for generators.

The main features available are summarized in the table below.



Function	Description	ANSI	ABB
Synchrocheck	Control of adequate conditions for parallel connection	25	SC
Active overpower protection	Protection against active overpower supply	32OF	OP
Reactive overpower protection	Protection against reactive overpower supply	32OF	OQ
Reverse active power protection	Protection against active power absorption (reverse power)	32R	RP
Directional overcurrent protection	Protection against directional current	67	D
Active underpower protection	Protection against active underpower supply	32LF	UP
Loss of field or reverse reactive power protection	Protection against energizing anomalies, check of reactive power absorption	40/32R	RQ
Overload protection	Current protection against temperature rise	49	L
Instantaneous overcurrent protection	Instantaneous protection against phase overcurrents	50	I
Time-delayed overcurrent protection	Inverse/definite time protection against phase overcurrents	51 50TD	S
Earth fault protection	Inverse/definite and instantaneous time protection against earth overcurrents	51N 50NTD 50N;	G; Gext 51G 50GTD
Differential ground fault protection	Definite time protection against earth overcurrents in the generator windings	87N	Rc
Voltage controlled overcurrent protection	Protection against short circuit between phases with current threshold depending on voltage (controlled/restrained mode)	51V	S(V)
Residual overvoltage protection	Protection detecting loss of insulation in the machine	59N	RV
Undervoltage protection	Protection against voltage decrease	27	UV
Overvoltage protection	Protection against voltage increase	59	OV
Current unbalance protection	Protection against phase current unbalance	46	IU
Voltage unbalance protection	Protection against voltage unbalance and detection of rotation direction of phases	47	VU
Rate of change of frequency protection	Protection against rapid frequency variations	81R	Rocof
Overfrequency protection	Protection against frequency increase	81H	OF
Underfrequency protection	Protection against frequency reduction	81L	UF

Logic zone selectivity for Emax 2/ML

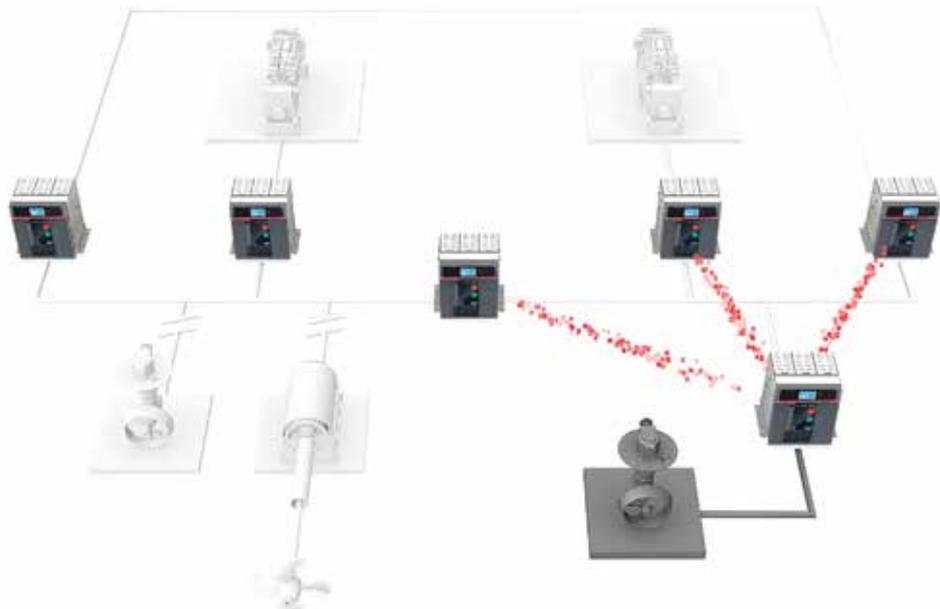
Emax 2/ML can manage the logic zone selectivity using the reliability, flexibility and efficiency of Ekip link, the ABB proprietary communication bus.

A major element of vessel power system design is protection against electrical faults. One very efficient method of handling faults is logic zone selectivity (or “discrimination”), which allows rapid fault isolation without users, other than those directly affected, seeing any effect. This approach can accurately isolate the fault branch by quickly opening the adjacent circuit breaker(s) and reduce the transitory on fault time and the electrical stresses.

Logic zone selectivity combines zone selectivity and directional protection. In contrast with traditional selectivity methods, which are based on time and/or current, the principle of logic zone selectivity is that the breaker that should trip for a fault sends a blocking signal to other breakers (upstreams) to prevent them from tripping. The principally impacted breaker can block other breakers from tripping, when appropriate. With Emax2, locking signal can be realized by traditional hardwire or by bus communication using Ekip Link.

Behind this scheme lies a logic that defines which breakers should and should not be tripped in certain situations. This logic is managed by Ekip Connect, the ABB software for the configuration of the electronic trip units.

