Work book
The standard IEC 61439 in practice

Power and productivity
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Work book on the seminar delivered by ABB
The standard IEC 61439

Basic standards
(definitions of personal protection, calculation and test procedures, assessment bases)

IEC 60364-4-41	**IEC / TR 60664-2-1**	**IEC 60529**
Protection against electric shock	Insulation co-ordination	Test devices and test procedures

Requirements for special installations or locations
IEC 60364-7...

Operation of electrical installations
EN 50110

Safety of machinery, electrical equipment of machines and mechanisms.
Part 1. General requirements
IEC 60204-1

Installation and connection of switchgear and distribution boards
IEC 60364-7-729

Low-voltage switchgear and controlgear ASSEMBLIES
- Protection against electric shock
- Protection against unintentional direct contact with hazardous live parts
EN 50274

Installation and implementation provisions
IEC 61439-1, IEC 61439-2
IEC 61439-3

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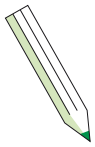
Notes



Work book
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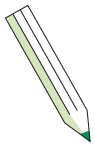


Foreword / introduction

This document is designed to assist you and enables us to secure our common success.

This workbook contains general information and proposals for designing, planning and building low voltage switchgear and controlgear ASSEMBLIES in compliance with the applicable laws, directives and provisions.

Basic knowledge in electrical engineering is essential for planning low voltage switchgear and controlgear ASSEMBLIES.

This workbook includes general and special information which is essential for safe, reliable and economical low voltage switchgear and controlgear ASSEMBLY operation.

In addition, the topics designed to protect people and assets are being dealt with.

Distribution boards in the low voltage network

Distribution boards serve as link between electrical appliances and users.
They form the visible part of an electrical system and represent the electrical company having installed the ASSEMBLY.

The requirements in terms of flexibility and safety for distribution boards are particularly high:

- Personal protection
- Property protection
- High operational and functional safety
- Ease of use

Solid design to prevent unprofitable investment:

- Optimum adaptability to use cases
- Cooperation between user / planner / manufacturer to balance specifications and costs

Parts of the standard

Standard	Title	Edition
IEC 61439-0	Guideline	April 2013
IEC 61439-1	General rules	08/14/2011
IEC 61439-2	Power switchgear and controlgear ASSEMBLIES	08/19/2011
IEC 61439-3	Distribution boards intended to be operated by ordinary persons	02/16/2012
IEC 61439-4	ASSEMBLIES for construction sites	11/15/2012
IEC 61439-5	Assemblies for power distribution in public networks	08/25/2014
IEC 61439-6	Busbar trunking systems	05/23/2012
Prestandard IEC/TS 61439-7	Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicle charging stations and similar	02/19/2014

Why a new standard?
Who is the manufacturer?

Health of the individual is regarded as fundamental asset within the economic space of the European Union.

The EU-Commission has therefore made it its goal to elaborate directives, which are then transposed into national law by Member States.

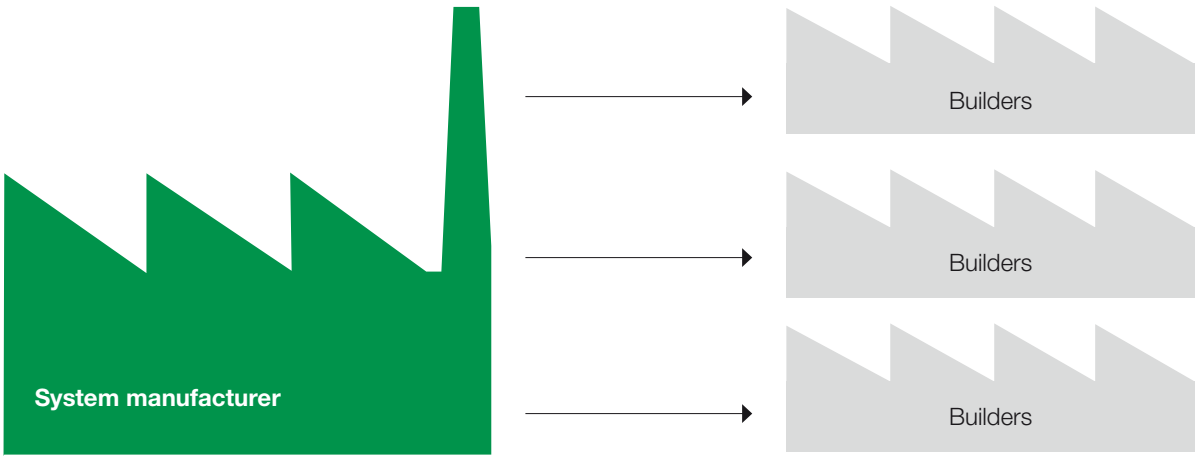
Thus, the low voltage directive is implemented in the German Product Safety Act.

Next to the German Product Safety Act, there is the Product Liability Act which is designed to protect the user in case of damages.

Both laws pursue safety targets and are designed to protect people, livestock and property. Regarding product liability for example, injured parties will only have to demonstrate that their legal rights have been violated and that this violation led to a loss and that the manufacturer has introduced a defective product to the market and that there is causality between the defective product, the violation of legal rights and the damage. The question whether a manufacturer is responsible for product defects puts an unacceptable burden of proof on the injured party.

This is the reason why a reversed burden of proof is applied here. Meaning that the manufacturer has to prove that the product was free from defects in design, workmanship and instructions upon marketing.

The new standard precisely defines the responsibilities for a marketed product. It differentiates between original manufacturer and ASSEMBLY manufacturer.



Original manufacturer

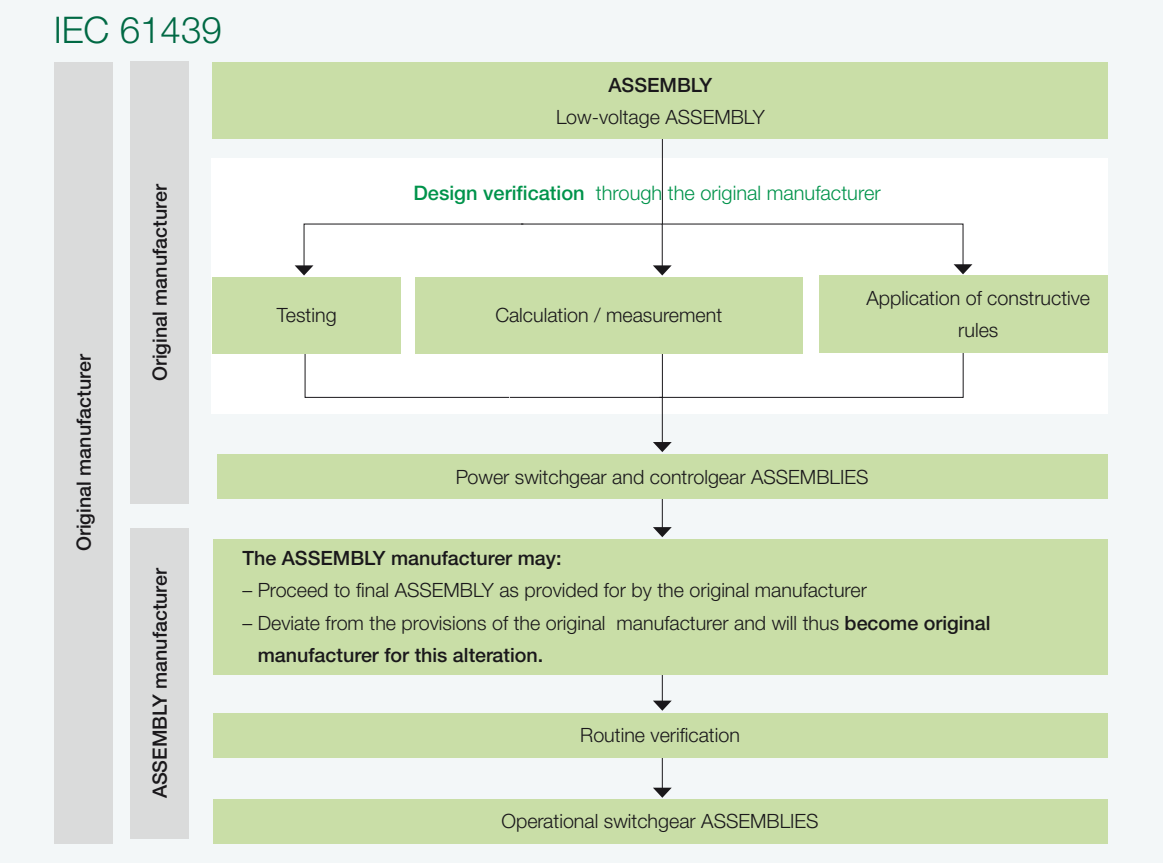
ASSEMBLY Manufacturer

How can the original manufacturer or the manufacturer verify the safety of an ASSEMBLY?

The new standard describes three design verification processes for ASSEMBLIES and requires a routine verification for every marketed product.

Testing	Calculation / measurement	Application of constructive rules
such as – electrical – mechanical – thermal tests in accordance with the requirements specified in the standard	such as – Calculating of temperature rises or of short-circuit forces – Measurement of clearances and creepage distances	such as – specified dimensions – test steps – ASSEMBLY sequences based on tested reference designs

These processes are essentially implemented by the original manufacturer. In case that the ASSEMBLY manufacturer does not install an ASSEMBLY in compliance with the instructions of the original manufacturer, the ASSEMBLY manufacturer will become original manufacturer for that alteration and will have to carry out the design verification in accordance with the described procedures.



The ASSEMBLY manufacturer always has to implement the routine verification.

How can a low-voltage switchgear and controlgear ASSEMBLY be realized safely?

The new standard does not only precisely define the responsibilities of the market participants, but also specifies the dimensions of low-voltage switchgear and controlgear ASSEMBLIES.

In addition it presents the possibilities and limits for the market participants in order to guarantee to the user safe low-voltage switchgear and controlgear ASSEMBLIES.

It is also designed to specify the documentation required for low-voltage switchgear and controlgear ASSEMBLIES and/or the required verifications.

Which are the dimensioning specifications enabling design verification?

One important aspect emphasised in the IEC 61439 is the earthing system as this has important consequences for planing the electrical circuits.

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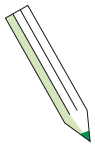
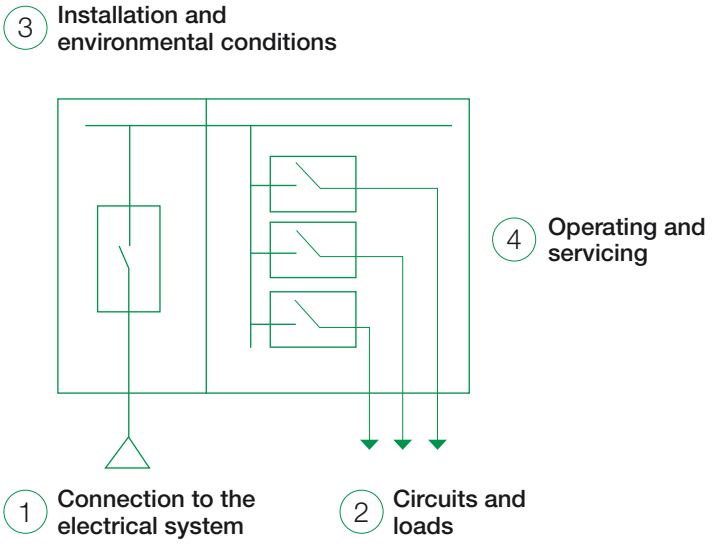


How are ASSEMBLIES dimensioned?

ASSEMBLIES are dimensioned through the definition of interface values.



1) Connection to the electrical system

- Nominal voltage of the incoming supply
- Electrical system
- Rated current
- Short-circuit withstand strength
- Overvoltage
- Connecting cable

2) Electrical cicuits and loads

- Distribution circuits for load-side subdistribution panels
- Final circuits

3) Installation and environmental conditions

- Indoor installations
- Outdoor installations
- Dimensions for transport and installation

4) Operating and servicing

Operation through:

- Device activation
- Access control

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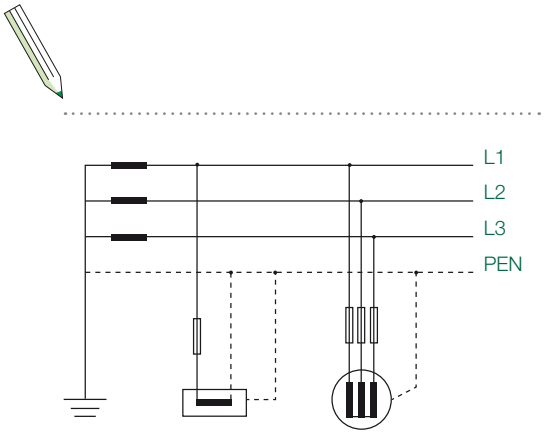

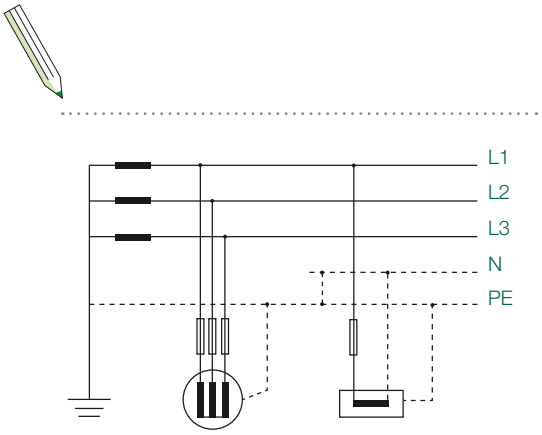

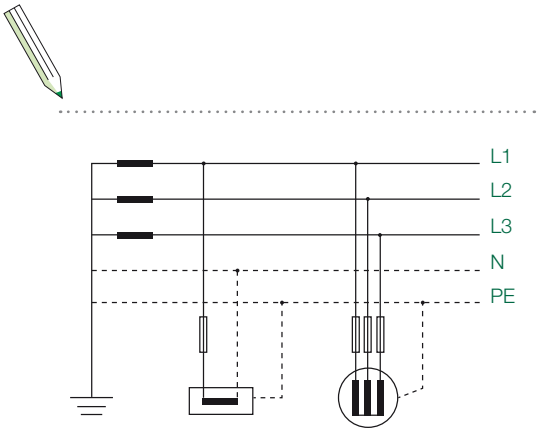

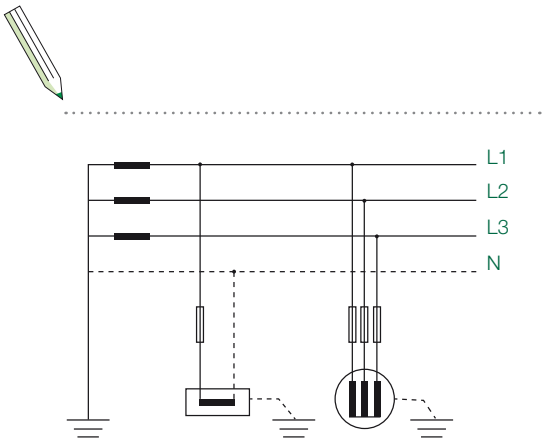

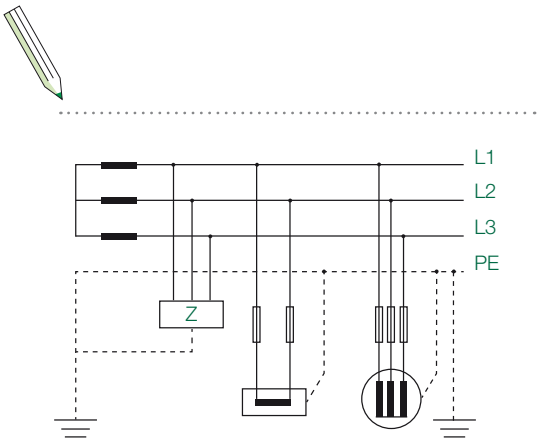

Evaluation of the types of earthing for systems, and protective measures in low voltage switchgear ASSEMBLIES

TN system	
Benefits:	Fast shut-up in case of faults and/or Short-circuits, lowest risk to people and property
Disadvantages:	High line and cabling overheads due to installed protective conductor, every fault leads to system downtimes
Preferred application:	Power plants, public power supply and grids
TT system	
Benefits:	Minor overheads for installed lines and cabling, different touch voltages acceptable for some areas, combination options with TN system
Disadvantages:	Complex system earthing (≤ 2 Ω), compulsory equipotential bonding for every building
Preferred application:	Agricultural for livestock farming
IT system	
Benefits:	Minor overheads for installed lines and cabling, high availability of supply: 1. Fault is only signalled 2. Fault is disconnected
Disadvantages:	Required continuous equipment insulation to the voltage between the phase conductors Equipotential bonding necessary
Preferred application:	Hospitals, industry
Double insulation	
Benefits:	Highest safety level, combination with other systems possible
Disadvantages:	Double insulation of the equipment is only economic for small-scale consumers. For thermal equipment there is a fire risk due to the insulation material
Preferred application:	Domestic, electrical distribution boards and small-scale equipment
Protection by extra low voltage	
Benefits:	No risks in case of contact
Disadvantages:	Limited economic equipment performance, special power circuit requirements
Preferred application:	Small appliances

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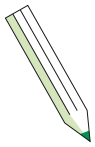

Protection measures must include
- a suitable combination of two independent protections, i.e. one basic protection and one fault protection, or
- one reinforced protection causing the basic protection (protection against direct contact) and the fault protection (protection against indirect contact).

Generally, the following protective measures are allowed:
- Protection by automatically disconnecting the power supply (section 4-41);
- Protection by double or reinforced insulation (section 4-42);
- Protection by protective separation of a consumer device (section 4-43);
- Protection by low voltage by SELV or PELV (section 4-44);

4-41 Protective measure: Automatic disconnection of the power supply
Automatic disconnection of the power supply is a protective measure designed to:

- ensure basic protection (protection against direct contact) by basic insulation of the live parts or by covering or sheathing in line with ANNEX A and
- and fault protection (protection against indirect contact) by protective equipotential bonding by the main earthing bar and automatic disconnection in case of faults, […]

4-42 Protective measure: Double or reinforced insulation
Double or reinforced insulation is a protective measure designed to:

- ensure basic protection (protection against direct contact) by basic insulation and fault protection (protection against indirect contact) by an additional insulation
  or
- ensure basic protection and fault protection by a reinforced insulation between live parts and accessible parts.

Protection classes
Protection class I
The protection target of protection class I is achieved by insulation of the live parts and connection of the accessible metal parts to the protective conductor.
The protective conductor terminal is identified by ⏚.

P rotection class II
The protection target of protection class II is achieved by double insulation.
Protection class II is identified by ⧈.

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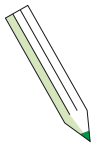

Overvoltage protection in buildings

Overvoltages can result from switching operations in the energy supply system or in own electrical systems. Overvoltages are then transferred via the system (supply lines and own electrical installations) and may then reach sensitive end devices, which might then be damaged or destroyed.

There are two types of overvoltage:
– Overvoltage generated by switching operations ("switching overvoltage") or by atmospheric influences
– Overvoltage generated by direct lightning strikes or lightning strikes in direct vicinity of a physical structure

The following types of surge arresters exist for buildings:

1. External lightning protection
2. Surge arresters in the precounter sector (Type 1)
3. Surge arresters in the distribution boards (Type 2)
4. Surge arresters for end devices
5. Surge arresters for PV systems
6. Surge arresters in data engineering and communication

Overvoltage categories

Category to describe overvoltages that might be generated by lightning or switching operations at the place of installation.

The following categories are used to describe overvoltages:

I Equipment with reduced lightning impulse withstand voltage for a connection to power circuits equipped with surge arrester systems (e.g. electronic appliances)
II Consumers connected to fixed installations (e.g. electronic tools)
III Equipment with special availability requirements and protected by lightning arresters
IV Use of equipment directly at the installation connection point. Direct lightning strikes are possible (e.g. meter panels)

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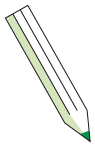


Connection to the electrical system
Characteristics and explanations

Nominal values

… are defined in DIN 40200 and specify a suitable, rounded parameter value used to describe or to identify an element, a group or installation. (Example: a general information describing a motor: Nominal current 25 A/nominal voltage 400 V)

Rated values

… are defined as applicable parameter value at specific operating conditions which are defined by the manufacturer of a given component, group or installation.
(Example: Rated current of 630 A of a fuse switch disconnector for fuse links according to DIN 43620 size 3 at a rated operational voltage of 690 V and a rated insulation voltage of 690 V.)

Connection of the incoming cables

… From below
… From above

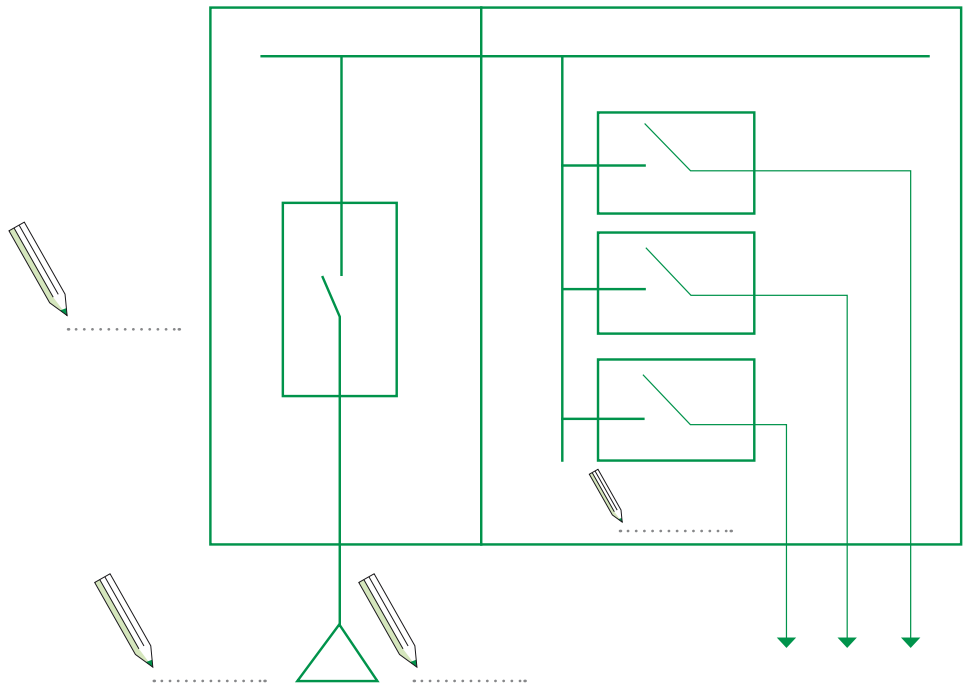
… Copper or aluminium conductor
… Connection using terminal blocks

… Single-core cable
… Multi-core cable / number /section in mm^2

… Connection to equipment / connection using terminal blocks

Notes

Insert the applicable voltage values into the installation scheme.



Rated voltage U_n

... is the highest stated nominal voltage of a system (AC voltage (effective) or DC voltage) to which the main circuits are designed.
For multi-phase systems this is the voltage between the phase conductors.

Rated operational voltage U_e

... is the stated voltage value defining the use together with the rated current. In main circuits the rated operational current refers to the design of the main contact and to the arc quenching behaviour of the switching device. In terms of their main current switching devices are only tested up to 105 % of the rated operational voltage. The operating voltage of a low voltage switchgear and controlgear ASSEMBLY must not exceed this value.
For multi-phase systems this is the voltage between the phase conductors.

Rated impulse voltage U_{imp} of the ASSEMBLY

The rated impulse withstand voltage must be equal or greater than the specified transient overvoltage values generated in the electrical system to which the circuit is to be connected.

Rated frequency f_n :

... is the frequency value stated by the ASSEMBLY manufacturer to which the ASSEMBLY is assigned and to which the operating conditions refer. **NOTE:** A number or a range of rated frequencies can be assigned to a circuit and be rated for AC or DC power.

The limits are between 98 % and 102 % of the rated frequency.
In practice, the usual rated frequency is 50 Hz.

Under 0 Hz (DC current), special switching devices with specific arc quenching systems are needed. Busbars can support higher loads.

