

Guideline for DC 24 V Systems in Machine Construction and Process Control



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Power Distibution Module PDMPower Distribution Box PDB

26-31

Guideline DC 24 V Systems in Machine Construction and Process Control

- Planning aspects
 - Power supply, load characteristics
 - Protection, wiring
 - Requirements of the Machinery Directive and Low Voltage Directive
 - International standards and approvals
- Professional overcurrent protection and power distribution for DC 24 V systems
- Flexible power distribution for centralised and decentralised control cabinet concepts

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Requirements and planning aspects

Systematics of a DC 24 V system



Tasks and questions

of electrical planning

1. Power supply

- Type, manufacturer, current rating, output characteristics, behaviour in the overload range, price?
- Utilisation rate of power supply in dynamic range of system?
- Current reserve for simultaneity factors or system extensions (up to 80 % utilisation)?

2. Load characteristics

- What loads have to be protected?
- What is the dynamic characteristic of the load current during switch-on or on duty in a group protection of several loads?

3. Overcurrent protection

- Current rating and trip curve of circuit breaker: fast or delayed?
- Total current consumption when protecting a group of devices?
- Selectivity ensured in the event of short circuit/overload? Can the occurring short circuit currents be calculated?
- Reaction of loads when the DC 24 V control voltage dips?

4. Wiring

- What cable lengths have to be expected?
- What are the cable cross sections in the string in questions: Sensor cables 0.25 mm², wiring 1 / 1.5 / 2.5 mm², mixed forms? I²t value, ampacity?
- Can the breaker trip due to cable attenuation?
- Wiring time for all load lines (plus, protected load output, minus, FE) and auxiliary contacts in the control cabinet?

DC 24 V control voltage level

Power supply

Supply voltage DC 24 V

- DC 24 V control voltage: Switch-mode power supplies (SMPS) widely replace conventional transformer power supplies (TPS). Reasons: Size, weight, efficiency.
- Output characteristics of the SMPS differ significantly from the TPS curve:
 - **TPS:** high overload capacity, as power $P = U \times I \sim \text{const.}$
 - SMPS: Overload behaviour depends on manufacturer, type and current rating of the SMPS (5 A / 10 A / 20 A / 40 A): often the output voltage is turned down already at 1.1 ... 1.5 times rated current \Rightarrow self-protection of the SMPS (I/U curve) or switch-off (foldback curve / hiccup mode).
- What's the use of a short-time boost function of the output current e.g. 3 times rated current for 20 ms, 6 times rated current for 12 ms?



Schematic diagram of switch-mode power supply

Power supply

Characteristic curve of the switch-mode power supply



DC control voltage level

Load characteristics

Load characteristics

(switch-on, dynamic processes in operation)

Electronic system components (PLC, safety technology, industrial computers, user terminals, sensors, drive controls, field bus modules, magnetic valve distributors etc.) have a high input capacity, i.e. high inrush currents. **Reason:** A great number of EMC and buffer capacitors in the DC24V input, number will continue to rise as the EMC standards for voltage dips in DC systems will be adjusted. DC24V motors (including brushless DC motors) and e.g. fans have high inrush currents.









DC control voltage level

Load characteristics / typical current-voltage curves



drive control



industrial PC













DC motor

Overcurrent protection

Standards and Approvals

Standard	IEC 60947-2 EN 60947-2 DIN EN 60947-2 VDE 0660-101	IEC 60934 EN 60934 DIN EN 60934 VDE 0642	IEC 60898 EN 60898 DIN EN 60898 VDE 0642	UL 489	UL 1077	UL 2367	UL 508 (is partly replaced by UL60947-4-1A)
Туре	MCBs	CBEs	MCBs	MCCBs	CBEs	Electronic overcur- rent protection	General; Control cabi- net components
Application:	MCBs with main contact for connection to circuits up to AC 1000 V and DC 1500 V, is also used for: protection of cables and devices in industrial applications	Protection of applianc- es (for household and similar) for the protection of circuits within electrical resources	MCBs for indoor installations and simi- lar purposes	Protection of branch circuits	Additional protection equipment for the use in electrical production means	Electronic over- current protection device	Industrial Control Equipment
	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers (mould- ed-case circuit breakers MCCB)	Circuit breaker for equipment (CBE) for household and similar applications	Circuit breakers for overcurrent protec- tion for household and similar instal- lations (miniature circuit breakers MCB)	Molded-case circuit breakers for branch circuit protection	Supplementary Protectors for Use in Electrical Equipment	Solid-state over- current protectors (for supplementary overcurrent protec- tion; for secondary circuits)	Industrial Control Equipment
Application area	up to AC 1000V up to DC 1500V	up to AC 440 V max. 125A up to DC 250 V, max. 125A	up to AC 440 V max. 125A up to DC 220 V, max. 125A	up to AC 600 V up to 220 V plus	up to AC 600 V up to DC 600 V	up to DC 60 V	up to 1500 V
Short circuit current	values which are reached, e.g. I _{cn} = 5 kA	values which are reached, e.g. $I_{cn} = 800 \text{ A}$	max. 25kA (AC) max. 10kA (DC)	5 kA / 10kA	200 A, 1 kA, 2 kA, 3,5 kA, 5 kA	min. 250A	
Dielectric strength	Ui ≤ 300V: 1.5kV, 5 s Ui ≤ 800V: 2.0kV, 5 s	AC250V: 1.5kV / 1 min AC440V: 2.0kV / 1 min		1 kV + 2 Un, 1 min	1 kV + 2 Un, 1 min		
E-T-A devices comply with the standard	4230-T (E) under preparation: ESS31-T, ESS20, 2216,	4220-T (Icn bis6 kA), 2210, 201, 3600, 3900, 8340, 8345, etc1180, 1180 ESS20 / ESS31-T	NO	4230-T (U) 8345 4220-T at AC 120V (ICN up to 5 kA) (File E223877)	201, 2210 2216-S, 3600, 3900, 1180, 8340, 8345, 4420-T, 4230-T (E), ESS20 / ESS31-T (File E673200)	ESX10 / ESX10-T / REF16-S (File E306740)	ESX10 / ESX10-T / REF16-S
Comment	Selected tests in accord- ance with this standard can be conducted. Self-certification.	Circuit breakers for equipment protection, protection of control voltages	not applicable to CBEs	not applicable to CBEs	Circuit breakers for equipment protection, protection of control voltages	Acc. to UL same application as CBEs due to integral current limitation	Typical applications in industrial switchgear, acc. to UL same application as CBEs due to integral current limitation

Electro-mechanical circuit breakers

thermal-magnetic

Fast DC curves (A, Z, F1 or B) in the lower tolerance band: Magnetic short circuit trip at $3 \dots 5 \times I_N$ or $4.5 \dots 7.5 \times I_N$ of CBE

Start-up of electronic system components often not possible as a **high** inrush current trips the breaker.