Ekip Link, the ABB communication module for low voltage circuit breaker, communicate between circuit breaker using an internal ABB proprietary bus. The use of a proprietary bus guarantees very fast and predictable communication (independent of traffic on other buses)



Using ABB communication protocol, Ekip Link can:

- Create complex logic selectivity without using complex wiring
- Provide redundancy, using both Ekip link bus and standard wiring
- Provide diagnostics (configurable) to test the wiring selectivity

ABB's Emax 2 is the first low-voltage circuit breaker with fully integrated directional protection and zone directional selectivity functions. using directional protection, there is also a possibility to set different delay times for the different directions.

Emax 2 air circuit breaker equipped with Ekip Link form the basis of a unique solution for low-voltage logical zone discrimination that has been designed to meet the most demanding requirements of reliability, flexibility and efficiency in vessels. This solution is easy to install, commission and test.



Load shedding

Emax 2/ML with embedded Load Shedding innovation creates the new benchmark for the service continuity in the naval electrical system.

ABB Emax 2, the all-in-one smart circuit breaker, embeds patented functions based on load shedding. This innovative algorithm manages the available resources maximizing the efficiency. Load Shedding functions are adopted to protect Microgrids, as vessels power system, during fault operation.

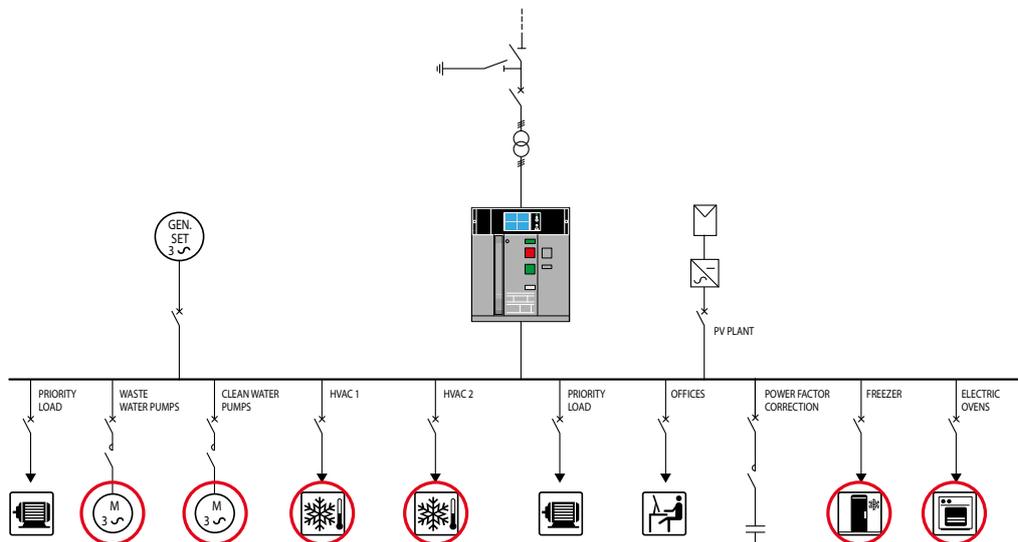
The load shedding function is able to switch from one source of energy to the other one, this happens when a fault occurs in one of the energy sources present in the power system. During this switch, the total amount of energy in the system falls down and not all loads can be fed. Load shedding, giving priority to the loads, maintains active only the primary loads while disconnecting the secondary. In this way the main functions are kept active even in case of a fault. This advanced function for Microgrid can be managed by an automatic transfer switching (ATS) logic. Emax 2/ML can provide two different customizations of the load shedding which are mentioned below:

- **Basic Load Shedding**, simple logic able to recognize the Microgrid disconnection event and shed a group of non-priority loads thus ensuring a fast time response and power balance.
- **Adaptive Load Shedding**, the advanced algorithm available with Emax 2 as an enhancement of the basic version. The intelligent software embedded in the circuit breaker sheds very quickly the non-priority loads according to the Microgrid power consumption and frequency measurements.

Moreover, such software has a dedicated configuration for backup generation related to ATS and the software itself is even able to estimate the energy produced by the backup energy source. Emax 2/ML with embedded Load Shedding provides the following benefits:

- **Service continuity:** When a naval system has a problem in one of the main generators, there is a significant stress that turns off all the generators with consequent blackout. Load Shedding logics embedded in Emax 2 reduce the frequency drop that usually makes the local generation protection trip, maintaining the plant alive.
- **Space saving:** Neither PLC nor external relays are needed as Emax 2 has embedded the intelligence to realize the load shedding logics, taking advantage of the internal current and voltage sensors for electrical parameter measurements. Significant space and material saving up to 50% in the power distribution switchgear for panel builders.
- **Ease of use:** Load shedding logics are generally set with high engineering skills and customization effort with devices as programmable logic controllers. While Emax 2 guarantees easy installation thanks to predefined templates and the user-friendly graphic interface in the SW commissioning tool.