Under $16^2/_3$ Hz the switching devices for 50 Hz have reduced switching capacities.

A switching device's switching capacity is reduced at 400 Hz due to the shorter arc quenching time. Busbars can only support reduced loads due to the skin effect.

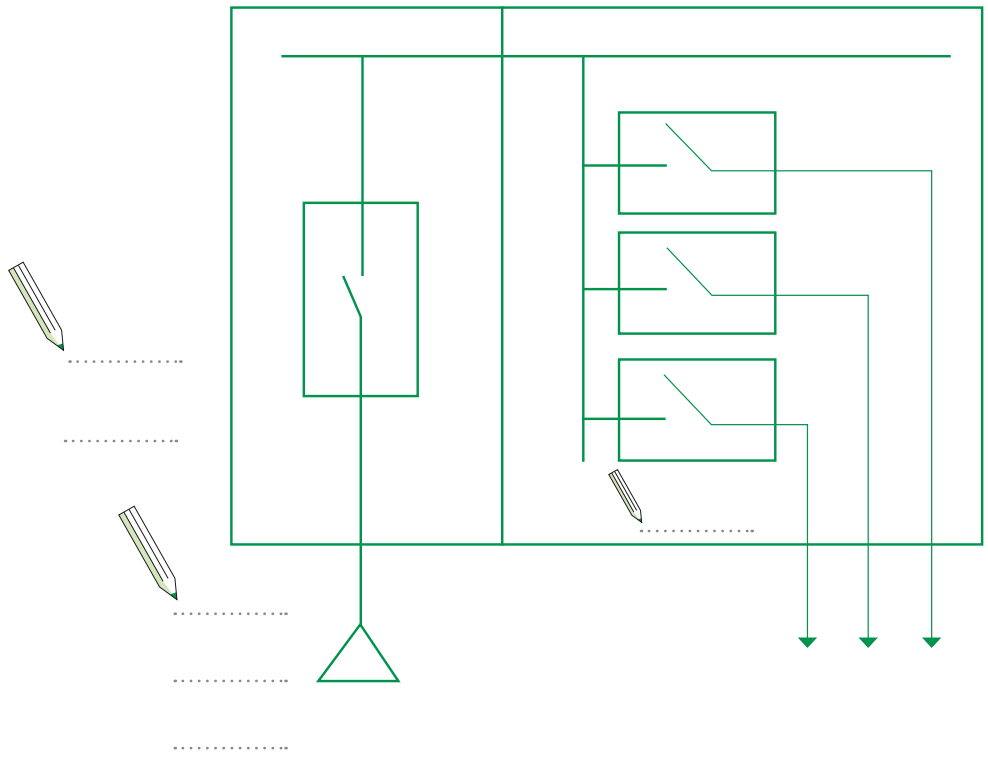
The rated current for busbars under a rated frequency above 50 Hz is calculated by the following formula:

$$I_{nf} = I_n * \sqrt{\frac{f_n}{f_N}}$$

I_n= rated current; I_{nf}= rated current under a defined frequency; f_n= rated frequency; f_N= nominal frequency of the system to which the low voltage switchgear and controlgear ASSEMBLY is to be connected

Notes

Insert the applicable current values into the installation scheme.



Rated current of the switchgear ASSEMBLY I_{nA}

... is the current value stated by the manufacturer which can be supported without exceeding the defined temperature rise limits.

Uninfluenced short-circuit current I_{cp}

... is the effective value of that current which would flow if the incoming line of a circuit would be short-circuited by a conductor in direct vicinity of the connections of the switchgear ASSEMBLY (for the strength and duration of the short-circuit current, see 10.11.5.4)

Rated peak withstand current I_{pk}

... is the highest short-circuit current peak value stated by the ASSEMBLY manufacturer that can be withstood under specified conditions.

Rated short-time withstand current I_{cw}

... is the effective value of the short-time current stated by the ASSEMBLY manufacturer , that can be withstood under specified conditions without damage.

(for example this is stated as follows: I_{cw}=40 kA/1s; since the thermal effect is square dependent on the current (I^2t), an effective AC current value of 80 kA would be acceptable for a duration of 0.25 s

$$(40kA * \sqrt{\frac{1}{0{,}25}} = 80kA)$$

in the 3 s range the rated peak withstand current can be calculated using the same formula I^2t, provided that the peak value does not exceed the rated peak withstand current).

Conditional rated short-time withstand current I_{cc}

... Is the value of the uninfluenced short-circuit current specified by the ASSEMBLY manufacturer which the circuit protected by a short-circuit protection device (SCPD) can withstand during the total turn-off time of the device (current flow duration) under specified conditions.

The SCPD may be an integral part of the switchgear ASSEMBLY or a separate unit.

Rated short-circuit current with fuse protections I_{cf}

When fuse protections are used, the rated short-circuit current is the uninfluenced short-circuit current. The turn-off times result then from the fuse characteristics.
The rated short-circuit current of the fuse is here equal or greater than the uninfluenced short-circuit current.

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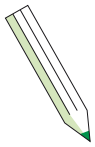
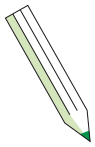


Connection to the electrical system
Check list

1 Connection to the electrical system

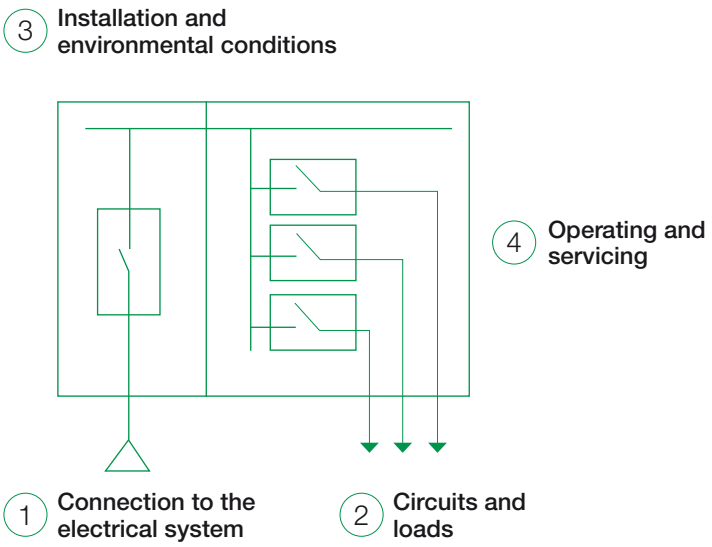
Characteristics	Information provided by the planner / customer	Information provided by the manufacturer
Nominal voltage of the incoming supply	AC _____ V _____ Hz DC _____ V	U_e = _____ V f_n = _____ Hz
System	_____ TN-C _____ TN-C-S _____ TN-S _____ TT _____ IT	_____ Protection by automatic disconnection of the power supply (PC I) _____ protection by protective insulation (PC II)
Rated current	Supply current (nominal current transformer / upstream protective device)	I_{nA} = _____ A
Short-circuit withstand strength (please see notes on pages 73 - 77)	I_{cp} = _____ kA (uninfluenced short-circuit current at the supply terminals)	I_{pk} = _____ kA I_{cw} = _____ kA I_{cc} = _____ kA
Overvoltage	Overvoltage category _____ III _____ IV	Rated impulse withstand voltage U_{imp} = _____ kV
Incoming line connection	_____ from below _____ from above _____ copper conductor _____ aluminium conductor _____ Connection using terminal blocks	_____ single-core cable _____ multi-core cable _____ number _____ mm^2 section _____ copper conductor _____ aluminium conductor _____ connection to equipment _____ connection using terminal blocks

Notes



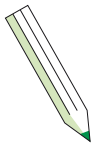
How are ASSEMBLIES dimensioned?

ASSEMBLIES are dimensioned using the interface definition values.



1) Connection to the electrical system – Nominal voltage of the incoming supply – Electrical system – Rated current – Short-circuit withstand strength – Overvoltage – Connecting cable	**2) Electrical cicuits and loads** – Distribution circuits for load-side subdistribution panels – Final circuits
3) Installation and environmental conditions – Indoor installations – Outdoor installations – Dimensions for transport and installation	**4) Operating and servicing** Operation through: – Device activation – Access control

Notes



Rated Diversity Factor (RDF)
.... is the per unit value of the rated current, assigned by the ASSEMBLY manufacturer, as a percent value of the rated current, to which outgoing circuits of an ASSEMBLY can be continuously and simultaneously loaded taking into account the mutual thermal influences.

Rated current of the circuit I_{nc}
... is the current value stated by the manufacturer which can be supported without exceeding the defined temperature rise limits.

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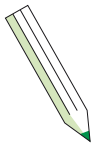
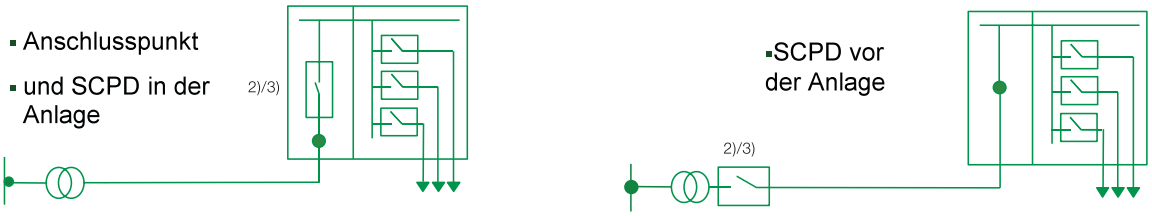


DIN EN 61439 Notes in the section

8.6 Electrical circuits and connections within ASSEMBLIES

8.6.1 Main circuits

The busbars (bare or insulated) are to be arranged in such a manner that no internal short-circuit is to be expected. They are to be dimensioned at least in accordance with the information on the short-circuit withstand strength (see 9.3)[1] and to be designed to withstand at least the short-circuit loads which might occur on the supply side of the busbars due to the limitation caused by the short-circuit protective device(s)[2] (SCPD)[3].



[1] Rated peak withstand current I_{pK} /
Rated short-time withstand current I_{cw} of the busbar system or
[2] rated short-circuit current stated by the manufacturer I_{cp}
in case of the use of a protection by SCPD required by the manufacturer
[3] SCPD = short-circuit protective device

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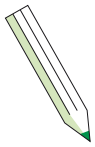
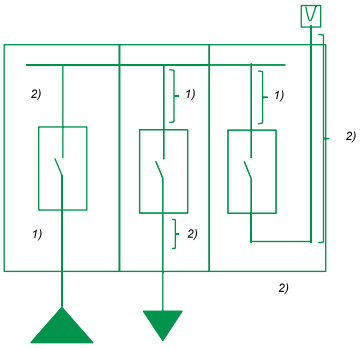


DIN EN 61439 Notes in the section

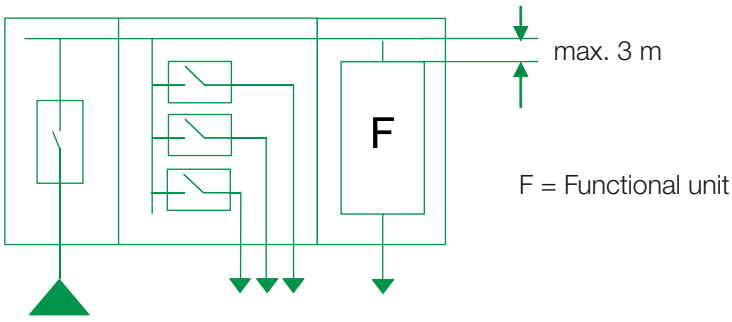
8.6 Electrical circuits and connections within ASSEMBLIES
8.6.4 Selection and installation of non-protected live conductors to reduce the possibility of short-circuits

The conductors in a panel (including the distribution busbar systems) between the main busbars and the supply side of functional units including the components of these units must be rated for the same reduced short-circuit load[1)] occurring at the outlet side[2)] of the short-circuit protective device of this unit, provided that these connections are arranged in such a manner that no short-circuit between phases or between phase and earth is to be expected (see 8.6.4). […]

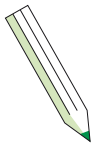
V Bar connection



Live conductors in an ASSEMBLY which are not protected by a short-circuit protective device (see 8.6.1 and 8.6.2) are to be selected and installed throughout the entire ASSEMBLY in such a manner that no short-circuit between phases or between phase and earth is to be expected. Conductor type examples and requirements are specified in Table 4. Non-protected live conductors selected and installed in compliance with Table 4 must not exceed a total length of 3 m between the main busbar and each associated SCPD.



Notes



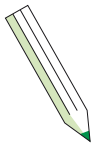
Electrical circuits and loads
Check list

2 Circuits and consumers

Consumer / circuit types	**Information provided by the planner / customer**			**Data to be derived from step 2 by manufacturer**	
	Number of circuits	Type of protective device	Distribution board ratings	Circuit ratings	Type of protective device
				Rated Diversity Factor (RDF) = _____ %	
Distribution circuits for downstream subdistribution boards		___ fuse ___ MCB ___ MCCB			

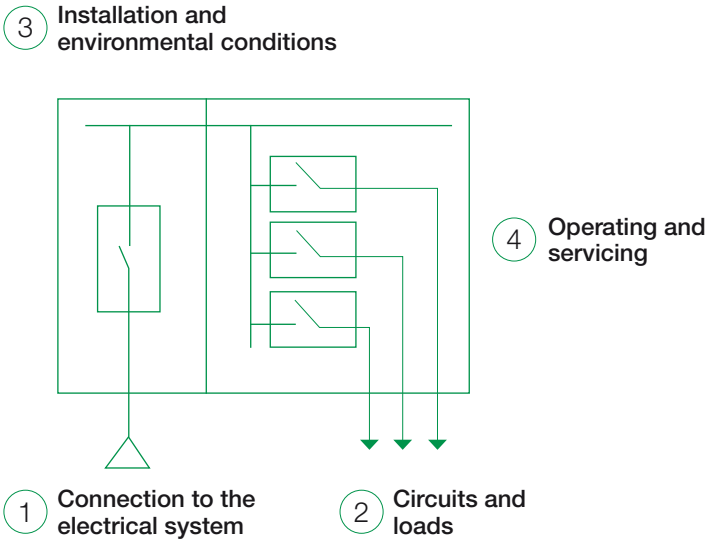
Final circuits					
	Number of circuits	Type of the protective conductor connection	Consumer ratings	Circuit ratings	Type of protective device
Socket		____ fuse ____ MCB ____ Circuit breaker and residual current device	_____ A	I_{nc} = _____ A	
Ohmic load, heater		____ fuse ____ MCB ____ MCCB	_____ kW	I_{nc} = _____ A	
Inductive consumer, motor, direct		___ fuse ____ MCB ___ MCCB	_____ kW _____ cosφ	I_{nc} = _____ A	
Inductive consumer, motor, controlled		____ fuse ____ MCB ____ manufacturer's description	_____ kW _____ cosφ	I_{nc} = _____ A	

Notes



How are ASSEMBLIES dimensioned?

ASSEMBLIES are dimensioned using the interface definition values.



1) Connection to the electrical system

- Nominal voltage of the incoming supply
- Electrical system
- Rated current
- Short-circuit withstand strength
- Overvoltage
- Connecting cable

2) Electrical cicuits and loads

- Distribution circuits for load-side subdistribution panels
- Final circuits

3) Installation and environmental conditions

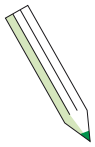
- Indoor installations
- Outdoor installations
- Dimensions for transport and installation

4) Operating and servicing

Operation through:

- Device activation
- Access control

Notes



Installation and environmental conditions
Typical conditions of installations of ASSEMBLIES

Mechanical conditions

Electrical conditions

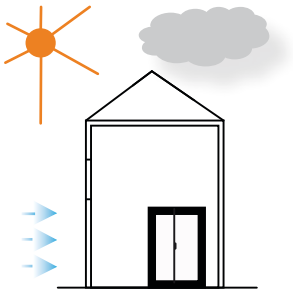
Thermal conditions

Climatic conditions

Installation conditions for switchgear ASSEMBLIES

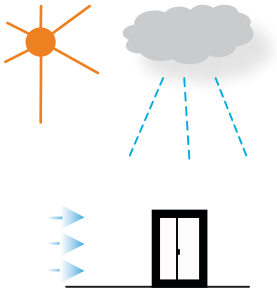
Indoor installation of switchgear ASSEMBLIES

… Is not subject to influences
… Room temperatures between -5°C and +40°C
(average over 24h +35°C)
… Relative humidity 50% at +40°C or 90% at 20°C
(i.e. slow temperature variations inside lead to occasional condensation only)
… The assumed use case is a degree of pollution of "3" for an industrial use
… The place of installation is ≤ 2,000 m above seal level



ASSEMBLY for outdoor installation

… Is exposed to direct sunlight and precipitations
… Ambient air temperatures between -25°C and +40°C
… Relative humidity at +25°C plus 100%
(i.e. frequent dew condensation inside possible)
… Usual powder and liquid paints which are perfectly suitable for indoor installations, fail completely outside
… The place of installation is not above 2,000 m above sea level



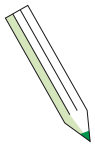
Stationary ASSEMBLIES

… Are ASSEMBLIES which are permanently installed to their position, e.g. on the floor or a wall, and which permanently fixed and operated.

Movable ASSEMBLIES

… Are ASSEMBLIES which can easily be moved from one place of installation to another.

Notes



IP code

The IP code identifies the degree of protection of enclosures and covers:
- ingress of solid foreign bodies
- against contact with hazardous parts
- ingress of water

The IP code is defined in accordance with IEC 60529.
The degree of protection is identified by the short sign IP and two numerals identifying the degree of protection and by two additional letters.

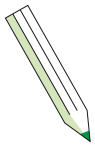
Element	Numeral or letter	Effect on the protection of the equipment	Effect on the protection of people
First digit		Against ingress of solid foreign bodies	Against contact with hazardous parts
	0	(no protection)	(no protection)
	1	≥ 50 mm diameter	Back of the hand
	2	≥ 12.5 mm diameter	Finger
	3	≥ 2.5 mm diameter	Tool
	4	≥ 1 mm diameter	Wire
	5	dust-protected	Wire
	6	dusttight	Wire
Second digit		Against harmful effects due to the ingress of water	
	0	(no protection)	
	1	Vertical dripping	
	2	Drops (15° tilt)	
	3	Spray water	
	4	Splashing of water	
	5	Water jets	
	6	Powerful water jets	
	7	Temporary immersion	
	8	Permanent immersion (1)	
Additional letter (option)			Against contact with hazardous parts
	A		Back of hand
	B		Finger
	C		Tool
	D		Wire
Complementary letter (option)		Complementary information about	
	H	High voltage device	
	M	Tested for hazardous effects caused by the ingress of water when the movable device components are being operated	
	S	Tested for hazardous effects caused by the ingress of water when the movable device components stand still	
	W	Suited for a use under defined weather conditions and equipped with additional protective measures or processes	

(1) as agreed between user and manufacturer

If one or two of the numeral(s) is/are not used, they are replaced by "X" and/or two "XX".

If none of the letters is used, this is not shown.

Notes

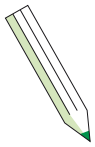


IK code

The IK code identifies the degree of protection of electric device enclosures against external mechanical impact. The IK code is defined in accordance with IEC 62262.
The degree of protection is identified by the short sign IK and two numerals identifying the degree of protection and by two additional letters. The impact energy is stated in joules.

IK code	IK00	IK01	IK02	IK03	IK04	IK05	IK06	IK07	IK08	IK09	IK10
Weight		200 g	200 g	200 g	200 g	200 g	500 g	500 g	1.7 kg	5 kg	5 kg
Height of fall		7.5 cm	10 cm	17.5 cm	25 cm	35 cm	20 cm	40 cm	29.5 cm	20 cm	40 cm
Joule	-	0.14	0.2	0.35	0.5	0.7	1	2	5	10	20

Notes

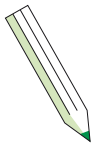


Installation and environmental conditions
Check list

(3) Installation and ambient conditions of ASSEMBLIES

Conditions of use	Information provided by the planner / customer	Measures/recommendations of the ASSEMBLY manufacturer		Selection
		Definition pursuant to standard IEC 61439-1	This information is to be taken into account in the planning of ASSEMBLIES	
Indoor installation	**Atmospheric conditions Foreign bodies / dust**	not less than IP2X	Comply with more severe requirements arising from the product standard	
	Foreign bodies	Diameter ≥ 12.5 mm	IP2X	
	Foreign bodies	Diameter ≥ 2.5 mm	IP3X	
	Dust Increased presence of dust	dust-protected	IP5X	
	Dust conductible	dusttight	IP6X	
	Humidity / water			
	Dripping water		IPX1	
	Occasional cleaning around the distribution board, impact by diverted water		IPX4	
	Functional cleaning around the distribution board, impact by diverted water		IPX5	
	Temporary immersion		IPX7	
	Room air conditioned / temperature range	-5 to +35 °C	Indicate the power loss of the ASSEMBLY for the dimensioning of the air-conditioning	
	Room ventilated / temperature range, relative humidity	-5 to +35 °C 90 % at 20 °C, up to 50 % at 40 °C	Indicate the power loss of the ASSEMBLY for ventilation dimensioning; and state the room size. Higher ambient air temperatures are to be taken into account in the planning of ASSEMBLIES	
Outdoor installation	**Protected installation /** temperature range, relative humidity (against rain, sunshine and wind)	-25 to +35 °C 90 % at 20 °C, up to 50 % at 40 °C, short term up to 100 % at 25 °C	Possible measures against moderate condensation due to temperature variations: Ventilating, heating, air conditioning	
	Foreign bodies / dust	not less than IP2X	For increased dust production use a higher degree of protection such as IP5X	
	Humidity / water	not less than IPX1	The manufacturer states the suitability of the protected installation, if necessary by applying additional measures	
	Unprotected installation / temperature range rel. humidity	-25 to +35 °C 90 % at 20 °C, up to 50 % at 40 °C, short term up to 100 % at 25 °C	Higher ambient air temperatures which might result from direct sunlight are to be taken into account in the planning of ASSEMBLIES Possible measures against moderate condensation due to temperature variations: Ventilating, heating, air conditioning	
	Direct sunlight	UV resistance	Follow manufacturer's instructions	
	Foreign bodies / dust	not less than IP2X	For increased dust production use a higher degree of protection such as IP5X	
	Humidity / water	not less than IPX1	The manufacturer states the suitability of the protected installation, if necessary by applying additional measures	

Notes

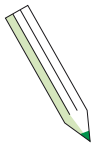


Installation and environmental conditions
Check list

3 Installation and ambient conditions of ASSEMBLIES

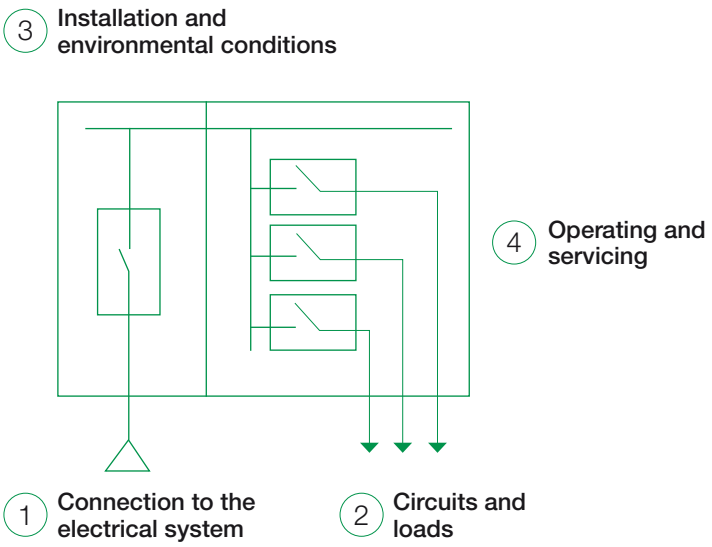
Conditions of use	Information provided by the planner / customer	Measures/recommendations of the ASSEMBLY manufacturer		Selection
		Definition pursuant to standard IEC 61439-1	This information is to be taken into account in the planning of ASSEMBLIES	
Dimensions for transport and installation	Type of installation: To the wall (recess), to the wall, free installation to base frame, double floor	None		_____ _____ _____
	Aisle widths / escape routes: Room dimensions and access doors	See IEC 60364-7-729 Requirements for special installations or locations – operating or maintenance gangways	Minimum aisle widths and the direction of the escape routes are to be taken into account in the planning of ASSEMBLIES	
	Distribution board: max. dimensions: W x H x D max. weight	None	Possible restrictions are to be stated	W _____ H _____ D _____ kg _____
	Transport: max. transport dimensions W x H x D, max. transport weight Transport type, e.g. crane Accessibility at the construction site	None	Possible restrictions are to be stated, such as only standing transport, max. acceleration values	W _____ H _____ D _____ kg _____
Chemical influences		None	Type of the enclosure material Chemical device version Special installation / ventilation	
Mechanical impact		Sub-distribution board Indoor installation Outdoor installation		IK05 IK07
Enclosure material	Sheet steel Plastic	None		
Enclosure colour			Comply with customer specifications / tender documents	
EMC	Environment A Non-public or industrial LV networks / areas / installations including strong sources of interference		Confirmation by the manufacturer in accordance with environment A	
	Environment B Public LV networks such as domestic, commercial and light industrial locations		Confirmation by the manufacturer in accordance with environment B	

Notes



How are ASSEMBLIES dimensioned?