Medium delayed DC curves (C, M1): trip at 7.5 \dots 15 x I_N SMPS cannot supply the current required for tripping the breaker, the output voltage is turned down (I/U curve) or disconnected (foldback, hiccup).

MCBs to IEC / EN 60898

C characteristics

Thermal-magnetic, C characteristics / AC

- thermal: trips between 1.13 and 1.45 times rated currentmagnetic: trips between 5 and 10 times
- rated current

Thermal-magnetic, C characteristics / AC

thermal: as with AC, trips between 1.13 and 1.45 times rated current
 magnetic: trips between 7.5 and 15 times rated current





Short circuit in SMPS output

MCBs with C characteristics



The magnetic trip range of the C breaker is no longer in the acceptable overload range of the power supply: The DC 24 V output voltage breaks down.



Graphical calculation

Trip at short circuit SMPS / MCB with C characteristics

Often the power supply cannot provide the trip current required for magnetic tripping and turns down the output voltage.



Overcurrent protection with thermal-magnetic circuit breakers

Characteristic curves

Thermal Magnetic Circuit Breakers						therma level: of rated	thermal trip magnetic trip level level: times after t < 100ms: of rated current times of rated current			
rip curve	voltage	DC factor	manufacturer	type	rated current IN	T-u	T-o	M-u	M-o	
Z	AC				1,05	1,05	1,20	2,00	3,00	
Z	DC	1,5		[]	1,05	1,05	1,20	3,00	4,50	
В	AC		1		1,13	1,13	1,45	3,00	5,00	▼
В	DC	1,5	ABB	Typ S201	1,13	1,13	1,45	4,50	7,50	T-u – Thermal lower trip level
С	AC		1		1,13	1,13	1,45	5,00	10,00	T T-o - Thermal higher trip level
С	DC	1,5			1,13	1,13	1,45	7,50	15,00	M-u - magnetic lower trip level
К	AC		1	[1,05	1,05	1,20	8,00	12,00	M-o - magnetic, higher trip level
К	DC	1,5	1	[1,05	1,05	1,20	12,00	18,00	m-o - magnetic, higher tip level
D	AC		1		1,13	1,13	1,45	10,00	20,00	
D	DC	1,5	1	l l	1,13	1,13	1,45	15,00	30,00	
F1	DC only	1,3			1,01	1,01	1,40	2,00	4,00	comparable magnetic
F2	AC			I	1,01	1,01	1,40	3,00	5,00	(= undelayed) trip curves
F2	DC	1,3	E-T-A	Тур 4220-Т	1,01	1,01	1,40	4,00	6,50	A, Z, F1
M1	AC		1		1,01	1,01	1,40	5,00	10,00	B, F2
M1	DC	1,3			1,01	1,01	1,40	7,00	13,00	C. M1
T1	AC				1,01	1,01	1,40	10,00	20,00	D. T1
T1	DC	1.3			1.01	1.01	1.40	13.00	26.00	
А	AC				1.13	1.13	1.45	2.00	3.00	
A	DC	1.4		Turn EQVA	1.13	1.13	1.45	2.80	4.50	
В	AC	í í	SIEIVIENS	Typ 5514	1.13	1.13	1.45	3.00	5.00	
В	DC	1.4	1		1.13	1.13	1.45	4.20	7.00	
С	AC	, í	1		1,13	1,13	1,45	5,00	10,00	
С	DC	1,4			1,13	1,13	1,45	7,00	14,00	
D	AC				1,13	1,13	1,45	10,00	20,00	
D	DC	1.4			1.13	1.13	1.45	14.00	28.00	
		1 /		Tv	pes of Circuit Break	ers (therma	l magne	etic)		
			trip curve	standard / FI	standard / III	standard	/ IEC	remark		
				EN 60909		IEC 60000		MCRass		
			A, B, C, D				20	Circu uit Pro -l	Jircuit Breakers)	
			7 1/	EIN000947-2	UL 489	IEC 00094	7.0	Circuit Breake	4	
			2, N	EIN000947-2	UL 489	IEC 60094	1-2	Orcuit Breake	r	
			F1, F2 M1, T1	EN600934	UL 1077	IEC 60943		CBE (Circuit Brea	ker for Equipment)	

Ampacity of cables vs. current rating of protection

The ampacity of the cables has been added as follows:

- rated cross section:
 - 0.14 $\rm mm^2$ to 0.5 $\rm mm^2$ following VDE 0891 T1
- rated cross section:
 - $0.75\ mm^2$ to $150\ mm^2$ following VDE 0100 T1

- Protection is provided by a blade fuse or an MCB
- Example:
 - at 0.34 mm² \Rightarrow max. I_N = 3 A at 30 °C

	ambient temperatur max. operating temp	e = 30 °C berature = 60 °C	ambient temperature = 40 °C max. operating temperature = 60 °C conversion factor = 0,82		
cross section in mm², Cu wire	max. load in A	CBE/MCB-Current rating in A	max. load in A		
0,14	2	1	1,6		
0,25	4	2	3,3		
0,34	6	3	4.9		
0,50	9	4	7,4		
0,75	12	6	9,8		
1	15	10	12,3		
1,5	18	16	14,8		
2,5	26	20	21,3		
4	34	25	27,9		
6	44	35	36,1		
10	61	50	50,0		
16	82	63	67,2		
25	108	80	88,6		
35	135	100	110,7		
50	168	125	137,8		
70	207	160	169,7		
95	250	200	205,0		
120	292	250	239,4		
150	335	350	274 7		

Caution:

This table is only an excerpt from the mentioned standards. Other vital parameters such as heat radiation on cables, laying modes and conditions, insulating materials of the cables as well as other ambient temperatures etc. have to be considered.

