



Low-Voltage special performances molded-case Mining Circuit Breaker

Circuit Breakers Overview

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1. Introduction

ABB SACE L.V. has gained long experience in the construction of Low Voltage molded-case circuit-breakers suitable for special applications and ambient conditions.

This circuit-breaker is fitted with particular characteristics which qualify it as one of the best pieces of apparatus currently available on the market for use in mines, but it is also just as suitable for use in all those situations where the ambient conditions are particularly severe, characterized by high distribution nominal voltage conditions of extreme temperature and relative humidity.

2. SACE Tmax



In the panorama of Tmax proposal there is also the range of T4, T5 and T6 circuit-breakers for applications in direct current or in alternating current up to 1150V AC and 1000V DC.

The typical sectors of application are in mining installations.

The circuit-breakers are available in the three-pole and four-pole version with TMD or TMA adjustable thermomagnetic trip units for use in direct and alternating current, or in the three-pole version with PR221DS and PR222DS/P electronic trip units for applications in alternating current.

The dimensions of these circuit-breakers are the same as those of the standard ones. The circuit breakers are supplied in the fixed version, with high terminal covers and insulating plates. They are compatible with all the electrical accessories, except for the residual current one.

The Tmax circuit-breakers can be used in ambient conditions where the surrounding air temperature varies between $-25\text{ }^{\circ}\text{C}$ and $+70\text{ }^{\circ}\text{C}$, and stored in ambients with temperatures between $-40\text{ }^{\circ}\text{C}$ and $+70\text{ }^{\circ}\text{C}$.

The circuit-breakers fitted with thermomagnetic release have their thermal element set for a reference temperature of $+40\text{ }^{\circ}\text{C}$.

For temperatures other than $+40\text{ }^{\circ}\text{C}$, with the same setting, there is a thermal trip threshold variation as shown in the table on Tmax Technical Catalogue

The electronic overcurrent releases do not undergo any variations in performance as the temperature varies but, in the case of temperatures exceeding $+40\text{ }^{\circ}\text{C}$, the maximum setting for protection against overloads L must be reduced, as indicated in the derating graph on the Tmax Technical Catalogue, to take into account the heating phenomena which occur in the copper parts of the circuit-breaker passed through by the phase current.

2.1 Main characteristics for application up to 1150V AC

SACE Tmax		T4		T5		T6	
Rated current	In	250		400/630		630/800	
Number of poles		3, 4		3, 4		3, 4	
Rated service voltage	(AC) 50-60 Hz	1000 1150		1000 1150		1000	
Rated impulse withstand voltage		8		8		8	
Rated insulating voltage	(AC) 50-60 Hz	1000 1150		1000 1150		1000	
Test voltage at industry frequency for 1min.		3500		3500		3500	
Rated ultimate short-circuit breaking capacity	Icu	L	V	L	V	L	
	(AC) 50-60 Hz 1000 V	12	20	12	20	12	
Rated service short-circuit breaking capacity	Ics	12		12			
	(AC) 50-60 Hz 1000 V	12	12	10	10	6	
Rated short-circuit making capacity (peak value)	Icm	6		6			
	(AC) 50-60 Hz 1150 V	24	40	24	40	24	
Category of use (according to IEC 947-2)		A		B (400A) - A(630 A)		B	
Aptitude to isolation (according to IEC 947-2)		■		■		■	
TM Trip unit	TMD	■					
	TMA *	■		■		■	
Electronic trip unit	PR221DS/LS	■	■	■	■	■	
	PR221DS/I	■	■	■	■	■	
	PR222DS/P_LSI	■	■	■	■	■	
	PR222DS/P_LSIG	■	■	■	■	■	
	PR222DS/PD_LSI	■	■	■	■	■	
	PR222DS/PD_LSIG	■	■	■	■	■	
	PR222MP	■		■			
Version		F, P, W	F	F, P, W***	F	F	
Terminals		FC Cu		FC Cu		F-FC CuAl-R	
Mechanical Life		20000		20000		20000	
	[No. Operation/h]	240		120		120	
Basic Dimensions for fixed**	3 poles	L	[mm]	105	140	210	210
		P	[mm]	140	184	280	280
	4 poles	L	[mm]	103,5	103,5	103,5	103,5
		H	[mm]	205	205	268	268
Weight	Fixed	3 / 4 poli	[kg]	2,35/3,05 2,35/3,05	3,25/4,15 3,25/4,15	9,5/12	
	Plug in	3 / 4 poli	[kg]	3,6/4,65	5,15/6,65		
	Withdrawable	3 / 4 poli	[kg]	3,85/4,9	5,4/6,9		

