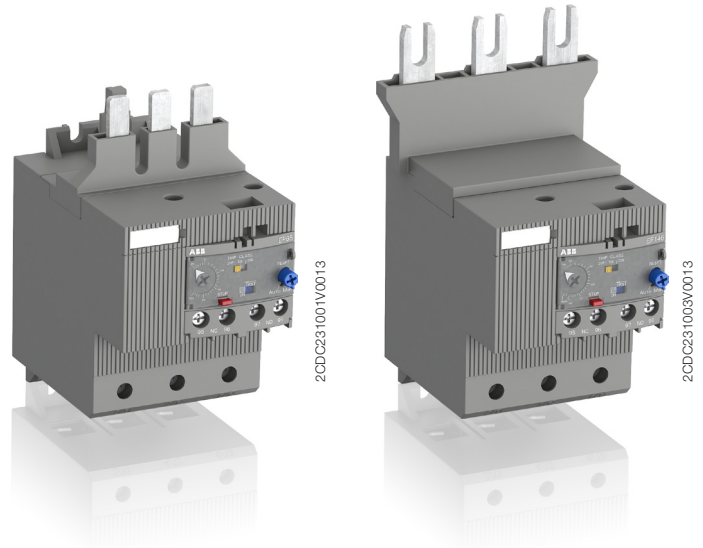


# Electronic overload relay EF65, EF96 and EF146

Electronic overload relays offer reliable protection in case of overload and phase-failure. They are the alternative to thermal overload relays. Motor starters are combinations of overload relays and contactors.



## Description

- Overload protection – trip class 10E, 20E, 30E selectable
- Phase loss sensitivity
- Temperature compensation from -25 ... +70 °C
- Adjustable current setting for overload protection
- Automatic or manual reset selectable
- Trip-free mechanism
- Status indication
- STOP and TEST function
- Direct mounting onto block contactors
- Sealable operating elements
- Self-supplied devices

## Order data

EF65, EF96, EF146 screw terminal



For AF40 ... AF146 block contactors

Setting range	Type	Order code	Suitable for	Packing unit	Weight per PCE
A				PCE	kg
20 ... 56	EF65-56	1SAX331001R1102	AF40, AF52, AF65	1	0.821
25 ... 70	EF65-70	1SAX331001R1101	AF40, AF52, AF65	1	0.821
36 ... 100	EF96-100	1SAX341001R1101	AF80, AF96	1	0.802
54 ... 150	EF146-150	1SAX351001R1101	AF116, AF140, AF146	1	0.879

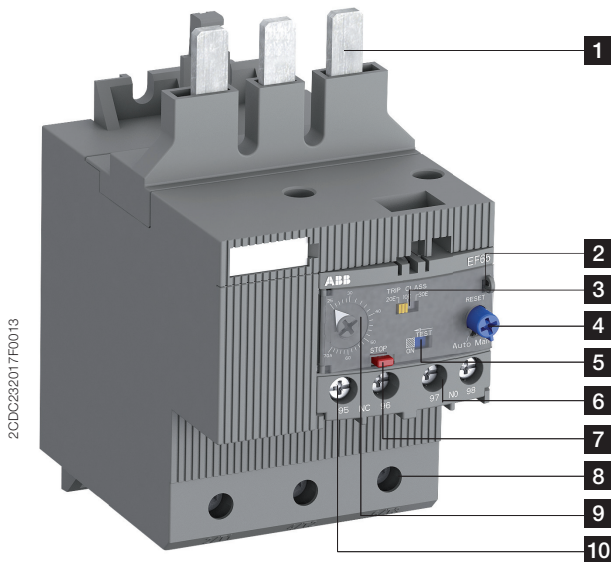
Suitable for mounting on:

AF40, AF52, AF65

AF80, AF96

AF116, AF140, AF146

## Functional description



- 1** Terminals (1L1, 3L2, 5L3)
- 2** Sealable operating elements
- 3** Trip class 10E, 20E, 30E selectable
- 4** RESET  
Automatic or manual reset selectable
- 5** TEST - Status indication
- 6** Signaling contacts 97-98
- 7** STOP
- 8** Terminals 2T1, 4T2, 6T3
- 9** Current setting range / Self-test function ST  
Adjustable current setting for overload protection
- 10** Tripping contacts 95-96