ASSEMBLIES are dimensioned using the interface definition values.



1) Connection to the electrical system

- Nominal voltage of the incoming supply
- Electrical system
- Rated current
- Short-circuit withstand strength
- Overvoltage
- Connecting cable

2) Electrical cicuits and loads

- Distribution circuits for load-side subdistribution panels
- Final circuits

3) Installation and environmental conditions

- Indoor installations
- Outdoor installations
- Dimensions for transport and installation

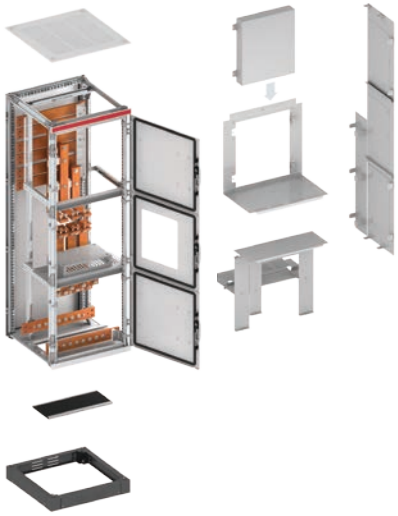
4) Operating and servicing

Operation through:

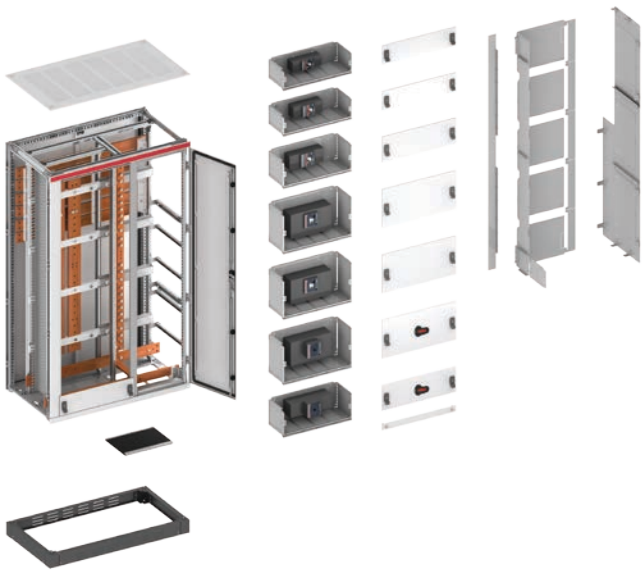
- Device activation
- Access control

Operating and servicing
Our solutions for internal forms of separation

Form 1

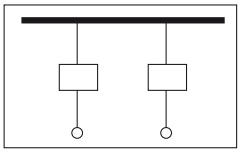
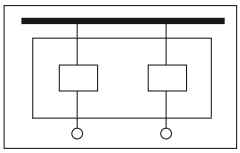
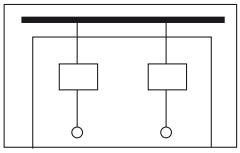
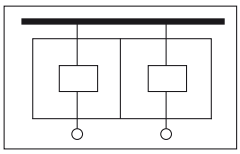
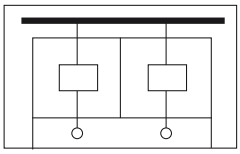
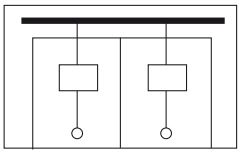
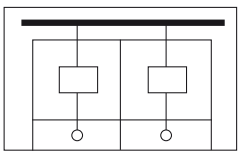


Form 2b



Form 4b

Operating and servicing
Internal forms of separation

Form	Main criteria	Further criteria	Figure
Form 1	No separation		
Form 2a	Separation of busbars from functional units	The terminals for external conductors do not need to be separated from the busbars.	
Form 2b	Separation of busbars from functional units	The terminals for external conductors are separated from the busbars	
Form 3a	Separation of busbars from functional units and separation of all functional units from one another. Separation of the terminals for external conductors from the units, but not from each other.	The terminals for external conductors do not need to be separated from the busbars.	
Form 3b	Separation of busbars from functional units and separation of all functional units from one another. Separation of the terminals for external conductors from the units, but not from each other.	The terminals for external conductors are separated from the busbars	
Form 4a	Separation of busbars from functional units and separation of all functional units from one another including the terminals for external conductors which are an integral part of the functional unit.	The terminals for external conductors are in the same compartment as the associated functional unit	
Form 4b	Separation of busbars from functional units and separation of all functional units from one another including the terminals for external conductors which are an integral part of the functional unit.	Terminals for external conductors are not in the same compartment as the associated function unit, but in individual, separate, enclosed protected spaces or compartments.	

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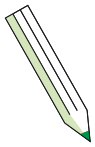


EN 50110-1 - Key terms

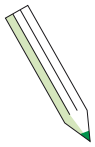
Nominated person
… a person, appointed by the customer, and who as electrician is technically in charge of the works and takes ultimate responsibility for the work activities.

Skilled person (electrically)
… persons with relevant education, knowledge and experience and know-how of standards to analyse possible hazards involved in the tasks assigned to them

Instructed person
… persons advised and/or instructed by skilled persons on the tasks assigned to them and the possible hazards involved in improper behaviours and also advised on required protection systems, personal protection equipment and devices.

Ordinary person
… a person who is neither a skilled person nor an instructed person.

Notes



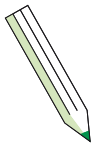
Operating and servicing
Check list

4 Operating and servicing

Characteristics	Information provided by the planner / customer	Information provided by the manufacturer	Selection
Operation through:	Skilled person (electrically) Instructed person Ordinary persons	IPXXB IPXXB IPXXC	
Device activation	Behind the door / cover From outside		
Access / door closure	Lock For semi-cylinder (central locking system) Other		

Accompanying standards:
EN 50110-1 Operation of electrical installations – general requirements
EN 50110-2 Operation of electrical installations / national annexes
IEC 60050 International electrotechnical vocabulary

Notes



Chapter 2
Distribution board design and design verification

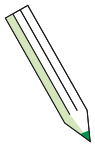
How can the original manufacturer or the manufacturer verify the safety of an ASSEMBLY?

The new standard describes three design verification processes for an ASSEMBLY and requires a routine verification for each marketed product

Testing	Calculation / measurement	Application of constructive rules
such as – electrical – mechanical – thermal tests in accordance with the requirements stated in the standard	such as – Calculating of temperature rises or of short-circuit forces – Measurement of clearances and of creepage distances	such as –specified dimensions –test steps –ASSEMBLY orders, based on tested reference constructions

These processes are essentially implemented by the original manufacturer. In case that the ASSEMBLY manufacturer does not install an ASSEMBLY in compliance with the instructions of the original manufacturer, the ASSEMBLY manufacturer will become original manufacturer for that alteration and will have to carry out the design verification in accordance with the described procedures.

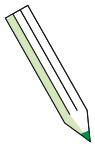
Notes



Distribution board design and design verification
Requirements arising from the standard

Sec.	Characteristics to be verified	verification by	remarks / annexes
10.2.2	Resistance to corrosion	ABB	
10.2.3.2	Strength against abnormal heat and fire	ABB	
10.2.4	Resistance to UV radiation	ABB	
10.2.5	Lifting	ABB	
10.2.6	Mechanical impact	ABB	
10.2.7	Marking	ABB	
10.3	Degree of protection of enclosures	ABB	
10.4	Clearances and creepage distances	ABB	
10.5.2	Continuity of the connection between parts of the ASSEMBLY and the protective circuit	ABB	
10.5.3	Short-circuit withstand strength of the protective circuit	ABB	
10.6	Incorporation of equipment	Manufacturer	The ASSEMBLY manufacturer shall comply with the design requirements of the original manufacturer and of the equipment manufacturer (8.6)
10.7	Internal electric circuits and connections	Manufacturer	The ASSEMBLY manufacturer shall comply with the design requirements of the original manufacturer (8.7)
10.8	Terminals for external conductors	Manufacturer	Compliance with the requirements of the original manufacturer and of the device manufacturer (8.8)
10.9.2	Dielectric properties Power-frequency withstand voltage	ABB	
10.9.3	Dielectric properties Withstand voltage	ABB	
10.10	Verification of temperature rises	Manufacturer	Annexes:
10.11	Short-circuit withstand strength	Manufacturer	Annexes:
10.12	Electro-magnetic compatibility (EMC)	Manufacturer	In general no verification necessary Annexes:
10.13	Mechanical operation	ABB	

Notes



10.2.2 Resistance to corrosion

The resistance to corrosion of ferrous metallic enclosures including internal and external ferrous metallic constructional parts of the ASSEMBLY is to be verified There are two test methods. Severity tests A and B. Severity test A applies to indoor installations and severity test B to outdoor installations.

These tests are described in IEC 60068.

The metallic ASSEMBLIES from STRIEBEL & JOHN are tested for indoor installations.

10.2.3.2 Strength against abnormal heat and fire

This paragraph describes the glow wire test according to IEC 60695.
It is used to verify the suitability of the materials used.
The glow wire tip temperatures are stated below and must have the following properties.

960 °C for parts necessary to retain current-carrying parts in position;
850 °C for enclosures intended for mounting in hollow walls;
650 °C for all other parts including parts necessary to retain the protective conductor.

10.2.4 Resistance to ultra-violet (UV) radiation

This test is only prescribed for enclosures and external parts of ASSEMBLIES intended for outdoor installation and made of plastic or metal and completely coated with insulating material.

UV test in accordance with ISO 4892.
This test is applied to enclosures made of insulating materials. This verification certifies that the flexural strength (according to ISO 178) and the IZOD impact strength (Charpy test according to ISO 179) of the insulating materials have not less than 70 % minimum retention.
Metal enclosures completely coated with insulating materials, pass this test when the adherence of the synthetic material has a minimum retention of category 3 as provided for in ISO 2409.
This test does not need to be conducted if the original manufacturer is able to present data from the material supplier certifying that material of the same type and thickness or thinner complies with these requirements.

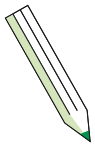
10.2.5 Lifting

For ASSEMBLIES equipped with lifting appliances compliance is verified by the following tests.
The highest number of sections allowed by the original manufacturer to be lifted in the same time is to be equipped thus to achieve a weight of 1.25-times the maximum transport weight. With the doors closed the ASSEMBLY shall be lifted using the lifting means specified by the original manufacturer.
After this test, the ASSEMBLY must not show cracks or permanent deformation potentially affecting its characteristics.

10.2.6 Mechanical impact

Mechanical impact tests are to be carried out as provided for in IEC62262.

Notes



10.2.7 Marking
Markings made by moulding, pressing, engraving or similar, including labels with laminated plastic surfaces, do not need to be tested separately. The test is described in this section and after the test, the markings must be legible without additional tools.

10.3 Degree of protection of enclosures
The degree of protection is to be verified as provided for in IEC 60529.
Where an empty enclosure in accordance with IEC 62208 is used, it must be verified by surveys that possible modifications which have been carried out do not impair the degree of protection. No further testing is required here.

10.4 Clearances and creepage distances
Clearances and creep distances are to be tested in accordance with the requirements.

10.5.2 Continuity of the connection between parts of the ASSEMBLY and the protective circuit
It is to be verified that the different parts of the ASSEMBLY are effectively connected to the terminal of the incoming external protective conductor and that the resistance of the circuit does not exceed 0.1 Ω.
Verification is to be carried out using a resistance measurement device which is capable of supplying a current of not less than 10 A (AC or DC). The current is passed from each part to the terminal for the external protective conductor. The resistance must not exceed 0.1 Ω.

10.5.3 Short-circuit withstand strength of the protective conductor
The rated Short-circuit withstand strength is to be verified. Verification may be made by comparison with a reference design or by test.
The original manufacturer has to define the reference design used for testing.

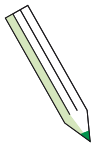
10.6 Incorporation of equipment
Compliance with the design requirements 5 for the incorporation of equipment is to be confirmed by the original manufacturer.

10.7 Internal electric circuits and connections
Compliance with the design requirements for internal electrical circuits and connections is to be confirmed by the original manufacturer.

10.8 Terminals for external conductors
Compliance with the design requirements for terminals for external conductors shall be confirmed by the original manufacturer.

10.9.2 Dielectric properties Power-frequency withstand voltage
For this test, all electrical equipment of the ASSEMBLY is to be connected, except those which are designed for lower test voltages in compliance with the applicable provisions; current consuming devices (e.g. windings, measuring instruments, surge arresters), in which the application of a test voltage could cause the current to flow, are to be disconnected. Such devices are to be disconnected at one of their terminals unless they are designed for the full test voltage, in which case every terminal may be disconnected.

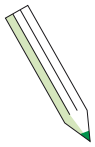
Notes



10.9.3 Dielectric properties Withstand voltage

For this test, all electrical equipment of the ASSEMBLY is to be connected, except those which are designed for lower test voltages; current consuming devices (e.g. windings, measuring instruments, surge arresters), in which the application of a test voltage could cause the current to flow, are to be disconnected. unless they are designed for the full test voltage, in which case every terminal may be disconnected. For tolerance variations of the test voltage and for the selection of the test devices, see IEC 61180.

Notes



10.10 Verification of temperature rise

Next to the option to verify temperature rises inside low-voltage switchgear and controlgear ASSEMBLIES using a test, DIN EN 61439-1 describes two calculation methods which may also be used:

Verification of temperature rise up to 630 A

– Comparison between the installed power loss and the power loss that can be dissipated in the range up to 630 A (only possible if there are no horizontal partitions)

For the verification, see page 69

Temperature rise verification up to 1600 A

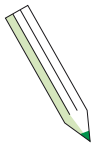
– Verification that temperature rise limits are not exceeded in the distribution board, this applies to the range up to 1600 A (according to DIN EN TR 60890)

For the verification, see page 85

Temperature rise verification up to 1600 A

– Temperature rise verifications above 1600 A are to be made by testing

Notes



10.10 Verification of temperature rise

Next to the option to verify temperature rises inside low voltage switchgear and controlgear ASSEMBLIES using a test, IEC 61439-1 describes two calculation methods which may also be used:

- Comparison between the installed power loss and the power loss that can be dissipated in the power range up to 630 A (only possible if there are no horizontal partitions)
- Verification that temperature rise limits are not exceeded in the distribution board, this applies to the power range up to 1600 A (according to IEC TR 60890)

Verification of temperature rise up to 630 A

Temperature rises up to 630 A may be verified under the assumption that the heat loss of all equipment and electrical conductors is evenly distributed across the enclosure. For this method the standard demands that no internal form separation restricts the heat flow. Since the actual distribution of the heat sources in enclosures does not necessarily comply with the above-stated ideal conditions, the standard requires for calculated verification methods (up to 630 A) the application of a reduction factor (derating factor).
There are two different starting conditions: a) the operating currents (load currents) are known or b) the rated current is specified by the preselection of equipment.

Example I

The operating currents are known and the rated current for the incoming supply is to be determined from the sum of the outgoing operating currents:

3 outgoing circuits having an operating current of I_B = 150 A

$$I_B = \frac{\sum I_{B\ \text{outgoing circuits}}}{n^*} = \frac{450\ A}{0{,}9} = 500\ A$$

with an assumed load factor n = 0.9 taken from table 101, EN 61439-2
(Attention: Part 3 provides for another reduction of the load factors)

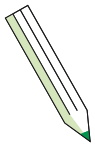
$$I_{nA} = \frac{I_B}{0{,}8^{**}} = \frac{500\ A}{0{,}8} = 625\ A$$

As incoming equipment a fuse switch disconnector size III (630 A) would have to be selected, for example.

*With an assumed load factor of n = 0,9 taken from table 101 of IEC 61439-2
(Attention part 3 provides for an other reduction of the load factors)

**Assumed load factor pursuant to section 10.10.4.2.1 of part 2 of the standard

Notes



Example II

The operating current of the outgoing circuit is defined by the equipment selection so that the rated current of the outgoing circuit is calculated as follows:

Disconnector size 00, 160 A

$I_{nc}=I_B \cdot 0.8^* = 160\ A \cdot 0.8 = 128\ A$

Reducing the rated current of each circuit leads also to another reduction of the power loss to be taken into account regarding the power losses occurring with the rated current.

Example III

I_{th}= 160 A at ambient air temperature, power loss of the equipment P_{Vth}=30 W

$I_{nc}= I_B \cdot 0.8 = 160\ A \cdot 0.8 = 128\ A$

$$\frac{P}{P_{Vth}} = \left(\frac{I}{I_n}\right)^2 ; \frac{P}{30} = \left(\frac{128}{160}\right)^2 ; P = 19{,}2W$$

Verified ASSEMBLIES are to be calculated so that the wiring sections are to be designed in accordance with the current rating of the associated circuit and all sections shall have not less than 1.25 times (125 %) of the current rating.

Example IV

I_{th}=160 A at ambient air temperature

$I_{nc}=I_B \cdot 0.8 = 160\ A \cdot 0.8 = 128\ A$

with a derating factor of 0.8 to be taken into account for the calculation up to 630 A.

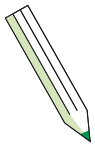
$I_{nc'} \cdot 1.25 = 160\ A$

Single-core cables, touching free in air in accordance with Table H.1, Anne H, IEC 61439-1

$I_{nc'}$ = 160 A Cross-sectional area of conductor: 70 mm^2 (max. operating current 171 A)

*Assumed load factor pursuant to section 10.10.4.2.1 of part 2 of the standard

Notes



Verification of temperature rise up to 630 A

The following table may be used for a simplified calculation up to 630 A:

Position	Number	Manufacturer	Type	Description	Rated current of the equipment I_n	P_{vn}	Derating [1]	Rated current of a circuit I_{nc}	Assumed load factor [2]	Assumed operating current I_B	Power loss of a device at I_B	Sum of the power losses
					(A)	(W)		(A)		(A)	(W)	(W)
										$I_B = I_{nc} \cdot$ assumed load factor	$P_B = P_{vn} \cdot (I_B/I_n)^2$	$P_{vB} = P_B \cdot$ number
Sum of the installed power losses												
Wiring power loss (%) [3] 30												
Power loss dissipation of the enclosure												
Difference = power loss dissipation – sum of the installed power loss= $P_{vzul} - \sum P_{vB}$												

1) According to IEC 61439-2 Table 101 – Values of assumed loading – depending on the number of equipment used in the same time
2) Manufacturer information for equipment under different conditions, but not less than 0.8 in line with section 10.10.4.2.1c
3) The wiring power loss is assumed as percentage of the equipment power losses – proposal: 30 %

If there is a positive difference between the dissipated power losses and the sum of the installed power losses, the temperature rise of the low voltage switchgear and controlgear ASSEMBLY is verified! In which case the ASSEMBLY manufacturer may indicate a RDF of 100 % for the complete installation since sufficient design reserves have been taken into account.

If there is a negative difference between dissipated power losses and installed power losses, further action is required in the field:

– Ventilation of the enclosure
– Selecting a larger enclosure

Or, as a third option, the manufacturer may also reduce the rated diversity factor:

– Determining of a smaller RDF (≤ 80 %)

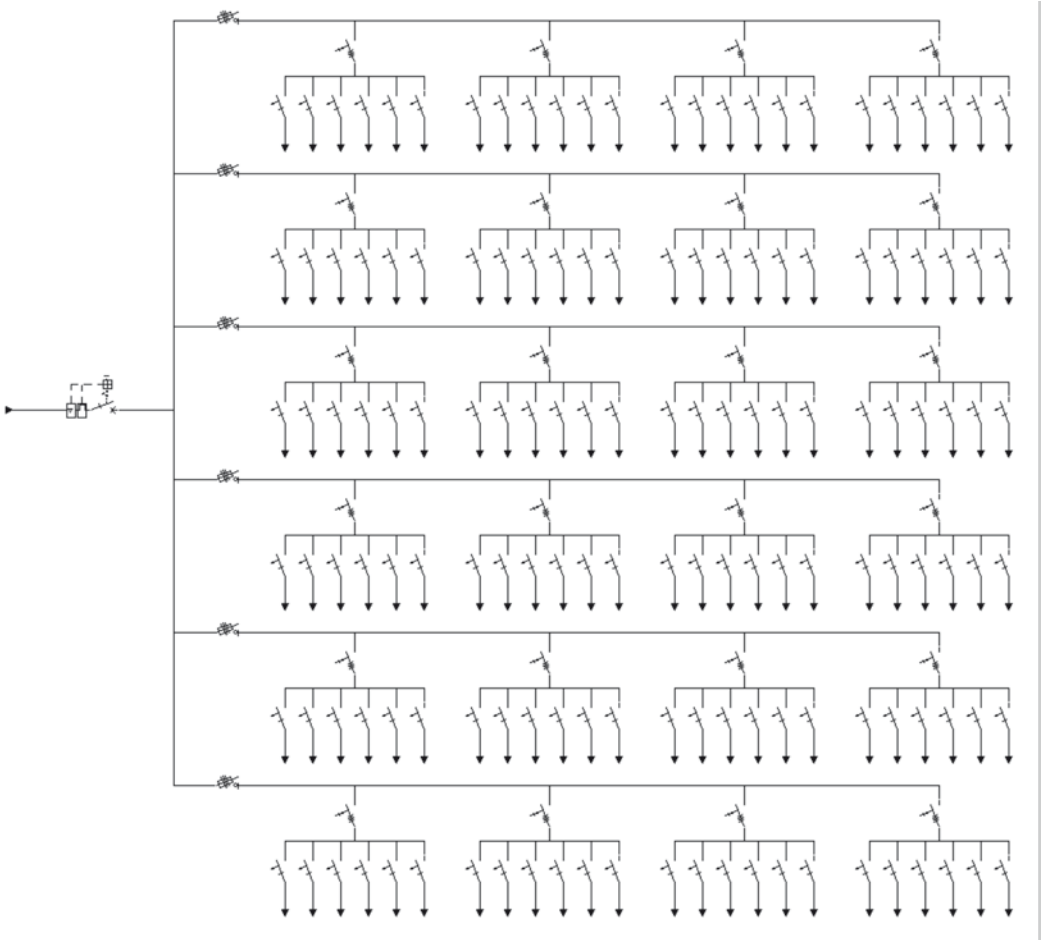
The RDF is the percent value of the rated current which the ASSEMBLY may carry continuously and simultaneously taking into account the mutual thermal influences.

$$RDF = \sqrt[2]{\frac{\text{dissipated power loss}}{\text{installed power loss}}} * 100\ [\%]$$

It may be specified by the ASSEMBLY manufacturer for the entire low voltage switchgear and controlgear ASSEMBLY combination or for groups of outgoing circuits.

You will find the necessary information on the installed power losses for our enclosures in the technical specifications of our catalogues and in our design software.

