Siemens Digital Industries Webinari

CP2: Clever engineering

Današnji predavač

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Tijana Džodžo

Responsibility

Technical Sales Support Professional

Industrial Controls

Low-Voltage Power Distribution

Electrical Installation Technology

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Belgrade, Serbia

Siemens Digital Industries Webinari 1/2

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Datum	Tema	Predavač
14.04. / 19.05.	FA1: Motion Control	*Darko Živković, Jelena Đukić*
15.04. / 14.05.	FA2: Energy Management System	*Zoran Jovanović*
22.04. / 21.05.	FA3: Redundantni kontroleri serije S7-1500R/H	*Mirko Milovanović*
05.05. / 26.05.	FA4: WinCC Unified	*Mirko Milovanović*
15.04. / 13.05.	MC1: DT konfigurator	*Nenad Bakal, Pavle Dragišić*
23.04. / 22.05.	MC2: Sizer, large drives	*Miloš Marković, Pavle Dragišić*
06.05. / 26.05.	MC3: Sizer, motion drives	*Miloš Marković, Pavle Dragišić*
21.04. / 21.05.	CI1: Industrial Networks	*Jelena Đukić*

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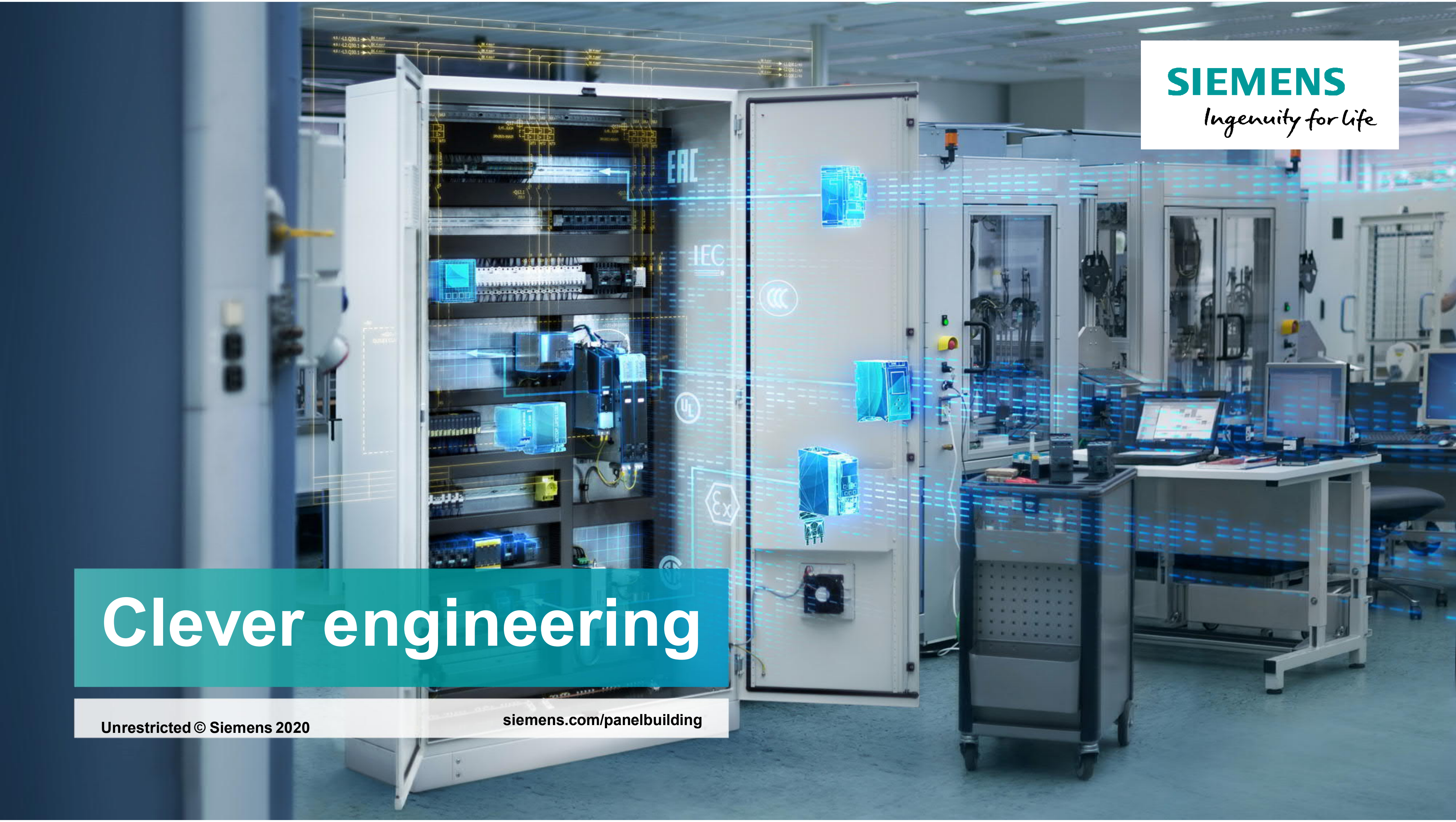
Datum	Tema	Predavač
16.04. / 15.05.	PI1: PI Academy world	*Andrijana Popara, Miljan Miljanić, Marko Marić*
24.04. / 22.05.	PI2: PI workshop for specialist	*Andrijana Popara, Miljan Miljanić, Marko Marić*
08.05. / 29.05.	PI3: #New@PI	*Andrijana Popara, Miljan Miljanić, Marko Marić*
30.04. / 29.05.	AE1: Digitalna rešenja u procesnoj industriji	*Jelena Đukić, Marko Milenković*
29.04.	CP1: Control Panel Online Symposium	*Siemens worldwide webinar*
22.04. / 27.05.	CP2: Clever engineering in the control panel	*Tijana Džodžo*
28.04. / 12.05.	CP3: New series of signaling devices 3SU	*Tijana Džodžo*
21.04. / 20.05.	CP4: SIRIUS 3RW Soft starters	*Bojan Janković*
07.05. / 28.05.	DE1: Siemens Digital Enterprise	*Zoran Jovanović*



Clever engineering

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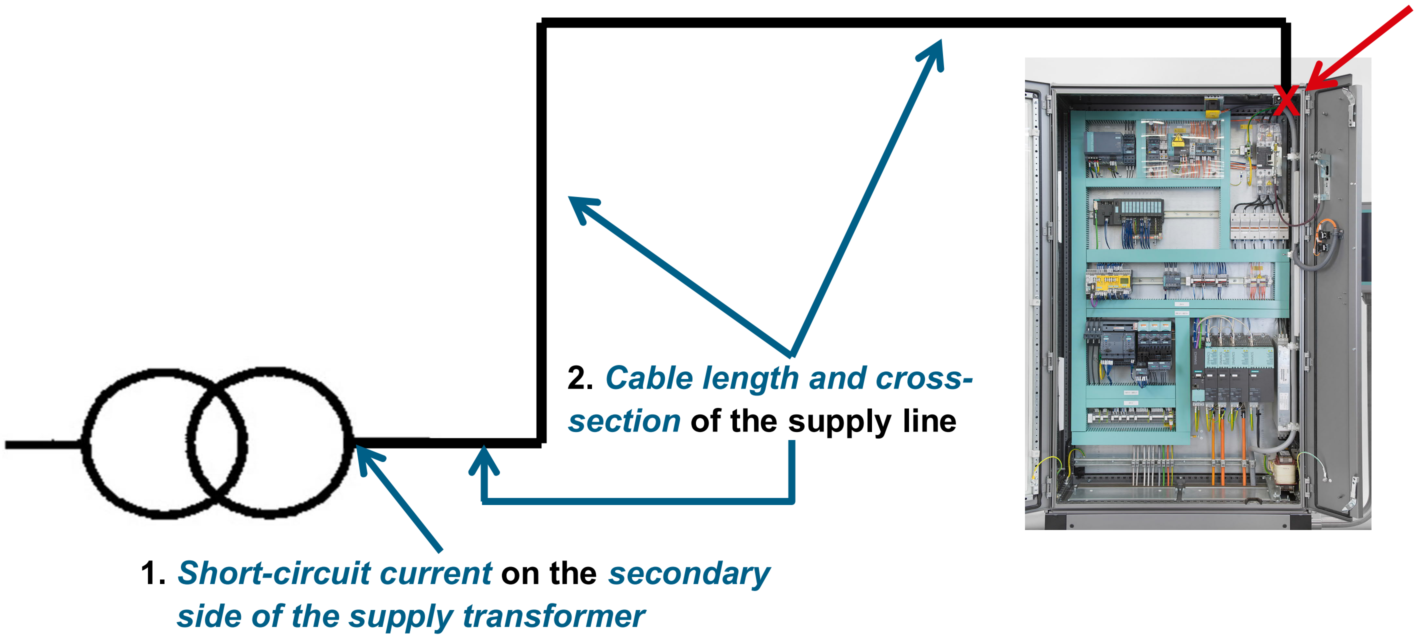
Short-circuit verification according to IEC standards