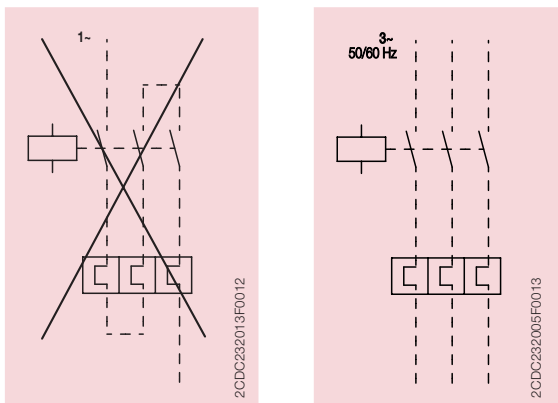
## Application / internal function

The self-supplied electronic overload relays are three pole electronic/mechanical devices. The motor current flows through build-in current transformers and an evaluation circuit will recognize an overload (over current). This will lead to a release of the relay and a change of the contacts switching position (95-96 / 97-98). The contact 95-96 is used to control the load contactor. The electronic overload relay is self-supplied, which mean no extra external supply is needed.

The overload relays have a setting scale in Amperes, which allows the direct adjusting of the relay without any additional calculation. In compliance with international and national standards, the setting current is the rated current of the motor and not the tripping current (no tripping at  $1.05 \times I$ , tripping at  $1.2 \times I$ ;  $I$  = setting current). The relays are constructed in a way that they protect themselves in the event of an overload. The overload relay has to be protected against short-circuit. The appropriate short-circuit protective devices are shown in the following tables.

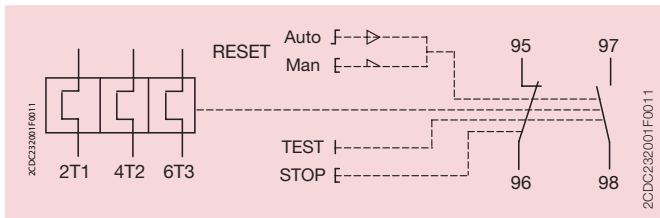
To prevent thermal overloads in heavy duty applications, the correct cable sizes have to be selected.

## Operation mode



	Contact 95-96	Contact 97-98	Opto-mechanical slide	Comment
Trip state	open	closed		
RESET state	closed	open	ON	
TEST manual reset mode	open	closed		
TEST auto reset mode	open	closed		
STOP while device is in trip state	open	closed		STOP button has no function
STOP while device is in RESET state	open	open		while STOP button is pressed

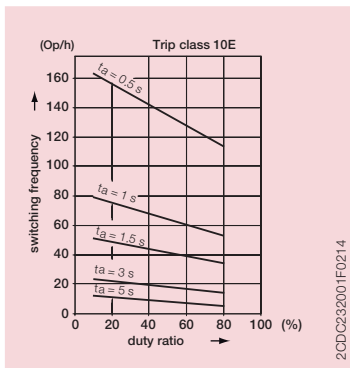
## Wiring diagram



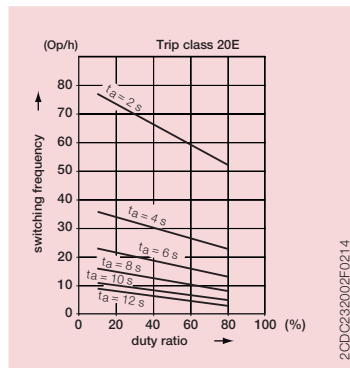
## Resistance and power loss per pole and short-circuit protective devices

Type	Setting range		Resistance per pole mΩ	Power loss per pole		Short-circuit protective devices coordination type 2
	lower value A	upper value A		at lower value W	at upper value W	
EF65-56	20	56	0.09	0.04	0.28	Fuse 160 A, Type gG
EF65-70	25	70	0.09	0.06	0.45	Fuse 160 A, Type gG
EF96-100	36	100	0.09	0.12	0.90	Fuse 200 A, Type gG
EF146-150	54	150	0.07	0.21	1.58	Fuse 315 A, Type gG