Wiring

Length, cross section, resistance

Line impedance defines the max. trip current in DC24V applications

trip current I = U/R_{total}; I = 24 V/1.19 Ohm; I = 20.17 A bei 50 m, 1.5 mm²

		resistiv	resistivity copper R0 = 0.0178 (Ohm x mm ²)/m										
cable cross section A in r	nm²	0.14;	0.25;	0.34;	0.5;	0.75;	1;	1.5;					
		total cable resistance R_{total} in Ohm = ($R_0 \times 2xL$)/A											
distance L in metres	5	1.27	0.71	0.52	0.36	0.24	0.18	0.12					
(one-way length)	10	2.54	1.42	1.05	0.71	0.27	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	25.43	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					

E-T-A planning tool:

Easy calculation of a DC 24 V system





Overview of electronic protection DC 24 $\rm V$

Innovative and professional

Product	ESS20-00x ESS31-T ESX10 ESX10-S		ESX10 ESX10-S	ESX10-TA	ESX10-TB	ESX10-TD	REF16-S1xx	ESS22-T	
		1	Ø	1	1	1			
Туре	electronic circuit breaker	electronic circuit breaker	electronic circuit protector	electronic circuit protector	electronic circuit protector	electronic circuit protector	electronic circuit protector	electronic circuit breaker	
Technical Data									
rated voltage	DC 24 V	DC 24 V	DC 24 V	DC 24 V	DC 24 V	DC 24 V	DC 24 V	DC 24 V	
operating voltage	DC 1832 V	DC 1830 V	DC 1832 V	DC 1832 V	DC 1832 V	DC 1832 V	DC 1830 V	DC 1832 V	
current rating I_N	- fixed current ratings	 fixed current ratings 	- fixed current ratings	- fixed current ratings	- fixed current ratings	- adjustable	- fixed current ratings	- fixed current ratings	
	0,5A - 10A 0,5A - 12A - adjustable current ratings 1A/2A und 3A/6A		0,5A - 12A (- adjustable current ratings 1A10A in 1A steps)	0,5A - 12A	0,5A - 16A	current ratings 0,5/1/2A 2/3/4A 2/4/6A 6/8/10A	0,5A - 10A	0,5A - 10A	
number of ways	1-way	1-way	1-way	1-way	1-way	1-way	1-way	1-way	
manual	push button	push button	Slide switch	Slide switch	Slide switch	Slide switch	Slide switch	Slide switch	
ON/OFF/reset									
trip (error)	- electronically - electronically - electronically - electronically - electronically - electronically - physically - physically - physically - physically		- electronically Power- MOSFET	- electronically Power- MOSFET	- electronically Power- MOSFET	- electronically Power- MOSFET	- electronically Power- MOSFET	 electronically Power- MOSFET physically, relay 	
overload	typ. 1.1 x I _N	typ. 1.2 x I _N	typ. 1.1 x I _N (1.2 x I _N)	typ. 1.1 x I _N	typ. 1.1 x I _N	typ. 1.1 x I _N	typ. 1.25 x I _N	typ. 1.1 x I _N	
overload trip time	tup 3s	tvp 500ms	turo 3e	tup 3e	tup 3e	turo 3e	tvp 130ms - 800ms	tup 3e	
short circuit current	typ. 35	typ. Journs	typ. 35 typ. 18 x $\ln(14 x \ln)$	typ. 35	typ. 35	typ. 35	typ. 125 x la	typ. 35	
short circuit	typ. 100ms - 3s	typ. 100ms - 3s	typ. 100ms - 3s	typ. 100ms - 3s	typ. 100ms - 3s	typ. 100ms - 3s	typ. 130ms - 800ms	typ. 100ms - 3s	
trip time									
max. switch-on capacity	75,000µF	up to 40,000µF	75,000µF (40,000µF)	75,000µF	75,000µF	75,000µF	20,000µF	20,000µF	
	- make contact	- make contact	- make contact	- without	- make contact	- make contact	- make contact	- make contact	
signalling	- break contact	- break contact	- change-over	- break contact		- break contact	- break contact - break contact		
	- change-over		- contact		- status output	- status output	- status output		
signal Input	- without	- withou	 remote ON/OFF remote reset 	- without	- remote ON/OFF - remote reset	 remote ON/OFF remote reset 	 remote ON/OFF remote reset 	 remote ON/OFF remote reset 	
General Data									
mounting method	- plug-in on terminal	- plug-in on terminal	- plug-in on terminal	- rail mounting	- rail mounting	- rail mounting	- plug-in on terminal	- rail mounting	
	block	block	block				block		
	17plus or SVS for	17plus or SVS for	17plus or SVS for				80Plus and 81Plus for		
to make at the stars	rail mounting	rail mounting	rail mounting	sorow torminals	sorow torminals	sorow torminals	rail mounting	sorow torminals	
terminai design	terminals	terminals	terminals	Sciew terminais	Sciew terminais		 Sockel 80Plus screw terminals, Sockel 81Plus 		
temperature range	0+50 °C	0+50 °C	0+50 °C	0+50 °C	0+50 °C	0+50 °C	-25 °C+50 °C	0+50 °C	
dimensions									
(w x h x d) without									
terminal block	12.5 x 105 x 60 mm	12.5 x 105 x 60 mm	12.5 x 70 x 60 mm	12.5 x 80 x 83 mm	12.5 x 80 x 83 mm	12.5 x 80 x 83 mm	12.1 x 52 x 45 mm	22.5 x 85 x 92 mm	
with terminal block	12.5 x 147.5 x 60mm	12.5 x 147.5 x 60mm	12.5 x 112.5 x 60mm	n/v	n/v	n/v	12.5 x 78 x 45 mm		
Approvals	- UL1077	- UL1077	- UL2367	- UL2367	- UL2367	- UL2367	- UL2367	- UL1077	
	- EN60934	- EN60934	- UL508 - CSA22.2 No.14 - IEC/EN 60079-0/-14/-15 - ATEX	- UL508 - UL 1604 class I, div. 2 - CSA22.2 No.14/ 142/213 - IEC/EN 60079-0/-14/-15	- UL508 - UL 1604 class I, div. 2 - CSA22.2 No.14 / 142 / 213 - IEC/EN 60079-0/-14/-15	- UL508 - UL 1604 class I, div. 2 - CSA22.2 No.14 / 142 / 213 - IEC/EN 60079-0/-14/-15	- cULus 508 listed	- EN60934	
				- ATEX	- ATEX	- ATEX			

Electronic circuit breaker

ESS20 (single pole), plug-in type

Product characteristics

- rated voltage DC24V (18 ... 32 V), also battery-buffered
- current ratings
 - adjustable: 1 A/2 A, 3 A/6 A
 - fixed: 0,5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A
- electronic, current limiting trip curve
- with physical isolation in accordance with UL1077 and VDE approval to IEC/EN60934
- capacitive loads up to 75,000,000µF and motors possible
- aux. contact break contact or make contact
- LED status indication
- manual ON/OFF switch

Electronic circuit breaker

ESS31-T (single pole) for rail mounting

Product characteristics

- rated voltage DC24V (18 ... 30 V), also battery-buffered
- fixed current ratings:
 0,5 A, 1 A, 2 A, 3 A, 3,6 A, 4 A, 6 A, 8 A, 10 A, 12 A
- electronic, current limiting trip curve
- with physical isolation in accordance with UL1077 and VDE approval to IEC/EN60934
- capacitive loads up to 40,000µF and motors possible
- aux. contact N/C or N/O
- LED status indication
- manual ON/OFF switch
- integral fail-safe element
- for rail mounting and for mounting side-by-side
- integral power distribution system up to 40A load distribution