Determining prospective short-circuit current at the incoming supply point to the machine

The expected ***minimum and maximum short-circuit current at the infeed point*** of the machine (rms value in kA) ***must be agreed by the customer and the manufacturer of the machine.***

The *short-circuit current at the supply point* is *dependent on several factors:*



Short-circuit verification according to IEC standards

Determining prospective short-circuit current at the incoming supply point to the machine

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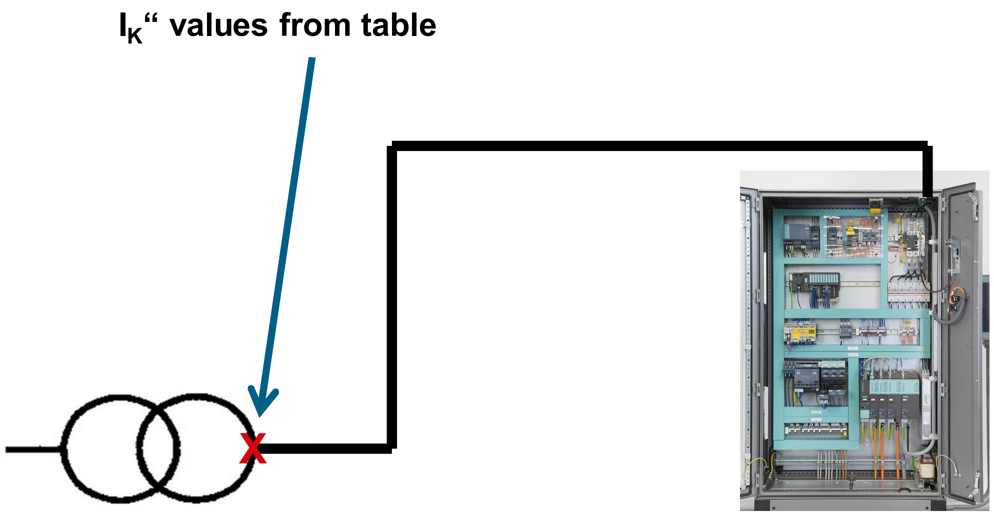
Approximate short-circuit current depending on transformer power (3-phase)							
Sn (kVA)	uk (%)	400 V		415 V		690 V	
		In (A)	Ik" (kA)	In (A)	Ik" (kA)	In (A)	Ik" (kA)
50	4	72	**1,8**	70	**1,7**	42	**1,0**
63	4	91	**2,3**	88	**2,2**	53	**1,3**
100	4	144	**3,6**	139	**3,5**	84	**2,1**
125	4	180	**4,5**	174	**4,3**	105	**2,6**
160	4	231	**5,8**	223	**5,6**	134	**3,3**
200	4	289	**7,2**	278	**7,0**	167	**4,2**
250	4	361	**9,0**	348	**8,7**	209	**5,2**
315	4	455	**11,4**	438	**11,0**	264	**6,6**
400	4	577	**14,4**	556	**13,9**	335	**8,4**
500	4	722	**18,0**	696	**17,4**	418	**10,5**
630	6	909	**15,2**	876	**14,6**	527	**8,8**
800	6	1155	**19,2**	1113	**18,5**	669	**11,2**
1000	6	1443	**24,1**	1391	**23,2**	837	**13,9**
1250	6	1804	**30,1**	1739	**29,0**	1046	**17,4**
1600	6	2309	**38,5**	2226	**37,1**	1339	**22,3**
2000	6	2887	**48,1**	2782	**46,4**	1673	**27,9**
2500	6	3608	**60,1**	3478	**58,0**	2092	**34,9**
3150	6	4547	**75,8**	4382	**73,0**	2636	**43,9**



Calculation formulas

$$I_n = \frac{S_n\,(VA)}{U_{sek}\,\sqrt{3}} \qquad I''_k = \frac{I_n\,(A)}{U_k\,(\%)}$$

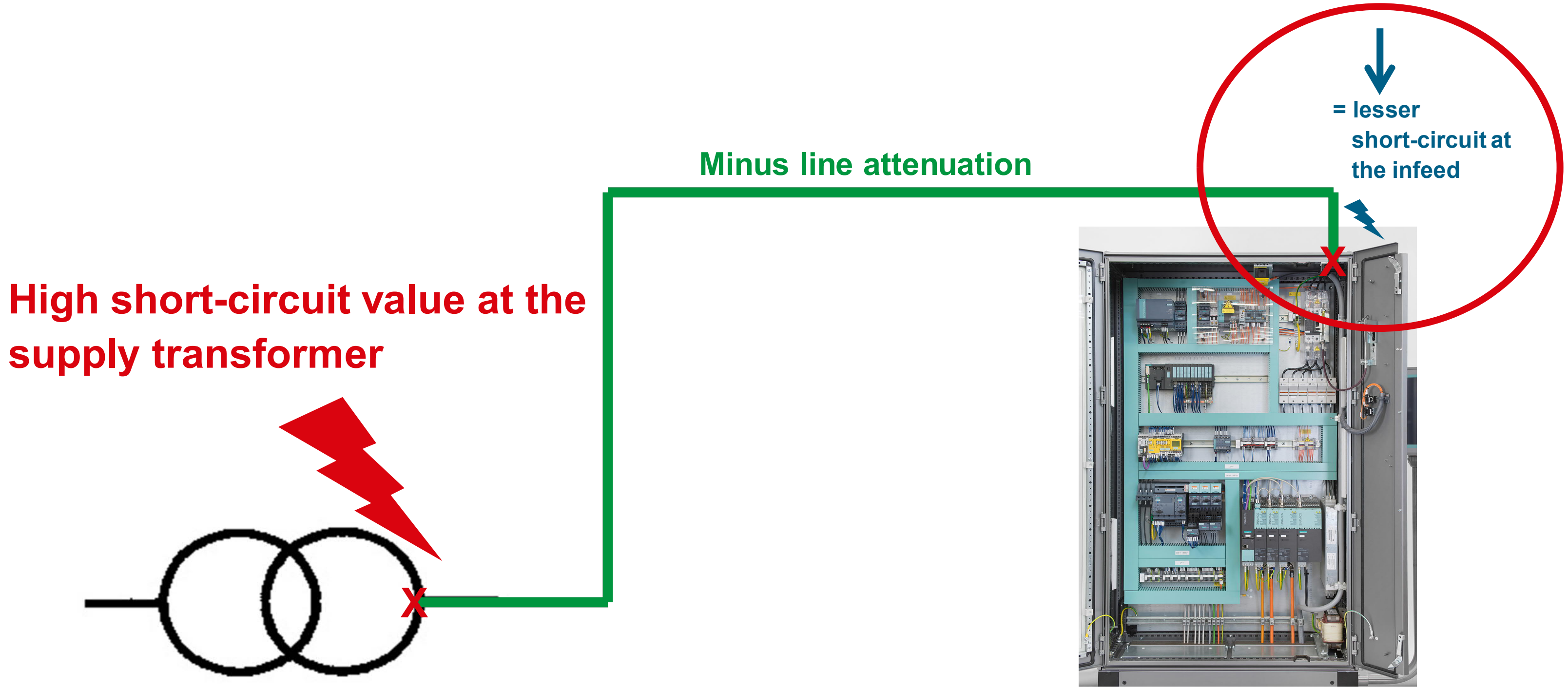
I_n = sec. rated current of transf.
U_{sec} = sec. voltage of transf.
U_k = relative short-circuit voltage (impedance)

S_n = transf. power
I_K“ = sec. short-circuit curr. of transf.

