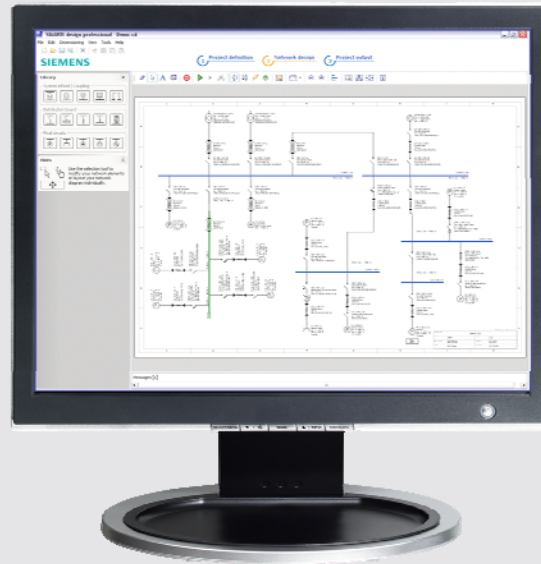




# SIMARIS design 6.0

## Technical information



Answers for infrastructure.

**SIEMENS**

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# 1 Used formula symbols

| Formula symbols          | Measurement unit | Description   |
|--------------------------|------------------|---|
| $\eta$                   |                  | efficiency  |
| $\varphi_{1ph\_n}$       | °                | phase angle at $I_{k1ph\_n}$ min/max  |
| $\varphi_{1ph\_pe}$      | °                | phase angle at $I_{k1ph\_pe}$ min/max   |
| $\varphi_{1\ min/max}$   | °                | phase angle at $I_{k1}$ min/max   |
| $\varphi_2$              | °                | phase angle at $I_{k2min}$  |
| $\varphi_3$              | °                | phase angle at $I_{k3}$ min/max   |
| $\varphi_{3\ min/max}$   | °                | phase angle at $I_{k3}$ min/max   |
| $\varphi_{motor}$        | °                | phase angle at $I_{kmotor}$   |
| $\Delta u$               | %                | relative voltage drop between beginning and end of a line section   |
| $\Delta U$               | V                | absolute voltage drop between beginning and end of a line section   |
| $\Delta u_{tr}$          | %                | relative voltage drop of transformer winding  |
| $\Delta U_{tr}$          | V                | absolute voltage drop of transformer winding  |
| $\Sigma \Delta u$        | %                | accumulated relative voltage drop up to a given point with/without voltage drop of transformer winding according to selected settings   |
| $\Sigma \Delta U$        | V                | accumulated absolute voltage drop up to a given point with/without voltage drop of transformer winding according to selected settings   |
| $\Sigma \Delta u_{dyn.}$ | %                | accumulated relative voltage drop at the starting motor with/without voltage drop of transformer winding according to selected settings |
| $\Sigma \Delta U_{dyn.}$ | V                | accumulated absolute voltage drop at the starting motor with/without voltage drop of transformer winding according to selected settings |
| $a_i$                    |                  | capacity factor   |
| $c_{\ min/max}$          |                  | minimum/maximum voltage factor in accordance with IEC 60909-0   |
| $\cos(\varphi)$          |                  | power factor  |
| F1                       |                  | the indicated short-circuit current refers to a fault at the medium-voltage busbar  |
| F2                       |                  | the indicated short-circuit current refers to a fault at the primary side of transformer  |
| F3                       |                  | the indicated short-circuit current refers to a fault at the secondary side of transformer  |
| F4                       |                  | the indicated short-circuit current refers to a fault at the end of the secondary connection of transformer                             |
| $f_{tot}$                |                  | reduction factor  |
| $f_n$                    | Hz               | nominal frequency   |
| $g_f$                    |                  | simultaneity factor   |
| $g_i$                    |                  | simultaneity factor   |