Electronic circuit protector

ESX10/ESX10-S (1-pole), pluggable

Product characteristics

- rated voltage DC24V (18 ... 32 V), also battery-buffered
- current ratings:
 - fixed: 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A, 12 A
- adjustable: 1 A...10 A (ESX10-S...)
- electronic, current limiting trip curve
- approval to UL 2367 as overcurrent protector, UL508 UL 1604 class I div.2, CSA 22.2, GL, ATEX, NEC class 2 (max. 3A)
- capacitive loads up to 75,000 µF and motors possible
- aux. contact, status output SF, remote ON/OFF, remote reset
- LED status indication
- manual ON/OFF and reset switch
- integral fail-safe element
- for power distribution systems Module 17plus, SVSxx and *Power-D-Box*[®]

integral fail-safe element

for power distribution systems
 Module 17plus, SVSxx and
 Power-D-Box[®]

Features and benefits:

- narrow width of only 12.5mm
- physical isolation
- plug-in type
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL1077 and VDE (IEC/EN60934)

Features and benefits:

- narrow width of only 12.5 mm
- physical isolation
- a single trip curve for all types of loads
- reliable protection through current limitation
- approval to UL1077 and VDE (IEC/EN60934)



Features and benefits:

- narrow width of only 12.5mm
- plug-in type
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL 2367 as overcurrent protector UL 508, UL 1604 class I div.2, CSA 22.2, GL, ATEX, NEC class 2 (max. 3 A)







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Electronic circuit protector

ESX10-T (single pole) for rail mounting

Product characteristics

- rated voltage DC24V (18 ... 32 V), also battery-buffered
- current ratings:
 - fixed values: 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A, 12 A, 16 A
 switchable: 0.5A/1A/2A, 2A/3A/4A, 2A/4A/6A, 6A/8A/10A
- electronic, current limiting trip curve
- capacitive loads up to 75,000 μF and motors possible
- aux. contact, status output SF, remote ON/OFF,
- remote reset
- LED status indication
- manual ON/OFF and reset switch
- integral fail-safe element
- approval to UL 2367 as overcurrent protector cUL 508, UL1604 class I div.2, CSA22.2, GL, ATEX, NEC class 2 (max. 3 A)
- for rail mounting and multi-way side-by-side mounting
- integral power distribution system up to 40 A load distribution

Features and benefits:

- narrow width of only 12.5 mm
- adjustable and fixed current ratings
- for rail mounting and mounting side-by-side
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL 2367 as overcurrent protector UL 508, UL 1604 class I div.2, CSA 22.2, GL, ATEX, NEC class 2 (max. 3 A)



Electronic circuit protector ESX10-TA and ESX10-TB



Electronic circuit protector ESX10-TB on symmetrical rail



Electronic circuit protector ESX10-TD

Electronic circuit protector

REF16-S (single pole), plug-in type

Product characteristics

- rated voltage DC 24 V (18 ... 30 V)
- fixed current ratings:
 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A
- electronic, current limiting trip curve
- capacitive loads up to 20,000 μF and motors possible
- auxiliary contact, status output SF remote ON/OFF (relay function), remote reset
- LED status indication
- manual ON/OFF and reset switch
- integral fail-safe element
- approval to UL 2367 as
 »Overcurrent Protector«, UL 508
- for socket 80PLUS (push-in terminals) and 81PLUS (screw terminals)

Features and benefits:

- narrow width of only 12.5mm
- fixed current ratings
- for rail mounting and mounting side-by-side
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL 2367 as overcurrent protector UL 508, UL 1604 class I div.2, CSA 22.2, GL, ATEX, NEC class 2 (max. 3 A)



Electronic circuit protector

ESS22-T (double pole)

Product characteristics

- rated voltage DC24V (18 ... 32 V), also battery-buffered
- fixed current ratings:
 - 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A
- electronic, current limiting trip curve
- with physical isolation in accordance with UL1077 and VDE approval to IEC/EN60934
- capacitive loads up to 20,000 μF and motors possible
- aux. contact N/O or N/C
- remote ON/OFF, remote reset
- LED status indication
- manual ON/OFF switch
- integral fail-safe element
- for direct rail mounting

Features and benefits:

- narrow width of only 22.5mm
- 2-pole physical isolation
- for direct rail mounting
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL1077 and VDE (IEC/ EN60934)
- meets the requirements of EN 60204-1, para 9.4.3.1
 »Double pole protection of ungrounded DC 24 V systems«



Electronic circuit breaker ESS22-T (2-pole)

Basic trip curve Electronic overcurrent protection

Example: Electronic circuit breaker ESS20

Electronic current limitation to 1.8 x IN at short circuit or start-up

- time slot 100 ms... 3 s (loading time for capacitive loads, start-up of DC motors)
- electronic disconnection at overcurrent





Electronic circuit breaker ESS20

Overcurrent protection with electronic circuit breakers

Characteristic curves

Electronic Circuit Breaker / Electronic Overcurrent Protector				overioa level ty 1.1 x I _N	ad trip /pically N	current limitation at overload or short-circuit							
trip curve	trip curve comp.	voltage	manu- facturer	type	rated current In	min.	max.	I _{Limit} *1)					
EH	B, C, d	nur DC		ESS20	0.510 A	1.05	1.35	typically 1.8/1.5 x I_N					
E	B, C, d	nur DC	E-T-A	ESX10	0.512 A	1.05	1.35	typically 1.8/1.5/1.3 x $\rm I_N$	max. = higher limit of trip level / overloa				
E	B, C, d	nur DC		ESX10-T	0.512 A	1.05	1.35	typically 1.8/1.5/1.3 x I _N	ILimit = current limitation, dependend IN				
	d-curve? Protection of small trip curve standard/ standard/					Breake standa	ers (ele ard/	ctronic) remark					
	DC motors			EU	UL	IEC							
			EH (electronic hybrid)	EN 60934	UL 1077	IEC 60	C 60934 Supplementary Protector CBE (Circuit breaker for equipment)						
			E (electronic)	open	UL 2367, UL 508 (UL1077/ *2)	open		Solid-State or Electronic Overcurrent Protector					

- In a range of 1.1...1.8 x I_N^{*1}) the trip time is typically 3 s.
- The electronic current limitation typically begins at 1.8 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.8 times rated current is applied until disconnection. The trip time varies between 100 ms and 3 s depending on the multiple of the current rating or at short circuit (I_K).
- Without the current limitation getting into effect at typically 1.8 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.

