

Description

Electronic circuit protector type ESX10 is designed to ensure **selective** disconnection of DC 24 V load systems.

DC 24 V power supplies, which are widely used in industry today, will shut down the output in the event of an overload with the result that one faulty load in the system can lead to complete disconnection of all loads. As well as an unidentified failure this also means stoppage of the whole system.

Through **selective** disconnection the ESX10 responds much faster to overload or short circuit conditions than the switch-mode power supply. This is achieved by active current limitation. The ESX10 limits the highest possible current to values between 1.3 to 1.8 times the selected rated current of the circuit protector. Thus it is possible to switch on **capacitive loads of up to 75,000 µF** lamp loads, but they are disconnected only in the event of an overload or short circuit.

For optimal alignment with the characteristics of the application the current rating of the ESX10 can be selected in fixed values from 0.5 A...12 A. Failure and status indication are provided by a multicolour LED and an integral short-circuit-proof status output or a potential-free signal contact.

The ESX10, with a width of only 12.5 mm, can be plugged into the E-T-A power distribution socket Module 17plus ensuring ease of installation and saving space in control cabinets.

Upon detection of overload or short circuit in the load circuit, the MOSFET of the load output will be blocked to interrupt the current flow. The MOSFET and the load circuit may be re-activated via the remote electronic reset input or manually by means of the ON/OFF button. When starting up the system, the load circuit may also be manually disconnected.

US patent number: US 6,490,141 B2

Features

- Selective load protection, electronic trip characteristics.
- Active current limitation for safe connection of capacitive loads up to 75,000 µF and on overload/short circuit.
- Current ratings 0.5 A...12 A.
- Reliable overload disconnection with $1.1 \times I_N$ plus, even with long load lines or small cable cross sections (see table 3).
- Manual ON/OFF button (S1).
- Clear status and failure indication through LED, status output SF or Si contact F.
- Electronic reset input RE (option).
- Integral fail-safe element.
- Width per unit only 12.5 mm.
- Plug-in mounting utilising power distribution system Module 17plus or SVSxx optionally (see product group Power distribution systems)
- Additional versions with ATEX approval available.

Marking: Ⓢ II 3G Ex nA IIB T4 Gc X
ESX10-...-E

Please observe separate operating instructions:



ESX10

Technical data ($T_{\text{ambient}} = 25^\circ\text{C}$, operating voltage $U_S = \text{DC } 24 \text{ V}$)

Operating data

Operating voltage U_S	DC 24 V (18...32 V)
Current rating I_N	fixed current ratings: 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A, 12 A
Closed current I_0	ON condition: typically 20...30 mA depending on signal output
Status indication by means of	• multicolour LED: GREEN: unit is ON, power-MOSFET is switched on - status output SF ON, supplies +DC 24 V ORANGE: in the event of overload or short circuit until electronic disconnection RED: - unit electronically disconnected - load circuit/Power-MOSFET OFF OFF: - manually switched off (S1 = OFF) or device is dead - undervoltage ($U_S < 8 \text{ V}$) - after switch-on till the end of the delay period • status output SF (option) • potential-free signal contact F (option) • ON/OFF/ condition of switch S1

Load circuit

Load output	Power-MOSFET switching output (high side switch)
Overload disconnection	typically $1.1 \times I_N$ ($1.05...1.35 \times I_N$)
Short-circuit current I_K	active current limitation (see table 1)
Trip time for electronic disconnection	see time/current characteristics typically 3 s at $I_{\text{Load}} > 1.1 \times I_N$ typically 3 s...100 ms at $I_{\text{Load}} > 1.8 \times I_N$ (or $1.5 \times I_N/1.3 \times I_N$)
Temperature disconnection	internal temperature monitoring with electronic disconnection
Low voltage monitoring load output	with hysteresis, no reset necessary load "OFF" at $U_S < 8 \text{ V}$
Starting delay t_{start}	typically 0.5 sec after every switch-on and after applying U_S
Disconnection of load circuit	electronic disconnection
Free-wheeling circuit	external free-wheeling diode recommended with inductive load
Several load outputs must not be connected in parallel	