Example calculation



1 x	Sace T5	20,35 W
6 x	XLP00	58,89 W
24 x	F204A-40/0,03	46,45 W
144 x	S201-B16	82,94 W

Distribution board design and design verification
Temperature rise verification up to 630 A

Pos	Number	Manufacturer	Type	Description	Rated current of the equipment I_n	P_{vn}	Derating [1]	Rated current of a circuit I_{nc}	assumed load factor [2]	assumed operating current I_B	Power loss of a device at I_B	Sum of the power losses
					(A)	(W)		(A)		(A)	(W)	(W)
										$I_B = I_{nc} \cdot$ assumed load factor	$P_B = P_{vn} \cdot (I_B/I_n)^2$	$P_{vB} = P_B$ number
										Sum of the installed power losses $\sum P_v$		
										Wiring power loss (30 %) [3]	30	

1) According to DIN EN 61439-2 Table 101 – Values of assumed loading – depending on the number of equipment used in the same time
2) Manufacturer information for equipment under different conditions, but not less than 0.8 in line with section 10.10.4.2.1c
3) The wiring power loss is assumed as percentage of the equipment power losses – proposal: 30 %

Scenario 1

$P_{v\ dissipatable} = 300\ W$

$\Delta P_v = P_{v\ diss} - P_{v\ total} = 300\ W - 271.23\ W = 28.77\ W$

Positive number

Verified built-in power loss smaller than power loss to be dissipated and consequently compliance with the standard.

Scenario 2

$P_{v\ dissipatable} = 150\ W$

$\Delta P_v = P_{v\ diss} - P_{v\ total} = 150\ W - 271.23\ W = -121.23\ W$

Negative number

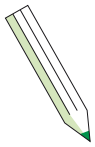
larger enclosure

or

reduced RDF

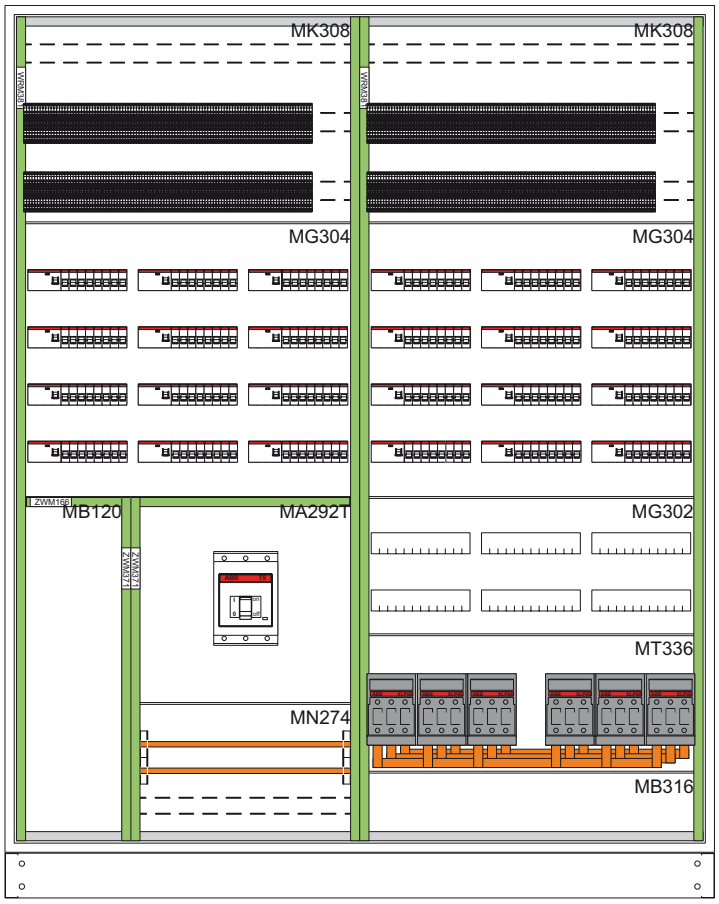
$$RDF = \sqrt{\frac{150\ W}{271.23\ W}} = 0.74$$

Notes



Distribution board design and design verification
Temperature rise verification up to 630 A

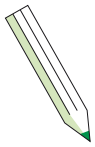
Solution



$P_{v\ equipment}$	208.63 W
$P_{v\ wiring}$	62.59 W
$P_{v\ total}$	271.23 W
$P_{v\ cabinet}$	354.50 W

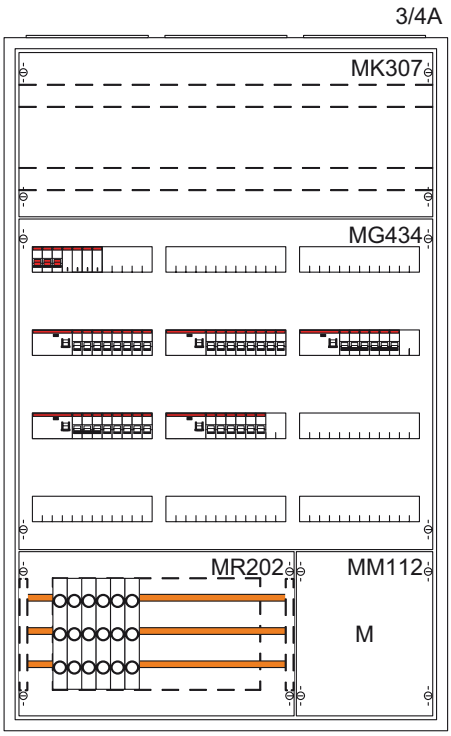
Distribution board:	Floor-standing cabinet with door
Make:	ABB STRIEBEL & JOHN
Type:	TW612G
Height:	1950 mm
Width:	1550 mm
Depth:	350 mm
Degree of protection:	IP55
Protection class:	I, earthed
Colour:	RAL 7035
Incoming cable from the:	bottom
Outgoing cables to:	the top
Cable entry:	Membrane flanges

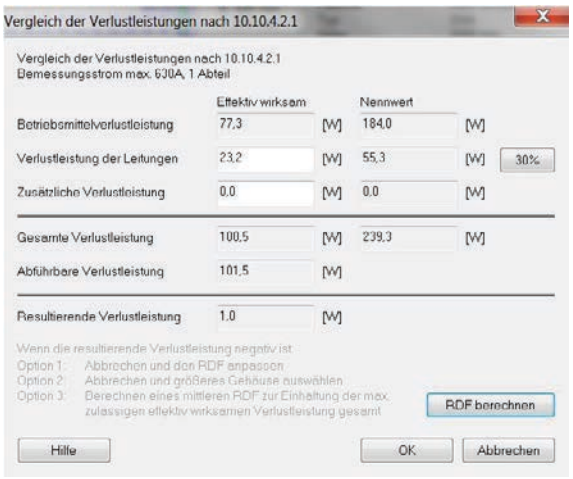
Notes

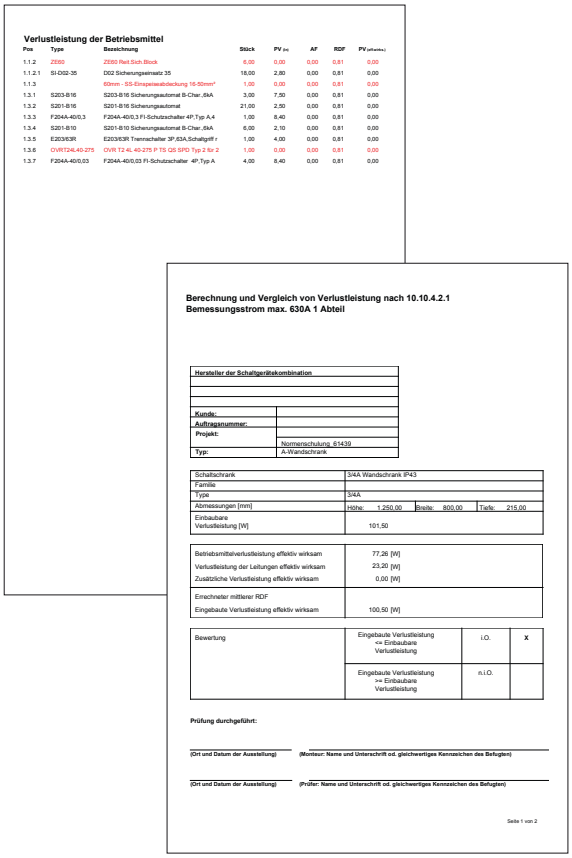


Distribution board design and design verification
Temperature rise verification up to 630 A

Example 1

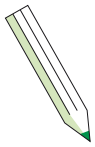






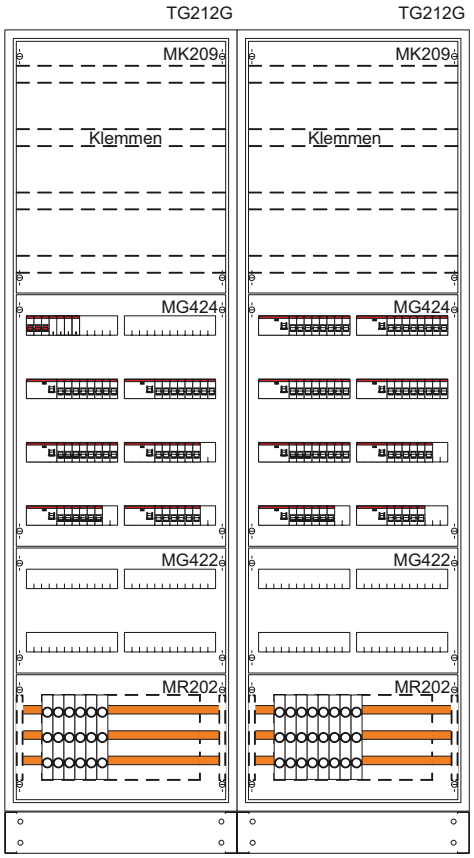
Distribution board:	Wall-mounted distribution board with door
Make:	ABB STRIEBEL & JOHN
Type:	3/4A
Height:	1250 mm
Width:	800 mm
Depth:	215 mm
Degree of protection:	IP43
Protection class:	II, double insulated
Colour:	RAL 9016
Incoming cable from the:	the top
Outgoing cables to:	the top
Cable entry:	Membrane flanges

Notes

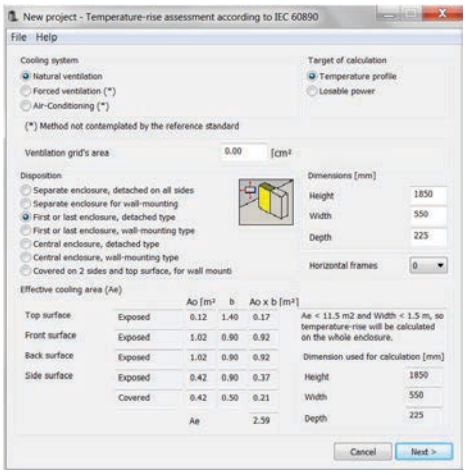


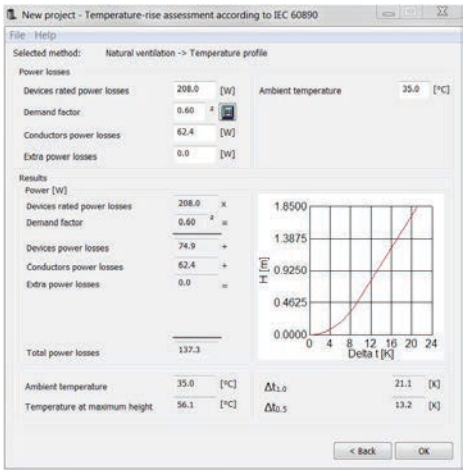
Distribution board design and design verification
Temperature rise verification pursuant to DIN EN 60890

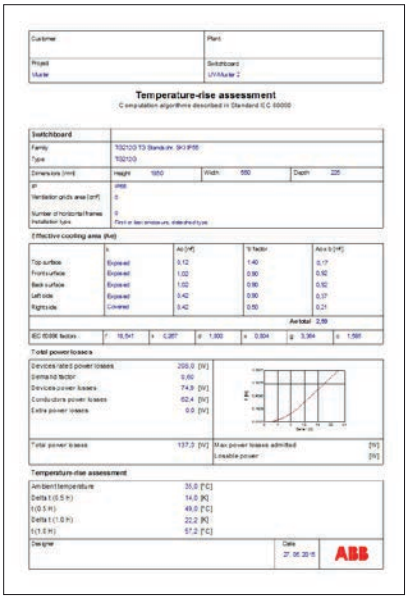
Temperature rise verification up to 630 A
Example 2



Distribution board:	Floor-standing distribution board with door
Make:	ABB STRIEBEL & JOHN
Type:	2 x TG212G
Height:	1950 mm incl. 100 mm plinth
Width:	1100 mm
Depth:	225 mm
Degree of protection:	IP55
Protection class:	I, earthed
Colour:	RAL 7035
Incoming cable from the:	the top
Outgoing cables to:	the top
Cable entry:	Membrane flanges







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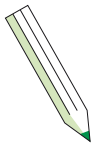
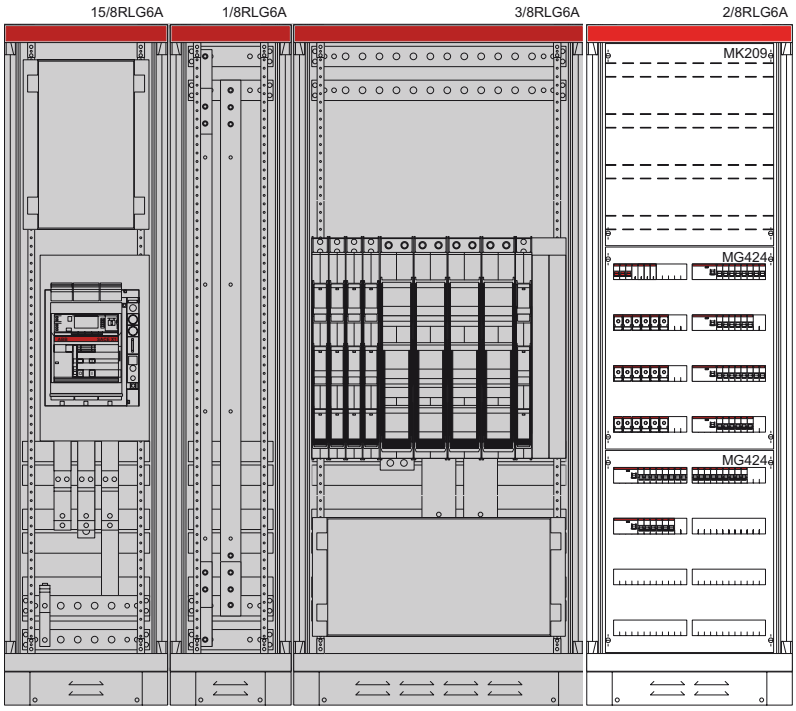


Distribution board design and design verification
Temperature rise verification pursuant to DIN EN 60890

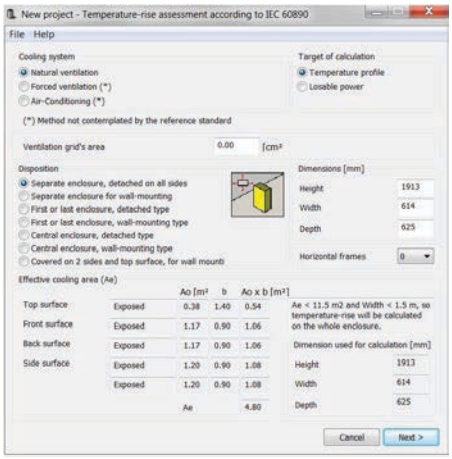
Temperature rise verification up to 630 A
Example 3

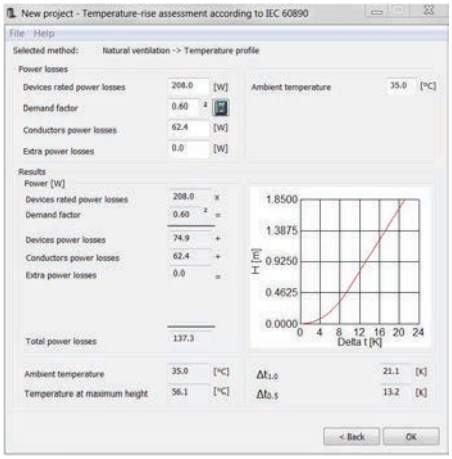


gray area
Tested area configured using EDS Power CON

white area
Temperature rise verification to be made by the procedure specified in DIN EN 60890

Distribution board:	ASSEMBLY tested pursuant to DIN EN 61439
Make:	ABB STRIEBEL & JOHN
Type:	TriLine power module system
Height:	Total 2013 mm
Width:	Total 2331 mm (3 transport units)
Depth:	625 mm
Degree of protection:	IP30
Protection class:	I, earthed
Colour:	RAL 7035
Incoming cable from the:	bottom through plinth
Outgoing cables to:	the top through flange plates
Busbar:	2000 A





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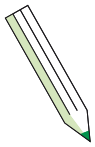
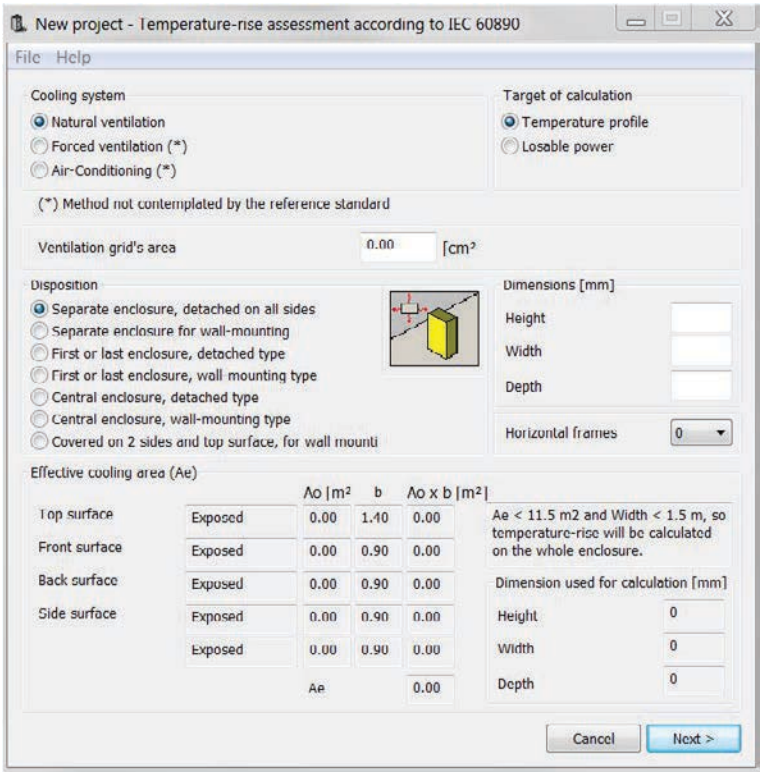
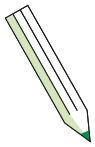


Verification of temperature rise up to 1600 A

For temperature rise verifications it is also possible to use a method to calculate the temperature rise limits according to IEC 61439.
This method (in accordance with IEC TR 60890) is implemented in our Panel Design Configurator software.



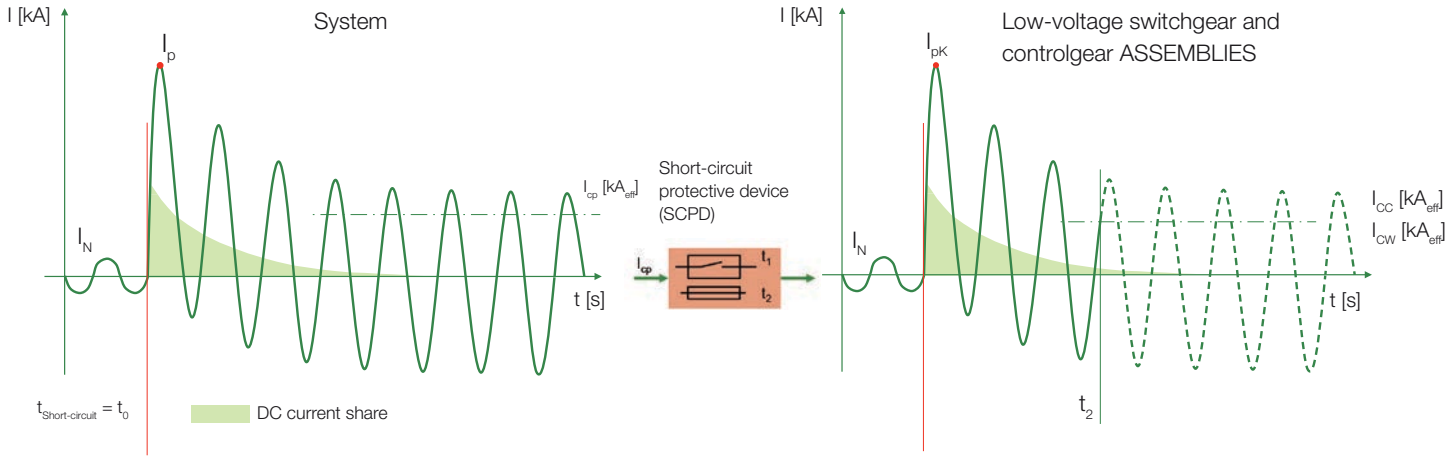
Notes



10.11 Verification of the Short-circuit withstand strength:

We have carried out numerous Short-circuit tests for our low voltage switchgear and controlgear ASSEMBLIES and for our system components, which we can use for the creation of our design verifications. In this section we will specify some general terms for you and give you some information to assist you in your daily selection of corresponding components.

The peak short-circuit current I_p is used to assess mechanical strength. The thermal effects of the short-circuit current can be assessed using the effective value I_{cp}.



I_p = Peak short-circuit current
I_{cp} = Uninfluenced short-circuit current (effective value)

System	Limit*	Installation
I_P	≤ 17 kA ≤	I_{pk}
$I_{cp\ (eff)}$	≤ 10 kA ≤	$I_{cw\ (eff)}$
$I_{cp\ (eff)}$	≤ 10 kA ≤	$I_{cc\ (eff)}$

A verification of the Short-circuit withstand strength is not required if the short-circuit current at the supply position is below the limits!

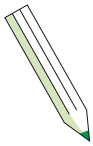
*Assumed to section 10.11.2 IEC 61439-1

I_{pk} = Rated peak withstand current
(strength of the ASSEMBLY against electro-dynamic forces; manufacturer information)
I_{cw} = Rated short-time withstand strength
(strength of the ASSEMBLY against the heat effect of the current (effective value); manufacturer information)
I_{cc} = conditional rated short-circuit current
(strength of the ASSEMBLY against heat effects and the electro-dynamic forces of the current defined in length and importance by a Short-circuit protective device (effective value); manufacturer information)

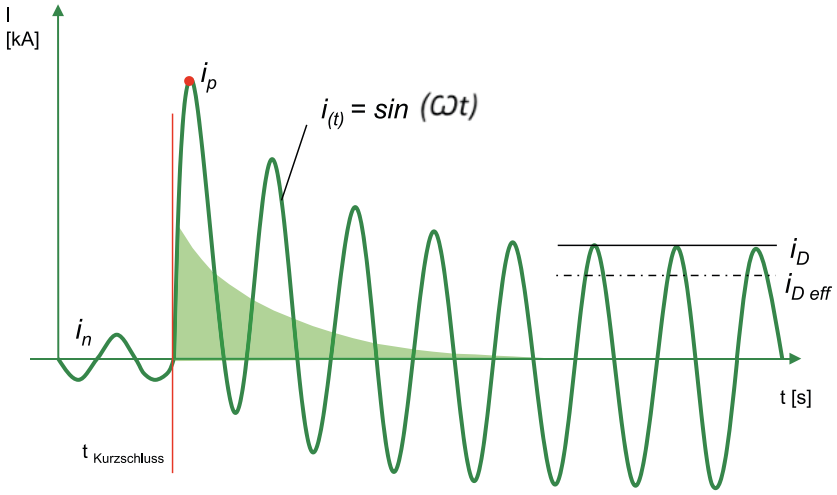
DIN EN 61439-1 / VDE 0660-600-1 Table 7

Effective value of the short-circuit current kA	cos φ	n
I ≤ 5	0.7	1.5
5 < I ≤ 10	0.5	1.7
10 < I ≤ 20	0.3	2
20 < I ≤ 50	0.25	2.1
50 < I	0.2	2.2

* The values match most use cases. At certain installation positions, e.g. in close proximity to transformers or generators, there may be lower power factor values, which may effect that the peak value of the uninfluenced short-circuit current will be the limiting value instead of the effective value.