Overload disconnection (OL) typically 1.1 x I_N (1.05...1.35 x I_N)

^{*1}) current limitation typically 1.8 x I_N at I_N = 0.5 A...6 A current limitation typically 1.5 x I_N at I_N = 8 A...10 A current limitation typically 1.3 x I_N at I_N = 12 A current limitation typically 1.15 x I_N at I_N = 16 A



*2) Due to the integral current limitation, the types ESX10 or ESX10-T (just like type ESS20) can be used as »Supplementary Protectors« directly at the DC 24 V output of a circuit breaker for the protection of the cables and loads in the control cabinet.



Electronic circuit protector ESX10

Characteristic curves

Electronic overcurrent protection

Electronic circuit breaker ESS20

- In a range of 1.1...1.8 x I_N^{*1}) the trip time is typically 5 s.
- Electronic current limitation typically starts at 1.8 x I_N*1) This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.8 times rated current is applied until disconnection*1. The trip time is between 100 ms (short circuit I_K) up to approx. 5 s (in the event of overload with high cable attenuation).
- Without the current limitation getting into effect at typically 1.8 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.
- When the ESS20-0.. has detected an overload or short circuit condition, the LED will change from GREEN to ORANGE. The LED goes out when the circuit breaker has tripped.
- Reset of the circuit breaker is only possible after the integral bimetal has cooled down (approx. 10 s).
- *1) current limitation typically 1.8 x I_N at I_N = 0.5 A...6 A current limitation typically 1.5 x I_N at I_N = 8 A...10 A

Electronic circuit breaker ESS31-T

- The overload trip time is typically 500 ms (e.g. ESS31-T-...-6 A)
- The electronic current limitation typically begins in at 1.2 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.2 times rated current is applied until disconnection*1. The corresponding current limitation value I_{Limit} depends on the current rating of the device I_N.
- Without the current limitation getting into effect at typically 1.2 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.
- Reset of the circuit breaker is only possible approximately 10 sec after tripping.



disconnection



Electronic circuit protector ESX10...

- In a range of 1.1...1.8 x I_N^{*1}) the trip time is typically 3 s.
- The electronic current limitation typically begins in at 1.8 x I_N.
 This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.8 times rated current is applied until disconnection*1. The trip time varies between 100 ms and 3 s depending on the multiple of the current rating or at short circuit (I_K).
- Without the current limitation getting into effect at typically 1.8 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.
- ^{*1}) current limitation typically 1.8 x I_N at I_N = 0.5 A...6 A current limitation typically 1.5 x I_N at I_N = 8 A...10 A current limitation typically 1.3 x I_N at I_N = 12 A



Characteristic curves

Electronic overcurrent protection

Elektronic circuit protector ESX10-S

- In a range of 1.1...1.8 x I_N*1) the trip time is typically 3 s (e.g. ESX10-TB-...-6A).
- The electronic current limitation typically begiins in at 1.8 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.8 times rated current is applied until disconnection. The corresponding current limitation value I_{Limit} depends on the current rating of the device I_N (see table 1) The trip time varies between 100 ms and 3 s depending on the multiple of the current rating or at short circuit (I_K).
- Without the current limitation getting into effect at typically 1.8 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.

Electronic overcurrent protector REF16-S

- The trip time is typically between 80 ms to 800ms depending on the current rating (I_N).
- Electronic disconnection and/or current limitation begins at typically 1.25 times IN. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.25 times rated current is applied.
- Without the current limitation getting into effect at typically 1.25 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.

Electronic circuit breaker ESS22-T

- In a range of 1.1...1.4 x I_N *1) the trip time is typically 3 s.
- The electronic current limitation typically begins in at 1.4 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.4 times rated current is applied. The trip time varies between 100 ms and 3 s depending on the multiple of the current rating or at short circuit (I_K).
- Without the current limitation getting into effect at typically 1.4 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.







Graphical calculation

Trip at short circuit SMPS / Electronic overcurrent protection

Active current limitation ensures trip at short circuit of the electronic overcurrent protection devices. The switch-mode power supply will not be overloaded and will reliably continue to supply the non-affected paths.



Reliable tripping of ESS20, ESX10(-T) and REF16-S

resistivity coppe	r R ₀ =	0.0178 (9	2 x mm²)/m										
U _B = DC 19.2 V	(=80% von 24 V)	The volta of the sw	The voltage drop at ESS20, ESX10 or REF16-S (Ri approx. 0.050 Ω independent of $ _N$) and the tolerance of the switch-off point (typically 1.1 x $ _N = 1.05 \dots 1.25 \times I_N$) has already been taken into account.										
ESS20/ESX10: F	Rated current I _N (in A)	3.0	6.0										
Trip current I _{ab} =	max. 1.25 x I _N (in A)	3.75	7.5 ESS20/ESX10 trip after 35 s, REF16 after 80800 ms aus.										
R _{max} in Ohm = (U _p /I _{ab}) - 0.050	5.07	2.51										
	ESS20/ES	X10/REE16	reliably trip f	from 0 Q to th	e max, circu	it resistance	B (*1)						
						nresistance			4.5				
	cable cross section A in r	nm²	0.14	0.25	0.34	0.5	0.75	1.0	1.5				
	distance L in metres		tot	al cable re	sistance G	2 = (R ₀ x 2	2 x L)/A						
	(one-way length)		I	I		V	I	I					
	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	(*2)	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		25.43	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./1	10.68	/.12	5.34	3.56				
	1/5		44.00 50.86	24.92	20.04	14.94	0.01	7.12	4.15				
	200		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. distance at 1.5 mm ²	and 3 A		214 n	n (200 m corres	p. to 4.75 Ohr	n, 214 m corre	esp. to 5.07 OI	hm				
Example2:	max. distance at 1.5 mm ²	and 6 A		106 n	n (100 m corres	p. to 2.37 Ohr	n, 106 m corre	esp. to 2.37 Of	nm				
Example 3:	mixed wiring:			R1 =	40 m in 1.5 mm	2 and R2 = 5 m	n in 0.25 mm ²						

Different supply lines and cable cross sections

rule of thumb (*1): ESS20/ ESX10/REF16 rated 3 A can protect cable resistances of 5 Ω

rule of thumb (*2):

at 1.5 mm²: 50 m distance = 100 m cable length = 1.2 Ω cable attenuation

Electronic overcurrent protection Benefits

What are the user benefits of E-T-A's electronic overcurrent protection devices?