Technical data ($T_{\text{ambient}} = 25^{\circ}\text{C}$, operating voltage $U_S = \text{DC } 24 \text{ V}$)

Status output SF	ESX10-104/-124
Electrical data	plus-switching signal output, connects U_S to terminal 12 of module 17plus nominal data: DC 24 V / max. 0.2 A (short circuit proof) status output is internally connected to GND with a 10 kOhm resistor
Status OUT	ESX10-104/-106/-124 (signal status OUT), at $U_S = +24 \text{ V}$ $+24 \text{ V} = \text{S1 is ON}$, load output connected through $0 \text{ V} = \text{S1 is ON}$, load output blocked and/or switch S1 is OFF
Status $\overline{\text{OUT}}$	ESX10-127 (signal status OUT inverted), at $U_S = +24 \text{ V}$ $+24 \text{ V} = \text{S1 is ON}$, load output blocked, red LED lighted $0 \text{ V} = \text{S1 is ON}$, load output connected through and/or switch S1 is in OFF position
OFF condition	0 V level at status output when: - switch S1 is in ON position, but device is still in switch-on delay - switch S1 is OFF, or control signal OFF, device is switched off - no operating voltage U_S
Signal output F	ESX10-103/-115/-125
Electrical data	potential-free signal contact max. DC 30 V/0.5 A, min. 10 V/10 mA
ON condition LED green	voltage U_S applied, switch S1 is in ON position no overload, no short circuit
OFF condition LED off	- device switched off (switch S1 is in OFF position) - no voltage U_S applied
Fault condition LED orange	overload condition $> 1.1 \times I_N$ up to electronic disconnection
Fault condition LED red	electronic disconnection upon overload or short circuit device switched off with control signal (switch S1 is in ON position)
ESX10-101	single signal, make contact contact SC/SO-SI open
ESX10-102	single signal, break contact contact SC/SO-SI closed
ESX10-103	group signal change-over contact contact SC-SO open, SC-SI closed
ESX10-115/-125	group signal, make contact contact SC-SO open
Fault	signal output fault conditions: - no operating voltage U_S - ON/OFF switch S1 is in OFF position - red LED lighted (electronic disconnection)

Table 1: voltage drop, current limitation, max. load current

current rating I_N	typically voltage drop U_{ON} at I_N	active current limitation (typically)	max. load current at 100 % ON duty	
			$T_U = 40^{\circ}\text{C}$	$T_U = 50^{\circ}\text{C}$
0.5 A	70 mV	$1.8 \times I_N$	0.5 A	0.5 A
1 A	80 mV	$1.8 \times I_N$	1 A	1 A
2 A	130 mV	$1.8 \times I_N$	2 A	2 A
3 A	80 mV	$1.8 \times I_N$	3 A	3 A
4 A	100 mV	$1.8 \times I_N$	4 A	4 A
6 A	130 mV	$1.8 \times I_N$	6 A	5 A
8 A	120 mV	$1.5 \times I_N$	8 A	7 A
10 A	150 mV	$1.5 \times I_N$	10 A	9 A
12 A	180 mV	$1.3 \times I_N$	12 A	10.8 A

Attention: when mounted side-by-side without convection the ESX10-0... should not carry more than 80 % of its rated load with 100 % ON duty due to thermal effects.

Technical data ($T_{\text{ambient}} = 25^{\circ}\text{C}$, operating voltage $U_S = \text{DC } 24 \text{ V}$)