For further information, please refer to the White Paper "Emax 2, all-in-one innovation – Load Shedding" (1SDC007119G0201).



CHAPTER 5

Dimensional drawings

42-42	Reading information
43-43	Emax E2.2/ML
44-44	Emax E4.2/ML
45-45	Emax E6.2/ML
46-46	Accessories

Reading information

Information on the overall dimensions is available on the web site <http://www.abb.com/abblibrary/DownloadCenter> in particular with the SACE Emax 2 IEC catalogue 1SDC210015D0208 and SACE Tmax IEC catalogue 1SDC210015D0208.

Emax E2.2/ML

Withdrawable version 3 poles

Document Number	Title
1SDH001000R0110	E2.2 2000A withdrawable flat terminals FL
1SDH001000R0111	E2.2 2500A withdrawable flat terminals FL
1SDH001252R0431	E2.2 III W 2000A N0761
1SDH001252R0104	E2.2 III W 2500A N0761
1SDH001252R0105	E2.2 III W Compartment door drilling
1SDH001252R0436	E2.2 III W Flat term 2000A lower
1SDH001252R0435	E2.2 III W Flat term 2000A upper
1SDH001252R0438	E2.2 III W Flat term 2500A lower
1SDH001252R0437	E2.2 III W Flat term 2500A upper
1SDH001252R0106	E2.2 III W Floor fixing
1SDH001252R0168	E2.2 III W IP30 Protection for switchgear
1SDH001252R0323	E2.2 III W Terminals F lower
1SDH001252R0324	E2.2 III W Terminals F upper
1SDH001252R0107	E2.2 III W Terminals HR lower 2000A
1SDH001252R0108	E2.2 III W Terminals HR lower 2500A
1SDH001252R0109	E2.2 III W Terminals HR upper 2000A
1SDH001252R0110	E2.2 III W Terminals HR upper 2500A
1SDH001252R0111	E2.2 III W Terminals SHR lower 2000A
1SDH001252R0112	E2.2 III W Terminals SHR lower 2500A
1SDH001252R0113	E2.2 III W Terminals SHR upper 2000A
1SDH001252R0114	E2.2 III W Terminals SHR upper 2500A
1SDH001252R0115	E2.2 III W Terminals SVR lower 2000A
1SDH001252R0116	E2.2 III W Terminals SVR lower 2500A
1SDH001252R0117	E2.2 III W Terminals SVR upper 2000A
1SDH001252R0118	E2.2 III W Terminals SVR upper 2500A
1SDH001252R0119	E2.2 III W Terminals VR lower 2000A
1SDH001252R0120	E2.2 III W Terminals VR lower 2500A
1SDH001252R0121	E2.2 III W Terminals VR upper 2000A
1SDH001252R0122	E2.2 III W Terminals VR upper 2500A
1SDH001000R0103	E2.2 III-IV Withdrawable front terminals F

Emax E4.2/ML

Withdrawable version 3 poles

Document Number	Title
1SDH001001R0110	E4.2 3200A withdrawable flat terminals FL
1SDH001001R0102	E4.2 3-4p Withdrawable HR-VR
1SDH001001R0111	E4.2 4000A withdrawable flat terminals FL
1SDH001252R0433	E4.2 III W 3200A N0761
1SDH001252R0185	E4.2 III W 4000A N0761
1SDH001252R0186	E4.2 III W Compartment door drilling
1SDH001252R0444	E4.2 III W Flat term 3200A lower
1SDH001252R0443	E4.2 III W Flat term 3200A upper
1SDH001252R0446	E4.2 III W Flat term 4000A lower
1SDH001252R0445	E4.2 III W Flat term 4000A upper
1SDH001252R0187	E4.2 III W Floor fixing
1SDH001252R0188	E4.2 III W IP30 Protection for switchgear
1SDH001252R0327	E4.2 III W Terminals F lower
1SDH001252R0328	E4.2 III W Terminals F upper
1SDH001252R0189	E4.2 III W Terminals HR lower 3200A
1SDH001252R0190	E4.2 III W Terminals HR lower 4000A
1SDH001252R0191	E4.2 III W Terminals HR upper 3200A
1SDH001252R0192	E4.2 III W Terminals HR upper 4000A
1SDH001252R0193	E4.2 III W Terminals VR lower 3200A
1SDH001252R0194	E4.2 III W Terminals VR lower 4000A
1SDH001252R0195	E4.2 III W Terminals VR upper 3200A
1SDH001252R0196	E4.2 III W Terminals VR upper 4000A
1SDH001001R0103	E4.2 III-IV Withdrawable Front Terminals F