Short-circuit verification according to IEC standards

Determining prospective short-circuit current at the incoming supply point to the machine

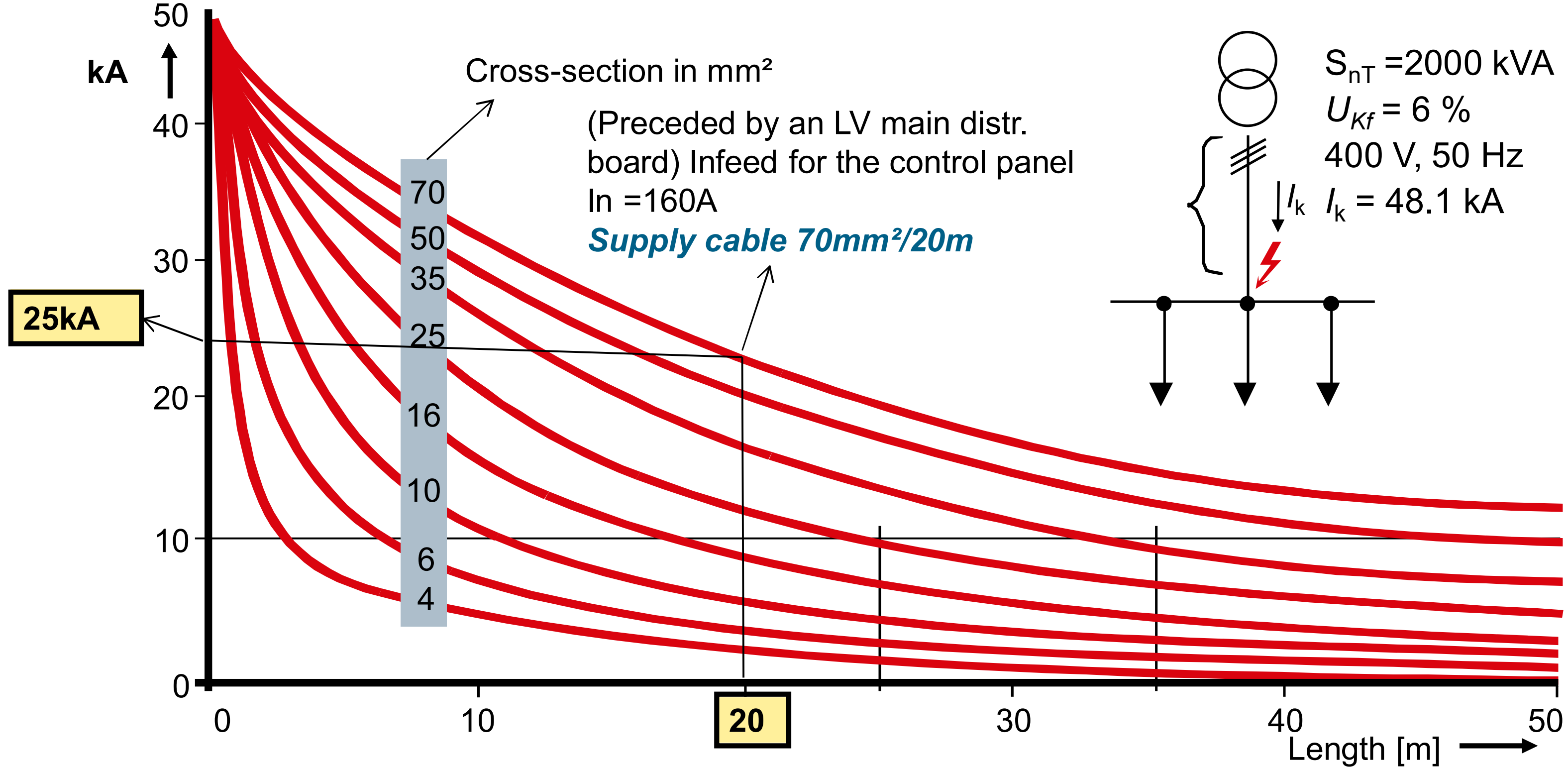
The ***minimum and maximum short-circuit at this point is*** subject to agreement between the manufacturer and the customer.



Short-circuit verification according to IEC standards

Determining prospective short-circuit current at the incoming supply point to the machine

Cables and conductors attenuate the short-circuit current



Short-circuit verification according to IEC standards

Determining prospective short-circuit current at the incoming supply point to the machine

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Attenuation of short-circuit currents through different lengths of copper cables at the cable end in the case of three-pole short-circuit in TN-C systems. ***I_k = 10 kA at the infeed point and with a line voltage of 230 V or 400 V, 50 Hz***

Conductor length	0.3 m		1.0 m		3.0 m		10 m		30 m		50 m	
Rated cross-section q_r mm^2	Line voltage											
	230 V	400 V	230 V	400 V	230 V	400 V	230 V	400 V	230 V	400 V	230 V	400 V
	kA	kA	kA	kA	kA	kA	kA	kA	kA	kA	kA	kA
240	9.98	9.99	9.92	9.96	9.77	9.87	9.26	9.58	8.06	8.83	7.14	8.19
120	9.97	9.98	9.89	9.94	9.69	9.82	9.02	9.42	7.48	8.41	6.36	7.58
95	9.96	9.98	9.88	9.93	9.64	9.79	8.88	9.33	7.17	8.19	5.96	7.27
70	9.96	9.97	9.85	9.92	9.56	9.75	8.64	9.19	6.64	7.82	5.32	6.75
50	9.94	9.97	9.81	9.89	9.44	9.68	8.27	8.96	5.89	7.27	4.50	6.02
35	9.93	9.96	9.76	9.86	9.29	9.59	7.83	8.69	5.14	6.65	3.75	5.28
25	9.91	9.95	9.69	9.82	9.08	9.47	7.24	8.30	4.31	5.88	3.01	4.45
16	9.86	9.92	9.53	9.73	8.63	9.20	6.18	7.54	3.17	4.66	2.10	3.29
10	9.79	9.88	9.29	9.59	7.95	8.79	4.92	6.49	2.20	3.44	1.40	2.29
6	9.65	9.80	8.84	9.33	6.86	8.07	3.51	5.07	1.40	2.29	0.87	1.46
4	9.48	9.70	8.30	9.01	5.77	7.24	2.56	3.92	0.96	1.61	0.59	1.00
2.5	9.18	9.53	7.42	8.45	4.42	6.04	1.71	2.76	0.61	1.04	0.37	0.64
1.5	8.65	9.22	6.13	7.54	3.07	4.57	1.07	1.79	0.37	0.64	0.23	0.39

See Switching, Protection and Distribution in Low-Voltage Networks - Siemens – 4, considerably revised and expanded edition 1997 (page 708, Table 10.7/1)

Short-circuit verification according to IEC standards
Determining prospective short-circuit current at the incoming supply point to the machine

Attenuation of short-circuit currents through different lengths of copper cables at the cable end in the case of three-pole short-circuit in TN-C systems. ***I_k = 50 kA at the infeed point and with a line voltage of 230 V or 400 V, 50 Hz***

Conductor length	0.3 m		1.0 m		3.0 m		10 m		30 m		50 m	
Rated cross-section q_r mm^2	Line voltage											
	230 V	400 V	230 V	400 V	230 V	400 V	230 V	400 V	230 V	400 V	230 V	400 V
	kA	kA	kA	kA	kA	kA	kA	kA	kA	kA	kA	kA
240	49.49	49.71	48.32	49.03	45.24	47.18	36.77	41.57	23.57	30.71	17.23	24.20
120	49.37	49.64	47.93	48.81	44.04	46.50	33.36	39.37	18.68	26.24	12.78	19.31
95	49.31	49.60	47.70	48.68	43.32	46.10	31.49	38.08	16.56	24.02	11.05	17.16
70	49.20	49.54	47.32	48.47	42.07	45.40	28.37	35.83	13.57	20.61	8.78	14.11
50	49.03	49.45	46.67	48.12	39.96	44.22	24.09	32.33	10.40	16.53	6.59	10.86
35	48.81	49.33	45.84	47.69	37.36	42.71	20.05	28.49	8.03	13.14	4.98	8.39
25	48.49	49.15	44.54	47.00	33.75	40.22	15.95	23.97	6.02	10.08	3.69	6.30
16	47.76	48.77	41.68	45.47	27.35	35.70	10.98	17.56	3.92	6.70	2.38	4.11
10	46.50	48.12	37.06	42.81	20.37	29.21	7.24	12.05	2.51	4.33	1.51	2.63
6	43.98	46.81	29.81	37.87	13.55	21.18	4.44	7.57	1.51	2.62	0.91	1.58
4	40.65	45.02	23.30	32.29	9.44	15.43	2.98	5.14	1.01	1.75	0.61	1.06
2.5	35.00	41.63	16.37	24.82	6.08	10.26	1.88	3.26	0.63	1.10	0.38	0.66
1.5	27.06	35.76	10.54	17.07	3.72	6.38	1.13	1.97	0.38	0.66	0.23	0.40

See Switching, Protection and Distribution in Low-Voltage Networks - Siemens – 4, considerably revised and expanded edition 1997 (page 709, Table 10.7/2)

Short-circuit verification according to IEC standards

Determining prospective short-circuit current at the incoming supply point to the machine

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The previous three slides show that the *line attenuation has a greater influence* on the short-circuit current at the machine infeed *than the transformer power*

The situation is similar with the cable attenuation tables. *Example: "50 m conductor length with a conductor cross-section of 50 m²":*

- Table 1: Short-circuit currents at the end of the cable with an initial short-circuit AC current at the transformer of ***10 kA*** →At the end of the cable ***6.02 kA***.
- Table 2: Short-circuit currents at the end of the cable with an initial short-circuit AC current at the transformer of ***50 kA*** →At the end of the cable ***10.86 kA***.

→ Initial short-circuit AC current ratio → ***5 : 1***

→ Short-circuit value at the end of the cable ratio → ***1.8 : 1***

The longer the cable and the smaller the cross section, the less influence the initial short-circuit AC current has on the short-circuit value at the end of the cable.