Distribution board design and design verification
Short circuit – key terms*1



$$I_{eff} = 1/\sqrt{2} * i_{(t)}^2$$

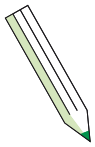
[I_{eff}] Effective value of the alternating current = direct current equivalent:
Direct current size at an ohmic load
The same electrical energy in a given period of time and/or
converting the same power as alternating current

$i_{(t)}$ = course of the alternating current over the time t
i_p = peak value (instantaneous value) of the alternating current
i_D = short-time current
$i_{D\ eff}$ = effective value of the short-time current
i_n = nominal value of the alternating current

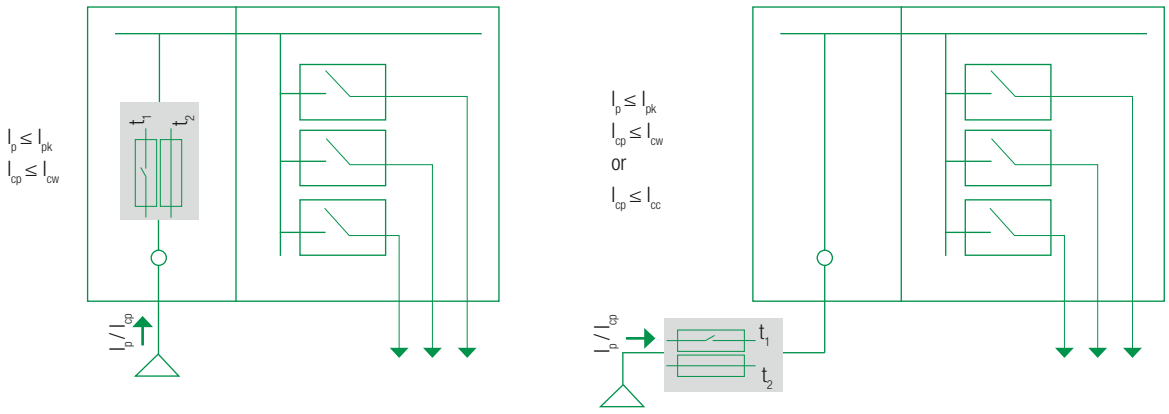
Ratio between surge current and short-time current*2
For approximate calculation purposes: $I_p = I_{D\ eff} \times n$

*1 See also EN 60909-0
*2 See also section 9.3.3 IEC 61439-1 and table 7

Notes



The short-circuit protective device may be installed inside or outside the low voltage switchgear and controlgear ASSEMBLY:



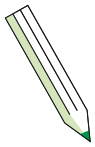
In this case it must be made sure that the short-circuit current I_p and the uninfluenced short-circuit current I_{cp} at the connection point are smaller and/or equal to the values specified by the manufacturer:

$$I_p \leq I_{pk}$$

$$I_{cp} \leq I_{cw}$$

If not duration is indicated for I_{cw} a test length t of 1 sec. is to be used.

Notes



If the ASSEMBLY manufacturer specifies the conditional rated short-circuit current for the connection point (I_{cc}) also the breaking capacity and the current limitation characteristic (I^2t, I_{pk}) of the specified, upstream Short-circuit protective device (taking into account the data submitted by the device manufacturer) are to be stated.
For simplification reasons, also the type and name of the device manufacturer (and of the fuse inserts, if necessary) should be inserted here.

A verification of the short-circuit withstand strength is not required for:

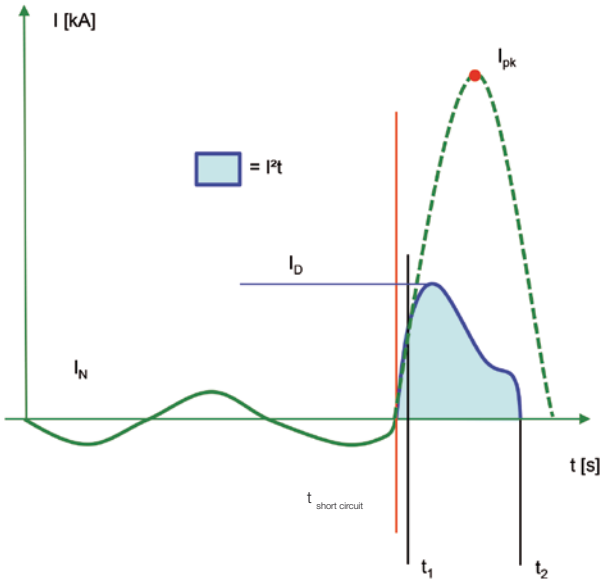
– ASSEMBLIES with a rated short-time withstand current (I_{pk}) or rated conditional short-circuit current (I_{cc}) not exceeding 10 kA effective value.

ASSEMBLIES or circuits of ASSEMBLIES protected by current-limiting devices having a cut-off current not exceeding 17 kA at the maximum allowable prospective short-circuit current at the terminals of the incoming circuit of the ASSEMBLY.

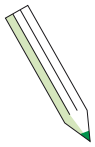
Auxiliary circuits of ASSEMBLIES intended to be connected to transformers whose rated power does not exceed 10 kVA for a rated secondary voltage of not less than 110 V, or 1.6 kVA for a rated secondary voltage less than 110 V, and whose short-circuit impedance is not less than 4 %. All other circuits are to be verified.

(for a text excerpt see DIN EN 61439-1 (VDE 0660-600) 10.11.2)

Example: Limiting the short-circuit current and the cut-off current I_D and cut-of energy I^2t by fuses.

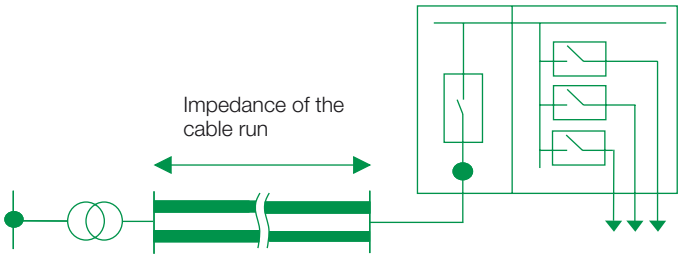


Notes

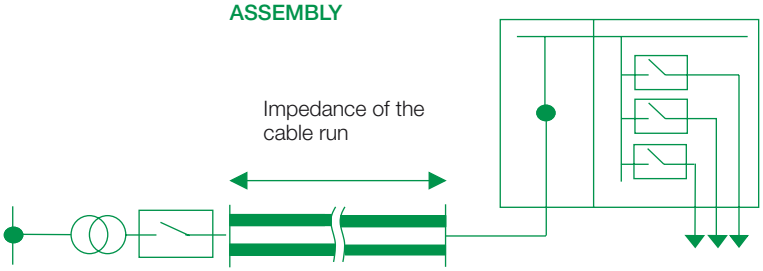


Distribution board design and design verification
Short-circuit current at the supply position

Connection point and SCPD in an ASSEMBLY



SCPD in front of the ASSEMBLY



The short-circuit current at the supply position might be significantly reduced due to impedances!

The actual occurring short-circuit current might be determined using graphical calculation methods or software tools such as e-Design.

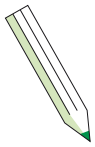
In order to solve the question whether a verification of the Short-circuit withstand strength by test or derivation is required or not, the values of the prospective uninfluenced short-circuit current I_{cp} or of the expected maximum peak current I_p at the connection point are to be determined.

(See IEC 61439-1 table 7)

Peak value of the short - circuit current I_p [kA]
$I_p = I_{cp\ (eff)} \times n$

Effective value of the short - circuit current $I_{cp\ (eff)}$ [kA]
$I_{cp\ (eff)} = I_p \times 1/n$

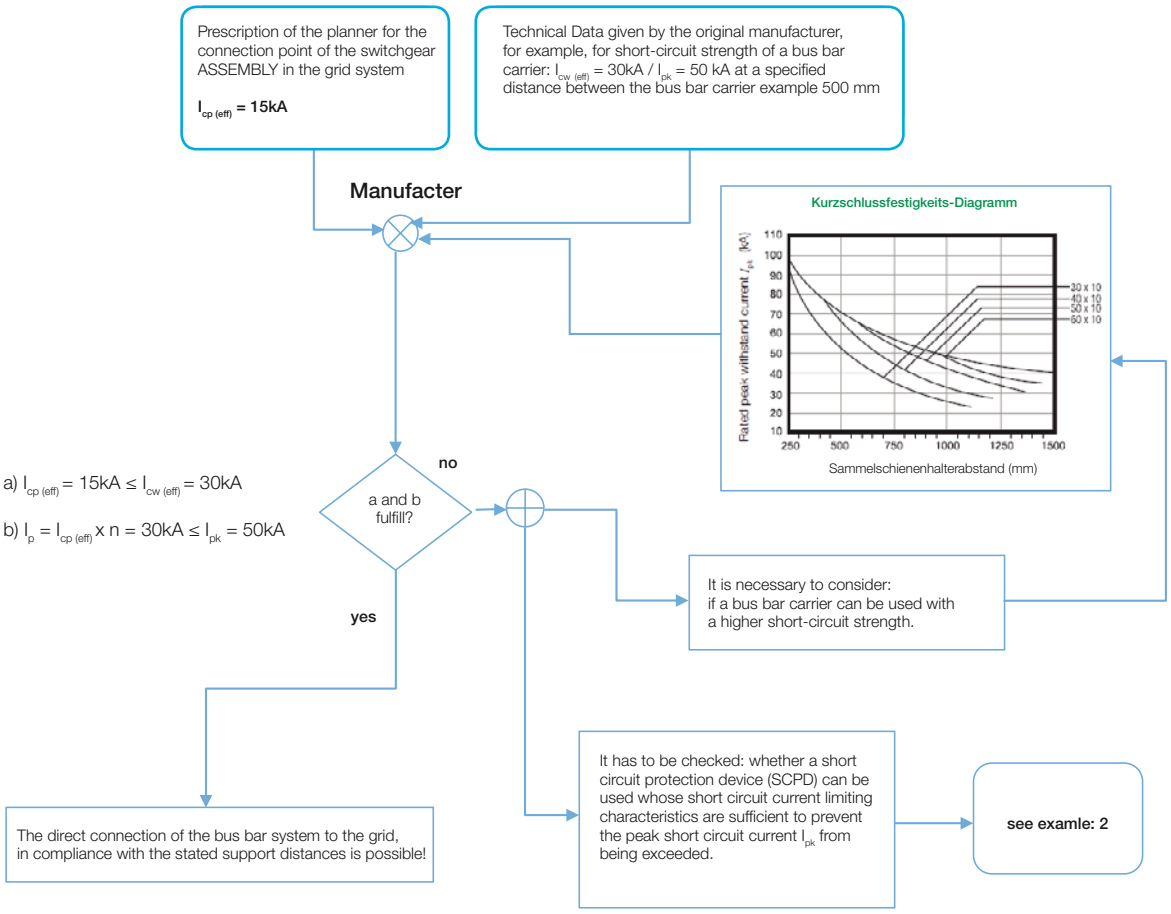
Notes



Distribution board design and design verification
Short-circuit current at the supply position

Example 1

Always verify whether the system's short-circuit current to be expected at the specified place of use (supply position) does not exceed the short-circuit current values specified by the manufacturer for its components and/or the manufacturer for the planned ASSEMBLY. To do so, you may use the following examples



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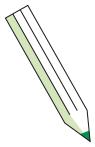
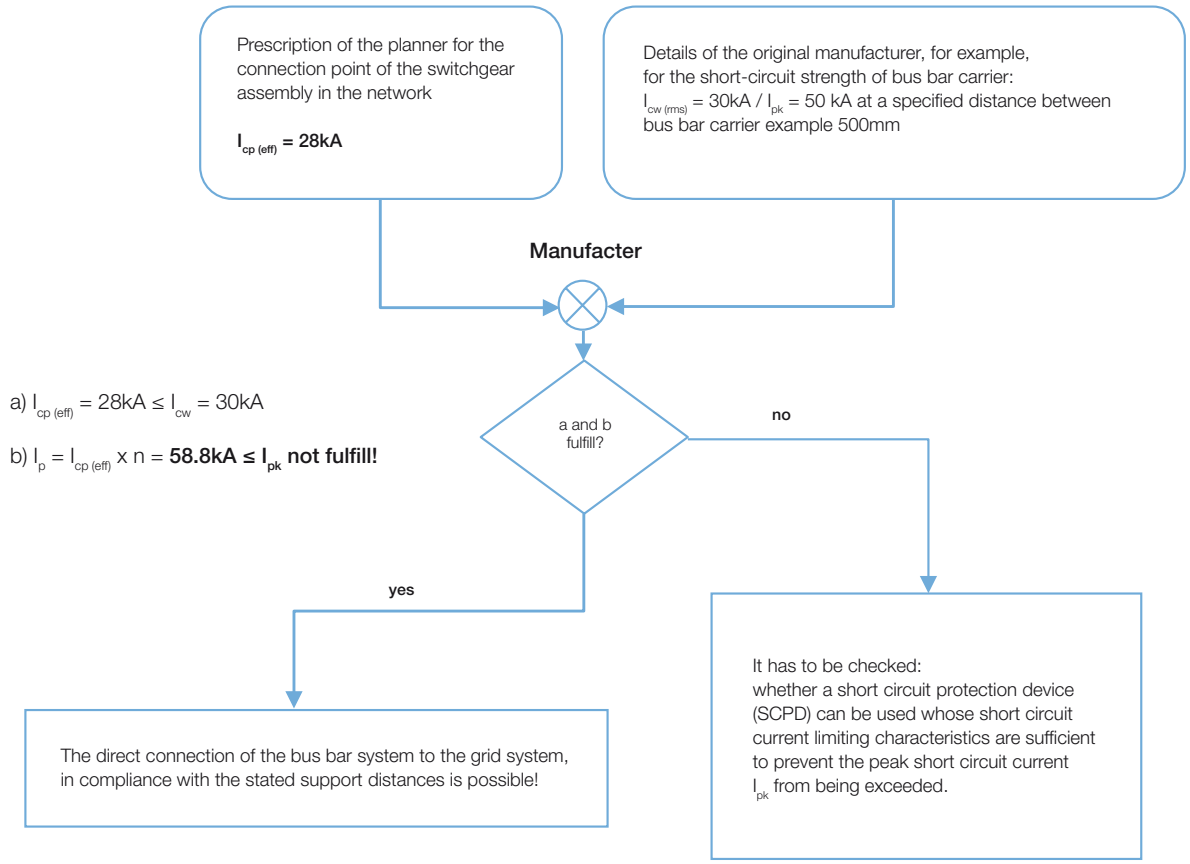


Example 2

If an ASSEMBLY for which the manufacturer specifies an $I_{cw\ (eff)}$, is to be connected to a system in which the peak value of the short-circuit current from the system (peak short-circuit current I_p) is higher than the rated peak short-circuit current specified by the manufacturer I_{pk} than a SCPD must be inserted upstream which is able to limit the peak value correspondingly.



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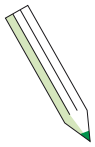
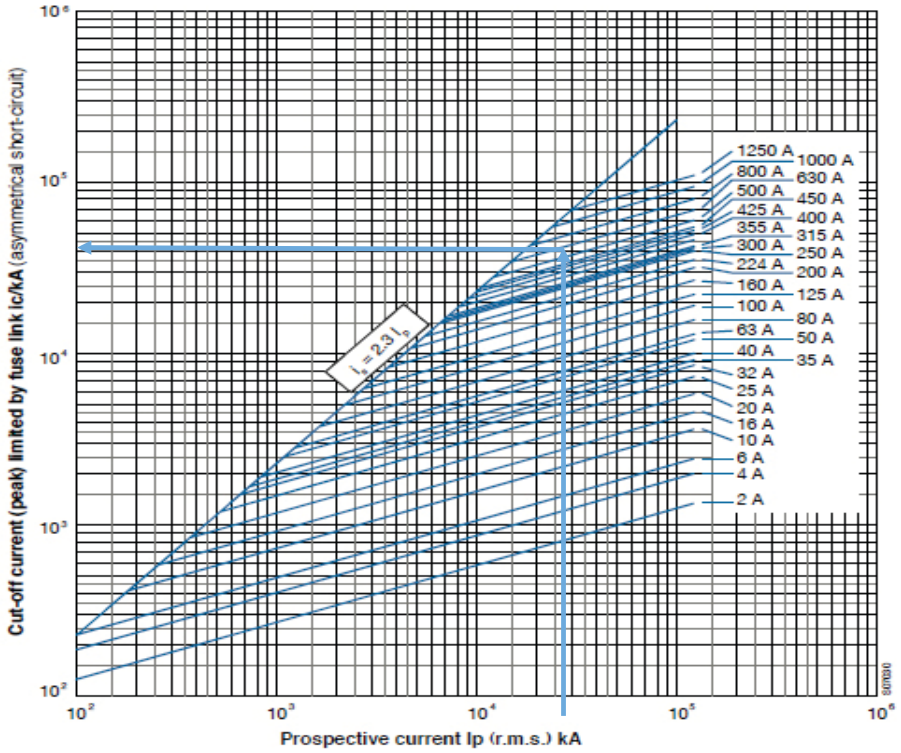


Evaluation of the cut-off current in combination with an NH fuse

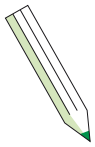
An NH fuse as upstream SCPD may sufficiently limit the cut-off current!

$I_{COC} \approx 42$ kA



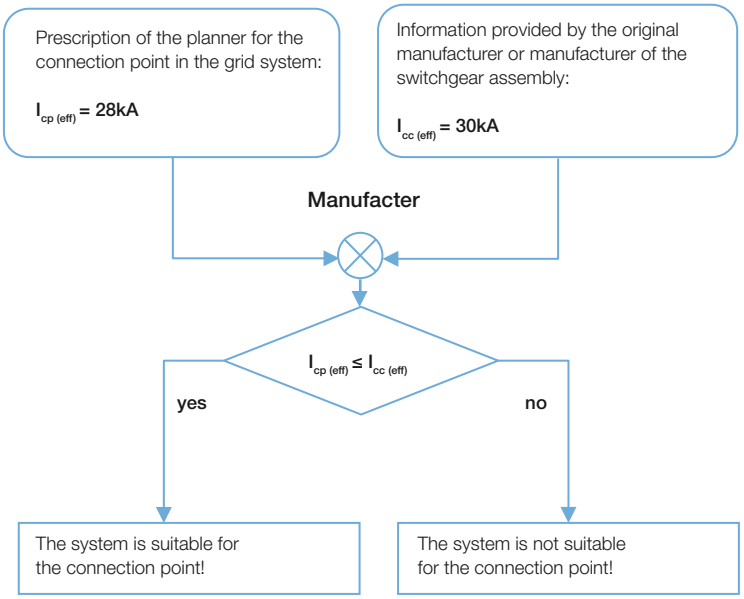
$I_{COC\ system} = 28$ kA

Notes



Example 3

The ASSEMBLY manufacturer or the original manufacturer may specify a conditional rated short-circuit current $I_{cc\ (eff)}$ and a suitable protection device. An ASSEMBLY is only suited for a use at the connecting point when the expected short-circuit current at the supply position I_{cp} does not exceed the specified I_{cc} .



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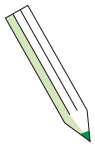
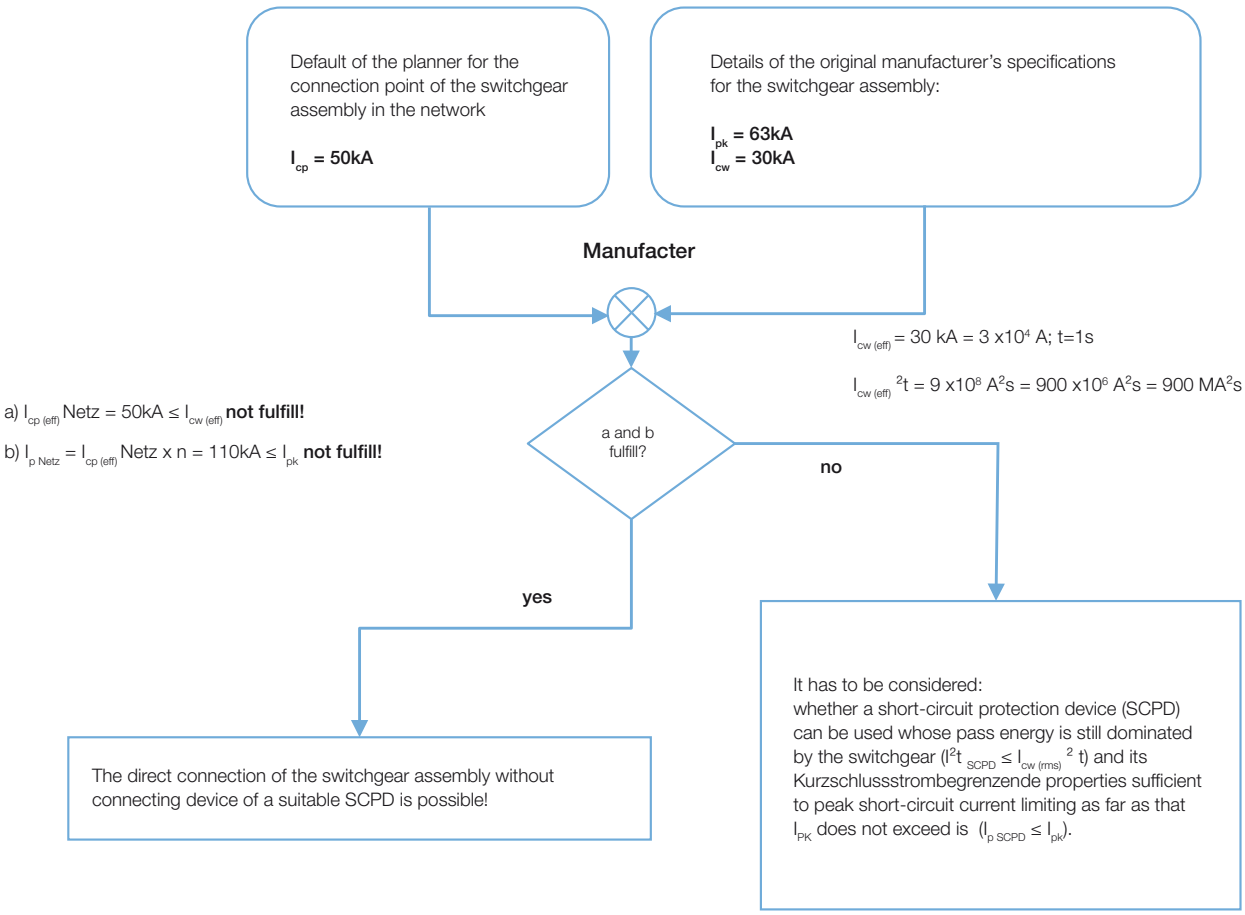


Example 4

If the expected short-circuit current at the supply position, the cut-off current and the power-limiting properties of a protective device to be inserted upstream are known, these values may also be matched to find out whether an ASSEMBLY may be used in a given system.