Emax E6.2/ML

Withdrawable version 3 poles

Document Number	Title
1SDH001060R0105	E6.2 3-4p Withdrawable HR
1SDH001060R0106	E6.2 3-4p Withdrawable VR
1SDH001252R0456	E6.2 4 FS W Flat term 6300A lower
1SDH001252R0455	E6.2 4 FS W Flat term 6300A upper
1SDH001060R0107	E6.2 4p FS Withdrawable HR-VR
1SDH001252R0237	E6.2 III W 6300A N0761
1SDH001252R0238	E6.2 III W Compartment door drilling
1SDH001252R0452	E6.2 III W Flat term 6300A lower
1SDH001252R0451	E6.2 III W Flat term 6300A upper
1SDH001252R0239	E6.2 III W Floor fixing
1SDH001252R0240	E6.2 III W IP30 Protection for switchgear
1SDH001252R0337	E6.2 III W Terminals F LOWER
1SDH001252R0338	E6.2 III W Terminals F upper
1SDH001252R0241	E6.2 III W Terminals HR lower 5000A
1SDH001252R0242	E6.2 III W Terminals HR lower 6300A
1SDH001252R0243	E6.2 III W Terminals HR upper 5000A
1SDH001252R0244	E6.2 III W Terminals HR upper 6300A
1SDH001252R0245	E6.2 III W Terminals VR lower 5000A
1SDH001252R0246	E6.2 III W Terminals VR lower 6300A
1SDH001252R0247	E6.2 III W Terminals VR upper 5000A
1SDH001252R0248	E6.2 III W Terminals VR upper 6300A
1SDH001060R0108	E6.2 III-IV Withdrawable Front Terminals F
1SDH001060R0110	E6.2 Withdrawable flat terminals 6300A FL

Accessories

Document Number	Title
1SDH001000R0811	Ekip AUP auxiliary contacts position - E1.2-E2.2-E4.2-E6.2
1SDH001000R0501	Ekip COM actuator - E2.2-E4.2-E6.2
1SDH001000R0514	Ekip COM Hub, IEC61850, Modbus TCP, ProfiNet, Ethernet IP, Ekip Link - E1.2-E2.2-E4.2-E6.2
1SDH001000R0512	Ekip COM Modbus RS-485, Profibus, DeviceNet - E1.2-E2.2-E4.2-E6.2
1SDH001000R0505	Ekip Measuring / Ekip Measuring Pro - E2.2-E4.2-E6.2
1SDH001000R0520	Ekip Multimeter - E1.2-E2.2-E4.2-E6.2
1SDH001257R0001	Ekip Programming - E1.2-E2.2-E4.2-E6.2-XT2-XT4
1SDH001000R0508	Ekip protection release - E1.2-E2.2-E4.2-E6.2
1SDH001000R0524	Ekip Signalling 2K - E1.2-E2.2-E4.2-E6.2
1SDH001000R0516	Ekip Signalling 4K - E2.2-E4.2-E6.2
1SDH001000R0511	Ekip supply - E1.2-E2.2-E4.2-E6.2
1SDH001000R0513	Ekip Synchrocheck - E1.2-E2.2-E4.2-E6.2
1SDH001000R0517	Ekip T&P - E1.2 - E2.2 - E4.2 - E6.2
1SDH001000R0519	Ekip TT, trip test unit - E1.2-E2.2-E4.2-E6.2

Installation

Document Number	Title
1SDH001000R0821	Installation instructions PF E2.2/E6.2 ML

For the complete information about current-limiting curve, temperature derating, installation environment, wiring diagrams and other dimensions please refer to the technical catalogue of the standard version.

CHAPTER 6

Ordering codes

48-49	Ordering examples
50-51	Emax 2.2/ML
52-52	Emax 4.2/ML
53-53	Emax 6.2/ML

Instructions for ordering

Ordering examples

The code for molded case circuit breakers includes a fixed list of accessories.
For further detail please contact ABB.

Ordering examples

- **Ordering for Ekip modules.**
Ekip Supply module enables Ekip Com, Ekip Link, Ekip 2K, Ekip Syncrocheck cartridge modules to be installed.

In addition to Ekip Supply modules, up to 3 cartridge modules can be installed on E2.2, E4.2 and E6.2.