We meet the requirements of the updated Machinery Directive 2006/42/(EC and EN60204-1 "Safety of machinery and electrical equipment", because:

- The electronic overcurrent protectors provide selective overcurrent protection: The faulty path is disconnected, the remaining components of the control technology (PLC, safety components, sensors, actuators, bus modules etc.) remain unaffected.
- The DC24V control voltage remains stable even in the event of a short circuit or overcurrent.
- Reliable trip at 1.1 x I_N is ensured even with small cable cross sections and long load lines.
- Availability of the plant is increased significantly, as trouble shooting and maintenance becomes much easier.
- MCBs often cannot ensure selectivity and cable protection in DC 24 V systems. The overload or short circuit current is always determined by the total circuit resistance R_{total}. (R_{total} = cable resistance + internal resistance of protective element + contact resistance of terminals)
- Planning a DC 24 V application becomes much easier as the active current limitation to typically 1.8 times rated current provides a reliable planning factor for designing the size of the switch-mode power supply to be used and the size of the cable cross sections.
- In addition the current limitation increases typical life of relay and safety contacts in load circuits.
- The plug-in types (ESX10, REF16-S) allow quick change of the rating.
- In the event of repair works, removing the component establishes physical isolation and the current path is protected against re-connection. The types ESS20 and ESS31-T ensure physical isolation in the event of a failure (by bimetal operation).

Using electronic overcurrent protection is also a considerable contribution to cost reduction of the entire system:

- Switch-mode power supplies can now be used without problems.
- The narrow width of only 12.5 mm including auxiliary contacts allows smaller control cabinets.
- The single way design allows adjustment to the application in question or to the number of required load outputs. There are no extra costs through unused load outputs.
- E-T-A's electronic overcurrent protection holds a single trip curve for resistive, inductive and capacitive loads. Even DC drives can easily be actuated and protected with these protection devices. The selected current rating has only to be adjusted to the load current and the cable cross sections used. This makes planning much easier and helps to reduce costs for electrical design.
- Besides fixed current ratings, we can also offer switchable devices. They help to realise the entire overcurrent protection design with only one or two types.



Electronic overcurrent protection

Overview of approvals

Overview of standards

- UL 1077 Supplementary Protectors for Use in Electrical Equipment
- UL 2367 Solid State Overcurrent Protectors
- UL 508 Industrial Control Equipment
- UL 1604 Electrical Equipment for Use in Class I and II, Division 2, and Class III Hazardous (Classified) Locations
- UL 489 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures
- UL 60950-1 Information Technology Equipment Safety Part 1 General Requirements
- UL 508A Industrial Control Panels (requirements for control cabinets)

Excerpt from the UL508 approval of the ESX10-T (example):

The UL approval document of type ESX10-T (to UL508), file no. E322549 shows an information on page 2 under "General" that the ESX10-T can even be used as a "Supplementary Protector" due to its integral current limitation. = page 1)

(1) UL Comment

GENERAL:

These devices are single pole electronic over-current switches which limit the overload current to 180 percent of rated current. They are intended to provide supplementary protection within electrical equipment.

Approval mark	Туре	Approvals / Standards as per 17 March 2014							
F L°	ESS20 Electronic Circuit Breaker	UL 1077: Supplementary Protectors for Use in Electrical Equipment, File E67320							
		Comment: According to UL 508A, table SA 1.1, section 40.1.3 only devices approved to UL 1077 («Supplementary Protectors«) may be used for overcurrent protection in control circuits which have been designed as «Industrial Control Panel« to UL 508A							
F L	ESS31-T Electronic Circuit Breaker	UL 1077: Supplementary Protectors for Use in Electrical Equipment, File E67320							
		Comment: According to UL 508A, table SA 1.1, section 40.1.3 only devices approved to UL 1077 (»Supplementary Protectors») may be used for overcurrent protection in control circuits which have been designed as »Industrial Control Panel« to UL 508A							
9 1°	ESX10-T Electronic Overcurrent Protector	UL 2367: Solid State Overcurrent Protectors File E306740 UL 508: Industrial Control Equipment File E32540							
In progress CUL US		CSA C22.2 No. 142 > UL 508 UL1604: Electrical Equipment for Use in Hazarous Locations Class I div 2, Groups A, B, C, D; TC T5; File E320024 CSA C22.2 No. 213 > UL 1604							
		UL comment > see (1)							
	ESX10 Electronic Overcurrent Protector	UL 2367: Solid State Overcurrent Protectors File E306740 UL 508: Industrial Control Equipment File E322549 CSA C22. No. 142 > UL 508 UL1604: see ESX10							
LISTED	200	UL comment > see (1)							
۶V	REF16-S Electronic Overcurrent Protector	UL 2367: Solid State Overcurrent Protectors File E306740 UL 508: Industrial Control Equipment File E322549 CSA C22.2 No. 14 > UL 508 UL comment > see (1)							
c Uus	REF16-S Electronic Overcurrent Protector	UL 508: Industrial Control Equipment File E322549 UL comment > see (1)							
LISTED	area.								



Space-saving design, application and wiring

Electronic overcurrent protection



Flexible power distribution for centralised and decentralised control cabinet concepts

Standard solutions

Modular power distribution Module 17plus



- modular power distribution system, total current max. 32A/ 50A
- two-way terminal block
- DC24V supply via busbars
- load output (protected): 1 x per way
- signal supply via left and and right terminal blocks
- signalling already pre-wired, external protection required
- for all types ESS20-..., ESX10-1.., 2210-S21.



Power distribution system Module 17plus

Standard solutions

Socket 80Plus / 81Plus





socket 80plus

Customer-specific solutions



Power distribution system SVS

product	number of slots	dimensions: d x w xh (without CBE, including rail) tolerances to DIN ISO 266 part 1 IT13	fitted with	max. ampacity a) total current b) I/way c) signalling	operating voltage	supply terminals a) +UB b) DV c) FE d) PE	load outputs per slot	minus outputs for load	signalling line entry / outputs	signalling	termination cross-sections a) supply b) load output c) signal output	remote (control input)	specials b) customers	bus- capable, connection
SVS02-x	4/8/12/16	4 ways 52.1 x 109.5 x 105.4 8 ways 52.1 x 17.1 5 x 105.4 12 ways 52.1 x 23.5 x 105.4 16 ways 52.1 x 295.5 x 105.4	ESS20-003 ESX10-103 2210-S21x 3500	a) 40 A cont. load b) max 8 A c) max 0.5 A	24 V DC/ max. 32 V DC	a) DC 24 V+ b) DC 24 V- c) FE functional earth loop-through 2 each termination	5 outputs per slot 1 x L+S group output (+) 1 x L+L protected load output 2 x minus 1 x FE	2 x per way	terminal X31 5-pole internal supply via insulated wire bridge (SC) external supply +24 V signal output (group signalling) (+) additional output -24 V ((FE) additional output FE	group signalling, supply X31, signal circuit protected on power distribution system	a) screw terminals max. 10 mm ² b/c) B10 plug-in type <u>screwless</u> connectors or B20 plug-in type screw terminals max 2.5 mm ² (without wire end ferrules)	n/a	by means of the 1st CBE several ET200 sub-assemblies can be protected via group output L+S = electronic voltage, L+L = load voltage) b) BMW FFT EDAG Produk- tionssysteme GmbH	n/a