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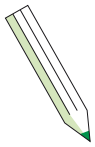
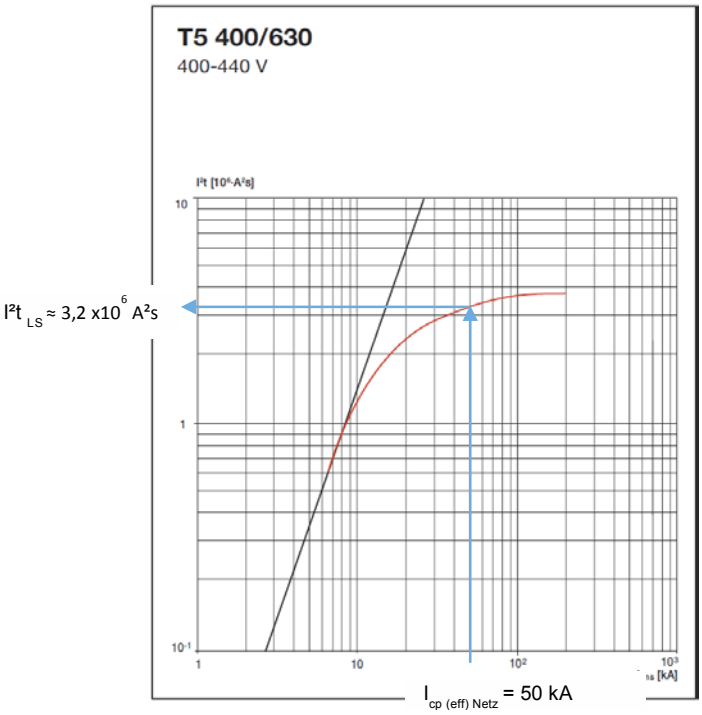


Distribution board design and design verification
Short-circuit current at the supply position

ABB SACE T-max T5 400 A as upstream SCPD

Evaluation of the cut-off energy

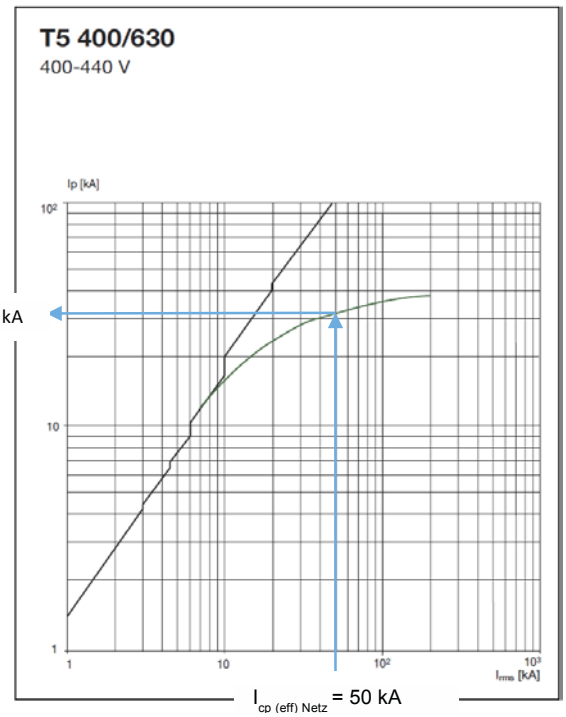


$I^2t_{LS} \approx 3{,}2 \times 10^6\ A^2s$

$I_{cp\ (eff)\ Netz} = 50\ kA$

$I^2t_{LS} \approx 3{,}2 \times 10^6\ A^2s < I_{cw\ (eff)}{}^2t = 900 \times 10^6\ A^2s$

Evaluation of the power limitation



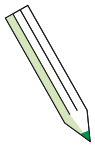
$I_{D\ LS} \approx 32\ kA$

$I_{cp\ (eff)\ Netz} = 50\ kA$

$I_{p\ LS} \approx 32\ kA < I_{pk} = 63\ kA$

An ABB SACE T-max T5 400 used as upstream SCPD would sufficiently protect the ASSEMBLY!

Notes



Distribution board design and design verification
Transformer nominal values table

For many cases it may be assumed that the short-circuit current will not exceed the limits* specified.

Transformer nominal values									
Nominal voltage									
U_N	230/400 V			525 V			400/690 V		
Short-circuit voltage									
U_K		4 %	6 %		4 %	6 %		4 %	6 %
Nominal rating S_N	Nominal current I_N	Short-circuit current I_K		Nominal current I_N	Short-circuit current I_K		Nominal current I_N	Short-circuit current I_K	
[kVA]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[A]
50	72	1805	-	55	1375	-	42	1042	-
100	144	3610	2406	110	2750	1833	84	2084	1302
160	230	5776	3850	176	4400	2933	133	3325	2230
200	280	7220	4860	220	5500	3667	168	4168	2784
250	360	9025	6015	275	6875	4580	210	5220	3560
315	455	11375	7583	346	8660	5775	263	6650	4380
400	578	14450	9630	440	11000	7333	336	8336	5568
500	722	18050	12030	550	13750	9166	420	10440	7120
630	910	22750	15166	693	17320	11550	526	13300	8760
800	1156	-	19260	880	-	14666	672	-	11336
1000	1444	-	24060	1100	-	18333	840	-	13920
1250	1805	-	30080	1375	-	22916	1050	-	17480
1600	2312	-	38530	1760	-	29333	1330	-	22300
2000	2888	-	48120	2200	-	36666	1680	-	27840
2500	3616	-	60210	2750	-	45833	2090	-	34830
3150	4546	-	75770	3464	-	57730	2635	-	43930

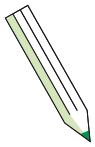
Rated currents and short-circuit current of standard transformers

S_N [kVA] = Apparent power of the transformer
U_N [V] = Nominal voltage of the transformer
I_N [A] = Nominal current of the transformer
U_K [%] = Short-circuit voltage of the transformer
I_K [A] = Short-circuit current of the transformer

$I_N = S_N / (\sqrt{3} * U_N)$ **$I_K = (I_N / U_N\ [\%]) * 100$**

* See chapter 2, section 10.11
Verification of the short - circuit strength

Notes



10.12 Electro-magnetic compatibility (EMC)

An ASSEMBLY'S functional units must undergo the following tests.
Emitted-interference and interference-immunity tests are to be carried out in accordance with the applicable EMC standards and the ASSEMBLY manufacturer will have to detail every action required to verify the performance criteria of an ASSEMBLY (such as the use of holding times).

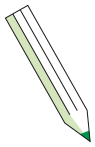
10.13 Mechanical operation

This verification must not be carried out for such ASSEMBLY parts (e.g. withdrawable circuit breakers) which have already been type tested according to the applicable provisions unless their mechanical function has changed through the process of installation.

For those parts which need to be verified (see 8.1.5), proper mechanical functioning has to be verified after their installation to an ASSEMBLY. The number of operating cycles shall be 200.

At the same time, the function of the locking devices associated with these movements is to be tested. A test will be passed satisfactorily if the operation of the devices, interlocks, the defined degree of protection, etc. are not impaired and if the effort required to operate is practically the same before and after testing.

Notes

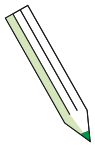


Distribution board design and design verification
Devices from other manufacturers

In general, our low voltage switchgear and controlgear ASSEMBLIES and the system components which we offer are tested with ABB equipment.
In case that devices from another manufacturer will be used as short-circuit protective devices in low voltage switchgear and controlgear ASSEMBLIES, a new short-circuit test has necessarily to be carried out.

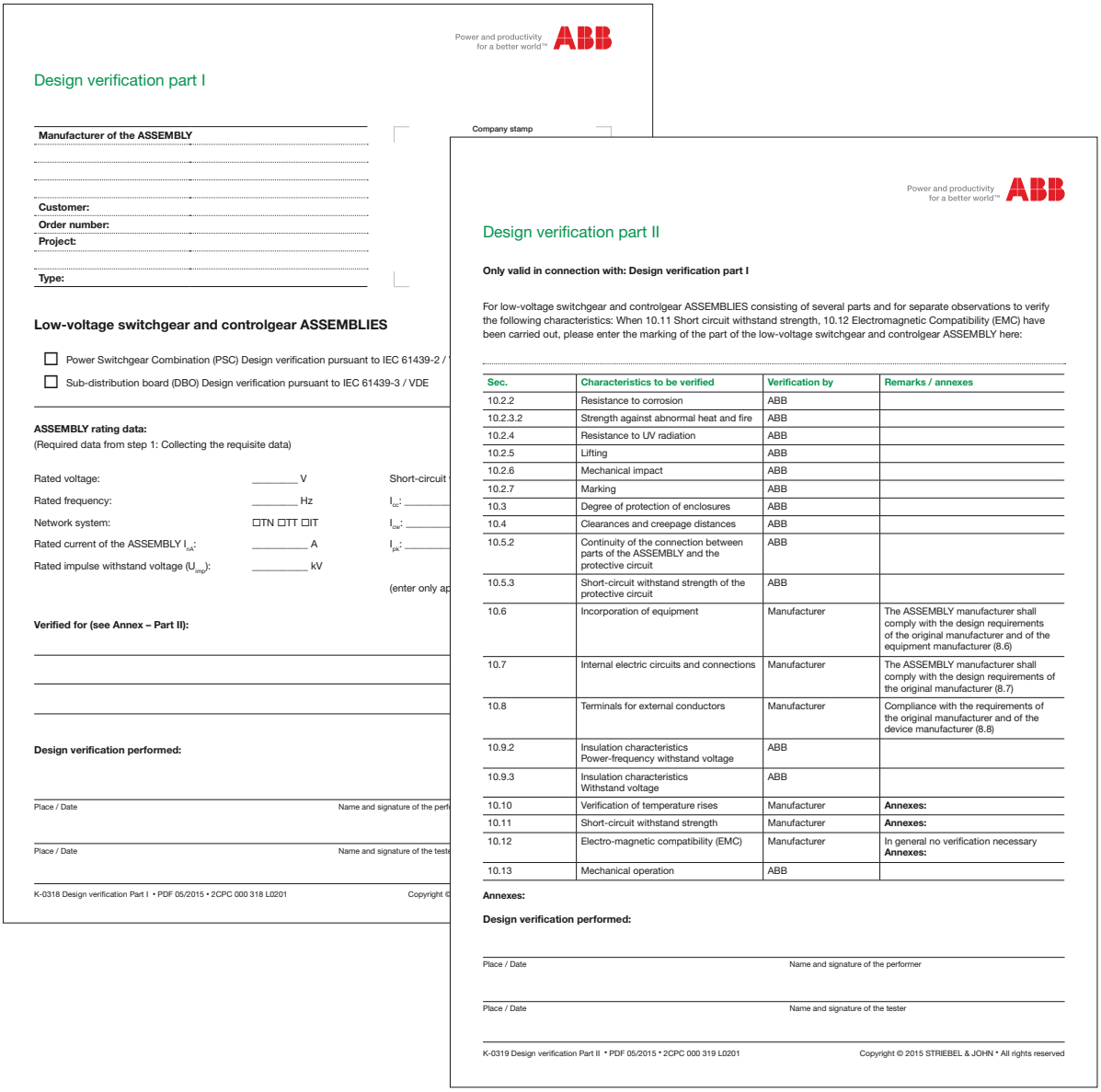
This means that (subject to the positive outcome of a mechanical test), products from other manufacturers might be incorporated.
This manufacturer, however, who offers this product (and who thus becomes original manufacturer due to the installation of the other product as provided for in IEC 61439-1), should carry out a short-circuit test.

Notes



Distribution board design and design verification
Form sheet examples

Our form sheets assist you as responsible manufacturer in the preparation of your design verifications.



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Design verification part I

Manufacturer of the ASSEMBLY

Company stamp

Customer:

Order number:

Project:

Type:

Low-voltage switchgear and controlgear ASSEMBLIES

☐ Power Switchgear Combination (PSC) Design verification pursuant to IEC 61439-2 /

☐ Sub-distribution board (DBO) Design verification pursuant to IEC 61439-3 / VDE

ASSEMBLY rating data:
(Required data from step 1: Collecting the requisite data)

Rated voltage: _____ V

Rated frequency: _____ Hz

Network system: ☐TN ☐TT ☐IT

Rated current of the ASSEMBLY I_{nA}: _____ A

Rated impulse withstand voltage (U_{imp}): _____ kV

Short-circuit

I_{cc}: _____

I_{cw}: _____

I_{pk}: _____

(enter only ap

Verified for (see Annex – Part II):

Design verification performed:

Place / Date

Name and signature of the perf

Place / Date

Name and signature of the teste

K-0318 Design verification Part I • PDF 05/2015 • 2CPC 000 318 L0201

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Design verification part II

Only valid in connection with: Design verification part I

For low-voltage switchgear and controlgear ASSEMBLIES consisting of several parts and for separate observations to verify the following characteristics: When 10.11 Short circuit withstand strength, 10.12 Electromagnetic Compatibility (EMC) have been carried out, please enter the marking of the part of the low-voltage switchgear and controlgear ASSEMBLY here:

Sec.	Characteristics to be verified	Verification by	Remarks / annexes
10.2.2	Resistance to corrosion	ABB	
10.2.3.2	Strength against abnormal heat and fire	ABB	
10.2.4	Resistance to UV radiation	ABB	
10.2.5	Lifting	ABB	
10.2.6	Mechanical impact	ABB	
10.2.7	Marking	ABB	
10.3	Degree of protection of enclosures	ABB	
10.4	Clearances and creepage distances	ABB	
10.5.2	Continuity of the connection between parts of the ASSEMBLY and the protective circuit	ABB	
10.5.3	Short-circuit withstand strength of the protective circuit	ABB	
10.6	Incorporation of equipment	Manufacturer	The ASSEMBLY manufacturer shall comply with the design requirements of the original manufacturer and of the equipment manufacturer (8.6)
10.7	Internal electric circuits and connections	Manufacturer	The ASSEMBLY manufacturer shall comply with the design requirements of the original manufacturer (8.7)
10.8	Terminals for external conductors	Manufacturer	Compliance with the requirements of the original manufacturer and of the device manufacturer (8.8)
10.9.2	Insulation characteristics Power-frequency withstand voltage	ABB	
10.9.3	Insulation characteristics Withstand voltage	ABB	
10.10	Verification of temperature rises	Manufacturer	**Annexes:**
10.11	Short-circuit withstand strength	Manufacturer	**Annexes:**
10.12	Electro-magnetic compatibility (EMC)	Manufacturer	In general no verification necessary **Annexes:**
10.13	Mechanical operation	ABB	

Annexes:

Design verification performed:

Place / Date

Name and signature of the performer

Place / Date

Name and signature of the tester

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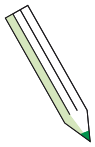
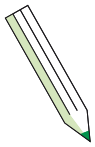
Notes



Chapter 3
Building / manufacture of the distribution board

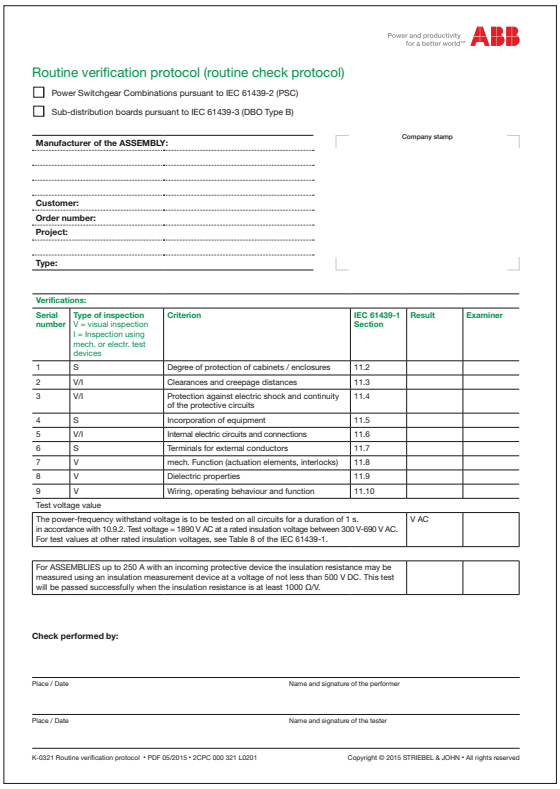
	Constructional requirements	Section from IEC 61439-2, 3
3.1	**ASSEMBLY of individual components / groups of components to enclosures / cabinets**	
	– Please observe the information in our catalogues / ASSEMBLY instructions	
	– Observing the protective measures for switchgear in	
	– Protection class I (with protective conductor)	8.4.3.2
	– Protection class II (double insulation)	8.4.4
3.2	**Installation of the devices**	
	– The devices must be installed according to our instructions and/or the instructions of the device manufacturer	8.5
	– Care should be taken in particular to ensure:	8.5.4
	– the accessibility of the devices	8.5.5
	– sufficient heat dissipation / ventilation	8.7
	– For installation distribution boards the protective devices must be suited for an operation by ordinary people	8.5.3
3.3	**Wiring inside switchgear**	
	– General requirements for the wiring of bare and insulated conductors	
	– Selecting the cross-sections	8.6.3 +
	– Recommendation of the cross-sections depending on the load capacities and types of installation	Annex H
	– Selecting the cross-sections of N, PE and PEN conductors	
	– Cross-section of N conductors	
	– Up to 16 mm^2 including, 100 % of the associated phase conductors	
	– Above 16 mm^2, 50 % of the associated phase conductors, not less than 16 mm^2	8.6.1
	– Cross-section of PEN conductors	
	– PEN min. 10 mm^2 for CU and 16 mm^2 for Al, not smaller than the neutral conductor	
	It is assumed that the neutral conductor will not exceed 50 % of the phase conductor currents. Due to the usual operating conditions (e.g. harmonics, non-synchronous loads due to AC consumers) the N, PEN conductor should correspond to the cross section of the phase conductors.	8.4. 3.2.3
	– Cross-section of PE conductors	
	– Earthed and short-circuit protected installation	8.4.3.2.3 + Table 3
	– Wire markings of insulated conductors in main and auxiliary circuits	8.6.1
	– Phase conductor marking (black)	Sections 1+2
	– Marking of PE, N, PEN	8.6.4 + Table 4
	– Compliance with clearances and creepage distances	
	– Up to a rated insulation voltage of AC 690 V, compliance with the following clearances is recommended (especially for busbars):	8.6.5
	– bare, energized live parts to each other: 10 mm	8.6.6
	– bare, energized live parts to bodies and constructional components: 15 mm	8.3
3.4	**Terminals for external conductors**	8.8
	– The terminals shall be designed to the circuit's current load capacity and Short-circuit withstand strength.	
	– Terminals for external protective conductors	Table A.1, Annex A
3.5	**ASSEMBLY of doors, covers and of cladding**	
	– Compliance with the protection against direct contact (e.g. IP2x or IPXXB)	8.4.2
	– Observing the protective measure	
	– Protection class I (with protective conductor)	8.4.2.3
	– Protection class II (double insulation)	8.4.4
	– Compliance with the IP degree of protection	8.2.2
3.6	**Labels / documentation**	
	– Type plate	6.1
	– Distribution board data	6.2.1
	– Handling, installation, operating and maintenance instructions	6.2.2
	– Equipment markings / wiring diagrams	6.3

Notes



Chapter 4
Routine verification

The ASSEMBLY manufacturer carries out routine verifications. They are intended to detect defects in workmanship and or materials and are designed to guarantee proper functioning of ASSEMBLIES prior to being introduced to the market



Routine verification protocol (routine check protocol)

☐ Power Switchgear Combinations pursuant to IEC 61439-2 (PSC)

☐ Sub-distribution boards pursuant to IEC 61439-3 (DBO Type B)

Manufacturer of the ASSEMBLY:

Company stamp

Customer:

Order number:

Project:

Type:

Verifications:

Serial number	Type of inspection V = visual inspection I = Inspection using mech. or electr. test devices	Criterion	IEC 61439-1 Section	Result	Examiner
1	S	Degree of protection of cabinets / enclosures	11.2		
2	V/I	Clearances and creepage distances	11.3		
3	V/I	Protection against electric shock and continuity of the protective circuits	11.4		
4	S	Incorporation of equipment	11.5		
5	V/I	Internal electric circuits and connections	11.6		
6	S	Terminals for external conductors	11.7		
7	V	mech. Function (actuation elements, interlocks)	11.8		
8	V	Dielectric properties	11.9		
9	V	Wiring, operating behaviour and function	11.10		
Test voltage value					
The power-frequency withstand voltage is to be tested on all circuits for a duration of 1 s. in accordance with 10.9.2. Test voltage = 1890 V AC at a rated insulation voltage between 300 V-690 V AC. For test values at other rated insulation voltages, see Table 8 of the IEC 61439-1.				V AC	
For ASSEMBLIES up to 250 A with an incoming protective device the insulation resistance may be measured using an insulation measurement device at a voltage of not less than 500 V DC. This test will be passed successfully when the insulation resistance is at least 1000 Ω/V.					

Check performed by:

Place / Date — Name and signature of the performer

Place / Date — Name and signature of the tester

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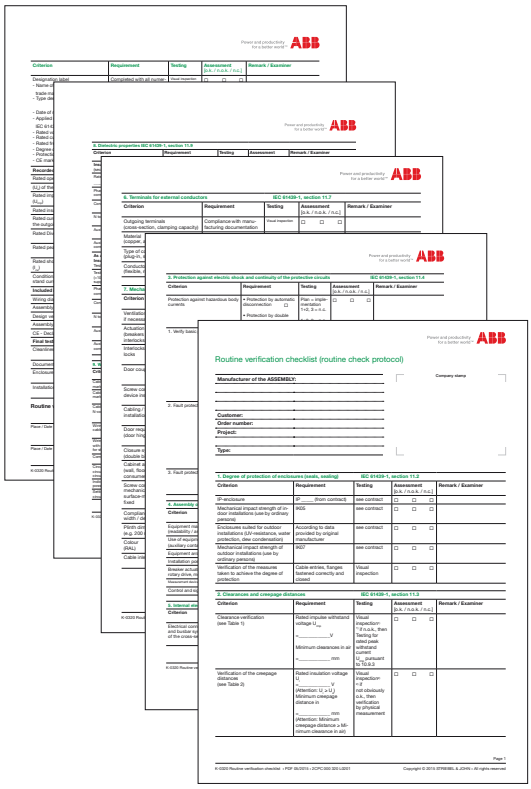


Routine verification checklist (routine check protocol)

Manufacturer of the ASSEMBLY:

Company stamp

Customer:

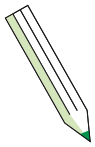
Order number:

Project:

Type:

Also the correct documents for the design verification should be available (see Step 2: Distribution board design and design verification).

Notes



Chapter 5
CE conformity declaration

The low voltage directive (2006/95/EC) stipulates that every marketed product falling within the scope of this directive has to bear the CE mark and that there has to be an associated declaration of conformity. This EU Directive is implemented as the Product Safety Act in German law.

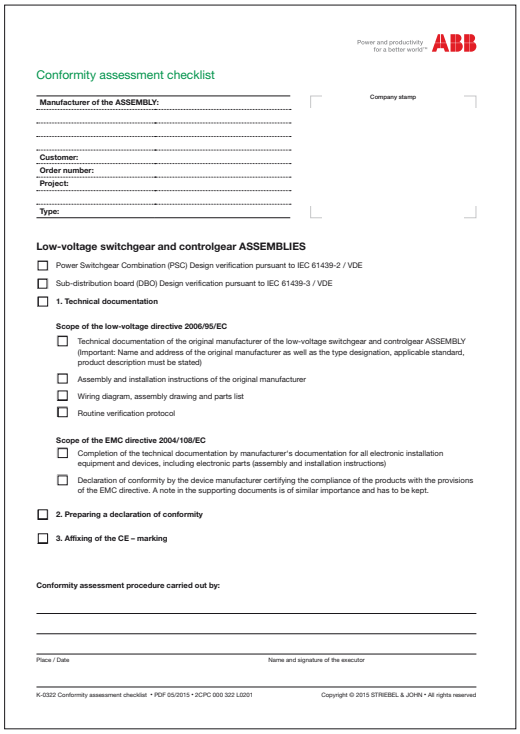
Declaration of conformity of the manufacturer (Manufacturer's declaration)

Manufacturers may issue their own declarations of conformity, i.e. there is no need to involve another entity. All this complies with the product liabilities provisions - manufacturers are liable for their products and therefore it is justified to trust in a manufacturer's declaration.
Prior to the delivery of a declaration of conformity the manufacturer has to undergo a conformity assessment procedure as provided for in the low voltage directive (Annex IV). This includes the preparation of the technical documentation including the design verifications, the test reports allowing to assess whether the requirements arising from the directives are being complied with. The manufacturer has to keep this technical documentation for a period of 10 years and to submit it to the authorities on request.
This documentation reduces the risk that you as manufacturer will be held liable pursuant to the Product Safety Act.

As manufacturer we assist you by our declaration of conformity (to the extent that we market products falling within the scope of the low voltage directive and/or the Product Safety Act) and by our form sheets:

- Routine verification protocol (see explanations under Step 4: Implementing routine verifications)
- Checklist on the conformity assessment procedure
- Declaration of conformity

In addition, you are free to use all shown tables as additional tools and may save them from our download area.