Reset input RE	ESX10-124/-125
Electrical data	voltage: max. + DC 32 V high $> \text{DC } 8 \text{ V} \leq \text{DC } 32 \text{ V}$ low $\leq \text{DC } 3 \text{ V} > 0 \text{ V}$ power consumption typically 2.6 mA (+DC 24 V) min. pulse duration typically 10 ms
Reset signal RE (= terminal 13,14 or 12 of Module 17plus)	The electronically blocked ESX10-124/-127 may remotely be reset via an external momentary switch due to the falling edge of a +24 V pulse. The reset signal will be fed in terminal 13, 14 or 12 of Module 17plus and is internally pre-wired. The reset simultaneously affects all blocked ESX10-124/-127 channels of the power distribution system, all switched on ESX10-124/-127 channels remain unaffected. With type ESX10-125 the reset only affects the device concerned. By connecting the individual terminals 12 of the Module 17plus a joint reset signal for all ESX10-125 may be generated.
Caution: unused slots have to be fitted with jumpers	
Control input IN+	ESX10-115
Electrical data	see reset input RE
Control signal IN+	+24 V level (HIGH): device will be switched on by a remote ON/OFF signal 0 V level (LOW): device will be switched off by a remote ON/OFF signal
Switch S1 ON/OFF	unit can only be switched on with S1 if a HIGH level is applied to IN+
General data	
Fail-safe element:	backup fuse for ESX10 <u>not required</u> because of the integral redundant fail-safe element
Blade terminals	6.3 mm to DIN 46244-A6.3-0.8
Housing	moulded
Mounting	plug-in mounting utilising power distribution system Module 17plus or SVSxx
Ambient temperature	0...+50 °C (without condensation, see EN 60204-1)
Storage temperature	-40...+70 °C
Humidity	96 hrs/95 % RH/40 °C to IEC 60068-2-78, test Cab. climate class 3K3 to EN 60721
Vibration	3 g, test to IEC 60068-2-6 test Fc
Degree of protection	housing: IP30 DIN 40050 terminals: IP00 DIN 40050
EMC (EMC directive, CE logo)	emission: EN 61000-6-3 susceptibility: EN 61000-6-2
Insulation co-ordination (IEC 60934)	0.5 kV/2 pollution degree 2 re-inforced insulation in operating area
dielectric strength	max. DC 32 V (load circuit)
Insulation resistance (OFF condition)	n/a, only electronic disconnection
Approvals	CE logo UL 2367, File # E306740 Solid State Overcurrent Protectors cURus: UL 508, CSA C22.2 No. 14, File # E322549 UL 1604, File # E320024 (class I, division 2, groups A, B, C, D) CSA C22.2 No. 142, File # 16186 CSA C22.2 No. 213 (class I, division 2)
Dimensions (W x H x D)	12.5 x 70 x 60 mm
Mass	approx. 40 g

Ordering configuration for ATEX versions: ...-E

Type No.	
ESX10	Electronic Circuit Protector for DC 24 V applications
Version	
1	standard, without physical isolation in the event of a failure
Signal input	
0	without signal input
1	with control input IN+
2	with reset input RE
Signal outputs	
0	without
3	signal output F (group signal, change-over)
4	status output SF
5	signal output F (group signal, N/O only ESX10-115 and ESX10-125)
Operating voltage	
DC 24 V	rated voltage DC 24 V
Current rating	
0.5...12 A	
Approvals	
E	ATEX
ESX10 - 1 0 3 - DC 24 V - 6 A E ordering example	

Ordering information

Type No.	
ESX10	Electronic Circuit Protector for DC 24 V applications
Version	
1	standard, without physical isolation in the event of a failure
Signal input	
0	without signal input
1	with control input IN+, only ESX10-115
2	with reset input RE, only ESX10-124
Signal outputs	
0	without, only ESX10-100
3	signal output F (group signal, change-over) only ESX10-103
4	status output SF (+24 V = OK), only ESX10-104, ESX10-124
5	signal output F (group signal, N/O only ESX10-115 and ESX10-125)
Operating voltage	
DC 24 V	rated voltage DC 24 V
Current rating	
0.5 A	
1 A	
2 A	
3 A	
4 A	
6 A	
8 A	
10 A	
12 A	
ESX10 - 1 0 3 - DC 24 V - 6 A ordering example	

Description of ESX10 signal inputs and outputs (wiring diagrams) see next page.