| Formula symbols         | Measurement unit  | Description   |
|-------------------------|-------------------|---|
| $I>$                    | A                 | phase energizing current for overcurrent element of DMT relay   |
| $I>>$                   | A                 | phase energizing current for high-set element of DMT relay  |
| $I>>>$                  | A                 | phase energizing current for highest-set element of DMT relay   |
| $\theta\Delta u$        | °C                | conductor temperature MV cable / conductor temperature LV cable for voltage drop calculation                            |
| $\theta\Delta I_{kmax}$ | °C                | conductor temperature MV cable / conductor temperature LV cable at $I_{kmax}$   |
| $\theta\Delta I_{kmin}$ | °C                | conductor temperature MV cable / conductor temperature LV cable for disconnection                                       |
| $I_2$                   | A                 | conventional tripping current   |
| $I^2t$                  | kA <sup>2</sup> s | let-through energy  |
| $I^2t_a$                | kA <sup>2</sup> s | let-through energy downstream of the lower switching device and accordingly at the target distribution board / consumer |
| $I^2t_b$                | kA <sup>2</sup> s | let-through energy upstream of the lower switching device   |
| $I^2t_c$                | kA <sup>2</sup> s | let-through energy downstream of the upper switching device   |
| $I^2t_d$                | kA <sup>2</sup> s | let-through energy at the output distribution board or upstream of the upper switching device                           |
| $I^2t(I_i)$             | kA <sup>2</sup> s | let-through energy of switching device at the border to I-release   |
| $I^2t(I_{kmax})$        | kA <sup>2</sup> s | let-through energy of switching device in the event of maximum short-circuit current                                    |
| $I^2t(I_{kmin})$        | kA <sup>2</sup> s | let-through energy of switching device in the event of minimum short-circuit current                                    |
| $I^2t(RCD)$             | kA <sup>2</sup> s | rated let-through energy of RCD   |
| $I^2t(fuse)$            | kA <sup>2</sup> s | let-through energy of fuse  |
| $I^2t(soll)$            | kA <sup>2</sup> s | let-through energy requirement for connecting line  |
| $I^2t\text{-value}$     |                   | let-through energy of switching device at $I_{kmax}$ (from characteristic curve)  |
| $I^2t_{max}(base)$      | kA <sup>2</sup> s | permissible $I^2t$ value of fuse base   |
| $I_a/I_n$               |                   | starting current ratio  |
| $I_b$                   | A                 | operating current   |
| $I_{bb}$                | A                 | reactive load current   |
| $I_{bel}$               | A                 | load current  |
| $I_{bem}$               | A                 | rated set-point current of the switching device   |
| $I_{bs}$                | A                 | apparent load current   |
| $I_{bw}$                | A                 | active load current   |
| $\hat{I}_c$ value       | kA                | cut-off current of switching device at $I_{kmax}$ (from characteristic curve, instantaneous value)                      |
| $I_c$ (fuse)            | kA                | cut-off current of fuse   |
| $I_{cm}$                | kA                | rated short-circuit making capacity   |

