2016

IEC 61439
Die neue Norm für Niederspannungs-Schaltgerätekombinationen

IEC 61439 = EN 61439 = VDE 0660-600

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

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.

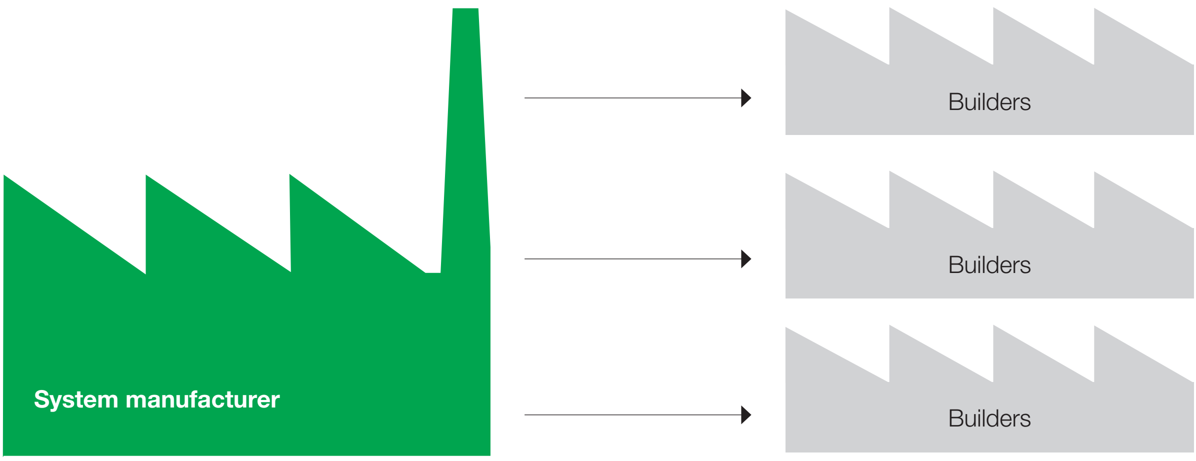
Both laws pursue safety targets and are designed to protect people, livestock and property.