Preferred types

Preferred types	Standard current ratings (A)							
	1	2	3	4	6	8	10	12
ESX10-103-DC24V	x	x	x	x	x	x	x	x

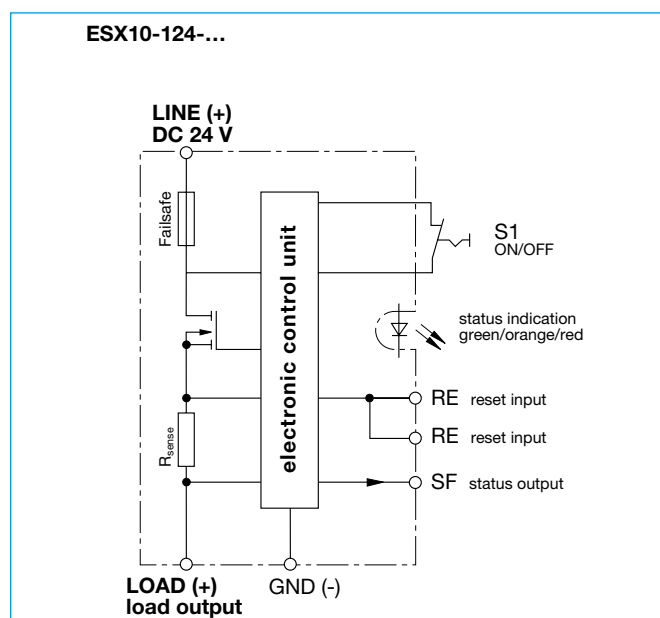
Please note:

- The user should ensure that the cable cross sections of the relevant load circuit are suitable for the current rating of the ESX10 used.
- Automatic start-up of machinery after shut down must be prevented (Machinery Directive 98/37/EG and EN 60204-1). In the event of a short circuit or overload the load circuit will be disconnected electronically by the ESX10.

Approvals

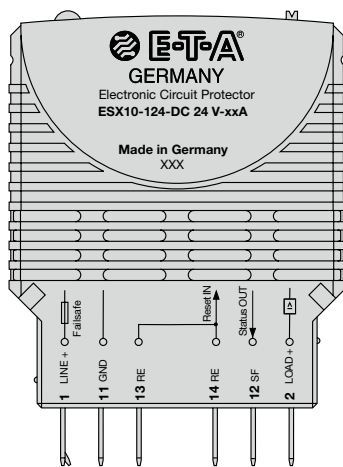
Authority	Standard	Voltage ratings	Current ratings
UL	UL 2367	DC 24 V	0.5...12 A
UL	UL 1604	DC 24 V	0.5...12 A
UL cURus	UL 508 CSA C22.2 No. 14	DC 24 V	0.5...16 A
CSA	C22.2 No. 142 C22.2 No. 213 (class I, division 2)	DC 24 V	0.5...12 A
TÜV Süd	ATEX 94/9/EC Annex VIII EN 60079-0 EN 60079-11 EN 60079-15	DC 24 V	
GL	Rules VI, part 7, GL 2012, category C, EMC1	DC 24 V	0.5...12 A

Schematic diagram ESX10-124

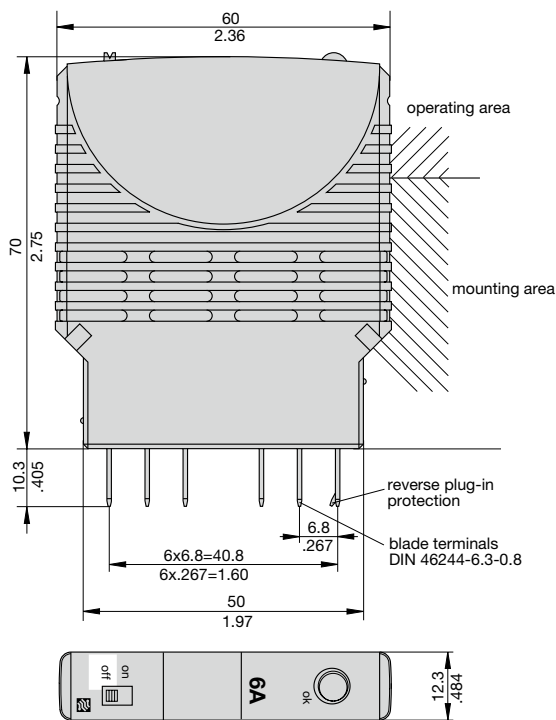


Terminal wiring diagram ESX10-124

ESX10



Dimensions



This is a metric design and millimeter dimensions take precedence ($\frac{\text{mm}}{\text{inch}}$)