| Formula symbols                         | Measurement unit | Description   |
|---|------------------|---|
| I <sub>cmax</sub> (base)                | kA               | rated short-circuit current of fuse base  |
| I <sub>cn</sub>                         | kA               | rated short-circuit breaking capacity acc. to IEC 60898-1   |
| I <sub>cu</sub>                         | kA               | rated ultimate short-circuit breaking capacity acc. to IEC 60947-2  |
| I <sub>cu korr a</sub>                  | kA               | requirement on the rated ultimate short-circuit breaking capacity downstream of lower switching device or at target distribution board (affected short-circuit current) |
| I <sub>cu korr b</sub>                  | kA               | requirement on the rated ultimate short-circuit breaking capacity upstream of lower switching device (affected short-circuit current)                                   |
| I <sub>cu korr c</sub>                  | kA               | requirement on the rated ultimate short-circuit breaking capacity downstream of upper switching device (affected short-circuit current)                                 |
| I <sub>cu korr d</sub>                  | kA               | requirement on the rated ultimate short-circuit breaking capacity at output distribution board or upstream of upper switching device (affected short-circuit current)   |
| I <sub>cu(fuse)</sub>                   | kA               | rated ultimate short-circuit breaking capacity - fuse   |
| I <sub>cu/I<sub>cn</sub> required</sub> | kA               | required short-circuit breaking capacity for protective device at installation location   |
| I <sub>cw 1s</sub>                      | kA               | rated short-time withstand current 1s   |
| I <sub>e</sub>                          | A                | earth energizing current of DMT relay / RCD module  |
| I <sub>g</sub>                          | A                | setting value of release for earth fault detection  |
| I <sub>gb</sub>                         | A                | total reactive current  |
| I <sub>gs</sub>                         | A                | total apparent current  |
| I <sub>gw</sub>                         | A                | total active current  |
| I <sub>HHmin</sub>                      | A                | minimum tripping current of high-voltage high-rupturing capacity fuse   |
| I <sub>i</sub>                          | A                | setting value of instantaneous short-circuit (I)-release  |
| I <sub>k1D</sub>                        | kA               | 1-pole continuous short-circuit current   |
| I <sub>k1max</sub>                      | kA               | maximum 1-pole short-circuit current  |
| I <sub>k1max(F1)</sub>                  | kA               | maximum 1-pole short-circuit current in the event of a fault in the medium-voltage busbar   |
| I <sub>k1maxph_n</sub>                  | kA               | maximum 1-pole short-circuit current phase to neutral conductor   |
| I <sub>k1maxph_pe</sub>                 | kA               | maximum 1-pole short-circuit current phase to protective conductor  |
| I <sub>k1min</sub>                      | kA               | minimum 1-pole short-circuit current  |
| I <sub>k1min(F2)</sub>                  | kA               | minimum 1-pole short-circuit current in the event of a fault at transformer primary side  |
| I <sub>k1min(F3)</sub>                  | kA               | minimum 1-pole short-circuit current in the event of a fault at transformer secondary side  |
| I <sub>k1min(F4)</sub>                  | kA               | minimum 1-pole short-circuit current in the event of a fault at the end of the secondary connection of transformer  |
| I <sub>k1minph_n</sub>                  | kA               | minimum 1-pole short-circuit current phase to neutral conductor   |
| I <sub>k1minph_pe</sub>                 | kA               | minimum 1-pole short-circuit current phase to protective conductor  |