Example no. 1

Emax E4.2H 3 poles with modules: Ekip Supply, Ekip Com Modbus TCP, Ekip Signalling 2K-1, Ekip Com Modbus TCP Redundant and Ekip Signalling 4K

1SDA083492R1	E4.2H/ML 3200 Ekip Hi-Touch LSI 3p
1SDA074173R1	Ekip Supply 24-48V DC E1.2..E6.2
1SDA074151R1	Ekip Com Modbus TCP E1.2..E6.2
1SDA074158R1	Ekip Com R Modbus TCP E1.2..E6.2
1SDA074167R1	Ekip Sign. 2K-1 E1.2..E6.2
1SDA074170R1	Ekip Sign. 4K E2.2..E6.2

Example no. 2

Emax E4.2H 3 poles with modules: Ekip Supply, Ekip Com EtherNet/IP™, Ekip Com Modbus RS-485 and Ekip Measuring Pro

1SDA083492R1	E4.2H/ML 3200 Ekip Touch LSI 3p
1SDA074173R1	Ekip Supply 24-48V DC E1.2..E6.2
1SDA074155R1	Ekip Com EtherNet/IP™ E1.2..E6.2
1SDA074150R1	Ekip Com Modbus RS-485 E1.2..E6.2
1SDA074189R1	Ekip Measuring Pro E4.2

- **Ordering for electrical accessories.**
All the accessories are available. In particular up to 4 coils for E2.2, E4.2 and E6.2.

Example no. 3**Emax E2.2S 3 poles with accessories: opening release, closing release, motor for automatic charging of the springs, second opening release**

1SDA083426R1	E2.2S/ML 2000 Ekip Touch LSi LSi 3p
1SDA073674R1	YO E1.2..E6.2 220-240V AC/DC
1SDA073687R1	YC E1.2..E6.2 220-240V AC/DC
1SDA073725R1	M E2.2...E6.2 220-250V AC/DC
1SDA073674R1	YO E1.2..E6.2 220-240V AC/DC

Emax E2.2/ML

Circuit breaker moving part

lu	performance frame	Type	Code
800	N	E2.2N/ML 800 Ekip Dip LSI	1SDA083405R1
800	N	E2.2N/ML 800 Ekip G Hi-Touch LSIG	1SDA083409R1
800	N	E2.2N/ML 800 Ekip G Touch LSIG	1SDA083408R1
800	N	E2.2N/ML 800 Ekip Hi-Touch LSI	1SDA083407R1
800	N	E2.2N/ML 800 Ekip Touch LSI	1SDA083406R1
1250	N	E2.2N/ML 1250 Ekip Dip LSI	1SDA083410R1
1250	N	E2.2N/ML 1250 Ekip G Hi-Touch LSIG	1SDA083414R1
1250	N	E2.2N/ML 1250 Ekip G Touch LSIG	1SDA083413R1
1250	N	E2.2N/ML 1250 Ekip Hi-Touch LSI	1SDA083412R1
1250	N	E2.2N/ML 1250 Ekip Touch LSI	1SDA083411R1
1600	N	E2.2N/ML 1600 Ekip Dip LSI	1SDA083415R1
1600	N	E2.2N/ML 1600 Ekip G Hi-Touch LSIG	1SDA083419R1
1600	N	E2.2N/ML 1600 Ekip G Touch LSIG	1SDA083418R1
1600	N	E2.2N/ML 1600 Ekip Hi-Touch LSI	1SDA083417R1
1600	N	E2.2N/ML 1600 Ekip Touch LSI	1SDA083416R1
2000	N	E2.2N/ML 2000 Ekip Dip LSI	1SDA083420R1
2000	N	E2.2N/ML 2000 Ekip G Hi-Touch LSIG	1SDA083424R1
2000	N	E2.2N/ML 2000 Ekip G Touch LSIG	1SDA083423R1
2000	N	E2.2N/ML 2000 Ekip Hi-Touch LSI	1SDA083422R1
2000	N	E2.2N/ML 2000 Ekip Touch LSI	1SDA083421R1
2500	N	E2.2N/ML 2500 Ekip Dip LSI	1SDA083425R1
2500	N	E2.2N/ML 2500 Ekip G Hi-Touch LSIG	1SDA083429R1
2500	N	E2.2N/ML 2500 Ekip G Touch LSIG	1SDA083428R1
2500	N	E2.2N/ML 2500 Ekip Hi-Touch LSI	1SDA083427R1
2500	N	E2.2N/ML 2500 Ekip Touch LSI	1SDA083426R1
800	S	E2.2S/ML 800 Ekip Dip LSI	1SDA083435R1
800	S	E2.2S/ML 800 Ekip G Hi-Touch LSIG	1SDA083439R1
800	S	E2.2S/ML 800 Ekip G Touch LSIG	1SDA083438R1
800	S	E2.2S/ML 800 Ekip Hi-Touch LSI	1SDA083437R1
800	S	E2.2S/ML 800 Ekip Touch LSI	1SDA083436R1
1250	S	E2.2S/ML 1250 Ekip Dip LSI	1SDA083440R1
1250	S	E2.2S/ML 1250 Ekip G Hi-Touch LSIG	1SDA083444R1
1250	S	E2.2S/ML 1250 Ekip G Touch LSIG	1SDA083443R1
1250	S	E2.2S/ML 1250 Ekip Hi-Touch LSI	1SDA083442R1
1250	S	E2.2S/ML 1250 Ekip Touch LSI	1SDA083441R1
1600	S	E2.2S/ML 1600 Ekip Dip LSI	1SDA083445R1
1600	S	E2.2S/ML 1600 Ekip G Hi-Touch LSIG	1SDA083449R1
1600	S	E2.2S/ML 1600 Ekip G Touch LSIG	1SDA083448R1
1600	S	E2.2S/ML 1600 Ekip Hi-Touch LSI	1SDA083447R1
1600	S	E2.2S/ML 1600 Ekip Touch LSI	1SDA083446R1
2000	S	E2.2S/ML 2000 Ekip Dip LSI	1SDA083450R1
2000	S	E2.2S/ML 2000 Ekip G Hi-Touch LSIG	1SDA083454R1
2000	S	E2.2S/ML 2000 Ekip G Touch LSIG	1SDA083453R1
2000	S	E2.2S/ML 2000 Ekip Hi-Touch LSI	1SDA083452R1
2000	S	E2.2S/ML 2000 Ekip Touch LSI	1SDA083451R1
2500	S	E2.2S/ML 2500 Ekip Dip LSI	1SDA083455R1
2500	S	E2.2S/ML 2500 Ekip G Hi-Touch LSIG	1SDA083459R1
2500	S	E2.2S/ML 2500 Ekip G Touch LSIG	1SDA083458R1
2500	S	E2.2S/ML 2500 Ekip Hi-Touch LSI	1SDA083457R1
2500	S	E2.2S/ML 2500 Ekip Touch LSI	1SDA083456R1