Information to UL-Approvals/CSA-Approvals

UL® ESX10
UL1604
UL File # E320024

Operating Temperature Code T4 A / 0 °C to 50 °C
- This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D or non-hazardous locations only

WARNING:

- Exposure to some chemicals may degrade the sealing properties of materials used in the following device: relay
- Sealant Material:
- Generic Name: Modified diglycidyl ether of bisphenol A
 - Supplier: Fine Polymers Corporation
 - Type: Epi Fine 4616L-160PK
- Casing Material:
- Generic Name: Liquid Crystal Polymer
 - Supplier: Sumitomo Chemical
 - Type: E4008, E4009, or E6008

RECOMMENDATION:

- Periodically inspect the device named above for any degradation of properties and replace if degradation is found

WARNING – EXPLOSION HAZARD:

- Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous
- Substitution of any components may impair suitability for Class I, Division 2

UL® ESX10
UL2367
Non-hazardous use - UL File # E306740

CSA® US ESX10
UL 508, CSA C22.2 No. 14
Non-hazardous use - UL File # E322549

SP® ESX10
CSA C22.2 No. 142 - File # 16186
CSA C22.2 No. 213 (Class I, Division 2) - File # 16186

Class 2

Meets requirement for Class 2 current limitation
(ESX10-...-0.5 A/1 A/2 A/3 A)



Electronic Circuit Protector ESX10

UL® UL1604
UL File # E320024

CSA® C22.2 No.213
CSA File # 16186

This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D or non-hazardous locations only. T4A / 0° C to 50° C

Warnings:

1. Remove power before disconnecting device or the area is known to be nonhazardous.
2. Components substitutions may impair suitability of Class I, Div 2.
3. Chemical exposure may degrade internal relay's sealing property.

UL® UL2367
Non-hazardous use
UL File # E306740

CSA® US UL508
CSA C22.2 No.14
Non-hazardous use
UL File # E322549

Refer to data sheet / installation guidelines for installation and safety instructions.

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EG-declaration of Conformity for ATEX-version ESX10-TA/-TB-...-E



E-T-A Elektrotechnische Apparate GmbH

EU-Konformitätserklärung Nr. 100.218.1018-03
Declaration of Conformity

Wir **E-T-A Elektrotechnische Apparate GmbH**
 We Industriestraße 2-8, D-90518 Altdorf, Germany
 (Name und Anschrift des Anbieters / supplier's name and address)

erklären in alleiniger Verantwortung, dass das Produkt
 declare under our sole responsibility that the product

Elektronischer Sicherungsautomat
 Solid state overcurrent protector

ESX10-TA (Hutschienenmontage 24Vdc / rail mounting 24Vdc)
 ESX10-TB (Hutschienenmontage 24Vdc / rail mounting 24Vdc)
 ESX10-... (Steckmontage, mit Modul 17PLUS, 24Vdc / plug-in mounting with module 17PLUS, 24Vdc)
 ESX10-TC (Hutschienenmontage 12Vdc / rail mounting 12Vdc)

(Bezeichnung, Typ/Modell, evtl. Spezifikation/ name, type/model, optionally specification)

auf das sich diese Erklärung bezieht, mit den wesentlichen
 Anforderungen folgender Richtlinie(n) übereinstimmt:
 to which this declaration relates, is in conformity with the essential requirements of following Directive(s)

2014/34/EU ATEX-Richtlinie / ATEX Directive

Zur Beurteilung der Übereinstimmung wurde(n) folgende Norm(en)
 oder normativen Dokumente herangezogen:
 For evaluation of the conformity following standard(s) or normative document(s) were consulted:

DIN EN 60079-0:2014-06
 Explosionsgefährdete Bereiche - Teil 0: Betriebsmittel - Allgemeine Anforderungen
 Explosive atmospheres - Part 0: Equipment - General requirements

EN 60079-15: 2010 - Explosive Atmosphäre - Geräteschutz durch Zündschutzart „n“
 Explosive atmospheres - Equipment protection by type of protection "n"

(Titel und/oder Nr. sowie Ausgabedatum der Norm(en) oder der anderen normativen Dokumente / Title and/or number and date of issue of the standard(s) or other _normative document(s))

Diese Konformitätserklärung folgt den grundlegenden Anforderungen der Norm EN ISO/IEC 17050-1:2010 Konformitätsbewertung - Konformitätserklärung von Anbietern - Teil 1: Allgemeine Anforderungen.
 This Declaration of Conformity is following the basic requirements of the standard EN ISO/IEC 17050-1:2010 Conformity assessment - Supplier's declaration of conformity - Part 1: General requirements.

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E-T-A Elektrotechnische Apparate GmbH

EU-Konformitätserklärung Nr. 100.218.1018-03
Declaration of Conformity

Zusätzliche Angaben: Additional information:

II 3G Ex nA IIB T4 Gc X
 -20°C ≤ T_{amb} ≤ +60°C (für / for ESX10-TC)
 0°C ≤ T_{amb} ≤ +50°C (für / for ESX10, ESX10-TA, ESX10-TB)

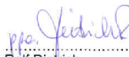
Besondere Bedingungen: Special conditions:

Die zugehörige Betriebsanleitung enthält wichtige sicherheitstechnische Hinweise und Vorschriften für die Inbetriebnahme der genannten Geräte gemäß der Richtlinie 2014/34/EU (ATEX)
 The pertinent user manual is including important safety-related information and regulations for placing into operation of the described devices in accordance with Directive 2014/34/EU (ATEX).

Werden die Produkte in eine übergeordnete Maschine/Anlage eingebaut, so müssen die durch den Einbau entstehenden neuen Risiken durch den Hersteller der neuen Maschine/Anlage beurteilt werden.
 In case the products will be fitted into a higher-level machine or system, the manufacturer of the new machine or system needs to assess possible new risks resulting from this action.

Altdorf, 28. Jun 2016


 Dr. Clifford Sell
 Geschäftsführer


 Ralf Dietrich
 Ltg. Produkt-, Marktentwicklung

(Ort und Datum der Ausstellung / Place and date of issue) (Name, Funktion, Unterschrift des/der Befugten / name, function, signature of authorized person(s))

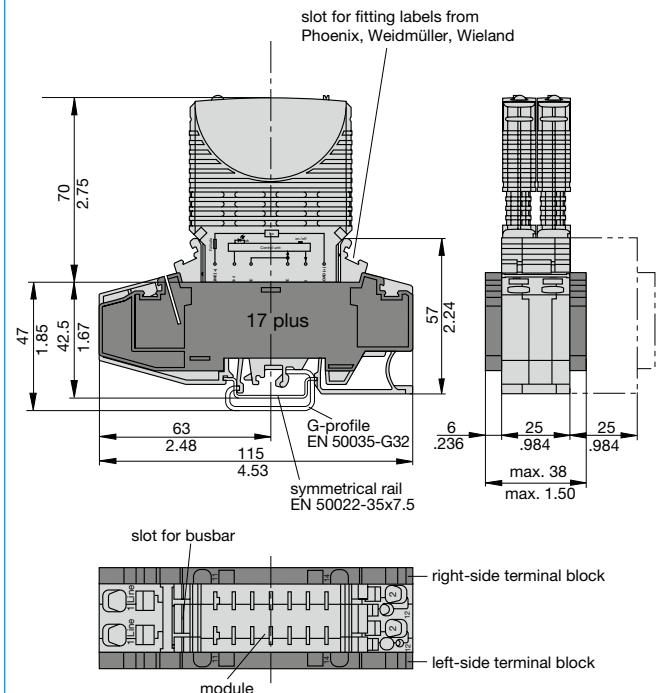
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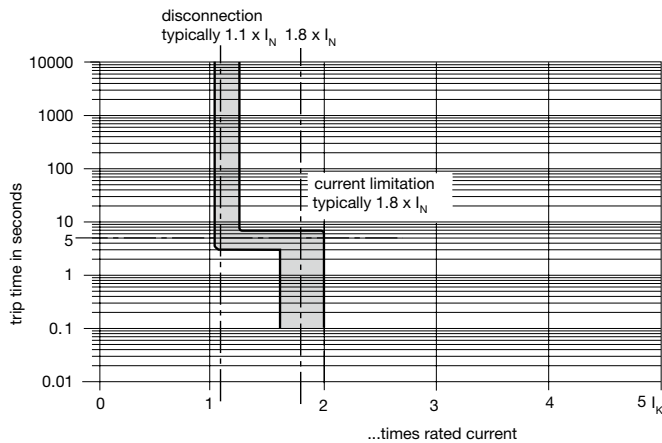
Accessories