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

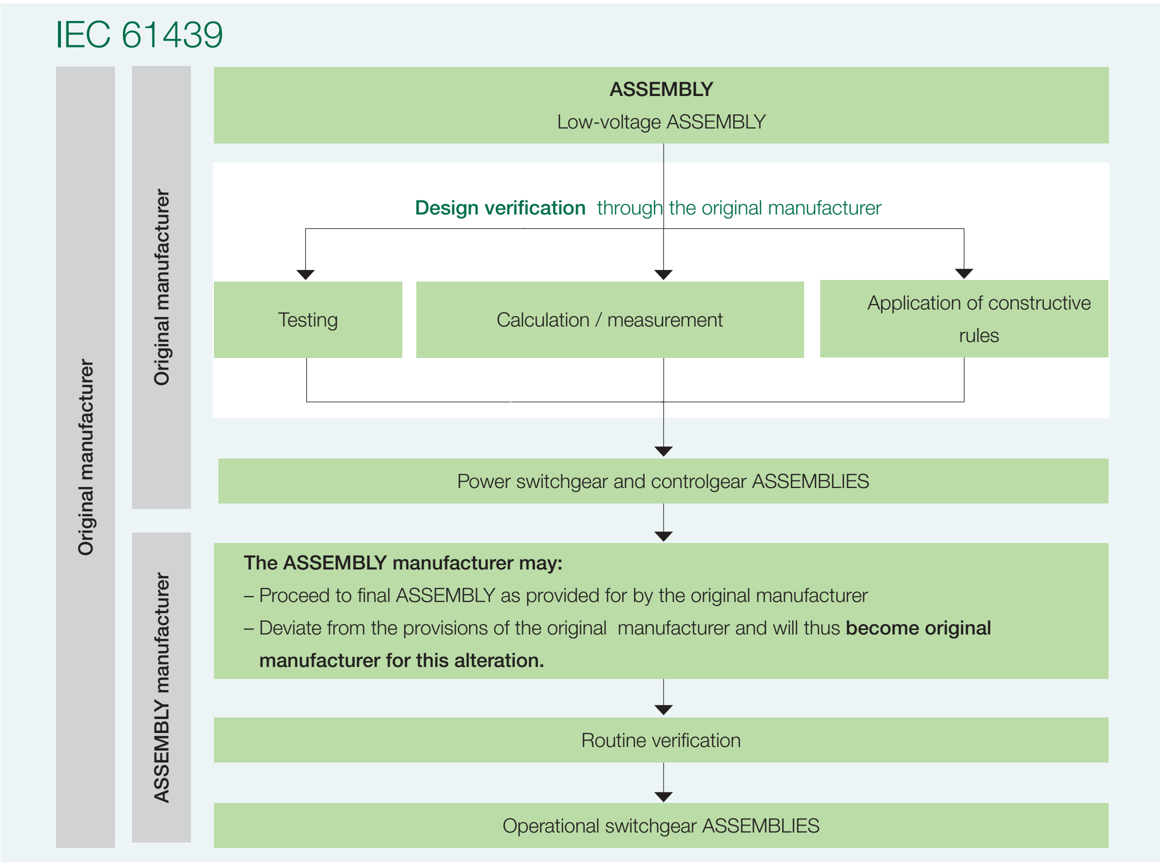
ASSEMBLY Manufacturer

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.

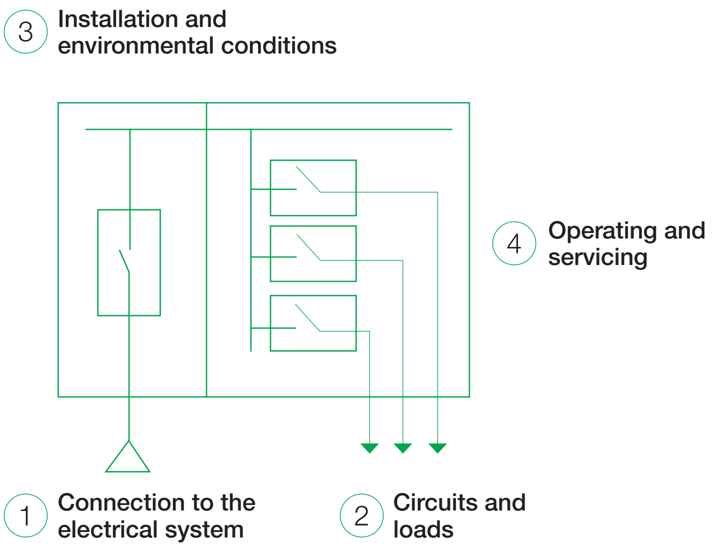
Which are the dimensioning specifications enabling design verification?

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

Collecting the requisite data
Connection to the electrical system

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

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

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 _______ cos φ	I_{nc} = _____ A	
Inductive consumer, motor, controlled		____ fuse ____ MCB ____ manufacturer's description	_______ kW _______ cos φ	I_{nc} = _____ A	