Reduction of short-circuit current at infeed – example 1

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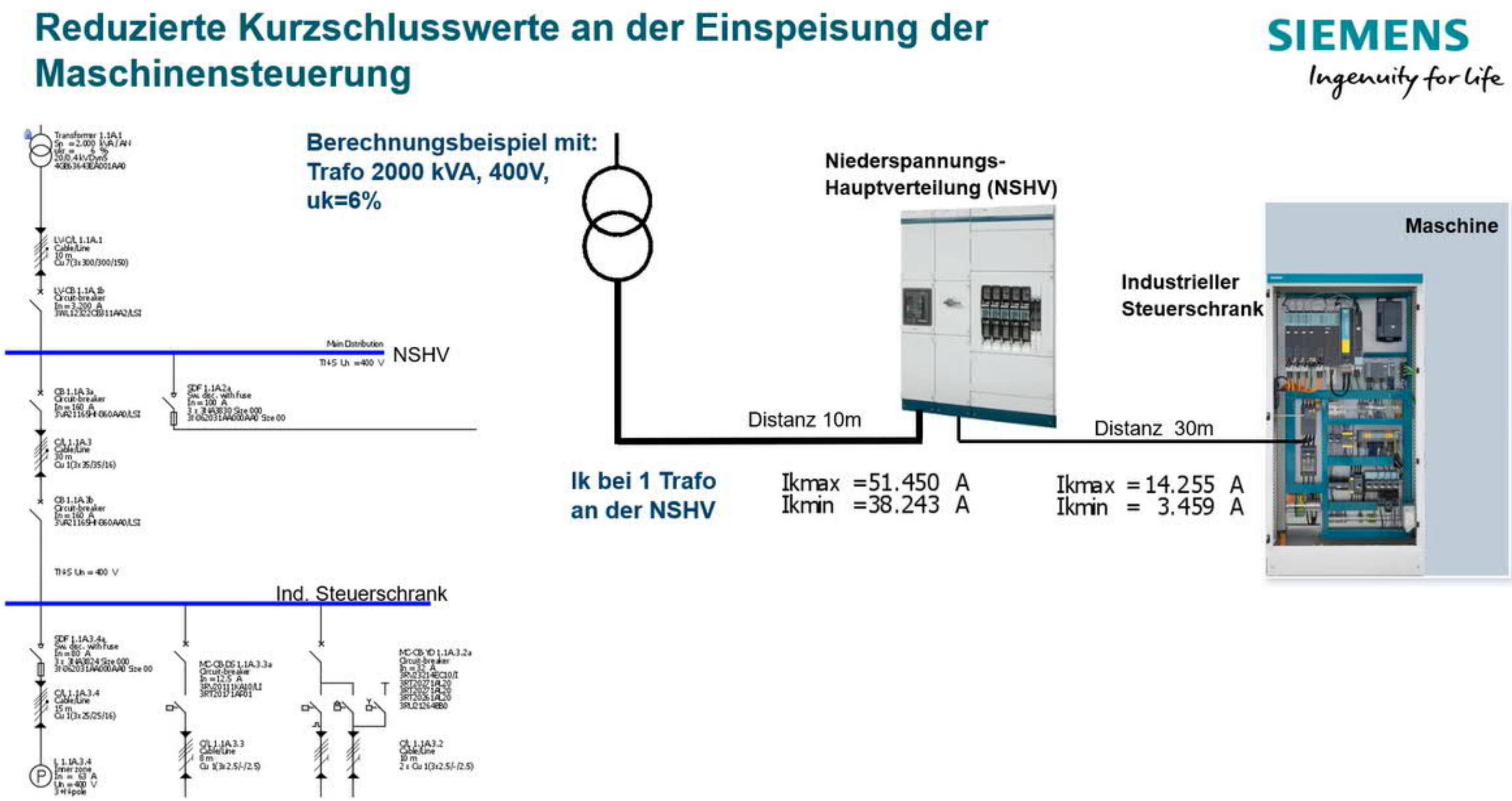
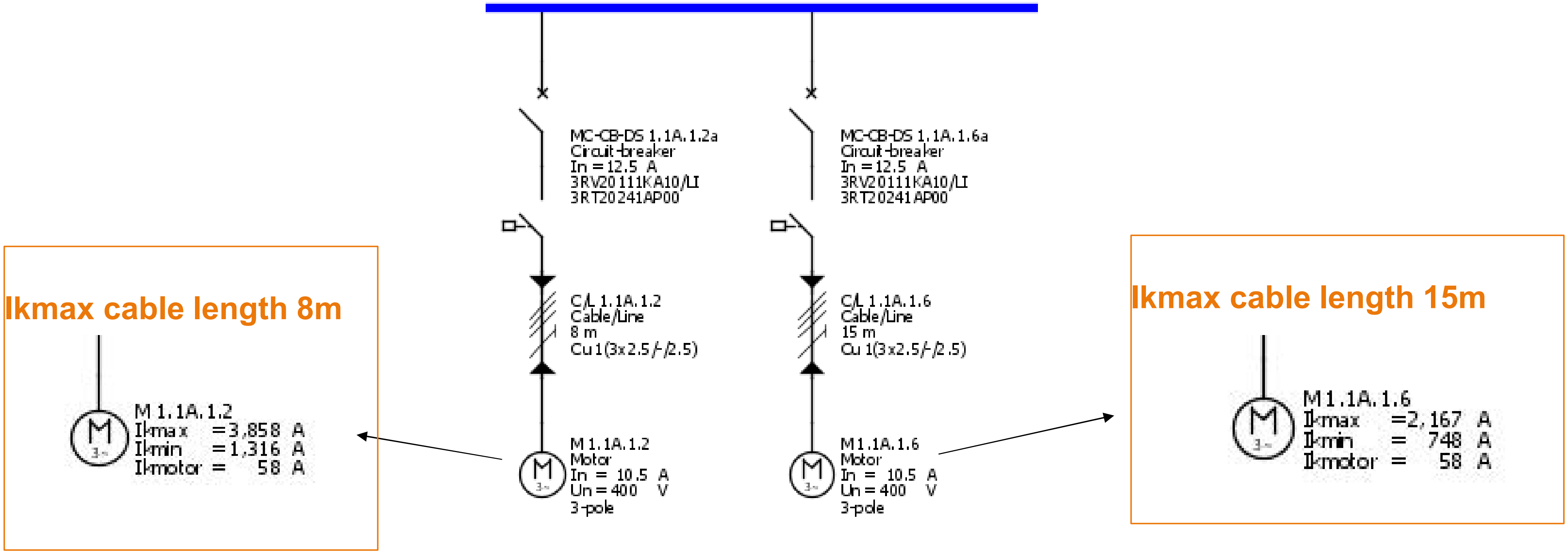
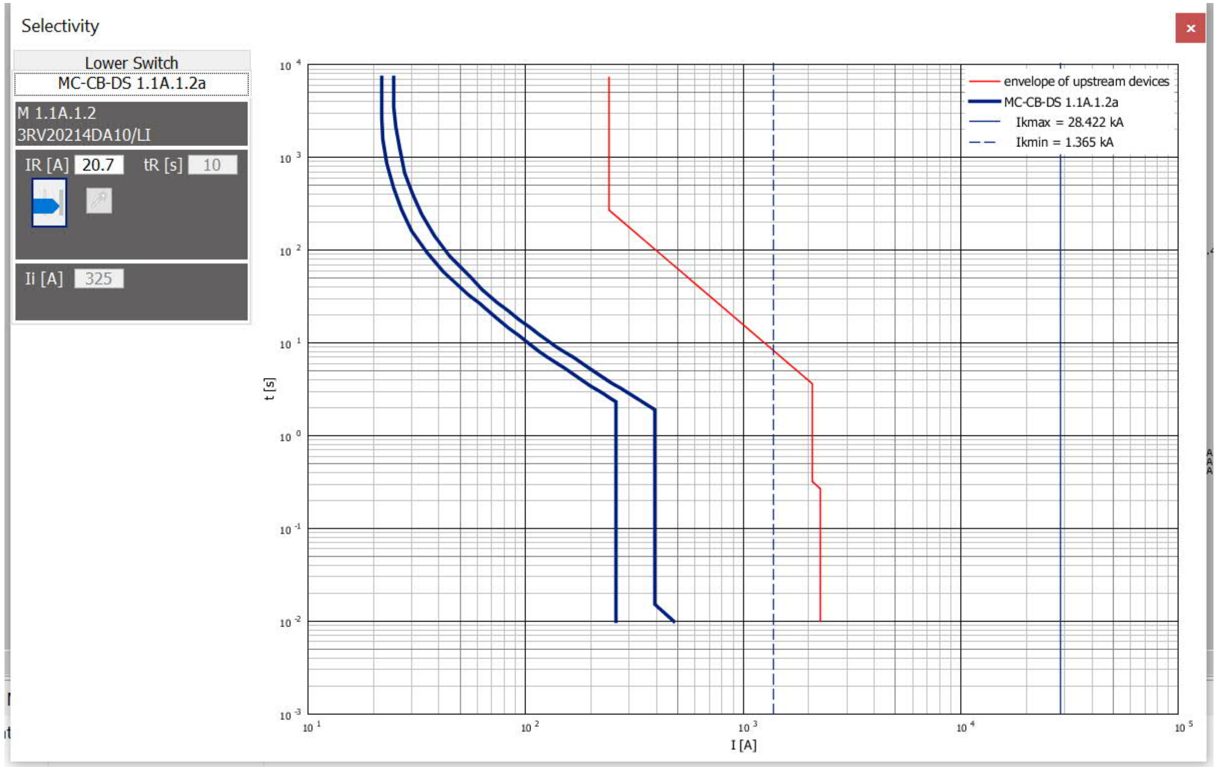