Module 17plus

For technical data see section Power Distribution Systems



Time/Current characteristic curve ($T_A = 25\text{ }^{\circ}\text{C}$)



- The trip time is typically 3 s in the range between 1.1 and $1.8 \times I_N^{*1}$.
- Electronic current limitation occurs at typically $1.8 \times I_N^{*1}$ which means that under all overload conditions (independent of the power supply and the resistance of the load circuit) the max. overload before disconnection will not exceed $1.8 \times I_N^{*1}$ times the current rating. Trip time is between 100 ms (short circuit current I_K) and 3 sec (at overload with high line attenuation).
- Without this current limitation a considerably higher overload current would flow in the event of an overload or short circuit.

*1) current limitation typically $1.8 \times I_N$ times rated current at $I_N = 0.5\text{ A} \dots 6\text{ A}$
 current limitation typically $1.5 \times I_N$ times rated current at $I_N = 8\text{ A}$ or 10 A
 current limitation typically $1.3 \times I_N$ times rated current at $I_N = 12\text{ A}$

Table 3: Reliable trip of ESX10

Reliable trip of ESX10 with different cable lengths and cross sections							
Resistivity of copper $\rho_0 = 0.0178 \text{ (Ohm} \times \text{mm}^2) / \text{m}$							
$U_S = \text{DC } 19.2 \text{ V}$ (= 80 % v. 24 V)	voltage drop of ESX10 and tolerance of trip point (typically $1.1 \times I_N = 1.05 \dots 1.35 \times I_N$) have been taken into account.						
ESX10-selected rating I_N (in A) →	3	6					
e. g. trip current $I_{ab} = 1.25 \times I_N$ (in A) →	3.75	7.5	→ ESX10 trips after 3 s				
$R_{\max}$ in Ohm = $(U_S / I_{ab}) - 0.050$ →	5.07	2.51					
The ESX10 reliably trips from 0 Ohm to max. circuitry resistance $R_{\max}$							
Cable cross section A in mm ² →	0.14	0.25	0.34	0.5	0.75	1	1.5
cable length L in meter (= single length)	cable resistance in Ohm = $(R_0 \times 2 \times L) / A$						
5	1.27	0.71	0.52	0.36	0.24	0.18	0.12
10	2.54	1.42	1.05	0.71	0.47	0.36	0.24
15	3.81	2.14	1.57	1.07	0.71	0.53	0.36
20	5.09	2.85	2.09	1.42	0.95	0.71	0.47
25	6.36	3.56	2.62	1.78	1.19	0.89	0.59
30	7.63	4.27	3.14	2.14	1.42	1.07	0.71
35	8.90	4.98	3.66	2.49	1.66	1.25	0.83
40	10.17	5.70	4.19	2.85	1.90	1.42	0.95
45	11.44	6.41	4.71	3.20	2.14	1.60	1.07
50	12.71	7.12	5.24	3.56	2.37	1.78	1.19
75	19.07	10.68	7.85	5.34	3.56	2.67	1.78
100	25.34	14.24	10.47	7.12	4.75	3.56	2.37
125	31.79	17.80	13.09	8.90	5.93	4.45	2.97
150	38.14	21.36	15.71	10.68	7.12	5.34	3.56
175	44.50	24.92	18.32	12.46	8.31	6.23	4.15
200	50.86	28.48	20.94	14.24	9.49	7.12	4.75
225	57.21	32.04	23.56	16.02	10.68	8.01	5.34
250	63.57	35.60	26.18	17.80	11.87	8.90	5.93
Example 1:	max. length at 1.5 mm ² and 3 A → 214 m						
Example 2:	max. length at 1.5 mm ² and 6 A → 106 m						
Example 3:	mixed wiring: R1 = 40 m in 1.5 mm ² and R2 = 5 m in 0.25 mm ² : (Control cabinet – sensor/actuator level) R1 = 0.95 Ohm, R2 = 0.71 Ohm Total (R1 + R2) = 1.66 Ohm						