lu	performance frame	Type	Code
800	H	E2.2H/ML 800 Ekip Dip LSI	1SDA083460R1
800	H	E2.2H/ML 800 Ekip G Hi-Touch LSI	1SDA083463R1
800	H	E2.2H/ML 800 Ekip G Touch LSI	1SDA083462R1
800	H	E2.2H/ML 800 Ekip Hi-Touch LSI	1SDA083461R1
800	H	E2.2H/ML 800 Ekip Touch LSI	1SDA083374R1
1250	H	E2.2H/ML 1250 Ekip Dip LSI	1SDA083464R1
1250	H	E2.2H/ML 1250 Ekip G Hi-Touch LSI	1SDA083467R1
1250	H	E2.2H/ML 1250 Ekip G Touch LSI	1SDA083466R1
1250	H	E2.2H/ML 1250 Ekip Hi-Touch LSI	1SDA083465R1
1250	H	E2.2H/ML 1250 Ekip Touch-LSI	1SDA083378R1
1600	H	E2.2H/ML 1600 Ekip Dip LSI	1SDA083468R1
1600	H	E2.2H/ML 1600 Ekip G Hi-Touch LSI	1SDA083471R1
1600	H	E2.2H/ML 1600 Ekip G Touch LSI	1SDA083470R1
1600	H	E2.2H/ML 1600 Ekip Hi-Touch LSI	1SDA083469R1
1600	H	E2.2H/ML 1600 Ekip Touch-LSI	1SDA083377R1
2000	H	E2.2H/ML 2000 Ekip Dip LSI	1SDA083472R1
2000	H	E2.2H/ML 2000 Ekip G Hi-Touch LSI	1SDA083476R1
2000	H	E2.2H/ML 2000 Ekip G Touch LSI	1SDA083475R1
2000	H	E2.2H/ML 2000 Ekip Hi-Touch LSI	1SDA083474R1
2000	H	E2.2H/ML 2000 Ekip Touch LSI	1SDA083473R1
2500	H	E2.2H/ML 2500 Ekip Dip LSI	1SDA083477R1
2500	H	E2.2H/ML 2500 Ekip G Hi-Touch LSI	1SDA083480R1
2500	H	E2.2H/ML 2500 Ekip G Touch LSI	1SDA083479R1
2500	H	E2.2H/ML 2500 Ekip Hi-Touch LSI	1SDA083478R1
2500	H	E2.2H/ML 2500 Ekip Touch-LSI	1SDA083376R1

Switch disconnecter moving part

lu	performance frame	Type	Code
800	N	E2.2N/ML/MS 800 3p WMP	1SDA083571R1
1250	N	E2.2N/ML/MS 1250 3p WMP	1SDA083572R1
1600	N	E2.2N/ML/MS 1600 3p WMP	1SDA083573R1
2000	N	E2.2N/ML/MS 2000 3p WMP	1SDA083574R1
2500	N	E2.2N/ML/MS 2500 3p WMP	1SDA083575R1
800	H	E2.2H/ML/MS 800 3p WMP	1SDA083576R1
1250	H	E2.2H/ML/MS 1250 3p WMP	1SDA083577R1
1600	H	E2.2H/ML/MS 1600 3p WMP	1SDA083578R1
2000	H	E2.2H/ML/MS 2000 3p WMP	1SDA083579R1
2500	H	E2.2H/ML/MS 2500 3p WMP	1SDA083580R1