Reduction of short-circuit current at motor side – example 2



Minimum short-circuit current

- Minimum short-circuit current clearance in 5s
- Motor 11kW, In=20,1A, Ikmin=1365A
- MSP 3RV2021-4DA10 (18-25A)
- In 5s clears fault current in range of 160-205A



Protection devices at infeed and load feeders

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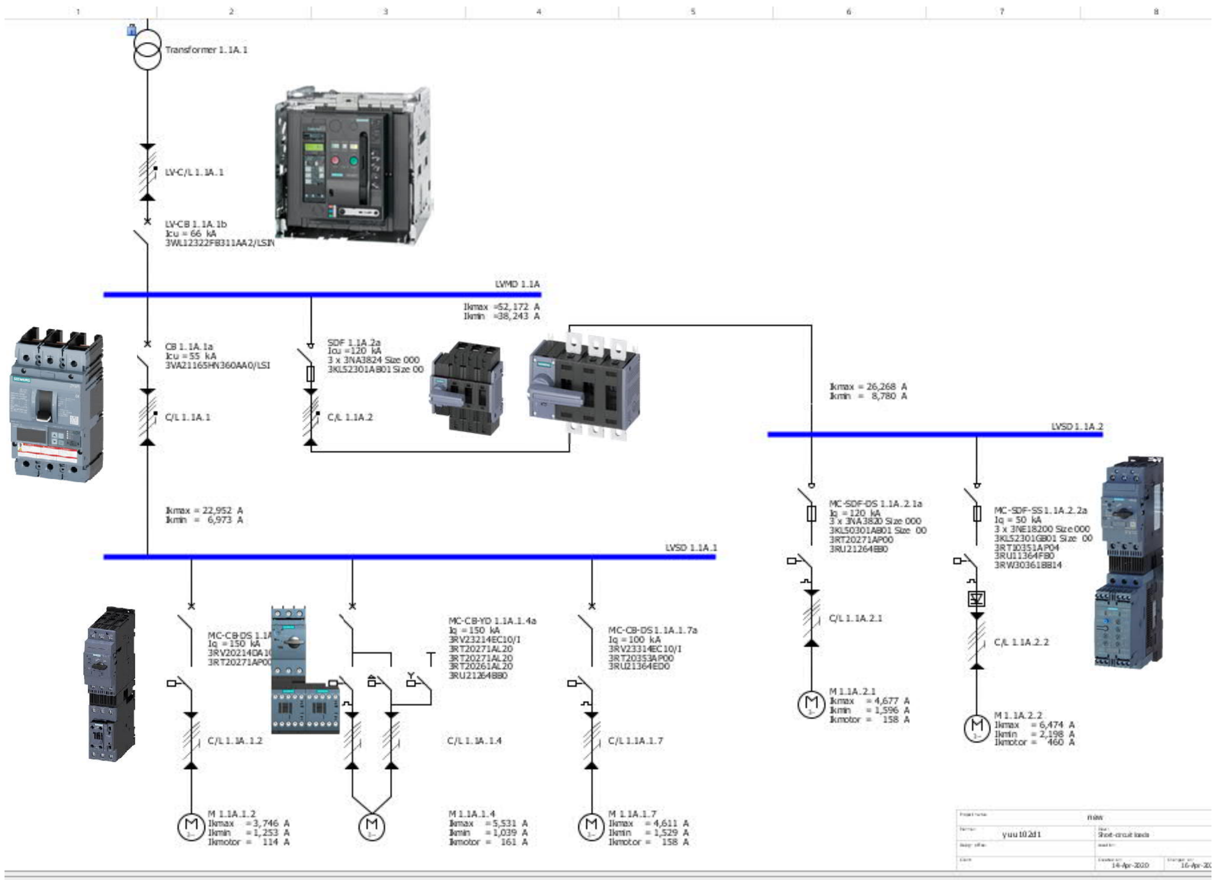
INFEED

LOAD FEEDERS



Protection devices

Electrical safety for machines- EN or IEC 60204-1

Acc. To EN or IEC 60947-3

Acc. To EN or IEC 60947-2

Fused design with switch disconnecting function

Switch disconnector without fuse

Fuseless design with circuit breaker

3KF, 3NP1, 3NA, 3NE3, SITOR

3KD

Potreban zaštitni uređaj iznad rastavljača!

3WL, 3VA, 3RV

Difference between Icu i Ics

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Standard IEC 60947-2 defines

Rated ultimate short-circuit breaking capacity Icu

- This current must be disconnected twice by the circuit breaker without damage
- Then the device must be replaced or examined

Rated service short-circuit breaking capacity Ics

- This current must be disconnected three times by the circuit breaker without damage
- The circuit breaker must then be capable of carrying the service current

Selectivity of protection devices

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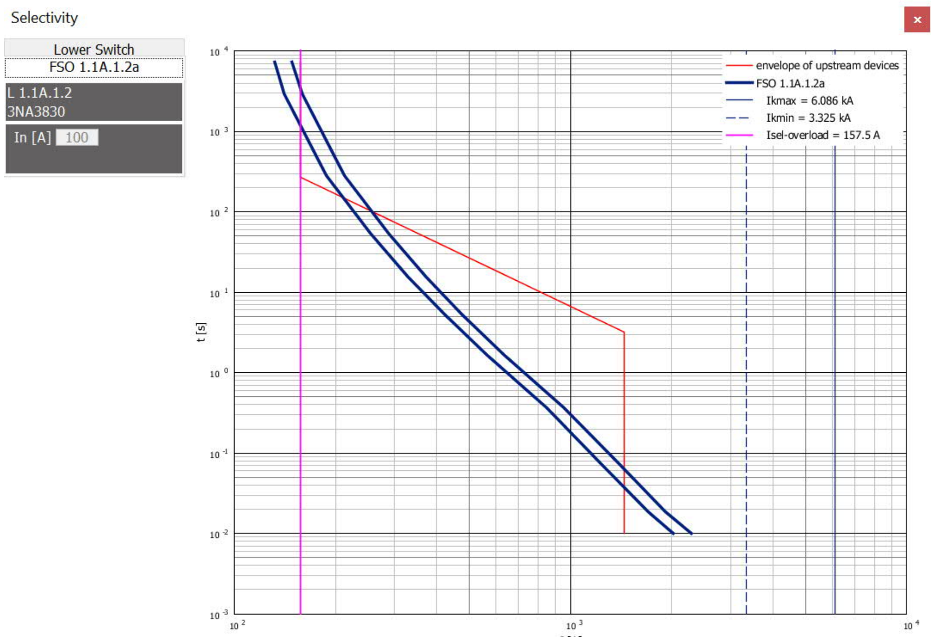
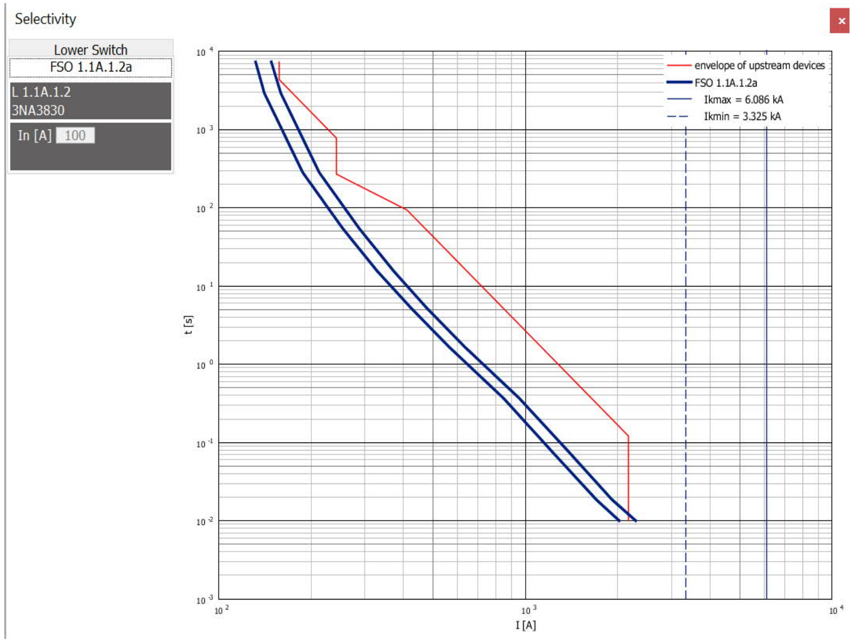
Selectivity- example 1