* Tmax T5 630 is only available up to TMD R500

**circuit breaker without high terminal covers

***Tmax T5 630 is only available in fixed version

2.2 Main characteristics for application up to 1000V DC

		T4	T5	T6
Rated current	Iu [A]	250	400/630	630/800
Poles		4	4	4
Rated service voltage, Ue	(DC) 4 poles in series [V]	1000	1000	1000
Rated impulse withstand voltage, Uimp	[kV]	8	8	8
Rated insulating voltage, Ui	(AC) 50-60 Hz [V]	1150	1150	1000
Test voltage at industry frequency for 1min.	[V]	3500	3500	3500
Rated ultimate short-circuit breaking capacity	Icu [kA]	V	V	L
	(DC) 4 poles in series	40	40	40
Rated service short-circuit breaking capacity	Ics [kA]			
	(DC) 4 poles in series	20	20	
Category of use (according to IEC 947-2)		A	B (400A) - A(500 A)	B
Aptitude to isolation (according to IEC 947-2)		■	■	■
TM Trip unit	TMD	■	-	-
	TMA	■	■	■
Version		F	F	F
Terminals		FC Cu	FC Cu	F-FC CuAl-R
Mechanical Life	[No. operation]	20000	20000	20000
	[No. Operation/h]	240	120	120
Basic Dimensions for fixed*	3 poles L [mm]	105	140	210
	4 poles L [mm]	140	184	280
	P [mm]	103,5	103,5	103,5
	H [mm]	205	205	268
Weight	fixed 3 / 4 poles [kg]	2,35/3,05	3,25/4,15	9,5/12

*Interruttore senza copriterminali alti

**Tmax T5630 è disponibile solamente in esecuzione fissa

3. SACE Isomax S



3.1 Main characteristics

SACE Isomax			S6X
Rated current	I_n	[A]	630
Number of poles			3
Rated service voltage	(AC) 50-60 Hz	[V]	1000
Rated impulse withstand voltage		[kV]	8
Rated insulating voltage	(AC) 50-60 Hz	[V]	1000
Test voltage at industry frequency for 1min.		[V]	3500
Rated ultimate short-circuit breaking capacity	I_{cu}		X
	(AC) 50-60 Hz 1000 V	[kA]	30
Rated short-circuit making capacity (peak value)	I_{cm}		
	(AC) 50-60 Hz 1000 V	[kA]	63
Category of use (according to IEC 947-2)			A
Aptitude to isolation (according to IEC 947-2)			■
Electronic trip unit	PR211/P LI		■
	PR212/P LSI-LSIG		■
Version			F
Terminals			F
Mechanical Life		[No. operation]	20000
		[No. Operation/h]	120
Basic Dimensions for fixed*	3 poles	L [mm]	210
	4 poles	L [mm]	406
		P [mm]	103,5
		H [mm]	268
Weight	Fixed	[kg]	15

*circuit breaker without high terminal covers

4. SACE Modul SH630/M



The special SACE MODUL SH630/M circuit-breaker has been made for use in mines. The use of particular materials and the increase in the surface insulation distances has made the apparatus suitable for ambient with temperatures up to 73 °C and relative humidity up to 98%.

Numerous tests have been carried out both in the ABB SACE L.V. laboratories and at independent testing laboratories.

The normal type tests which characterize the behavior of the circuit-breaker under the foreseen severe ambient conditions are listed below, and these have been passed by the SACE MODUL SH630/M circuit breaker, allowing its approval for use in mines:

1. Circuit- breaker stay for ten days in an ambient with relative humidity up to 98%, with periodic checks of the insulation resistance and of the dielectric strength.
2. Tests on the thermal releases in an ambient at 73°C with 70% relative humidity.
3. Performing of mechanical operations. Cycles of 10,000 mechanical operations with automatic opening by means of shunt opening releases and undervoltage release:
 - 5,000 cycles in an ambient at 73 °C - 70% R.H.
 - 5,000 cycles in an ambient at 35 °C - 98% R.H.
4. Performing of electrical operations. Cycles of:
 - 1000 operations carried out at 1000V – 630A – $\cos f = 0.8$
 - 25 operations carried out at 1100V – 3780A – $\cos f = 0.5$

The SACE MODUL SH630/M circuit-breaker has passed particularly severe tests: of considerable interest is the approval obtained from the EMAG test laboratory in Katowice (Poland) which, on behalf of the relative Ministry, sees to controlling and accepting electrical materials destined for use in local mines.

4.1 Main characteristics

	SACE MODUL	SH630/M	
Rated current (with 73°C ambient temperature and 70% relative humidity)	Iu	630	[A]
Number of poles		3	
Rated service voltage	Ue 50-60Hz	1000	[V]
Rated impulse withstand voltage	Uimp	8	[kV]
Rated insulating voltage	Ui	1000	[V]
Test voltage at industry frequency for 1min.		3500	
Rated ultimate short-circuit breaking capacity ($\cos \varphi = 0.2$) (1)	Icu	500 V ~	30 [kA]
		750 V ~	20 [kA]
		1000 V ~	15 [kA]
		250 V =	60 [kA]
Rated short-circuit making capacity (peak value)	Icm	500 V ~	66 [kA]
		750 V ~	44 [kA]
		1000 V ~	33 [kA]
Trip Unit	TMA	R160...R630	
	MA	Im=1000-1600	
		Im=3150-6300	
	Adjustable	Ith=0.5-1xIn	
		Im=5-10xIn	
Intechangeability		■	
Version		Fixed	
Terminals		EF - FC Cu -RC-R	
Category of use (according to IEC 947-2)		B	
Aptitude to isolation (according to IEC 947-2)		■	
Total breaking time		15-20	[ms]
Basic overall dimensions (in fixed version)	(HxWxD)	257x210x103	[mm]
Weights (Fixed version with terminal)	EF - FC Cu	9	[kg]
	R	10.5	[kg]
	RC	9.7	[kg]

(1)= The breaking test certificates are also available for the following values:

1100V AC +10% 15 kA

1200V AC + 5% 9 kA