| Formula symbols     | Measurement unit | Description   |
|---------------------|------------------|---|
| $I_{k2min}$         | A                | minimum 2-pole short-circuit current  |
| $I_{k2min}(F2)$     | kA               | minimum 2-pole short-circuit current in the event of a fault at transformer primary side  |
| $I_{k2min}(F3)$     | kA               | minimum 2-pole short-circuit current in the event of a fault at transformer secondary side  |
| $I_{k2min}(F4)$     | kA               | minimum 2-pole short-circuit current in the event of a fault at the end of the secondary connection of transformer                      |
| $I_{k3}(F3)$        | kA               | 3-pole short-circuit current in the event of a fault at transformer secondary side  |
| $I_{k3D}$           | kA               | 3-pole continuous short-circuit current   |
| $I_{k3max}$         | kA               | maximum 3-pole short-circuit current  |
| $I_{k3max}(F1)$     | kA               | maximum 3-pole short-circuit current in the event of a fault in the medium-voltage busbar   |
| $I_{k3min}$         | kA               | minimum 3-pole short-circuit current  |
| $I_{kmax}$          | A                | maximum short-circuit current of all short-circuit currents   |
| $I_{kmax a}$        | kA               | maximum short-circuit current downstream of lower switching device or at target distribution board (unaffected short-circuit current)   |
| $I_{kmax b}$        | kA               | maximum short-circuit current upstream of lower switching device (unaffected short-circuit current)                                     |
| $I_{kmax c}$        | kA               | maximum short-circuit current downstream of upper switching device (unaffected short-circuit current)                                   |
| $I_{kmax d}$        | kA               | maximum short-circuit current at the output distribution board or upstream of upper switching device (unaffected short-circuit current) |
| $I_{kmax}/I_{kmin}$ |                  | ratio of maximum/minimum short-circuit current  |
| $I_{kmin}$          | A                | minimum short-circuit current of all short-circuit currents   |
| $I_{kmotor}$        | kA               | 3-pole short-circuit current proportion of motor  |
| $I_{kre}$           |                  | energetic recovery factor of short-circuit current  |
| $I_{max}$           | A                | maximum rated current of busbar trunking system   |
| $I_n$               | A                | nominal / rated current   |
| $I_n$ (RCD)         | mA               | rated current of RCD  |
| $I_n$ (switch)      | A                | nominal / rated current of medium-voltage switching device  |
| $I_n$ (fuse)        | A                | nominal / rated current of medium-voltage fuse  |
| $I_n max$           | A                | rated current of device at standard temperature of 40 °C  |
| $I_n zul$           | A                | permissible switch load according to ambient temperature  |
| $I_{n1}$            | A                | rated current of transformer, primary side  |
| $I_{n2}$            | A                | rated current of transformer, secondary side  |
| $I_n$               | A                | rated current of transformer at rated power   |

| Formula symbols | Measurement unit | Description   |
|-----------------|------------------|---|
| $I_{pk}$        | kA               | peak short-circuit current  |
| $I_{pk}$        | kA               | short-circuit-strength lightning / surge arrester with maximum permissible fuse |
| $I_q$           | kA               | conditional rated short-circuit current - motor starter combination             |
| IR              | A                | setting value for overload (L)-release  |
| $I_{sd}$        | A                | setting value of short-time delayed short-circuit (S)-release                   |
| $I_{sel-kurz}$  | A                | calculated selectivity limit value between $I_{kmin}$ and $I_{kmax}$            |
| $I_{sel-über}$  | A                | calculated selectivity limit value in range less than $I_{kmin}$                |
| $I_z, I_{zul}$  | A                | permissible load current of a connecting line                                   |
| $I_{\Delta n}$  | mA               | rated earth-fault current – RCD protection                                      |
| L               |                  | phase   |
| L1              |                  | phase 1   |
| L2              |                  | phase 2   |
| L3              |                  | phase 3   |
| max             |                  | maximum   |
| min             |                  | minimum   |
| MLFB            |                  | machine-readable product code   |
| MV              |                  | medium voltage  |
| N               |                  | neutral conductor   |
| LV              |                  | low voltage   |
| P               | kW               | active power, electric  |
| PE              |                  | protective conductor  |
| $P_{mech}$      | kW               | active power, mechanical  |
| $P_n$           | kW               | nominal active power  |
| $P_0$           | kW               | no load losses  |
| $P_v, P_k$      | kW               | short circuit losses  |
| pz              |                  | number of poles, switching device   |
| Q               | kvar             | reactive power  |
| $Q_e$           | kvar             | effective reactive capacitor power  |
| $Q_n$           | kvar             | nominal reactive power  |
| R/X             |                  | ratio of resistance to reactance  |
| $R_0$           | m $\Omega$       | resistance in the zero sequence component                                       |