Short-circuit verification according to IEC standards

Short-circuit verification according to IEC 60204-1

***IEC 60204-1* does not *describe any short-circuit verification*!**

It only describes that…

- the ***rated short-circuit breaking capacity*** for a short-circuit by ***overcurrent protection devices*** shall be ≥ ***the prospective fault current at the point of installation and***
- the ***cable*** shall be ***designed according to the short-circuit current***, among other things

Other components in the control panel such as switching devices, frequency converters, terminal strips, etc. are not described in greater detail

Short-circuit verification according to IEC standards

Short-circuit verification according to IEC 61439-1 – Verification n/a

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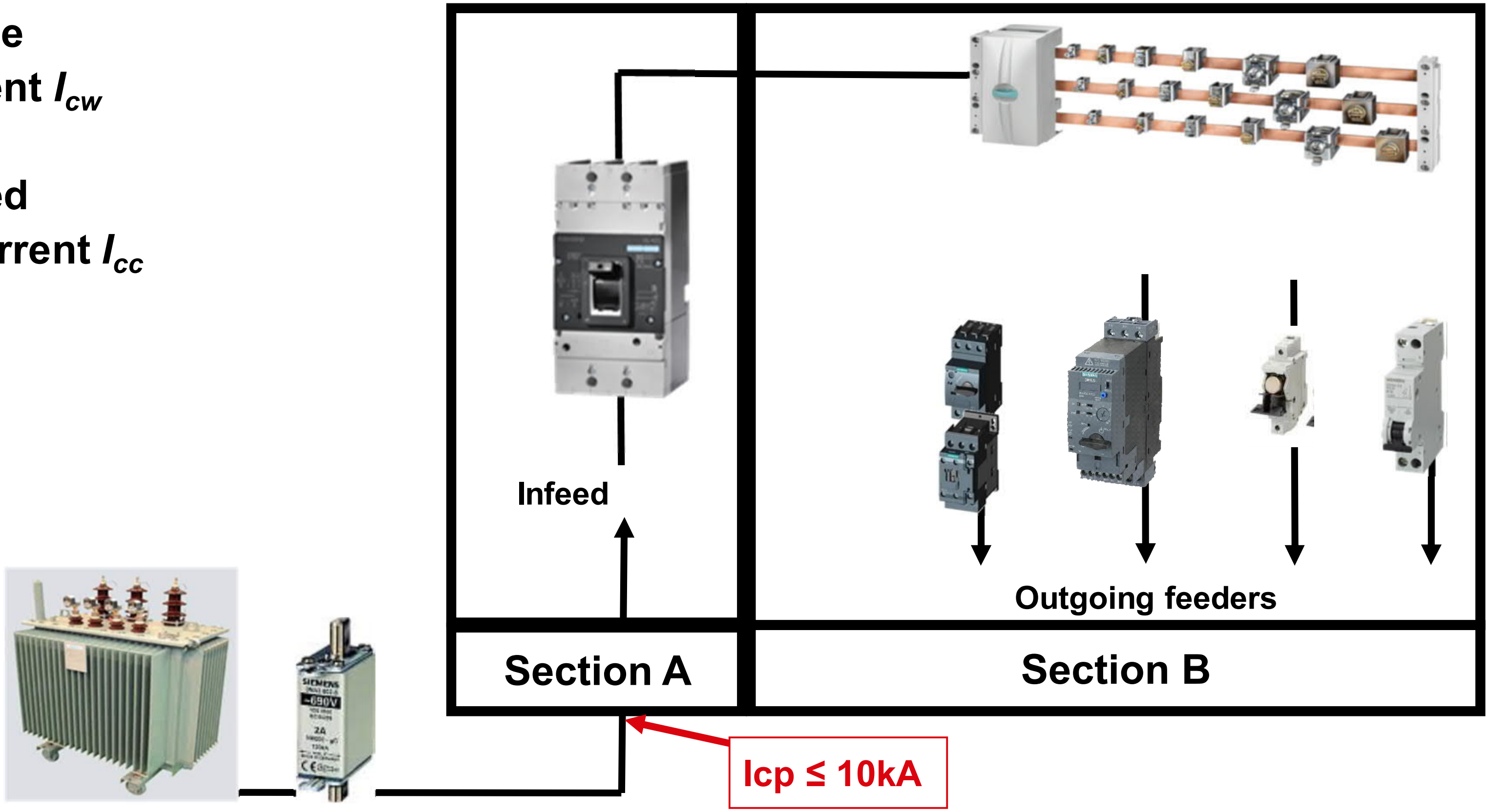
Rated short-time withstand current I_{cw}
or
conditional rated short-circuit current I_{cc}

≤ 10 kA

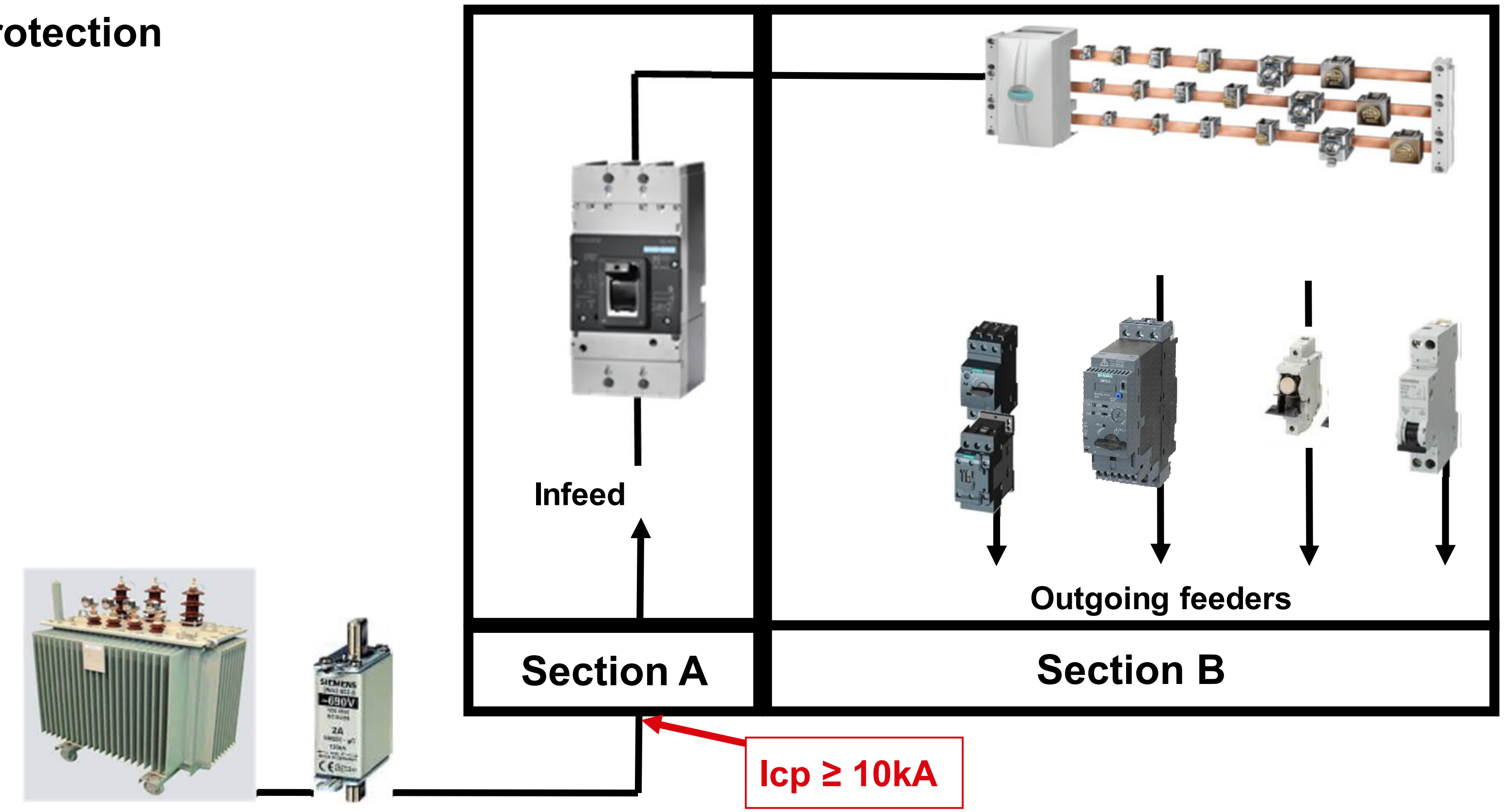


Short-circuit verification according to IEC standards

Short-circuit verification according to IEC 61439-1 – Verification n/a

Overcurrent protection devices:

I_{peak} ≤ 17kA
at I_{cp} ≥ 10kA



Short-circuit verification according to IEC standards

Short-circuit verification according to IEC 61439-1 - Overview of 3VA.. molded case circuit breakers with let-through values ≤ 17

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3VA molded-case circuit breakers
Integration IEC 61439 – Ic ≤ 17kA

Integration		Switching capacity class						
IEC 61439 – Short-Circuit-Test								
Values for 415V		B	N	S	M	H	C	L
3VA1	Icu	16 kA	25 kA	36 kA	55 kA	70 kA	–	–
3VA10 (3/4p)								
	16-80 A	OK	OK	OK	–	–	–	–
	100 A	OK	OK	33,0 kA	–	–	–	–
3VA11 (1/2p)								
	16-160 A	–	OK	OK	–	–	–	–
3VA11 (3/4p)								
	16-32 A	–	OK	OK	OK	OK	–	–
	40-80 A	–	OK	OK	OK	68,0 kA	–	–
	100-160 A	–	OK	33,0 kA	33,0 kA	33,0 kA	–	–
3VA12 (3/4p)								
	160-250 A	–	–	14,5 kA	14,5 kA	14,5 kA	–	–
3VA2	Icu	–	–	–	55 kA	85 kA	110 kA	150 kA
3VA20								
	25-100 A	–	–	–	38,1 kA	38,1 kA	38,1 kA	38,1 kA
3VA21								
	25-160 A	–	–	–	19,4 kA	19,4 kA	19,4 kA	19,4 kA
3VA22								
	160-250 A	–	–	–	16,7 kA	16,7 kA	16,7 kA	16,7 kA
3VA23								
	250-400 A	–	–	–	> 17kA	> 17kA	> 17kA	> 17kA
3VA24								
	400-630 A	–	–	–	> 17kA	> 17kA	> 17kA	> 17kA

Legend:

Rated short-time withstand current or rate conditional short-time withstand current < 10 kA rms value
-> no test required

Rated short-time withstand current or rate conditional short-time withstand current -> 10 kA rms value

OK	No test required: Ic < 17 kA
x kA	If the expected short-circuit current does not exceed x kA, no test is required: Ic < 17 kA
> 17 kA	Test required: Ic > 17 kA

Note:
The table above is an excerpt from the characteristic curves of the 3VA molded-case circuit breaker for current limiting for a rated voltage of 415 V. You will find further details and data of other rated voltages in the characteristic curves:

- in Industry Online support
- or in the free SIMARIS curves tool.

Short-circuit verification according to IEC standards

Short-circuit verification according to IEC 61439-1 - Overview of fuse systems with let-through values ≤ 17 kA

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Technical specifications

In the case of the rated short-circuit current of 50 kA, the fuses listed below have an rms let-through current of up to 17 kA.

Thus, in compliance with IEC 61439-1, Section 10.11.2, short-circuit testing of the system can be dispensed with. The data refers to the rated voltage of the fuse.

NEOZED fuse links
Rated voltage 400 V AC/250 V DC
Operational class gG
Betriebsklasse gG

	Size	I_n	I_d 1)	I_k 2)	Identification color (Kennfarbe)	Overall width (Baubreite) TE	Article No. (Artikel-Nr.)
	D01	2	< 17 kA	50 kA	Pink	--	5SE2302
		4	< 17 kA	50 kA	Brown		5SE2304
		6	< 17 kA	50 kA	Green		5SE2306
		10	< 17 kA	50 kA	Red	--	5SE2310
		13	< 17 kA	50 kA	Black		5SE2013-2A
		16	< 17 kA	50 kA	Gray		5SE2316
	D02	20	< 17 kA	50 kA	Blue	--	5SE2320
		25	< 17 kA	50 kA	Yellow		5SE2325
		32	< 17 kA	50 kA	Violet		5SE2332
		35	< 17 kA	50 kA	Black	--	5SE2335
		40	< 17 kA	50 kA	Black		5SE2340
		50	< 17 kA	50 kA	White		5SE2350
		63	< 17 kA	50 kA	Copper		5SE2363
	D03	80	< 17 kA	50 kA	Blue	--	5SE2280
		100	< 17 kA	50 kA	Red		5SE2300

1) Let-through current of fuse

2) System-specific short-circuit current

Short-circuit verification according to IEC standards

Short-circuit verification according to IEC 61439-1 - SIMARIS curves

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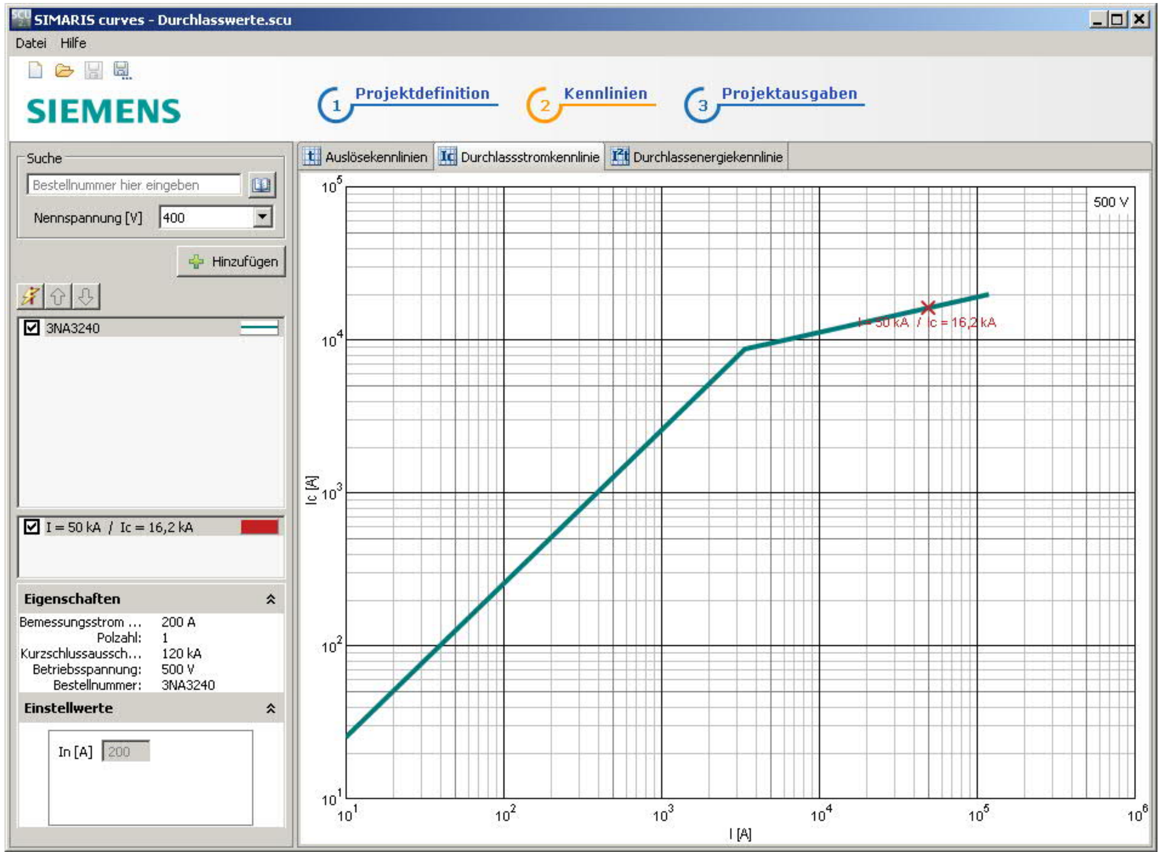
Example with SIMARIS curves:

- ***LV HRC fuse 3NA***.., 200 A, I_{cu} = 120 kA
- I_c = 50 kA → I_c = 16.2 kA

→ $I_c \leq$ 17 kA
→ No verification of short-circuit withstand strength necessary