Power and productivity for a better world™ ABB

Conformity assessment checklist

Company stamp

Manufacturer of the ASSEMBLY:

Customer:
Order number:
Project:
Type:

Low-voltage switchgear and controlgear ASSEMBLIES

☐ Power Switchgear Combination (PSC) Design verification pursuant to IEC 61439-2 / VDE
☐ Sub-distribution board (DBO) Design verification pursuant to IEC 61439-3 / VDE
☐ **1. Technical documentation**

Scope of the low-voltage directive 2006/95/EC

☐ Technical documentation of the original manufacturer of the low-voltage switchgear and controlgear ASSEMBLY (Important: Name and address of the original manufacturer as well as the type designation, applicable standard, product description must be stated)
☐ Assembly and installation instructions of the original manufacturer
☐ Wiring diagram, assembly drawing and parts list
☐ Routine verification protocol

Scope of the EMC directive 2004/108/EC

☐ Completion of the technical documentation by manufacturer's documentation for all electronic installation equipment and devices, including electronic parts (assembly and installation instructions)
☐ Declaration of conformity by the device manufacturer certifying the compliance of the products with the provisions of the EMC directive. A note in the supporting documents is of similar importance and has to be kept.

☐ **2. Preparing a declaration of conformity**
☐ **3. Affixing of the CE – marking**

Conformity assessment procedure carried out by:

Place / Date — Name and signature of the executor

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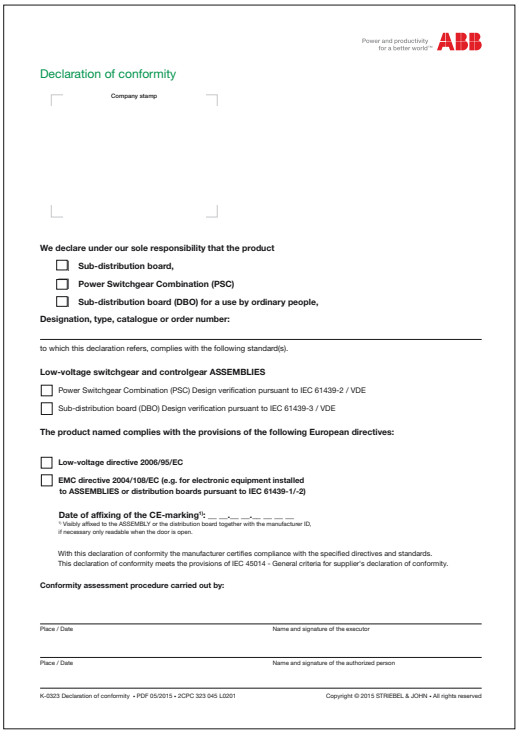

Power and productivity for a better world™ ABB

Declaration of conformity

Company stamp

We declare under our sole responsibility that the product

☐ **Sub-distribution board,**
☐ **Power Switchgear Combination (PSC)**
☐ **Sub-distribution board (DBO) for a use by ordinary people,**

Designation, type, catalogue or order number:

to which this declaration refers, complies with the following standard(s).

Low-voltage switchgear and controlgear ASSEMBLIES

☐ Power Switchgear Combination (PSC) Design verification pursuant to IEC 61439-2 / VDE
☐ Sub-distribution board (DBO) Design verification pursuant to IEC 61439-3 / VDE

The product named complies with the provisions of the following European directives:

☐ **Low-voltage directive 2006/95/EC**
☐ **EMC directive 2004/108/EC (e.g. for electronic equipment installed to ASSEMBLIES or distribution boards pursuant to IEC 61439-1/-2)**

Date of affixing of the CE-marking[1]: __.__.__

[1] Visibly affixed to the ASSEMBLY or the distribution board together with the manufacturer ID, if necessary only readable when the door is open.

With this declaration of conformity the manufacturer certifies compliance with the specified directives and standards.
This declaration of conformity meets the provisions of IEC 45014 - General criteria for supplier's declaration of conformity.

Conformity assessment procedure carried out by:

Place / Date — Name and signature of the executor

Place / Date — Name and signature of the authorized person

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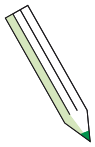
Notes



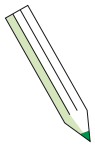
Symbols and abbreviations

Symbol / abbreviation	Characteristic feature	Section
CTI	Comparative number of the creeping movement	3.6.17
ELV	Extra-low voltage	3.7.11
EMC	Electromagnetic Compatibility	3.8.13
f_n	Rated frequency,	3.8.12
I_c	Short-circuit current	3.8.6
I_{cc}	Conditional short-circuit current	3.8.10.4
I_{cp}	Uninfluenced short-circuit current	3.8.7
I_{cw}	Rated short-time current	3.8.10.3
I_{nA}	Rated current of an ASSEMBLY	5.3.1
I_{nc}	Rated current of a circuit	5.3.2
I_{pk}	Rated peak withstand current	3.8.10.2
N	Neutral conductor	3.7.5
PE	Protective conductor	3.7.4
PEN	PEN conductor	3.7.6
RDF	Rated Diversity Factor	3.8.11
SCPD	Short-circuit protective device	3.1.11
SPD	Surge protective device	3.6.12
U_e	Rated operational voltage	3.8.9.2
U_i	Rated insulation voltage	3.8.9.3
U_{imp}	Rated impulse withstand voltage	3.8.9.4
U_n	Rated voltage	3.8.9.1

Comparisons and effects in connection with different standards

Short-circuit currents in AC systems IEC 73/162/CD	Low-voltage switchgear and controlgear ASSEMBLIES IEC 61439-1	Low voltage switching devices IEC 60947-2
I_r Rated current of anelectrical equipment	**I_{nA} / I_{nc}**	**I_n** Rated current
I_k Sustained short-circuit current	**I_{cp}**	**I_{cu}** Rated ultimate short-circuit breaking capacity **I_{cs}** Rated service short-circuit breaking capacity
I_p Peak short-circuit current	**I_{pk}**	**I_{cm}** Rated short-circuit making capacity
I_{th} Thermally effective short-circuit current	**I_{cw}**	**I_{cw}** Rated short-time withstand current

Notes



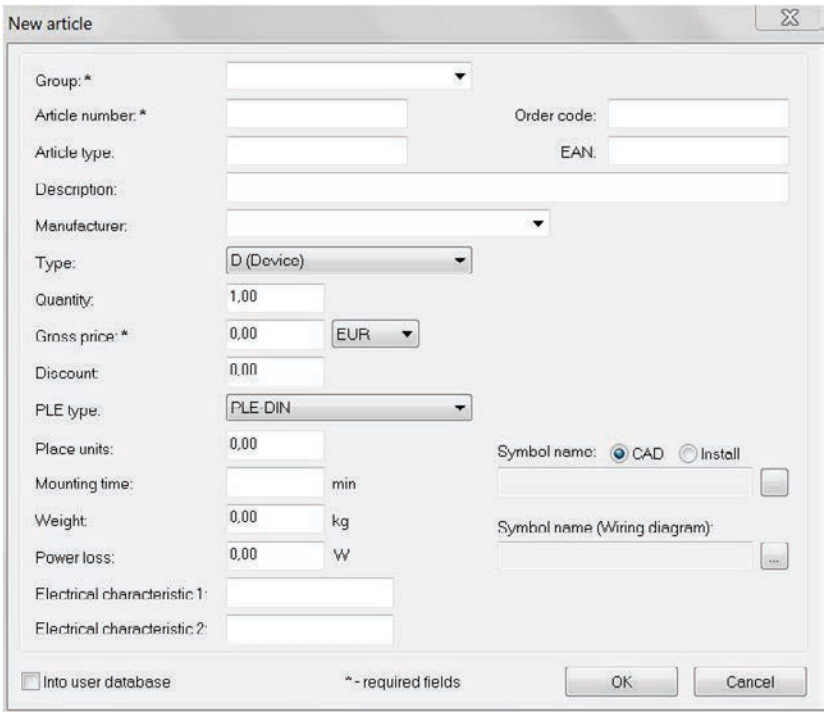
Minimum requirements for the type plate
Example ABB

IEC	**61439-2**
Type code	**TW-series with plinth**
Rated voltage	**400 V**
Current Type / Frequency	**AC / 50 HZ**
Degree of protection	**IP55**
Protection class	**I (earthed)**
max. Fuse	**400 A**
Rated current	**250 A**
Projekt	**Example**
DB	**Distribution board - DBO**
Production date	**XX/20XX** Order-No. **000 000 000** CE

Minimum requirements:
a. Name of the Manufactor of the ASSEMBLY
b. IEC 61439-X
c. Type or code number
d. production date

Using part 3, the rated current of an ASSEMBLY is additionally specify!

Notes


New article
Group: *
Article number: *
Order code:
Article type:
EAN:
Description:
Manufacturer:
Type:
D (Device)
Quantity:
1,00
Gross price: *
0,00
EUR
Discount:
0,00
PLE type:
PLE DIN
Place units:
0,00
Symbol name: CAD Install
Mounting time:
min
Weight:
0,00
kg
Symbol name (Wiring diagram):
Power loss:
0,00
W
Electrical characteristic 1:
Electrical characteristic 2:
Into user database
* - required fields
OK
Cancel

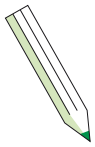
New use articles

Also such articles may be used at any time, which are not recorded in the default database. You may use an article for a single project only or save it to the user database. Under 'Edit' select 'Insert new article' or use the button 'New user article' from the product list bar.

PLE type

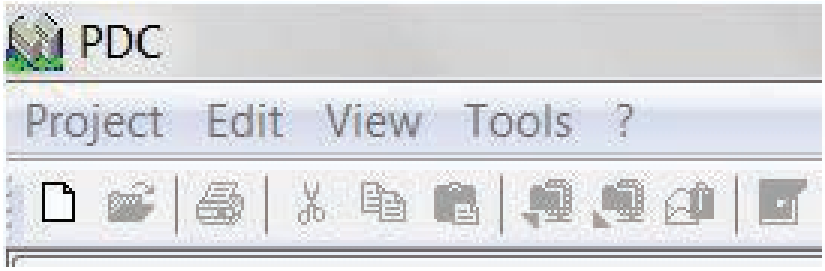
SpaceName	Spaceunit	Description
PLE-DIN	SU	SU for DIN rail devices
PLE-K	SU	SU for terminals on DIN rails
PLE-M	SU	SU for devices on mounting plates
PLE-U	SU	SU
PLE-A	SU	SU for wiring space for devices
PLE-B60 mm	SU	for mounting fuse socket
PLE-L100 mm	SU	for fuse switch disconnectors with a CU busbar spacing of 100 mm
PLE-L185 mm	SU	for fuse switch disconnectors with a CU busbar spacing of 185 mm
PLE-NH00	Unit	SU for size 00 separator
PLE-NH1	Unit	SU for size 01 separator
PLE-NH2	Unit	SU for size 02 separator
PLE-NH3	Unit	SU for size 03 separator
Z	Unit	SU for meters
TSG	Unit	SU for TSG
RE	Unit	SU grid unit for modules in the enclosure
PLE-C	SU	SU for covers
PLE-SS	SU	SU for CU busbars
PLE-NH00	Unit	SU for size 00 separator on CU busbars
PLE-NH1-SS	Unit	SU for size 01 separator on CU busbars
PLE-DIN-S	SU	SU for DIN rail devices for SmissLine
T4	Unit	SU for Tmax T4
PLE-Tx	mm	SU
PLE-T45x	mm	SU
eHZ	Unit	SU for EDS
PLE-XTx	mm	SU
XT4	Unit	SU for Tmax XT4 load switches/MCCB
PLE-L50 mm	SU	for fuse switch disconnectors with a CU busbar spacing of 50 mm
T1	Unit	SU for Tmax T1 load switches/MCCB
T2	Unit	SU for Tmax T2 load switches/MCCB
T3	Unit	SU for Tmax T3 load switches/MCCB
T5	Unit	SU for Tmax T5 load switches/MCCB
T6	Unit	SU for Tmax T6 load switches/MCCB
T7	Unit	SU for Tmax T7 load switches/MCCB
PLE-T	SU	SU
PLE-S700	SU	SU for S700 selective main circuit breakers
XT2	Unit	SU for Tmax XT2 load switches/MCCB

Notes



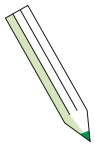
Export/import of user article data

It is possible to export or import user data.
To do so, you should not be working at a project.



Select 'Tools' then 'Data import or export' to import or export the user data.

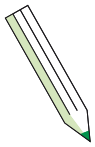
Notes



Temperature rise verification up to 630 A
Solution example

Pos	Number	Manufacturer	Type	Description	Rated current of the equipment I_n	P_{vn}	Derat-ing [1]	Rated current of a circuit I_{nc}	assumed load factor [2]	assumed operating current I_B	Power loss of a device at I_B	Sum of the power losses
					(A)	(W)		(A)		(A)	(W)	(W)
										$I_B = I_{nc} \cdot$ assumed load factor	$P_B = P_{vn} \cdot (I_B/I_n)^2$	$P_{vB} = P_B$ number
1	1	ABB	T5	Tmax	400 A	31,8 W	1	400 A	0,8	320 A	20,35 W	20,35 W
2	6	ABB	NH	XLP00	160 A	42,6 W	0,6	96 A	0,8	76,8 A	9,82 W	58,89 W
3	40	ABB	FI	F204A-40/0,03	40A	8,4 W	0,6	24 A	0,8	19,2 A	1,94 W	46,45 W
4	144	ABB		S201-B16	16 A	2,5 W	0,6	9,6 A	0,8	7,68 A	0,58 W	82,94 W
											Sum of the installed power losses $\sum P_v$	208,63
											Wiring power loss (30 %) [3] 30	62,59

Notes

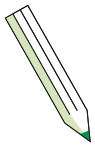


Data collection tables

Characteristics	Information provided by the planner / customer	Information provided by the manufacturer
Nominal voltage of the incoming supply	AC _____ V _____ Hz DC _____ V	U_e = _____ V f_n = _____ Hz
System	_____ TN-C _____ TN-C-S _____ TN-S _____ TT _____ IT	_____ Protection by automatic disconnection of the power supply (PC I) _____ protection by protective insulation (PC II)
Rated current	Supply current (nominal current transformer / upstream protective device)	I_{nA} = _____ A
Short-circuit withstand strength (please see notes on pages 9 - -12)	I_{cp} = _____ kA (uninfluenced short-circuit current at the supply terminals)	I_{pk} = _____ kA I_{cw} = _____ kA I_{cc} = _____ kA
Overvoltage	Overvoltage category _____ III _____ IV	Rated impulse withstand voltage U_{imp} = _____ kV
Incoming line connection	_____ from below _____ from above _____ copper conductor _____ aluminium conductor _____ connection using terminal blocks	_____ single-core cable _____ multi-core cable _____ number _____ mm^2 section _____ copper conductor _____ aluminium conductor _____ connection to equipment _____ connection using terminal blocks

Consumer / circuit types	Information provided by the planner / customer			Data to be derived from step 2 by manufacturer	
	Number of circuits	Type of protective device	Distribution board ratings	Circuit ratings	Type of protective device
Distribution circuits for downstream subdistribution boards		___ fuse ___ MCB ___ MCCB			
Final circuits					
	Number of circuits	Type of the protective conductor connection	Consumer ratings	Circuit ratings	Type of protective device
Socket		____ fuse ___ MCB ____ Circuit breaker and residual current device	_____ A	I_{nc} = _____ A	
Ohmic load, heater		____ fuse ___ MCB ____ MCCB	_____ kW	I_{nc} = _____ A	
Inductive consumer, motor, direct		___ fuse ___ MCB ___ MCCB	_____ kW _____ cos φ	I_{nc} = _____ A	
Inductive consumer, motor, controlled		____ fuse ___ MCB ____ manufacturer's description	_____ kW _____ cos φ	I_{nc} = _____ A	
Capacitive consumers		____ fuse ___ MCB ____ manufacturer's description	_____ kW _____ cos φ	I_{nc} = _____ A	

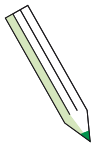
Notes



Data collection tables

Conditions of use	Information provided by the planner / customer	Measures/recommendations of the ASSEMBLY manufacturer		Selection
		Definition pursuant to standard IEC 61439-1	This information is to be taken into account in designing ASSEMBLIES	
Indoor installation	**Atmospheric conditions Foreign bodies / dust**	not less than IP2X	Comply with more severe requirements arising from the product standard	
	Foreign bodies	Diameter ≥ 12.5 mm	IP2X	
	Foreign bodies	Diameter ≥ 2.5 mm	IP3X	
	Dust Increased presence of dust	dust-protected	IP5X	
	Dust conductive	dusttight	IP6X	
	Humidity / water			
	Dripping water		IPX1	
	Occasional cleaning around the distribution board, impact by diverted water		IPX4	
	Functional cleaning around the distribution board, impact by diverted water		IPX5	
	Temporary immersion		IPX7	
	Room air conditioned / temperature range	-5 to +35 °C	Indicate the power loss of the ASSEMBLY for the dimensioning of the air-conditioning	
	Room ventilated / temperature range, relative humidity	-5 to +35 °C 90 % at 20 °C, up to 50 % at 40 °C	Indicate the power loss of the ASSEMBLY in order for ventilation dimensioning; and state the room size. Higher ambient air temperatures are to be taken into account in the planning of ASSEMBLIES	
Outdoor installation	**Protected installation /** temperature range, relative humidity (against rain, sunshine and wind)	-25 to +35 °C 90 % at 20 °C, up to 50 % at 40 °C, short term up to 100 % at 25 °C	Possible measures against moderate condensation due to temperature variations: Ventilating, heating, air conditioning	
	Foreign bodies / dust	not less than IP2X	For increased dust production use a higher degree of protection such as IP5X	
	Humidity / water	not less than IPX1	The manufacturer states the suitability of the protected installation, if necessary by applying additional measures	
	Unprotected installation / temperature range rel. humidity	-25 to +35 °C 90 % at 20 °C, up to 50 % at 40 °C, short term up to 100 % at 25 °C	Higher ambient air temperatures which might result from direct sunlight are to be taken into account in the planning of ASSEMBLIES Possible measures against moderate condensation due to temperature variations: Ventilating, heating, air conditioning	
	Direct sunlight	UV resistance	Follow manufacturer's instructions	
	Foreign bodies / dust	not less than IP2X	For increased dust production use a higher degree of protection such as IP5X	
	Humidity / water	not less than IPX1	The manufacturer states the suitability of the protected installation, if necessary by applying additional measures	

Notes

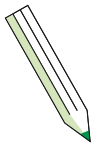


Data collection tables

Conditions of use	Information provided by the planner / customer	Measures/recommendations of the ASSEMBLY manufacturer		Selection
		Definition pursuant to standard IEC 61439-1	This information is to be taken into account in the planning of ASSEMBLIES	
Dimensions for transport and installation	Type of installation: To the wall (recess), to the wall, free installation to base frame, double floor	None		_____ _____ _____
	Aisle widths / escape routes: Room dimensions and access doors	See IEC 60364-7-729 Requirements for special installations or locations – operating or maintenance gangways	Minimum aisle widths and the direction of the escape routes are to be taken into account in the planning of ASSEMBLIES	
	Distribution board: max. dimensions: W x H x D max. weight	None	Possible restrictions are to be stated	W _____ H _____ D _____ kg _____
	Transport: max. transport dimensions W x H x D, max. transport weight Transport type, e.g. crane Accessibility at the construction site	None	Possible restrictions are to be stated, such as only standing transport, max. acceleration values	W _____ H _____ D _____ kg _____
Chemical influences		None	Type of the enclosure material Chemical device version Special installation / ventilation	
Mechanical impact		Sub-distribution board Indoor installation Outdoor installation		IK05 IK07
Enclosure material	Sheet steel Plastic	None		
Enclosure colour			Comply with customer specifications / call for tender documents	
EMC	Environment A Non-public or industrial LV networks / areas / installations including strong sources of interference		Confirmation by the manufacturer in accordance with environment A	
	Environment B Public LV networks such as domestic, commercial and light industrial locations		Confirmation by the manufacturer in accordance with environment B	

Characteristics	Information provided by the planner / customer	Information provided by the manufacturer	Selection
Operation through:	Skilled person (electrically) Instructed person Ordinary persons	IPXXB IPXXB IPXXC	
Device activation	Behind the door / cover From outside		
Access / door closure	Lock For semi-cylinder (central locking system) Other		

Notes



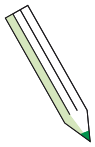
Verification of temperature rise up to 630 A

Pos	Number	Manufacturer	Type	Description	Rated current of the equipment I_n	P_{vn}	Derating [1)]	Rated current of a circuit I_{nc}	Assumed load factor [2)]	Assumed operating current I_B	Power loss of a device at I_B	Sum of the power losses
					(A)	(W)		(A)		(A)	(W)	(W)
										$I_B = I_{nc} \cdot$ assumed load factor	$P_B = P_{vn} \cdot (I_B/I_n)^2$	$P_{vB} = P_B \cdot$ number

Sum of the installed power losses		
Wiring power loss (%) [3)]	30	
Power loss dissipation of the enclosure		
Difference = power loss dissipation – sum of the installed power loss= $P_{vzul} - \sum P_{vB}$		

1) According to IEC 61439-2 Table 101 – Values of assumed loading – depending on the number of equipment used in the same time
2) Manufacturer information for equipment under different conditions, but not less than 0.8 in line with section 10.10.4.2.1c
3) The wiring power loss is assumed as percentage of the equipment power losses – proposal: 30 %

Notes



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Design verification part I

Manufacturer of the ASSEMBLY

Company stamp

Customer:

Order number:

Project:

Type:

Low-voltage switchgear and controlgear ASSEMBLIES

☐ Power Switchgear Combination (PSC) Design verification pursuant to IEC 61439-2 / VDE

☐ Sub-distribution board (DBO) Design verification pursuant to IEC 61439-3 / VDE

ASSEMBLY rating data:
(Required data from step 1: Collecting the requisite data)

Rated voltage:	_____ V	Short-circuit withstand strength
Rated frequency:	_____ Hz	I_{cc}: _____ kA
Network system:	☐TN ☐TT ☐IT	I_{cw}: _____ kA
Rated current of the ASSEMBLY I_{nA}:	_____ A	I_{pk}: _____ kA
Rated impulse withstand voltage (U_{imp}):	_____ kV	

(enter only applicable values)

Verified for (see Annex – Part II):

Design verification performed:

Place / Date — Name and signature of the performer

Place / Date — Name and signature of the tester

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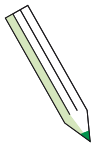
Notes



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Design verification part II

Only valid in connection with: Design verification part I

For low-voltage switchgear and controlgear ASSEMBLIES consisting of several parts and for separate observations to verify the following characteristics: When 10.11 Short circuit withstand strength, 10.12 Electromagnetic Compatibility (EMC) have been carried out, please enter the marking of the part of the low-voltage switchgear and controlgear ASSEMBLY here:

Sec.	Characteristics to be verified	Verification by	Remarks / annexes
10.2.2	Resistance to corrosion	ABB	
10.2.3.2	Strength against abnormal heat and fire	ABB	
10.2.4	Resistance to UV radiation	ABB	
10.2.5	Lifting	ABB	
10.2.6	Mechanical impact	ABB	
10.2.7	Marking	ABB	
10.3	Degree of protection of enclosures	ABB	
10.4	Clearances and creepage distances	ABB	
10.5.2	Continuity of the connection between parts of the ASSEMBLY and the protective circuit	ABB	
10.5.3	Short-circuit withstand strength of the protective circuit	ABB	
10.6	Incorporation of equipment	Manufacturer	The ASSEMBLY manufacturer shall comply with the design requirements of the original manufacturer and of the equipment manufacturer (8.6)
10.7	Internal electric circuits and connections	Manufacturer	The ASSEMBLY manufacturer shall comply with the design requirements of the original manufacturer (8.7)
10.8	Terminals for external conductors	Manufacturer	Compliance with the requirements of the original manufacturer and of the device manufacturer (8.8)
10.9.2	Insulation characteristics Power-frequency withstand voltage	ABB	
10.9.3	Insulation characteristics Withstand voltage	ABB	
10.10	Verification of temperature rises	Manufacturer	**Annexes:**
10.11	Short-circuit withstand strength	Manufacturer	**Annexes:**
10.12	Electro-magnetic compatibility (EMC)	Manufacturer	In general no verification necessary **Annexes:**
10.13	Mechanical operation	ABB	

Annexes:

Design verification performed:

Place / Date — Name and signature of the performer

Place / Date — Name and signature of the tester

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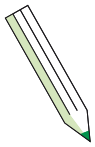
Notes



Unit test protocol

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Routine verification protocol (routine check protocol)

☐ Power Switchgear Combinations pursuant to IEC 61439-2 (PSC)

☐ Sub-distribution boards pursuant to IEC 61439-3 (DBO Type B)

Manufacturer of the ASSEMBLY:

Company stamp

Customer:

Order number:

Project:

Type:

Verifications:

Serial number	Type of inspection V = visual inspection I = Inspection using mech. or electr. test devices	Criterion	IEC 61439-1 Section	Result	Examiner
1	S	Degree of protection of cabinets / enclosures	11.2		
2	V/I	Clearances and creepage distances	11.3		
3	V/I	Protection against electric shock and continuity of the protective circuits	11.4		
4	S	Incorporation of equipment	11.5		
5	V/I	Internal electric circuits and connections	11.6		
6	S	Terminals for external conductors	11.7		
7	V	mech. Function (actuation elements, interlocks)	11.8		
8	V	Dielectric properties	11.9		
9	V	Wiring, operating behaviour and function	11.10		

Test voltage value

The power-frequency withstand voltage is to be tested on all circuits for a duration of 1 s. in accordance with 10.9.2. Test voltage = 1890 V AC at a rated insulation voltage between 300 V-690 V AC. For test values at other rated insulation voltages, see Table 8 of the IEC 61439-1.	V AC	

For ASSEMBLIES up to 250 A with an incoming protective device the insulation resistance may be measured using an insulation measurement device at a voltage of not less than 500 V DC. This test will be passed successfully when the insulation resistance is at least 1000 Ω/V.		