| Formula symbols               | Measurement unit | Description   |
|-------------------------------|------------------|---|
| R0 min/max                    | mΩ               | minimum/maximum resistance in the zero sequence component   |
| R0 N                          | mΩ               | resistance in the zero sequence component, phase N  |
| R0 PE(N)                      | mΩ               | resistance in the zero sequence component, phase PE(N)  |
| R0ΔU                          | mΩ               | resistance in the zero sequence component for voltage drop  |
| R0/R1                         |                  | resistance ratio of zero/positive sequence component  |
| r0ph-n                        | mΩ/m             | specific active resistance of zero sequence component for conductor loop phase to neutral   |
| r0ph-pe(n)                    | mΩ/m             | specific active resistance of zero sequence component for conductor loop phase to protective conductor  |
| r1                            | mΩ/m             | specific active resistance of positive sequence component   |
| r1                            | %                | related resistance value in the positive sequence component   |
| R1                            | mΩ               | resistance in the positive sequence component   |
| R1ΔU                          | mΩ               | resistance in the positive sequence component for voltage drop  |
| R1 min/max                    | mΩ               | minimum/maximum resistance in the positive sequence component   |
| Ra+Rb max                     | mΩ               | sum of resistances of earth electrode - and possibly wired protective conductor - between exposed conductive part and earth in IT or TT network |
| Rs min/max                    | mΩ               | minimum/maximum loop resistance   |
| S                             | kVA              | apparent power  |
| S <sup>2</sup> k <sup>2</sup> |                  | thermal short-circuit strength of cable   |
| Sn                            | kVA              | rated apparent power  |
| SnT                           | kVA              | rated apparent power of transformer   |
| t>                            | s                | delay time for overcurrent element of DMT relay   |
| t>>                           | s                | delay time for for high-set element of DMT relay  |
| ta zul (li)                   | s                | permissible break-time of the switch for setting value of I-release, without violating the condition $k^2S^2 > I^2t$                            |
| ta zul (Ikmax)                | s                | permissible break-time at maximum short-circuit current, without violating the condition $k^2S^2 > I^2t$  |
| ta zul (Ikmin)                | s                | permissible break-time at minimum short-circuit current, without violating the condition $k^2S^2 > I^2t$  |
| ta zul ABS                    | s                | permissible break-time in compliance with DIN VDE 0100-410 (IEC 60364-4-41)   |
| ta(min abs)                   | s                | break-time of switch for breaking condition   |
| ta(min kzs)                   |                  | break-time of switch for short-circuit protection   |
| ta_max                        | s                | maximum break-time of considered switch   |
| te                            | s                | delay time of earth energizing current of DMT relay / of RCD-module   |
| tg                            | s                | time value of the G-release (absolute)  |

| Formula symbols | Measurement unit | Description  |
|-----------------|------------------|--|
| tR              | s                | time value of the L-release  |
| tsd             | s                | time value of the S-release  |
| Tu              | °C               | ambient temperature of device  |
| ukr             | %                | relative rated short-circuit voltage   |
| Umax            | V                | maximum rated voltage of busbar trunking system  |
| Un              | V                | rated voltage  |
| Uprim           | kV               | primary voltage  |
| Usec            | V                | secondary voltage  |
| LVSD            |                  | low-voltage sub-distribution   |
| V               |                  | load   |
| X0 min/max      | mΩ               | minimum/maximum reactance in the zero sequence component   |
| X0 N            | mΩ               | reactance of phase N in the zero sequence component  |
| X0 PE(N)        | mΩ               | reactance of phase PE(N) in the zero sequence component  |
| X0ΔU            | mΩ               | reactance of zero sequence component for voltage drop, independent of temperature                        |
| X0/X1           |                  | reactance ratio zero/positive sequence component   |
| x0ph-n          | mΩ/m             | specific reactive resistance of zero sequence component for conductor loop phase to neutral              |
| x0ph-pe(n)      | mΩ/m             | specific reactive resistance of zero sequence component for conductor loop phase to protective conductor |
| x1              | mΩ/m             | specific reactive resistance of positive sequence component  |
| X1              | mΩ               | reactance in the positive sequence component   |
| X1 min/max      | mΩ               | minimum/maximum reactance in the positive sequence component   |
| X1ΔU            | mΩ               | reactance in the positive sequence component for voltage drop  |
| xd"             | %                | subtransient reactance   |
| Xs min/max      | mΩ               | minimum/maximum loop reactance   |
| Z0              | mΩ               | impedance of zero sequence component   |
| Z0 min/max      | mΩ               | minimum/maximum impedance in the zero sequence component   |
| Z0ΔU            | mΩ               | impedance in the zero sequence component for voltage drop  |
| Z1              | mΩ               | impedance of positive sequence component   |
| Z1 min/max      | mΩ               | minimum/maximum impedance in the positive sequence component   |
| Z1ΔU            | mΩ               | impedance in the positive phase- sequence component for voltage drop                                     |
| Zs              |                  | loop impedance   |
| Zs min/max      |                  | minimum/maximum loop resistance  |