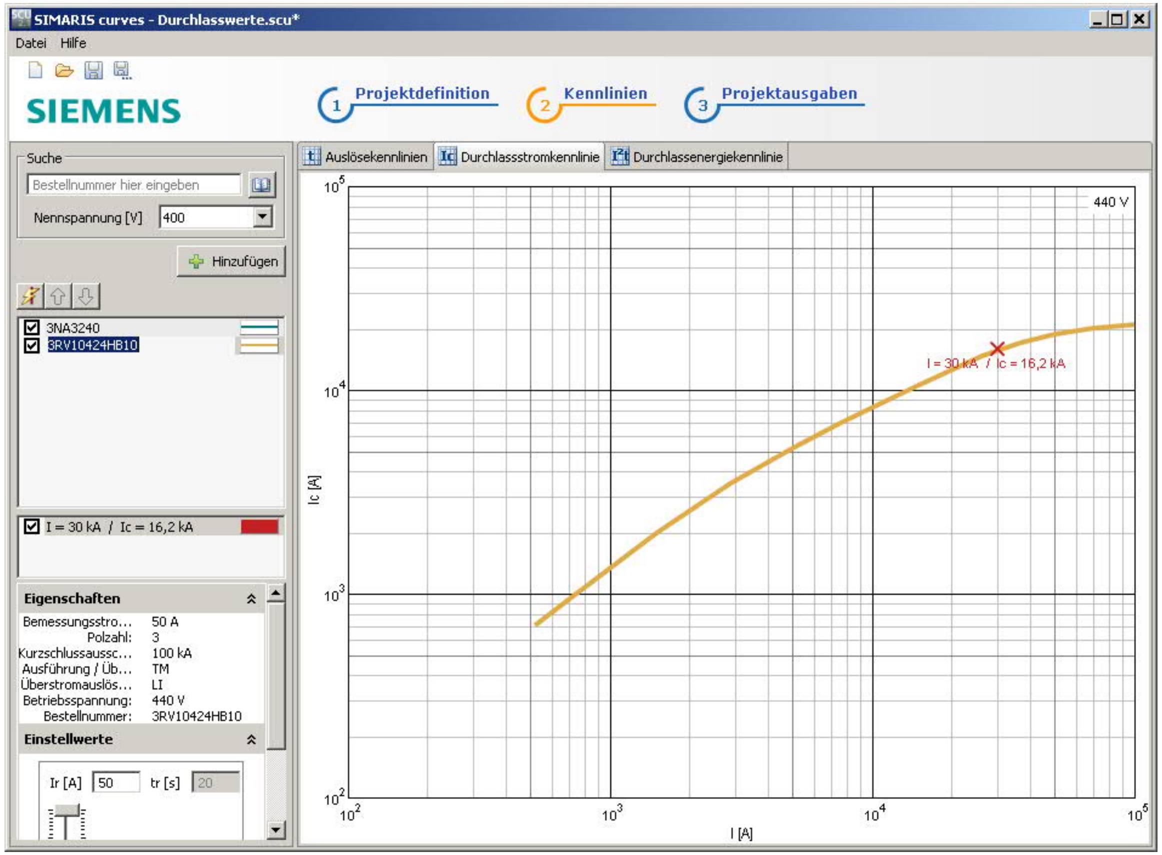
Short-circuit verification according to IEC standards

Short-circuit verification according to IEC 61439-1 - SIMARIS curves

Example with SIMARIS curves:

- ***Circuit breaker 3RV1042,*** 50 A, I_{cu} = 100 kA
- I_c = 30 kA → I_c = 16.2 kA

→ $I_c \leq$ 17 kA
→ No verification of short-circuit withstand strength necessary



Short-circuit verification according to IEC standards

Short-circuit verification according to IEC 61439-1

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Recommendation:

Machinery control panels often have ***long connection cables*** and ***are thus subject to only moderate short-circuits***

If ***short-circuit > 10 kA should be possible at the infeed***, ***fuse protection with a let-through value of ≤ 17 kA*** is recommended at the ***infeed or upstream of the panel***.

If the conditions described above should not be possible, short-circuit verification by comparison according to IEC 61439-1 is recommended

→ Observe specifications of the manufacturers of the components used

Short-circuit verification according to IEC standards

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Easy, fast and safe electrical planning with SIMARIS planning tools

SIMARIS planning tools set standards in terms of electrical design software as they save a lot of work for the electrical power distribution's dimensioning and determination of the required devices and distribution boards. SIMARIS planning tools – your software for all phases of electrical planning.

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- Dimensioning of electric networks based on real products including automatic selection of suitable equipment
- Dimensioning performed according to the accepted rules of good installation practice and all applicable standards (VDE, IEC)
- Calculation of short-circuit current, load flow, voltage drop and energy balance
- Consideration of required personal, short-circuit and overload protection

Pregled ostalih SIMARIS alata

SIEMENS
Ingenuity for life

The SIMARIS planning tools provide efficient support in dimensioning an electric power distribution system and determining the equipment and distributing systems for it.

SIMARIS design

for network calculation and dimensioning

SIMARIS project

for determining the space requirements of distributing systems and the budget as well as creating technical specifications

SIMARIS curves

for visualizing characteristic tripping curves,
cut-off current and let-through energy curves,

SIMARIS Suite

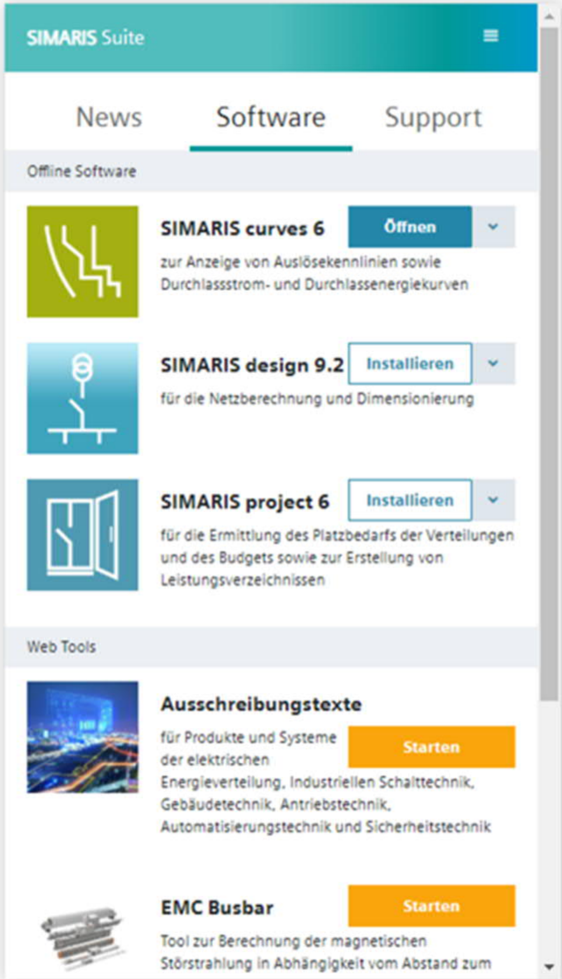
SIEMENS
Ingenuity for life

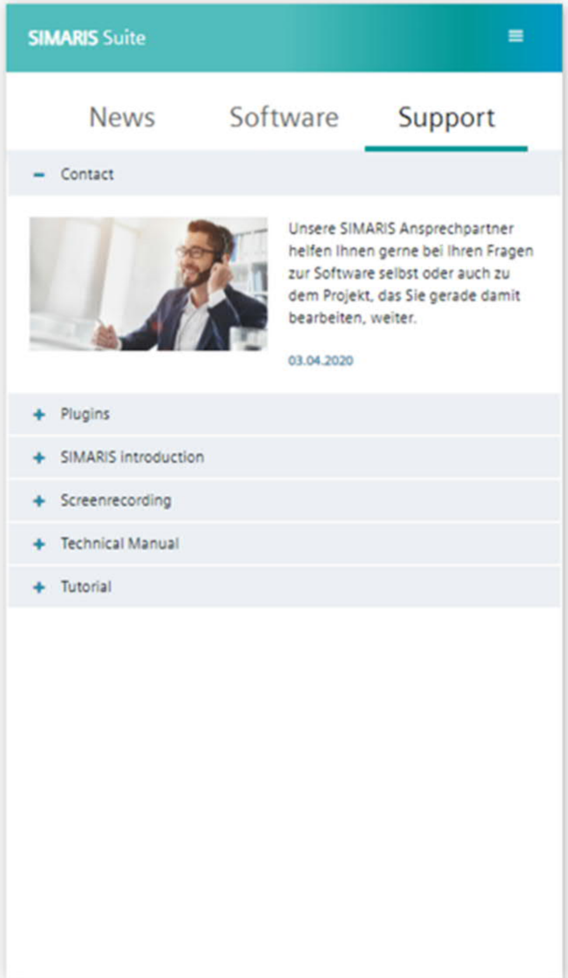
SIMARIS Suite is our customer’s plattform for an uniform access to all Simaris tools

- **Direkt download**
- **One time registration**
- **Fast download and installation of the separate tools**
- **Access to all Simaris planning tools (online and offline)**
- **All the time up-to-date (software updates, news,..)**

http://www.siemens.com/simaris

SIMARIS Suite





What support does Siemens offer?

1. **Overview of 3VA.. molded case circuit breakers with let-through values ≤ 17 kA**
   → available in Siemens Industry Online Support
2. **Overview of 3RV.. circuit breakers with let-through values ≤ 17 kA**
   → coming soon!
3. **Overview of fuse systems with let-through values ≤ 17 kA**
   → available in Siemens Industry Online Support
4. **SIMARIS tools**
5. **Website on IEC 61439-1**
6. **Contact person (tool-based advisory discussion instead of e-mail/phone number)**

Thank you for your attention!

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