Fixed part

Size	performance	lu range	Type of terminal	Type	Code
E2.2	N, S, H	400-2000	HR-HR	E2.2/ML W FP lu=2000 HR HR	1SDA083381R1
E2.2	N, S, H	2500	HR-HR	E2.2/ML W FP lu=2500 HR HR	1SDA083382R1

Emax E4.2/ML

Circuit breaker moving part

lu	performance frame	Type	Code
3200	N	E4.2N/ML 3200 Ekip Dip LSI	1SDA083481R1
3200	N	E4.2N/ML 3200 Ekip G Hi-Touch LSI	1SDA083485R1
3200	N	E4.2N/ML 3200 Ekip G Touch LSI	1SDA083484R1
3200	N	E4.2N/ML 3200 Ekip Hi-Touch LSI	1SDA083483R1
3200	N	E4.2N/ML 3200 Ekip Touch LSI	1SDA083482R1
4000	N	E4.2N/ML 4000 Ekip Dip LSI	1SDA083486R1
4000	N	E4.2N/ML 4000 Ekip G Hi-Touch LSI	1SDA083490R1
4000	N	E4.2N/ML 4000 Ekip G Touch LSI	1SDA083489R1
4000	N	E4.2N/ML 4000 Ekip Hi-Touch LSI	1SDA083488R1
4000	N	E4.2N/ML 4000 Ekip Touch LSI	1SDA083487R1
3200	H	E4.2H/ML 3200 Ekip Dip LSI	1SDA083491R1
3200	H	E4.2H/ML 3200 Ekip G Hi-Touch LSI	1SDA083494R1
3200	H	E4.2H/ML 3200 Ekip G Touch LSI	1SDA083493R1
3200	H	E4.2H/ML 3200 Ekip Hi-Touch LSI	1SDA083492R1
3200	H	E4.2H/ML 3200 Ekip Touch LSI	1SDA083375R1
4000	H	E4.2H/ML 4000 Ekip Dip LSI	1SDA083495R1
4000	H	E4.2H/ML 4000 Ekip G Hi-Touch LSI	1SDA083498R1
4000	H	E4.2H/ML 4000 Ekip G Touch LSI	1SDA083497R1
4000	H	E4.2H/ML 4000 Ekip Hi-Touch LSI	1SDA083496R1
4000	H	E4.2H/ML 4000 Ekip Touch LSI	1SDA083380R1
2000	V	E4.2V/ML 2000 Ekip Dip LSI	1SDA083499R1
2000	V	E4.2V/ML 2000 Ekip G Hi-Touch LSI	1SDA083503R1
2000	V	E4.2V/ML 2000 Ekip G Touch LSI	1SDA083502R1
2000	V	E4.2V/ML 2000 Ekip Hi-Touch LSI	1SDA083501R1
2000	V	E4.2V/ML 2000 Ekip Touch LSI	1SDA083500R1
2500	V	E4.2V/ML 2500 Ekip Dip LSI	1SDA083504R1
2500	V	E4.2V/ML 2500 Ekip G Hi-Touch LSI	1SDA083508R1
2500	V	E4.2V/ML 2500 Ekip G Touch LSI	1SDA083507R1
2500	V	E4.2V/ML 2500 Ekip Hi-Touch LSI	1SDA083506R1
2500	V	E4.2V/ML 2500 Ekip Touch LSI	1SDA083505R1
3200	V	E4.2V/ML 3200 Ekip Dip LSI	1SDA083509R1
3200	V	E4.2V/ML 3200 Ekip G Hi-Touch LSI	1SDA083513R1
3200	V	E4.2V/ML 3200 Ekip G Touch LSI	1SDA083512R1
3200	V	E4.2V/ML 3200 Ekip Hi-Touch LSI	1SDA083511R1
3200	V	E4.2V/ML 3200 Ekip Touch LSI	1SDA083510R1
4000	V	E4.2V/ML 4000 Ekip Dip LSI	1SDA083514R1
4000	V	E4.2V/ML 4000 Ekip G Hi-Touch LSI	1SDA083518R1
4000	V	E4.2V/ML 4000 Ekip G Touch LSI	1SDA083517R1
4000	V	E4.2V/ML 4000 Ekip Hi-Touch LSI	1SDA083516R1
4000	V	E4.2V/ML 4000 Ekip Touch LSI	1SDA083515R1