Check performed by:

Place / Date — Name and signature of the performer

Place / Date — Name and signature of the tester

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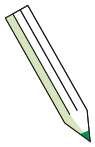
Notes



Unit test protocol checklist

Power and productivity for a better world™

Routine verification checklist (routine check protocol)

Manufacturer of the ASSEMBLY:

Company stamp

Customer:

Order number:

Project:

Type:

1. Degree of protection of enclosures (seals, sealing)		IEC 61439-1, section 11.2			
Criterion	**Requirement**	**Testing**	**Assessment** [o.k. / n.o.k. / n.c.]		**Remark / Examiner**
IP-enclosure	IP _____ (from contract)	see contract	☐	☐ ☐	
Mechanical impact strength of indoor installations (use by ordinary persons)	IK05	see contract	☐	☐ ☐	
Enclosures suited for outdoor installations (UV-resistance, water protection, dew condensation)	According to data provided by original manufacturer	see contract	☐	☐ ☐	
Mechanical impact strength of outdoor installations (use by ordinary persons)	IK07	see contract	☐	☐ ☐	
Verification of the measures taken to achieve the degree of protection	Cable entries, flanges fastened correctly and closed	Visual inspection	☐	☐ ☐	

2. Clearances and creepage distances		IEC 61439-1, section 11.3			
Criterion	**Requirement**	**Testing**	**Assessment** [o.k. / n.o.k. / n.c.]		**Remark / Examiner**
Clearance verification (see Table 1)	Rated impulse withstand voltage U_{imp} =_____V Minimum clearances in air =_____ mm	Visual inspection[1)] [1)] if n.o.k., then Testing for rated peak withstand current U_{imp} pursuant to 10.9.3	☐	☐ ☐	
Verification of the creepage distances (see Table 2)	Rated insulation voltage U_i =_____ V (Attention: $U_i \geq U_e$) Minimum creepage distance in =_____ mm (Attention: Minimum creepage distance ≥ Minimum clearance in air)	Visual inspection[2)] [2)] if not obviously o.k., then verification by physical measurement	☐	☐ ☐	

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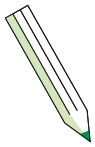
Notes



Unit test protocol checklist

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3. Protection against electric shock and continuity of the protective circuits			IEC 61439-1, section 11.4	
Criterion	**Requirement**	**Testing**	**Assessment** [o.k. / n.o.k. / n.c.]	**Remark / Examiner**
Protection against hazardous body currents	• Protection by automatic disconnection ☐ • Protection by double insulation ☐	Plan = implementation 1+2, 3 = n.c. 1+3, 2 = n.c.	☐ ☐ ☐	
1. Verify basic protection	Complete covering of all conductive parts by double insulation	Visual inspection	☐ ☐ ☐	
	Enclosures and covers have completely and as a minimum IPXXB (>1.6 m above the base, minimum IPXXD)	Visual inspection	☐ ☐ ☐	
	If PCII and/or use by ordinary persons: Enclosures and covers have completely and as a minimum IP2XC	Visual inspection	☐ ☐ ☐	
2. Fault protection	Full integration of all components into the protective circuit	Visual inspection	☐ ☐ ☐	
	Complete marking of the protective conductors PE/ PEN	Visual inspection	☐ ☐ ☐	
	Continuous connection of the protective circuit	Resistance measurement < 0.1Ω	☐ ☐ ☐	
	Spot checks screw connections	Torque check	☐ ☐ ☐	
3. Fault protection	No connection of the components to the protective circuit	Visual inspection	☐ ☐ ☐	
	Graphic symbol attached	Visual inspection	☐ ☐ ☐	

4. Assembly of equipment		IEC 61439-1, section 11.5		
Criterion	**Requirement**	**Testing**	**Assessment** [o.k. / n.o.k. / n.c.]	**Remark / Examiner**
Equipment marking (readability / assignment)	Texts comply with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Use of equipment (auxiliary contacts, fuse links)	Complies with wiring diagram	Visual inspection	☐ ☐ ☐	
Equipment arrangement	complies with assembly plan	Visual inspection	☐ ☐ ☐	
Installation position of:				
Breaker actuators (direct drive, rotary drive, motor)	Complies with wiring diagram / assembly plan	Visual inspection	☐ ☐ ☐	
Measurement devices (in door, behind the door)	Complies with assembly plan	Visual inspection	☐ ☐ ☐	
Control and signalling devices	Complies with assembly plan	Visual inspection	☐ ☐ ☐	

5. Internal electrical circuits and connections		IEC 61439-1, section 11.6		
Criterion	**Requirement**	**Testing**	**Assessment** [o.k. / n.o.k. / n.c.]	**Remark / Examiner**
Electrical connections / devices and busbar system (spot checks of the cross-sections and torques)	According to data provided by original manufacturer (spot check matrix)	Spot check and visual inspection	☐ ☐ ☐	

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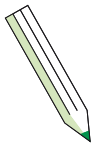

Unit test protocol checklist

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6. Terminals for external conductors		IEC 61439-1, section 11.7		
Criterion	**Requirement**	**Testing**	**Assessment** [o.k. / n.o.k. / n.c.]	**Remark / Examiner**
Outgoing terminals (cross-section, clamping capacity)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Material (copper, aluminium)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Type of contacting (plug-in, screw-in)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Conductor type (flexible, rigid)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	

7. Mechanical function (actuation elements, interlocks)		IEC 61439-1, section 11.8		
Criterion	**Requirement**	**Testing**	**Assessment** [o.k. / n.o.k. / n.c.]	**Remark / Examiner**
Ventilation grid, assembled, if necessary	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Actuation elements (breakers / resetting devices / interlocks / selector switches)	Compliance with manufacturing documentation	Functional and visual inspection	☐ ☐ ☐	
Interlocks / locks	Compliance with manufacturing documentation	Functional and visual inspection	☐ ☐ ☐	
Door couplings / switch actuators	Compliance with manufacturing documentation	Functional and visual inspection	☐ ☐ ☐	
Screw connections / device installation / fastening	According to data provided by original manufacturer	Functional and visual inspection	☐ ☐ ☐	
Cabling / fastening / type of installation	According to data provided by original manufacturer	Visual inspection	☐ ☐ ☐	
Door requirements (door hinge l./r.)	Compliance with manufacturing documentation	Functional and visual inspection	☐ ☐ ☐	
Closure system (double bit, swivel handle, …)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Cabinet and/or enclosure type (wall, floor-standing, modular consumer units)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Screw connections of the mechanical parts (plinths, supply, surface-mounted wall enclosures) fixed	Torque requirements complied with	Functional and visual inspection	☐ ☐ ☐	
Compliance with max. height / width / depth	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Plinth dimensions (e.g. 200 mm)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Colour (RAL)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Cable inlet flanges	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	

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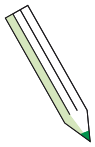
Notes



Unit test protocol checklist

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8. Dielectric properties IEC 61439-1, section 11.9

Criterion	Requirement	Testing	Assessment [o.k. / n.o.k. / n.c.]	Remark / Examiner
Insulation check (10.9.1 General / 10.9.2 Power-frequency withstand voltage) (secure sample by barrier, only the examiner is allowed to the test area. test duration of not less than 1 s.)				
Rated insulation voltage U_i _____ V	Test voltage (AC effective value)		☐ ☐ ☐	
Phase conductor to enclosure / constructive parts	pursuant to Table 8 _____ V	Measurement _____ V	☐ ☐ ☐	
Conductor to conductor		Measurement _____ V	☐ ☐ ☐	
N to PE		Measurement _____ V	☐ ☐ ☐	
Auxiliary circuit to main circuits	pursuant to Table 9 _____ V	Measurement _____ V	☐ ☐ ☐	
Auxiliary circuit to enclosure / constructive parts		Measurement _____ V	☐ ☐ ☐	
As alternative to the insulation test for ASSEMBLIES with an incoming protective device rated up to 250 A: Insulation resistance verification (insulation measurement device with not less than 500 V) Testing of the insulation resistance (>1000 Ω/V per circuit referred to the supply voltage of the circuits to earth)				
Testing of the insulation resistance (>1000 Ω/V per circuit referred to the supply voltage of the circuits to earth)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Phase conductor to enclosure / constructive parts	1k Ω/V * U_e _____V = _____kΩ	Measurement _____ kΩ	☐ ☐ ☐	
Conductor to conductor		Measurement _____ kΩ	☐ ☐ ☐	
N to PE		Measurement _____ kΩ	☐ ☐ ☐	
Auxiliary circuit to main circuits		Measurement _____ kΩ	☐ ☐ ☐	
Auxiliary circuit to enclosure / constructive parts		Measurement _____ kΩ	☐ ☐ ☐	

9. Wiring, operational performance and function IEC 61439-1, section 11.10

Criterion	Requirement	Testing	Assessment [o.k. / n.o.k. / n.c.]	Remark / Examiner
Cable colours and marking main circuits	IEC 60446 AC/DC: black (brown, grey)	Visual inspection	☐ ☐ ☐	
Cable colours and marking control circuits	IEC 60204 AC: red, DC: blue Exceptions: orange	Visual inspection	☐ ☐ ☐	
Cable colours and marking PE- and N-conductor	IEC 60446 (green/yellow for PE, blue for N, PEN green/yellow with blue marking at the end)	Visual inspection	☐ ☐ ☐	
Wiring /cables / cable and fastening type	No installation to sharp-edged corners and edges	Visual inspection	☐ ☐ ☐	
Wiring and equipment arrangement with regard to interferences / EMC (check for shielded cables, grounding, etc.)	Compliance with manufacturing documentation	Visual inspection	☐ ☐ ☐	
Complies with wiring diagram	Compliance with manufacturing documentation	Functional test	☐ ☐ ☐	
Circuitry / control / interlocks (complete circuitry/ complete control / special circuitry requirements)	Compliance with manufacturing documentation	Functional test	☐ ☐ ☐	
Individual switching devices (where possible, e.g. circuit breaker/RCD)	Compliance with manufacturing documentation	Functional test	☐ ☐ ☐	
Settings (e.g. motor protection switch, circuit breaker)	Compliance with manufacturing documentation	Setting	☐ ☐ ☐	

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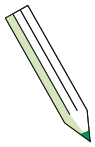
Notes



Unit test protocol checklist

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Criterion	Requirement	Testing	Assessment [o.k. / n.o.k. / n.c.]	Remark / Examiner
Designation label - Name of the manufacturer or trade mark - Type designation or identifier - Date of manufacture - Applied standard IEC 61439-2/-3 - Rated voltage (U_n) - Rated current (I_{nA}) - Rated frequency (f_n) - Degree of protection - Protection class - CE marking	Completed with all numerals and values	Visual inspection	☐ ☐ ☐	
Recorded to the documentation:				
Rated operational voltage		Visual inspection	☐ ☐ ☐	
(U_e) of the outgoing circuits		Visual inspection	☐ ☐ ☐	
Rated impulse withstand voltage (U_{imp})		Visual inspection	☐ ☐ ☐	
Rated insulation voltage (U_i)		Visual inspection	☐ ☐ ☐	
Rated current (I_{nc}) of the outgoing circuits		Visual inspection	☐ ☐ ☐	
Rated Diversity Factor (RDF)		Visual inspection	☐ ☐ ☐	
Rated peak withstand current (I_{pk})		Visual inspection	☐ ☐ ☐	
Rated short-time withstand current (I_{cw})		Visual inspection	☐ ☐ ☐	
Conditional rated short-time withstand current (I_{cc})		Visual inspection	☐ ☐ ☐	
Included in the documentation				
Wiring diagram		Visual inspection	☐ ☐ ☐	
Assembly plan		Visual inspection	☐ ☐ ☐	
Design verification		Visual inspection	☐ ☐ ☐	
Assembly, operating instructions		Visual inspection	☐ ☐ ☐	
CE - Declaration of conformity		Visual inspection	☐ ☐ ☐	
Final testing				
Cleanliness of the installation	No shavings, cable residues, pollution	Visual inspection	☐ ☐ ☐	
Documentation attached		Visual inspection	☐ ☐ ☐	
Enclosure surface	Free from scratches, pollution, pockets	Visual inspection	☐ ☐ ☐	
Installation suited for transport	Fixed to transport means, no loose parts, labels	Visual inspection	☐ ☐ ☐	

Routine verification performed:

Place / Date — Name and signature of the performer

Place / Date — Name and signature of the tester

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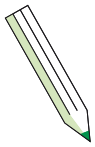


Unit test protocol checklist

Table 1 – Minimum clearances in air [a] IEC 61439-1, section 8.3.2

Rated impulse withstand voltage U_{imp} kV	Minimum clearance in air mm
≤ 2.5	1.5
4.0	3.0
6.0	5.5
8.0	8.0
12.0	14.0

[a] Based on inhomogenous field and pollution degree 3.

Table 2 – Minimum clearances in air IEC 61439-1, section 8.3.3

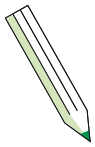
Rated insulation voltage U_i	Minimum clearance in air in mm							
	Degree of pollution							
	1	2			3			
	Material group [c]	Material group [c]			Material group [c]			
V[b]	All material groups	I	II	IIIa and IIIb	I	II	IIIa	IIIb
32	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
40	1.5	1.5	1.5	1.5	1.5	1.6	1.8	1.8
50	1.5	1.5	1.5	1.5	1.5	1.7	1.9	1.9
63	1.5	1.5	1.5	1.5	1.6	1.8	2	2
80	1.5	1.5	1.5	1.5	1.7	1.9	2.1	2.1
100	1.5	1.5	1.5	1.5	1.8	2	2.2	2.2
125	1.5	1.5	1.5	1.5	1.9	2.1	2.4	2.4
160	1.5	1.5	1.5	1.6	2	2.2	2.5	2.5
200	1.5	1.5	1.5	2	2.5	2.8	3.2	3.2
250	1.5	1.5	1.8	2.5	3.2	3.6	4	4
320	1.5	1.6	2.2	3.2	4	4.5	5	5
400	1.5	2	2.8	4	5	5.6	6.3	6.3
500	1.5	2.5	3.6	5	6.3	7.1	8	8
630	1.8	3.2	4.5	6.3	8	9	10	10
800	2.4	4	5.6	8	10	11	12.5	a
1000	3.2	5	7.1	10	12.5	14	16	
1250	4.2	6.3	9	12.5	16	18	20	
1600	5.6	8	11	16	20	22	25	

NOTE 1 The CTI values refer to the values obtained in accordance with IEC 60112:2003, method A, for the insulation material.
NOTE 2 Values taken from IEC 60664-1, but maintaining a minimum value of 1.5 mm.

[a] Insulation of material group IIIb is not recommended for use in pollution degree 3 above 630 V.
[b] As an exception, for rated insulation voltages 127, 208, 415, 440, 660/690 and 830 V, creepage distances corresponding to the lower values 125, 200, 400, 630 and 800 V may be used.
[c] The following material groups are classified according to the range of values of the comparative tracking index (CTI) (see 3.6.16)
- Material group I 600 ≤ CTI
- Material group II 400 ≤ CTI ≤ 600
- Material group IIIa 175 ≤ CTI ≤ 400
- Material group IIIb 100 ≤ CTI ≤ 175

Text excerpt, see IEC 61439-1

Notes



Unit test protocol checklist

Table 8 – Power-frequency withstand voltage for main circuits IEC 61439-1, section 10.9.2

Rated insulation voltage U_i (conductor to conductor, AC or DC)				Test voltage (AC effective value)	Test voltage [b] (DC)
P				P	P
	U_i	≤	60	1000	1415
60 <	U_i	≤	300	1500	2120
300 <	U_i	≤	690	1890	2670
690 <	U_i	≤	800	2000	2830
800 <	U_i	≤	1000	2000	3110
1000 <	U_i	≤	1500[a]		3820

[a] for DC only
[b] Test voltages based on 6.1.3.4.1, fifth paragraph of IEC 60664-1.

Table 9 – Power-frequency withstand voltage for auxiliary and control circuits IEC 61439-1, section 10.9.2

Rated insulation voltage U_i (Conductor to conductor)			Test voltage (AC effective value)
P			P
	U_i	≤ 12	250
12 <	U_i	≤ 60	500
60 <	U_i		see Table 8

Spot checks – Matrix for electrical screw connections

Test level III

All tested screw connections are to marked using an indelible marker!

Use only calibrated test tools!

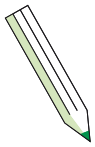
Screw connections: Terminals, terminal blocks and snap-in devices		
Number of screw connections/panel	Sample size	Assumption numeral a
2 to 8	2	0
9 to 15	5	0
16 to 25	8	0
26 to 50	13	0
51 to 90	20	0
91 to 150	32	0
151 to 280	50	0
501 to 1200	80	0

[a] assumption numeral 0 means:

No erroneous screw connections are accepted for spot checks ➜ immediate reworking / 100% check!

Text excerpt, see IEC 61439-1

Notes



Conformity assessment checklist

Power and productivity
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Conformity assessment checklist

Manufacturer of the ASSEMBLY:

Company stamp

Customer:

Order number:

Project:

Type:

Low-voltage switchgear and controlgear ASSEMBLIES

☐ Power Switchgear Combination (PSC) Design verification pursuant to IEC 61439-2 / VDE

☐ Sub-distribution board (DBO) Design verification pursuant to IEC 61439-3 / VDE

☐ **1. Technical documentation**

Scope of the low-voltage directive 2006/95/EC

☐ Technical documentation of the original manufacturer of the low-voltage switchgear and controlgear ASSEMBLY (Important: Name and address of the original manufacturer as well as the type designation, applicable standard, product description must be stated)

☐ Assembly and installation instructions of the original manufacturer

☐ Wiring diagram, assembly drawing and parts list

☐ Routine verification protocol

Scope of the EMC directive 2004/108/EC

☐ Completion of the technical documentation by manufacturer's documentation for all electronic installation equipment and devices, including electronic parts (assembly and installation instructions)

☐ Declaration of conformity by the device manufacturer certifying the compliance of the products with the provisions of the EMC directive. A note in the supporting documents is of similar importance and has to be kept.

☐ **2. Preparing a declaration of conformity**

☐ **3. Affixing of the CE – marking**

Conformity assessment procedure carried out by:

Place / Date

Name and signature of the executor

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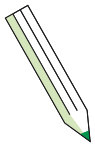
Notes



Declaration of conformity

Power and productivity
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Declaration of conformity

Company stamp

We declare under our sole responsibility that the product

- ☐ **Sub-distribution board,**
- ☐ **Power Switchgear Combination (PSC)**
- ☐ **Sub-distribution board (DBO) for a use by ordinary people,**

Designation, type, catalogue or order number:

_____

to which this declaration refers, complies with the following standard(s).

Low-voltage switchgear and controlgear ASSEMBLIES

- ☐ Power Switchgear Combination (PSC) Design verification pursuant to IEC 61439-2 / VDE
- ☐ Sub-distribution board (DBO) Design verification pursuant to IEC 61439-3 / VDE

The product named complies with the provisions of the following European directives:

- ☐ **Low-voltage directive 2006/95/EC**
- ☐ **EMC directive 2004/108/EC (e.g. for electronic equipment installed to ASSEMBLIES or distribution boards pursuant to IEC 61439-1/-2)**

Date of affixing of the CE-marking[1]: __ __.__ __.__ __ __ __

[1] Visibly affixed to the ASSEMBLY or the distribution board together with the manufacturer ID, if necessary only readable when the door is open.

With this declaration of conformity the manufacturer certifies compliance with the specified directives and standards.
This declaration of conformity meets the provisions of IEC 45014 - General criteria for supplier's declaration of conformity.

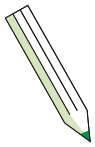
Conformity assessment procedure carried out by:

Place / Date — Name and signature of the executor

Place / Date — Name and signature of the authorized person

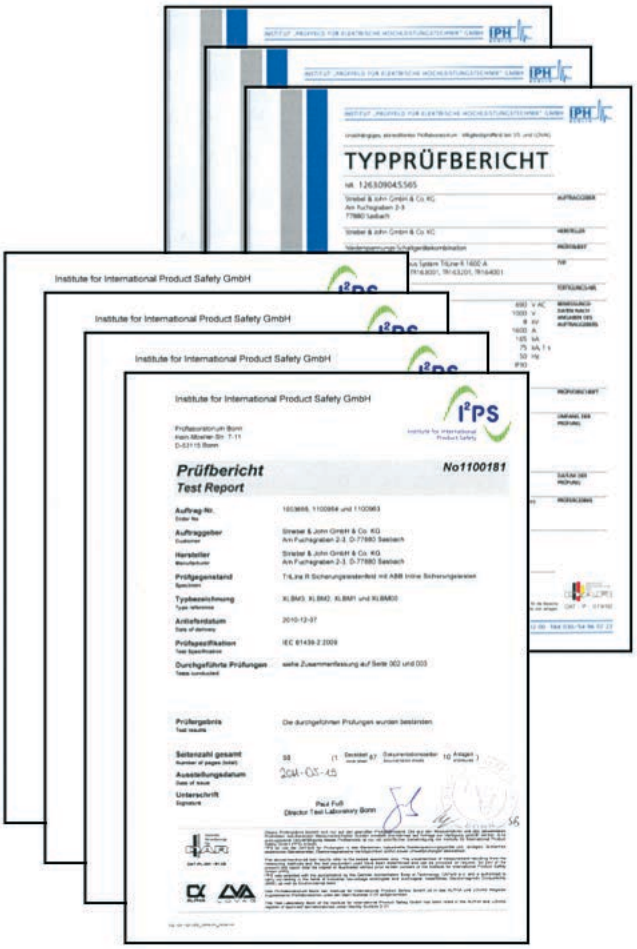
K-0323 Declaration of conformity • PDF 05/2015 • 2CPC 323 045 L0201

Notes



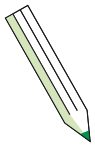
Examples STRIEBEL & JOHN

For many of the characteristics required for a design verification of our products we as system manufacturer have the associated test documents delivered by independent test institutes.



You as SUJ's system partner are free to access these documents using our web portal.

Notes



Contact us

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