

# Electronic overload relay EF65, EF96 and EF146

Electronic overload relays are the alternative to the thermal overload relays. An electronic overload relay offers reliable and fast protection for motors in the event of overload or phase failure. Starter combinations are setup together with 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
25 ... 70	EF65-70	1SAX331001R1101	AF40, AF52, AF65	1	0.790
36 ... 100	EF96-100	1SAX341001R1101	AF80, AF96	1	0.780
54 ... 150	EF146-150	1SAX351001R1101	AF116, AF140, AF146	1	0.890

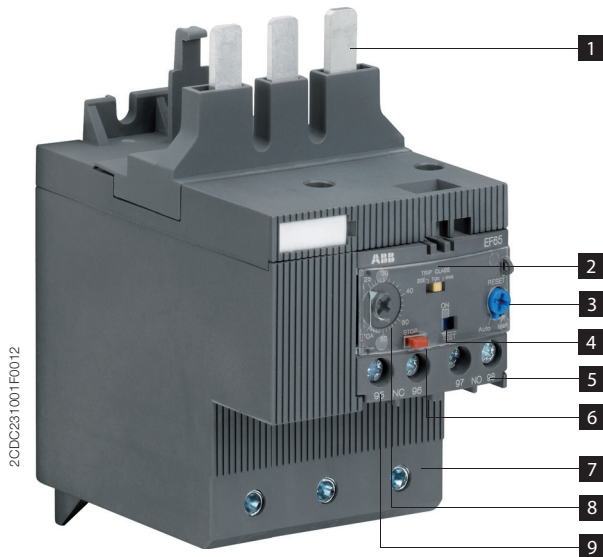
Suitable for mounting on:

AF40, AF52, AF65

AF80, AF96

AF116, AF140, AF146

## Functional description



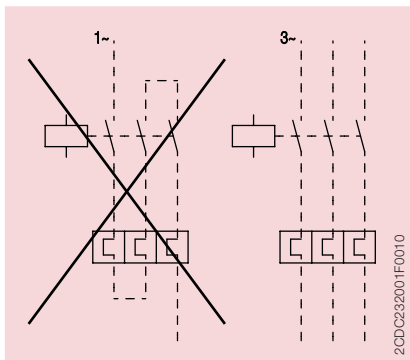
- 1 Terminals (1L1, 3L2, 5L3)
- 2 Trip class 10E, 20E, 30E selectable
- 3 RESET button  
Automatic or manual reset selectable
- 4 Status indication
- 5 Signaling contacts 97-98
- 6 STOP button
- 7 Terminals 2T1, 4T2, 6T3
- 8 Current setting range  
Adjustable current setting for overload protection
- 9 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.

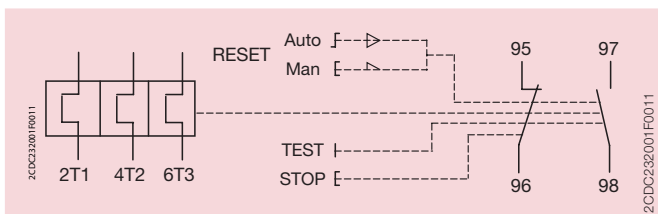
The overload relays have a setting scale in Amperes, which allows the direct adjusting of the relay without any additional calculation. In compliance with international and national standards, the setting current is the rated current of the motor and not the tripping current (no tripping at  $1.05 \times I$ , 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 table.

## 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

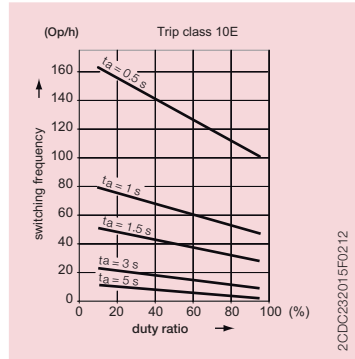
## Wiring diagram



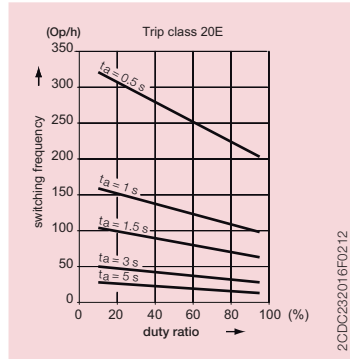
## Resistance and power loss per pole and short-circuit protective devices

Type	Setting range		Resistance per pole mΩ	Power loss		Short-circuit protective devices coordination type 2
	lower value A	upper value A		at lower value W	at upper value W	
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