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	

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	

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

Distribution board design and design verification

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

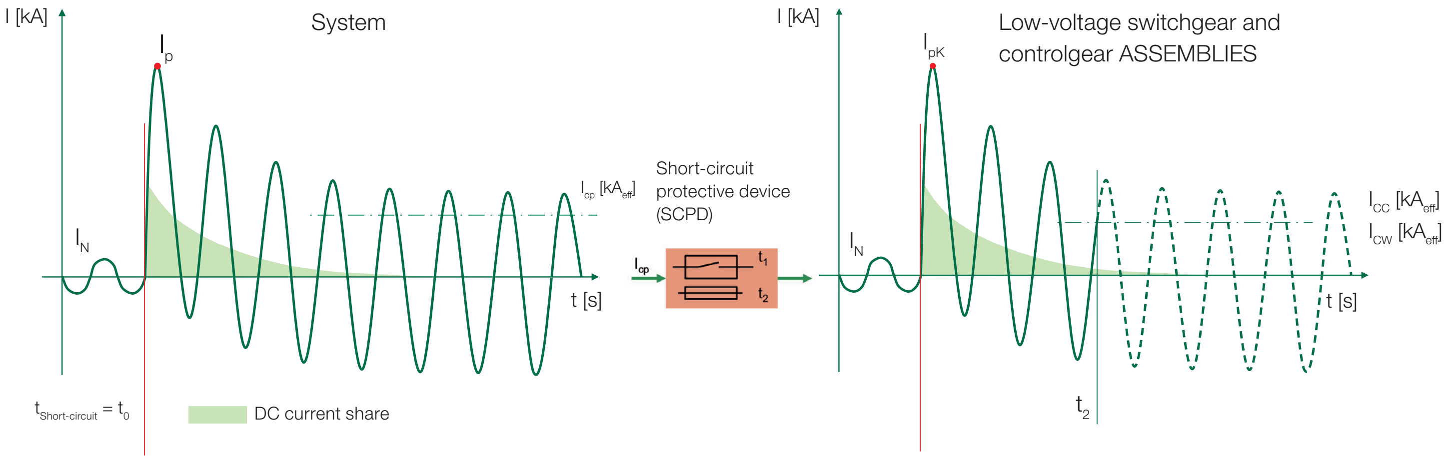
The new standard describes three design verification processes for an ASSEMBLY and requires a routine verification for each marketed product

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.

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!

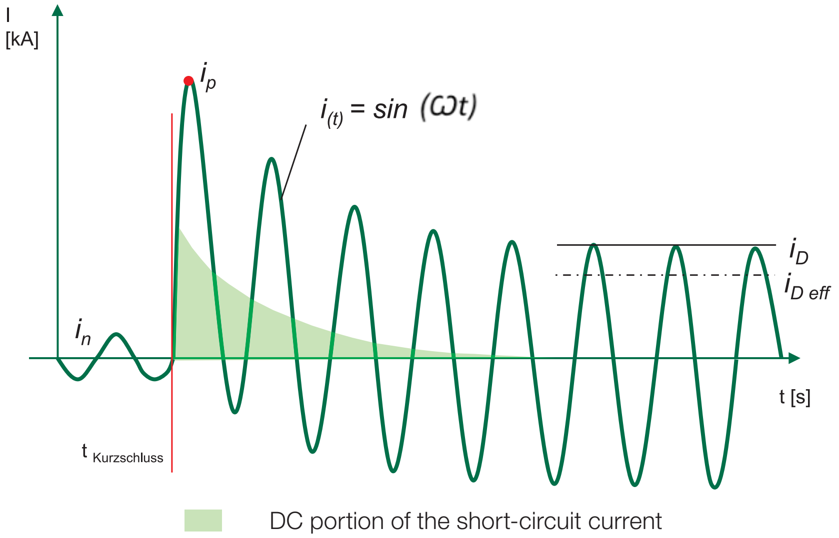
*Assumed to section 10.11.2 IEC 61439-1

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)

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

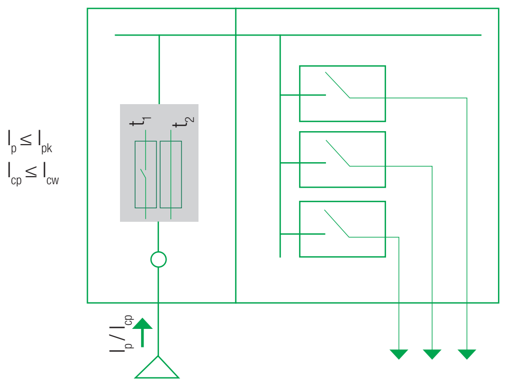
$i_{(t)}$ = course of the alternating current over the time t
i_p = peak value (instantaneous value) of the alternating current
i_D = short-time current
$i_{D\,eff}$ = effective value of the short-time current
i_n = nominal value of the alternating current