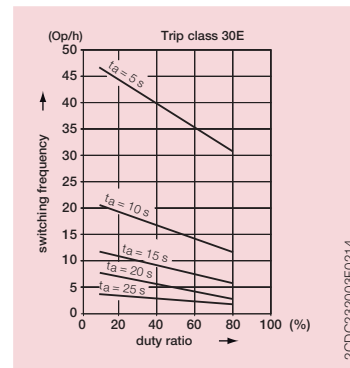
## Intermittent periodic duty



Trip class 10E



Trip class 20E



Trip class 30E



## Technical data IEC/EN

Data at  $T_A = 40\text{ °C}$  and at rated values, if nothing else indicated

### Main circuit

		EF65, EF96, EF146
Rated operational voltage $U_e$		1000 V AC - V DC
Setting range - electronic overload protection		see table on page 1
Rated operational current AC-3 $I_e$		see upper value of setting range, table on page 3
Trip class		10E, 20E, 30E, selectable
Rated frequency		50/60 Hz
Number of poles		3
Resistance per pole		see table on page 3
Power loss per pole		see table on page 3
Short-circuit protective devices		see table on page 3

		EF65, EF96, EF146
Rated impulse withstand voltage $U_{imp}$		8 kV
Rated insulation voltage $U_i$		1000 V
Pollution degree		3
Overvoltage category		up to III

Electrical connection		EF65	EF96	EF146	
Connecting capacity	rigid	1x	4 ... 35 mm <sup>2</sup>	6 ... 70 mm <sup>2</sup>	10 ... 95 mm <sup>2</sup>
		2x	4 ... 35 mm <sup>2</sup>	6 ... 35 mm <sup>2</sup>	10 ... 35 mm <sup>2</sup>
	flexible with ferrule	1x	4 ... 35 mm <sup>2</sup>	6 ... 50 mm <sup>2</sup>	10 ... 70 mm <sup>2</sup>
		2x	4 ... 35 mm <sup>2</sup>	6 ... 35 mm <sup>2</sup>	10 ... 35 mm <sup>2</sup>
	flexible with ferrule insulated	1x	4 ... 35 mm <sup>2</sup>	6 ... 50 mm <sup>2</sup>	10 ... 70 mm <sup>2</sup>
		2x	4 ... 35 mm <sup>2</sup>	6 ... 35 mm <sup>2</sup>	10 ... 35 mm <sup>2</sup>
flexible	1x	4 ... 35 mm <sup>2</sup>	6 ... 70 mm <sup>2</sup>	10 ... 70 mm <sup>2</sup>	
	2x	4 ... 35 mm <sup>2</sup>	6 ... 35 mm <sup>2</sup>	10 ... 35 mm <sup>2</sup>	
Stripping length		20 mm	20 mm	20 mm	
Tightening torque		4 Nm	6 Nm	8 Nm	
Recommended screw driver		Pozidriv 2	Hexagon 4	Hexagon 4	

## Auxiliary circuit

			<b>95-96, 97-98</b>
Rated operational voltage $U_e$			600 V AC / DC
Conventional free air thermal current $I_{th}$			6 A
Rated frequency			DC, 50/60 Hz
Number of poles			1NC + 1NO
Rated operational current $I_e$			
acc. to IEC/EN 60947-5-1 for utilization category			
at AC-15 at 110-120 V	NC, 95-96		3.00 A
	NO, 97-98		3.00 A
at AC-15 at 220-230-240 V	NC, 95-96		3.00 A
	NO, 97-98		3.00 A
at AC-15 at 400 V	NC, 95-96		1.10 A
	NO, 97-98		1.10 A
at AC-15 at 480-500 V	NC, 95-96		0.75 A
	NO, 97-98		0.75 A
at DC-13 at 24 V	NC, 95-96		1.50 A
	NO, 97-98		1.50 A
at DC-13 at 60 V	NC, 95-96		0.55 A
	NO, 97-98		0.55 A
at DC-13 at 110-120-125 V	NC, 95-96		0.55 A
	NO, 97-98		0.55 A
at DC-13 at 250 V	NC, 95-96		0.27 A
	NO, 97-98		0.27 A
Minimum switching capacity			12 V / 3 mA
Short-circuit protective devices			$\lambda = 10^{-7}$ ; $U_{kp} = 3$ V / 500,000 operating cycles fuse 6 A, Type gG
<b>Isolation data</b>			<b>95-96, 97-98</b>
Rated impulse withstand voltage $U_{imp}$			6 kV
Rated insulation voltage $U_i$			690 V
Pollution degree			3
Overvoltage category			up to III
<b>Electrical connection</b>			<b>95-96, 97-98</b>
Connecting capacity	rigid	1x	1 ... 4 mm <sup>2</sup>
		2x	1 ... 4 mm <sup>2</sup>
	flexible with ferrule	1x	0.75 ... 2.5 mm <sup>2</sup>
		2x	0.75 ... 2.5 mm <sup>2</sup>
	flexible with ferrule insulated	1x	0.75 ... 2.5 mm <sup>2</sup>
		2x	0.75 ... 2.5 mm <sup>2</sup>
	flexible	1x	0.75 ... 2.5 mm <sup>2</sup>
		2x	0.75 ... 2.5 mm <sup>2</sup>
Stripping length			9 mm
Tightening torque			0.8 ... 1.2 Nm
Recommended screw driver			Pozidriv 2