Switch disconnecter moving part

lu	performance frame	Type	Code
3200	N	E4.2N/ML/MS 3200 3p WMP	1SDA083581R1
4000	N	E4.2N/ML/MS 4000 3p WMP	1SDA083582R1
3200	H	E4.2H/ML/MS 3200 3p WMP	1SDA083583R1
4000	H	E4.2H/ML/MS 4000 3p WMP	1SDA083584R1
2000	V	E4.2V/ML/MS 2000 3p WMP	1SDA083585R1
2500	V	E4.2V/ML/MS 2500 3p WMP	1SDA083586R1
3200	V	E4.2V/ML/MS 3200 3p WMP	1SDA083587R1
4000	V	E4.2V/ML/MS 4000 3p WMP	1SDA083588R1

Fixed part

Size	performance	lu range	Type of terminal	Type	Code
E4.2	N, H	3200	HR-HR	E4.2/ML W FP lu=3200 HR HR	1SDA083383R1
E4.2	V	2000-4000	HR-HR	E4.2/ML W FP lu=4000 o versione V HR HR	1SDA083596R1

Emax E6.2/ML

Circuit breaker moving part

lu	performance frame	Type	Code
4000	H	E6.2H/ML 4000 Ekip Dip LSI	1SDA083519R1
4000	H	E6.2H/ML 4000 Ekip G Hi-Touch LSI	1SDA083523R1
4000	H	E6.2H/ML 4000 Ekip G Touch LSI	1SDA083522R1
4000	H	E6.2H/ML 4000 Ekip Hi-Touch LSI	1SDA083521R1
4000	H	E6.2H/ML 4000 Ekip Touch LSI	1SDA083520R1
5000	H	E6.2H/ML 5000 Ekip Dip LSI	1SDA083524R1
5000	H	E6.2H/ML 5000 Ekip G Hi-Touch LSI	1SDA083528R1
5000	H	E6.2H/ML 5000 Ekip G Touch LSI	1SDA083527R1
5000	H	E6.2H/ML 5000 Ekip Hi-Touch LSI	1SDA083526R1
5000	H	E6.2H/ML 5000 Ekip Touch LSI	1SDA083525R1
6300	H	E6.2H/ML 6300 Ekip Dip LSI	1SDA083529R1
6300	H	E6.2H/ML 6300 Ekip G Hi-Touch LSI	1SDA083533R1
6300	H	E6.2H/ML 6300 Ekip G Touch LSI	1SDA083532R1
6300	H	E6.2H/ML 6300 Ekip Hi-Touch LSI	1SDA083531R1
6300	H	E6.2H/ML 6300 Ekip Touch LSI	1SDA083530R1
4000	V	E6.2V/ML 4000 Ekip Dip LSI	1SDA083534R1
4000	V	E6.2V/ML 4000 Ekip G Hi-Touch LSI	1SDA083538R1
4000	V	E6.2V/ML 4000 Ekip G Touch LSI	1SDA083537R1
4000	V	E6.2V/ML 4000 Ekip Hi-Touch LSI	1SDA083536R1
4000	V	E6.2V/ML 4000 Ekip Touch LSI	1SDA083535R1
5000	V	E6.2V/ML 5000 Ekip Dip LSI	1SDA083539R1
5000	V	E6.2V/ML 5000 Ekip G Hi-Touch LSI	1SDA083543R1
5000	V	E6.2V/ML 5000 Ekip G Touch LSI	1SDA083542R1
5000	V	E6.2V/ML 5000 Ekip Hi-Touch LSI	1SDA083541R1
5000	V	E6.2V/ML 5000 Ekip Touch LSI	1SDA083540R1
6300	V	E6.2V/ML 6300 Ekip Dip LSI	1SDA083544R1
6300	V	E6.2V/ML 6300 Ekip G Hi-Touch LSI	1SDA083548R1
6300	V	E6.2V/ML 6300 Ekip G Touch LSI	1SDA083547R1
6300	V	E6.2V/ML 6300 Ekip Hi-Touch LSI	1SDA083546R1
6300	V	E6.2V/ML 6300 Ekip Touch LSI	1SDA083545R1

Switch disconnecter moving part

lu	performance frame	Type	Code
4000	H	E6.2H/ML/MS 4000 3p WMP	1SDA083589R1
5000	H	E6.2H/ML/MS 5000 3p WMP	1SDA083590R1
6300	H	E6.2H/ML/MS 6300 3p WMP	1SDA083591R1
4000	X	E6.2X/ML/MS 4000 3p WMP	1SDA083592R1
5000	X	E6.2X/ML/MS 5000 3p WMP	1SDA083593R1
6300	X	E6.2X/ML/MS 6300 3p WMP	1SDA083594R1

Fixed part

Size	performance	lu range	Type of terminal	Type	Code
E6.2	H, V	4000-5000	HR-HR	E6.2/ML W FP lu=5000 HR HR	1SDA083597R1
E6.2	H, V, X	4000-5000	HR-HR	E6.2/ML W FP lu=6300 o versione X HR HR	1SDA083598R1

For more info about the accessories please refer to the Emax 2 catalogue.

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