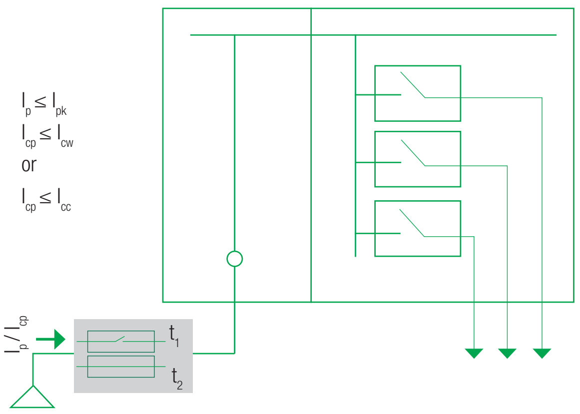
Ratio between surge current and short-time current*[2]
For approximate calculation purposes: $I_p = I_{D\,eff} \times n$

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

Verification of the short-circuit withstand strength

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.

Verification of the short-circuit withstand strength

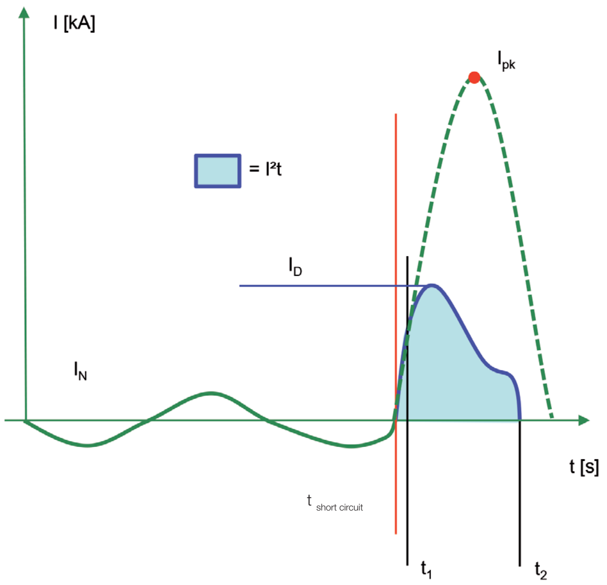
If the ASSEMBLY manufacturer specifies the conditional rated short-circuit current for the connection point (I_{cc}) also the breaking capacity and the current limitation characteristic (I^2t, I_{pk}) of the specified, upstream Short-circuit protective device (taking into account the data submitted by 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.



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

Distribution board design and design verification
Verification of temperature rises

10.10 Verification of temperature rise

Next to the option to verify temperature rises inside lowvoltage 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

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

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

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)

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

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

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

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.