product	number of slots	dimensions: dxwxh (without CBE, including rail) tolerance to DIN ISO 266 part 1 IT13	fitted with	max. ampacity a) total current b) I/way c) signalling	operating voltage	supply terminals a) +UB b) DV c) FE d) PE	load outputs per slot	minus outputs for load	signalling line entry / outputs	signalling	termination cross-sections a) supply b) load output c) signal output	remote (control input)	specials b) customers	bus- capable, connection
SVS04-x	4/8/12/16	4 ways 52.1 x 125.5 x 105.4 6 ways 52.1 x 167.5 x 105.4 8 ways 52.1 x 211.5 x 105.4	ESS20-003 ESX10-103 2210-S21x 3600	a) 40 A cont. load b) max. 8 A c) max 0.5 A	24 V DC	a) DC 24 V+ b) DC 24 V- c) FE integral loop-through distributions and connection of an external buffer module	5 outputs per slot 5x (L+) protected	15 x terminals X22-X24 30 x terminals X22-X24 Version K01	terminal X31 5-pole ()DC 24 V supply of terminal X21 (S) supply group signalling DC 24 V (AS) output group signalling (GH) supply two-group signalling (AS) output group A (F5-F8) (B) output group B (F1-F4)	group signalling two-group signalling supply X31 aux. circuit protected on distribution rail	a) screwless terminals max. 10 mm2 b/c) B10 plug-in type screwless connectors or B20 plug-in type screw terminals or C10 screwless spring-loaded terminals max 2.5 mm ² (without wire end ferrules)	n/a	versions S80x terminals special marking versions S00x pre-fitted with ESS20 b) Grob Werke GmbH & Co.KG Osram GmbH	n⁄a

product	number of slots	dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 266 part 1 IT13	fitted with	max. ampacity a) total current b) I/way c) signalling	operating voltage	supply terminals a) +UB b) DV c) FE d) PE	load outputs per slot	minus outputs for load	signalling line entry / outputs	signalling	termination cross-sections a) supply b) load output c) signal output	remote (control input)	specials b) customers	bus- capable, connection
SVS14-x	4/8/12/16	10 ways 64.5 x 104 x 184 vertical mounting position	ESS20-003 ESX10-103 2210-S211 3600-P10 3900-P10	a) max. 25 A b) max. 8 A c) max. 0.5 A	24 V DC (1832 V)	a) DC 24 V+ b) DC 24 V- loop- through 2 each termination	2 outputs per slot terminals X1-X10 (L+) protected load output 1 x each	1 x per way	terminal X31 2-pole (S1) external supply 24 V DC (+) (S2) signal output If the distribution rail is not completely fitted with circuit breakers, the open signal path (S2) to (S1) can be closed with the integral Si switch (per way), Close Si switch (switch over)	group signalling, supply X31 S1/S2	 a) screw terminals marked max. 16 mm² b) 2-pole double level terminal with screw terminal max. 4 mm² marked c) 2-pole screw terminal, marked, max 2.5 mm² 	n⁄a	Caution: Provide external protection for signalling (0.5 A/fast) integral ammeter	n/a

product	number of slots	dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 266 part 1 IT13	fitted with	max. ampacity a) total current b) l/way c) signalling	operating voltage	supply terminals a) +UB b) DV c) FE d) PE	load outputs per slot	minus outputs for load	signalling line entry / outputs	signalling	termination cross-sections a) supply b) load output c) signal output	remote (control input)	specials b) customers	bus- capable, connection
SVS16	4/8/12/16	8 ways 56.5 x 184 x 127.8 16 ways 56.5 x 284 x 127.8	ESX10-1x5 E-1048-7xx	a) max. 40 A b) max. 8 A c) via bus connection	24 V DC	load pcb a) 1+/2+ b) 1-/2- c) PE bus pcb a) 1+/2+ b) 1-/2- integral loop-through for sub- distribution and connection of an external buffer module	3 outputs per slot X1-X3 1 x + 1 x - 1 x PE	1 x per way	terminal X31 supply bus module 9-pole D-Sub connector X50 bus connection	single signalling via PROFIBUS	a) screwless terminals max. 10 mm ² load supply push-in terminal max. 1.5 mm ² bus supply b) three-level screwless spring-loaded terminals max. 1.5 mm ² screw terminals optional c) 9-pole D-Sub connector	via PROFIBUS	bus-capable power distribution system PROFIBUS b) Lead customer Arcelor Mittal Belgium	PROFIBUS

product	number of slots	dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 266 part 1 IT13	fitted with	max. ampacity a) total current b) I/way c) signalling	operating voltage	supply terminals a) +UB b) DV c) FE d) PE	load outputs per slot	minus outputs for load	signalling line entry / outputs	signalling	termination cross-sections a) supply b) load output c) signal output	remote (control input)	specials b) customers	bus- capable, connection
SVS18	10	10 ways 50 x 185 x 142,3	ESS20-003 ESX10-103 max. 6 A	a) max. 25 A b) typically 3 A per slot typically 1.5 A per diode c) max. 0.5 A	24 V DC	a) L1 b) L2 2 x U1/U2 bridge deach, bridge can be removed b) L- 3 x	max. 4 outputs per slot 2 x 1+/2+ 2 x 3-/4- 2 x U1/U2 2 x 0 V	2 x per way	terminal X31 total current 0.5A 131 x input 145 x output	group signalling terminals X31	a) push-in terminals max. 10 mm ² b) push-in terminals max. 2.5 mm ² c) push-in terminals max. 2.5 mm ²	n/a	a) supply of 2 different potentials possible U1/U2 per load output 2 redundancy diodes connected in parallel via jumpers (typically rated 3A) jumper can be removed (typically rated 1.5A) b) DOW Chemical	n/a

product	number of slots	dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 266 part 1 IT13	fitted with	max. ampacity a) total current b) l/way c) signalling	operating voltage	supply terminals a) +UB b) DV c) FE d) PE	load outputs per slot	minus outputs for load	signalling line entry / outputs	signalling	termination cross-sections a) supply b) load output c) signal output	remote (control input)	specials b) customers	bus- capable, connection
SVS20	8	8 ways 56.4 x 210 x 142.3	ESS20-003 ESX10-103	a) max. 40 A b) max. 8 A c) max. 0.5 A	24 V DC	a)+/+/+ b)-/-/-	10 load outputs per way 10 x L1/2/3/4/5/ 6/7/8/9	5-pole terminals X22-X28 total: 35 minus terminals	terminal X31 5-pole X31.1 (Out-S/GR1) signal output X31.2 (24 V DC+) ext. supply X31.3 (IN-GR) supply group signal X31.4 (PROT24) aux. circuit X31.5 (IN-S/Out-GR2)	group signalling two-group signalling supply X31 aux. circuit protected on distribution rail	a) screwless terminals max. 10 mm ² a)b)c) load outputs / minus terminals / signalling, plug-in type screwless connectors, marked max. 2.5 mm ²	n/a	10 protected load output terminals per slot external supply possible between load output terminals (L) and (!) per slot (safety disconnection) b) Grob/Daimler	n⁄a