## General data

Duty time		100 %
Operating frequency without early tripping		up to 15 operations/h or 60 operations/h with 40 % duty ratio, if the motor breaking current $6 \times I_n$ and the motor starting time does not exceed 1 s
Dimensions (W x H x D)		see dimension drawing
Weight		see ordering data
Mounting		mount on the contactor and tighten the screws of the main circuit terminals
Mounting position		optional, position 1-6
Minimum distance to other units same type	horizontal	none
	vertical	not applicable
Minimum distance to electrical conductive board	horizontal	1.5 mm
	vertical	1.5 mm
Degree of protection	housing	IP20
	main circuit terminals	IP10
Maximum operating altitude		2000 m

## Electromagnetic compatibility

Immunity acc. to IEC 60947-1		Environment A
Emission acc. to IEC 60947-1		Environment B

## Environmental data

Ambient air temperature		
Operation	open - compensated	-25 ... +70 °C
	open	-25 ... +70 °C
Storage		-50 ... +85 °C
Ambient air temperature compensation		acc. to IEC/EN 60947-4-1
Resistance to vibrations acc. to IEC 60068-2-6		5g / 3 ... 150 Hz
Resistance to shock acc. to IEC 60068-2-27		15g / 11 ms

## Standards / directives

Standards		IEC/EN 60947-1
		IEC/EN 60947-4-1
		IEC/EN 60947-5-1
		UL 60947-1
		UL 60947-4-1
Low Voltage Directive		2006/95/EC
EMC Directive		2004/108/EC
RoHS Directive		2002/95/EC

## Technical data UL/CSA

### Full load amps and short-circuit protective devices

Type	Full load amps (FLA)	Short circuit protective devices				Fuse K5 / RK5	Circuit breaker	600 V AC		Fuse J	600 V AC	
		480 V AC SCCR	Circuit breaker	600 V AC SCCR	600 V AC SCCR			600 V AC SCCR	Circuit breaker			
EF65-56	56 A	65 kA	250 A	10 kA	150 A	150 A	100 kA	150 A	25 kA	250 A		
EF65-70	70 A	65 kA	250 A	10 kA	150 A	150 A	100 kA	150 A	25 kA	250 A		
EF96-100	100 A	65 kA	250 A	10 kA	200 A	150 A	100 kA	200 A	25 kA	250 A		
EF146-150	150 A	100 kA	250 A	10 kA	250 A	250 A	100 kA	250 A	100 kA	250 A		

### Main circuit

Maximum operational voltage	600 V AC
Trip rating	125 % of FLA
Full load amps (FLA)	see table above
Short-circuit rating RMS symmetrical	see table above
Short-circuit protective devices	see table above

Electrical connection		EF65	EF96	EF146
Connecting capacity	stranded	1x AWG 10 ... 2	AWG 8 ... 2	AWG 6 ... 0
		2x AWG 10 ... 2	AWG 8 ... 2	AWG 6 ... 2
	flexible	1x AWG 10 ... 2	AWG 8 ... 2	AWG 6 ... 0
		2x AWG 10 ... 2	AWG 8 ... 2	AWG 6 ... 2
Stripping length		20 mm	20 mm	20 mm
Tightening torque		55 lb.in	70 lb.in	70 lb.in
Recommended screw driver		Pozidriv 2	Hexagon 4	Hexagon 4

### Auxiliary circuit

Conventional thermal current		6 A
Making and breaking capacity	NC / NO	B600, Q600

Electrical connection		
Connecting capacity	stranded	1x AWG 18 ... 10
		2x AWG 18 ... 10
	flexible	1x AWG 18 ... 10
		2x AWG 18 ... 10
Stripping length		9 mm
Tightening torque		7 ... 11 lb.in
Recommended screw driver		Pozidriv 2



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