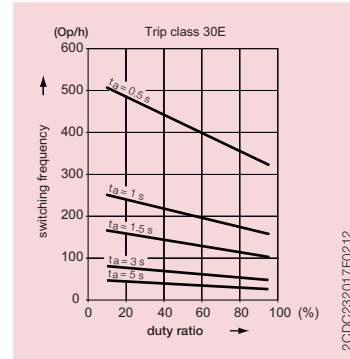
## Intermittent periodic duty



Trip class 10E

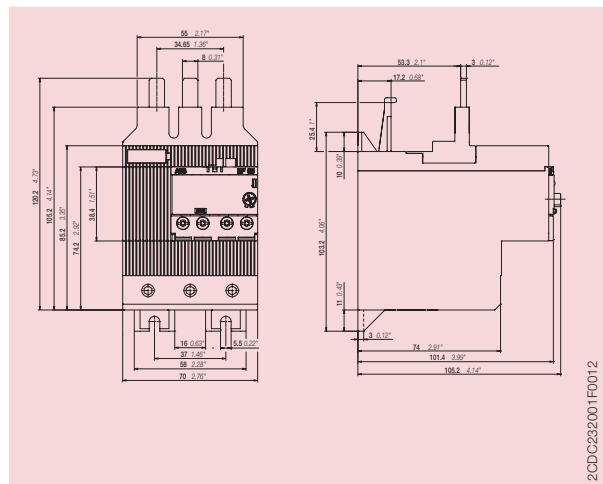


Trip class 20E

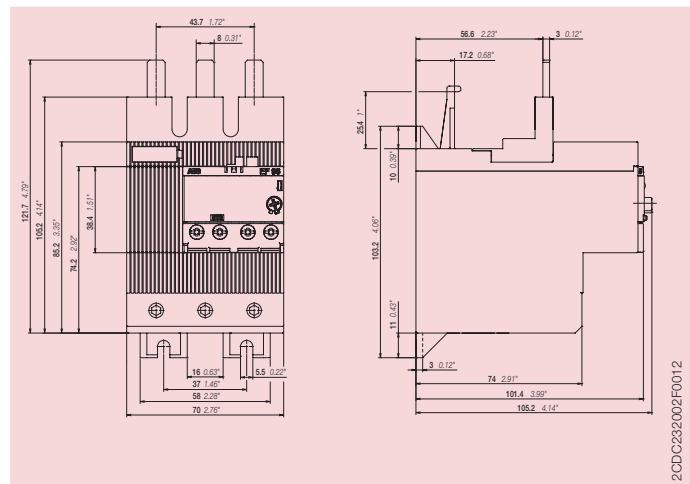


Trip class 30E

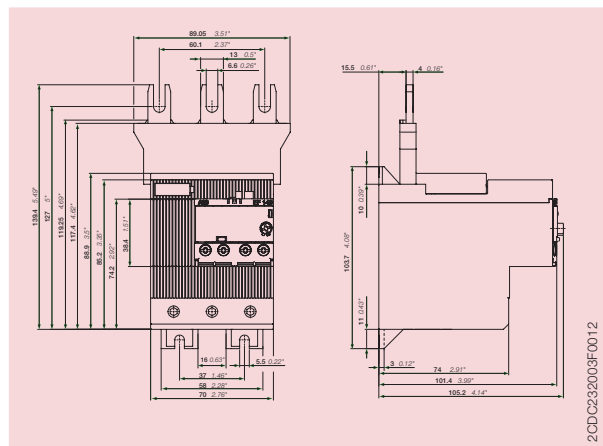
## Dimensions



EF65-70



EF96-100



EF146-150

## 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
Connection screw		M8 (Pozidriv 2)	M8 (Hexagon 4)	M8 (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		$\lambda = 10^{-7}$ ; $U_{kld} = 3$ 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	
Connection screw		M3.5 (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
Altitude		up to 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
Vibration (sinusoidal) acc. to IEC/EN 60068-2-6 (Fc)		5g / 3 ... 150 Hz
Shock (half-sine) acc. to IEC/EN 60068-2-27 (Ea)		15g / 11 ms

## Standards / directives

Product standard		IEC/EN 60947-4-1 IEC/EN 60497-5-1 IEC/EN 60947-1 UL 508, CSA22.2 No. 14
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			
		480 V AC		600 V AC	
		SCCR	Fuse type	SCCR	Fuse type
EF65-70	70 A	10 kA	150 A, K5/RK5	10 kA	150 A, K5/RK5
EF96-100	100 A	10 kA	200 A, K5/RK5	10 kA	200 A, K5/RK5
EF146-150	150 A	10 kA	250 A, K5/RK5	10 kA	250 A, K5/RK5

### 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		EF96	EF146
Connecting capacity	stranded	1x AWG 8 ... 2	AWG 6 ... 0
		2x AWG 8 ... 2	AWG 6 ... 2
	flexible	1x AWG 8 ... 2	AWG 6 ... 0
		2x AWG 8 ... 2	AWG 6 ... 2
Stripping length	20 mm	20 mm	
Tightening torque	70 lb.in	70 lb.in	
Connection screw	M8 (Hexagon 4)	M8 (Hexagon 4)	

### Auxiliary circuit

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

Electrical connection		EF65	EF96	EF146
Connecting capacity	stranded	1x AWG 18 ... 10	AWG 18 ... 10	AWG 18 ... 10
		2x AWG 18 ... 10	AWG 18 ... 10	AWG 18 ... 10
	flexible	1x AWG 18 ... 10	AWG 18 ... 10	AWG 18 ... 10
		2x AWG 18 ... 10	AWG 18 ... 10	AWG 18 ... 10
Stripping length	9 mm	9 mm	9 mm	
Tightening torque	7 ... 11 lb.in	7 ... 11 lb.in	7 ... 11 lb.in	
Connection screw	M8 (Pozi driv 2)	M8 (Pozi driv 2)	M8 (Pozi driv 2)	

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