Control Plex®

Intelligent power distribution system SVS100

ControlPlex® consists of SVS100-PWR and SVS100-COM

- Power distribution backplane for 16 ways (or 8 ways)
- Supply +24 V, 0 V, PE 2 x 10 mm² each, max. 40 A
- All terminals: spring-loaded terminals or push-in
- To be used in decentralised IP67 systems and at the same time as IP20 solution
- Voltage supply for all ways F1 to F16 and of the loads is effected directly from the DC24V supply. The supply for the electronic control unit (COM module) can also be fed separately
- Protection for SVS100-COM is already integrated
- Additional integral total current measurement on the SVS100 (max. 50A)
- Complete wiring of US1, US2, 0 V, 0 V, PE per slot
- Joint US1 supply (SVS100-16-PWR)
 A) 1 x US1 via F1 (7 x US2 output to F2, F3, ..., F8)
 B) 1 x US1 via F9 (7 x US2 output to F10, F11, ..., F16)
- Extendable to 64 ways by way of cascading of the power distribution systems



Intelligent power distribution system SVS100

Control Plex® Board

Intelligent power distribution system SVS100

ControlPlex® for electronic circuit protectors type **ESX50D-S**, plug-in types for F1 to F16, parameterisable current rating 1...10 A, per software with internal communication interface (right unit)

ESX50D version: "OFFLINE" rating adjustment directly on the unit via selector switch 1 A ... 10 A (left unit)

Features of type ESX50D-S

- A single trip curve for all types of loads (capacitive load up to 40,000µF, DC motors etc.)
- Adjustable alarm values for the load current, e.g. 90% (50% ... 100%)
- Indication of input voltage, load current, load voltage, limit values, unit temperature
- Status indication system voltage ("DC24V OK")
- Status indication per way (overload/short circuit)
- Adjustment of switch-on delay/disconnection sequences per software (e.g. for PROFlenergy)
- QUIT/RESET and ON and OFF operation per way possible (e.g. for PROFlenergy)
- Additional manual reset on the device possible
- Multicoloured LED, to be switched off ONLINE & OFFLINE, "Sleep Mode" (e.g. PROFlenergy)
- History memory ("HISTOMEMO"), event-triggered recording of measuring values



ControlPlex® HISTO-MEMO



Electronic circuit protector ESX50D-S

ControlPlex® Software and user dialogue platform

- Clear lay-out "At a glance: Everything hunky-dory".
- Parameterisable via USB or directly via communication interface e.g. current rating 1 A to 10 A in 1A steps, limit values, switch-on sequences ...

Optional: current rating adjustable directly on the unit

- All adjustments can be saved (internally or externally), documentation serves as a test record of machine/system. All future changes or replacements will be recorded.
- Ease of start-off without manual, only "Windows" and "Mouse" knowledge required.
- Start-up configuration is saved for machine approval, system documentation etc.
- Overcurrent parameters are not accessible to the user.
 The only electronic trip curve for all DC 24 V load types makes electrical planning easy!

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Software interface ControlPlex®

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Menu "actions"

Standard 19" box

PDB-P-L-ESS20-30A0-B1for the electronic circuit breaker ESS20



Electronic circuit breaker ESS20



front view



rear view



Special version 19" box S438 with de-coupling diodes 19BGT-3-ESS20-30R2RB-B1GR-LS438

• for the electronic circuit breaker ESS20







front view



top view and de-coupling diodes

Control cabinet SBG T018

- economic and space-saving control cabinet design
- saves up to 50% of costs through use of cascadable power distribution systems for DC24V with slots for electronic circuit breakers

New possibilities provided by additional electronic sub-assemblies:

- intelligent alarm processing
- remote control
- bus connection
- emergency functions
- redundancy



control cabinet SBG T018



power supplies, diode de-coupling and protection



load distribution modules



de-coupling module



Demo control cabinet T029



Redundant power supply with diode de-coupling



Power Distribution Module (PDM) for ESS20, 2216 and REF16



Power distribution systems SVS for ESX10-S and ESS20



High current distribution by means of **X8345-D01** and hydraulic-magnetic Circuit Breaker Type **8345**

AC power distribution system **SBG-V0071** for 10 load circuits protected with thermal-magnetic Circuit breaker **2216** and main switch (back-up fuse) through 2-pole, hydraulic-magnetic circuit breaker **8340-F.**



front view



top view





side view



Power supply and protection module **SBG-V0057** with SMPS 20A and for eight load circuits, protected by electronic circuit protector type **REF16** for installation in control cabinets, compatible with servo outputs for motor drives



compact module with power supply

installation between servo converters



Power Distribution Module (PDM) and Power Distribution Box (PDB) for thermal-magnetic circuit breaker type 2216 and electronic circuit protector type REF16-S

- Redundant (2 x 15 ways) or non-redundant (1 x 30 ways)
- Mounting on rear wall in control cabinet (PDM) or inm 19" rack (PDB)
- Spring-loaded terminals on the rear or front
- Line entry up to 2 x 80A
- Group signalling
- Voltage monitoring optional



Power Distribution Module PDM fitted with REF16



Power Distribution Module PDM fitted with REF16 and 2216

E-T-A A globe-spanning network



Europe

- Belgium
- Bosnia/Herzegovina
- Bulgaria
- Denmark
- Germany
- Finland
- FranceIreland
- Italy
- Croatia
- Luxemburg
- Macedonia
- Montenegro
- Netherlands
- Norway
- Austria
- Poland
- Portugal
- Russia
- SwedenSwitzerland
- Serbia
- Slovakia
- Slovenia
- Spain
- Czech Republic
- Turkey
- Hungary
- United Kingdom

America

- Argentina
- Brazil
- Chile
- Canada
- Mexico
- USA

Asia

- Brunei
- China
- Hong Kong
- India
- Indonesia
- Japan
- Korea
- Malaysia
- Philippines
- Singapore
- Taiwan
- Thailand

Africa

- South Africa
- Tunisia

Oceania

- Australia
- New Zealand



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