Table 2: ESX10 - product version

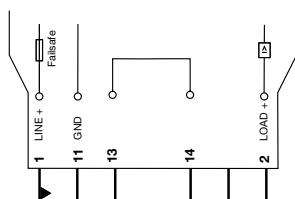
version	signal input		signal output		
			signal output F		status output SF
ESX10 -...	control input ON/OFF +24 V Control IN+	reset input +24 V RE	group signal N/O	group signal change-over	status OUT +24 V = OK
-100					
-103				X	
-104					X
-115	X		X		
-124		X			X
-125		X	X		

ESX10 Signal inputs / outputs (wiring diagram)

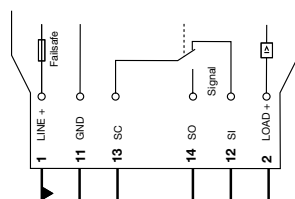
ESX10 signal inputs / outputs (wiring diagrams)

Signal contacts are shown in the OFF or fault condition.

ESX10-100 without signal input/output

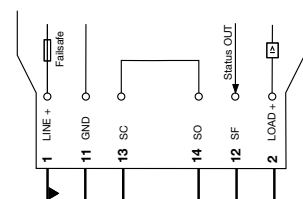


ESX10-103 without signal input with signal output F (group signal, change-over)



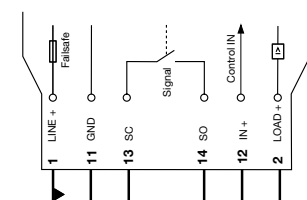
operating condition: SC/SO closed, SC-SI open
fault condition: SC/SO open, SC-SI closed

ESX10-104 without signal input with status output SF (+24 V = load output ON)



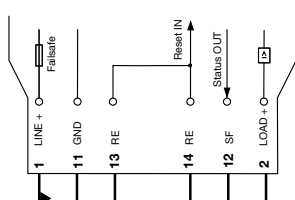
operating condition: SF +24 V = OK
fault condition: SF 0V

ESX10-115-... with control input IN+ (+DC 24 V) with signal output F (group signal, N/O)



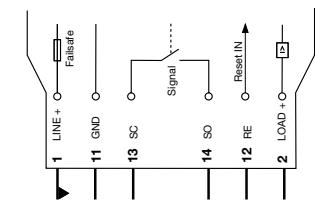
operating condition: SC-SO closed
fault condition: SC-SO open

ESX10-124-... with reset input RE (+DC 24 V↓) with status output SF (+24V = load output ON)



operating condition: SF +24V = OK
fault condition: SF 0V

ESX10-125-... with reset input RE (+DC 24 V↓) with signal output F (group signal, N/O)



operating condition: SC-SO closed
fault condition: SC-SO open

This is a metric design and millimeter dimensions take precedence ($\frac{\text{mm}}{\text{inch}}$)

All dimensions without tolerances are for reference only. In the interest of improved design, performance and cost effectiveness the right to make changes in these specifications without notice is reserved. Product markings may not be exactly as the ordering codes. Errors and omissions excepted.

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