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

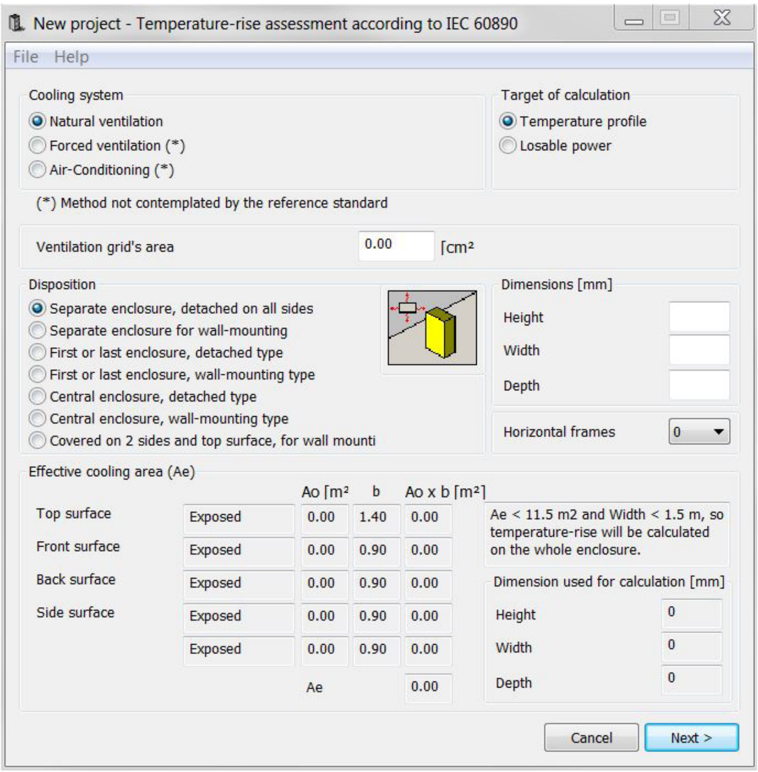
It may be specified by the ASSEMBLY manufacturer for the entire low voltage switchgear and controlgear ASSEMBLY combination or for groups of outgoing circuits.

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.

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.



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) – Protection class II (double insulation)	 8.4.3.2 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 – Care should be taken in particular to ensure: – the accessibility of the devices – sufficient heat dissipation / ventilation – For installation distribution boards the protective devices must be suited for an operation by ordinary people	 8.5 8.5.4 8.5.5 8.7 8.5.3
3.3	**Wiring inside switchgear** – General requirements for the wiring of bare and insulated conductors – Selecting the cross-sections – Recommendation of the cross-sections depending on the load capacities and types of installation – Selecting the cross-sections of N, PE and PEN conductors – Cross-section of N conductors – Up to 16 mm² including, 100 % of the associated phase conductors – Above 16 mm², 50 % of the associated phase conductors, not less than 16 mm² – Cross-section of PEN conductors – PEN min. 10 mm² for CU and 16 mm² 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. – Cross-section of PE conductors – Earthed and short-circuit protected installation – Wire markings of insulated conductors in main and auxiliary circuits – Phase conductor marking (black) – Marking of PE, N, PEN – 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): – bare, energized live parts to each other: 10 mm – bare, energized live parts to bodies and constructional components: 15 mm	 8.6.3 + Annex H 8.6.1 8.4. 3.2.3 8.4.3.2.3 + Table 3 8.6.1 Sections 1+2 8.6.4 + Table 4 8.6.5 8.6.6 8.3
3.4	**Terminals for external conductors** – The terminals shall be designed to the circuit's current load capacity and Short-circuit withstand strength. – Terminals for external protective conductors	8.8 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) – Observing the protective measure – Protection class I (with protective conductor) – Protection class II (double insulation) – Compliance with the IP degree of protection	 8.4.2 8.4.2.3 8.4.4 8.2.2
3.6	**Labels / documentation** – Type plate – Distribution board data – Handling, installation, operating and maintenance instructions – Equipment markings / wiring diagrams	 6.1 6.2.1 6.2.2 6.3

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 __________ mm² 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 _______ $\cos\varphi$	I_{nc} = _____ A	
Inductive consumer, motor, controlled		____ fuse ___ MCB ____ manufacturer's description	_______ kW _______ $\cos\varphi$	I_{nc} = _____ A	
Capacitive consumers		____ fuse ___ MCB ____ manufacturer's description	_______ kW _______ $\cos\varphi$	I_{nc} = _____ A	

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	

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		

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 %

Contact us

ABB STRIEBEL & JOHN GmbH & Co. KG
Am Fuchsgraben 2 - 3
77880 Sasbach
Germany
Phone: + 49 7841 609 0
Fax: + 49 7841 609 545
E-Mail: info.desuj@de.abb.com

www.striebelundjohn.com

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for a better world™