## 2 Mapping table for tap-off units for busbar systems

| Busbar system | Device selection  |  |   |   |
|---------------|---|--|---|---|
|               | Dimensioned device  |  | Devices to be tendered or ordered   |   |
| BD01          | Miniature circuit breaker<br>MCB up to 63 A               | 5SJ.., 5SP..,<br>5SQ.., 5SX..,<br>5SY.   | Tap-off unit:   | BD01-AK1../..<br>BD01-AK2../..                                    |
| BD2           | Circuit breaker<br>MCCB up to 530 A                       | 3VL...                                   | Tap-off unit:<br>up to 125 A<br>up to 250 A<br>up to 400 A<br>up to 530 A | BD2-AK03X/..<br>BD2-AK04/..<br>BD2-AK05/..<br>BD2-AK06/..         |
|               | Miniature circuit breaker<br>MCB up to 63 A               | 5SJ.., 5SP..,<br>5SQ.., 5SX..,<br>5SY... | Tap-off unit:<br>up to 16 A<br>up to 63 A                                 | BD2-AK1/..<br>BD2-AK02X/..<br>BD2-AK2X/..                         |
|               | Switch-disconnector with<br>fuses<br>up to 125 A<br>Fuse: | 3KL5..,<br>3NA3.. size 00                | Tap-off unit:<br>up to 125 A<br>Fuse:                                     | BD2-AK3X/..<br>3NA3..size 00                                      |
|               | Fuse-switch-disconnector<br>up to 400 A<br>Fuse:          | 3NP4..<br>3NA3.. up to size 2            | Tap-off unit:<br>up to 125 A<br>up to 250 A<br>up to 400 A<br>Fuse:       | BD2-AK03X/..<br>BD2-AK04/..<br>BD2-AK05/..<br>3NA3.. up to size 2 |
|               | Fuse base<br>Neozed up to 63 A<br>Fuse:                   | 5SG5..<br>5SE23..                        | Tap-off unit:<br>up to 63 A<br>Fuse:                                      | BD2-AK02X/..<br>BD2-AK2X/..<br>5SE23..                            |
|               | Diazed up to 63 A:<br>Fuse:                               | 5SF..<br>5SA.., 5SB..                    | Fuse:   | 5SA.., 5SB...   |
|               | CD-K  | Fuse base<br>Neozed up to 16 A<br>Fuse   | 5SG5..<br>5SE23..   | Tap-off plug:   |
| LD            | Circuit breaker<br>MCCB up to 1250 A                      | 3VL                                      | Tap-off unit:   | LD-K-AK./..   |
|               | Fuse-switch-disconnector<br>up to 630 A<br>Fuse:          | 3NP4..<br>3NA3.. up to size 3            | Tap-off unit:<br>Fuse:  | LD-K-AK./..<br>3NA3.. up to size 3                                |
|               | Circuit breaker<br>MCCB up to 1250 A                      | 3VL..                                    | Tap-off unit:   | LX-AK./FS..   |
| LX            | Switch-disconnector with<br>fuses<br>up to 630 A<br>Fuse: | 3KL5/6..<br>3NA3.. up to size 3          | Fuse:   | 3NA3.. up to size 3   |

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