Welcome!
Welcome!

Verifications and Documentation for Control Panel Design

The path to documentation for control panel design according to European directives and IEC standards.
Speaker

Gerhard Flierl
Graduate in Electrical Engineering and Business Administration

Industrial Automation
Industrial Controls

Application consulting:
- North American Standards and Codes
- European Directives and international IEC/ISO standards

www.usa.siemens.com/controlpaneldesign
www.usa.siemens.com/planning-efficiency
The following topics will be covered here:

- Scope of responsibility of manufacturers or operators of control panels
- The latest on relevant EU guidelines and IEC standards for control panel construction
- Differentiating between the low-voltage directive and the machinery directive in relation to control panel construction
- The scope of application of the EMC directive and its relevance to control panel construction
- Overview of practical tools which simplify the documentation that is required
- The structure and requirements of IEC 61439-1 for control panel design
- Overview of the verifications that have to be performed in line with IEC 61439-1 and -2 and their appropriate documentation
- An example: "Displaying the individual steps meaningfully and practically"
- Extensive training documents with checklists and recommendations for liability-assured documentation
Seminar: "Verifications and Documentation for Control Panel Construction"

Agenda:
I. Introduction: Seminar content and objectives
II. Overview of European directives
   1. Differentiating MD 2006/42/EC from LVD 2006/95/EC
   2. Relevance of the EMC directive to control panels
III. Introduction and concept of the IEC 61439 series
IV. Required verifications of IEC 61439-1 and -2
V. Documentation
   1. based on the IEC standards for ordering parties (IEC 61439-1 / IEC 60204-1)
   2. based on the low-voltage directive (CE declaration of Conformity / internal production audit)
VI. Markings
VII. Tools for assisting with documentation
VIII. Example of internal documentation in accordance with the LVD and IEC 61439-1 using a sample panel
Now you certainly have questions ...
Thank you for your attention!

Gerhard Flierl
Siemens Industry Inc.
Industrial Automation

5300 Triangle Parkway
Norcross 30092, Atlanta / GA

Phone: +1 (770) 871-3835
Cell Phone: +1 (404) 434-6403

E-mail: gerhard.flierl@siemens.com
Introduction and seminar objectives

- Why this seminar?
- Seminar objectives
- General Notes
Why this seminar?

- Increasing confusion and uncertainty when deciding *which European Directives are important for control panel design*

- **Which standards** are important for control panel design and how can these be fulfilled?

- Uncertainty with regard to the question: "*Who holds the responsibility?*"

- **How** should the documentation be produced?

- **Which documentation** must be prepared for the user and which for internal use?

- What is the **distinction between** the important *Machinery directive [MD] 2006/42/EC and Low-voltage directive [LVD] 2006/95/EC*?

- To what extent is the *EMC directive 2004/108/EC for control panel design* important?
Seminar objectives

- To provide assistance and support in understanding important European directives and standards
- To clarify the relationships between relevant standards and their significance for control panel construction
- To perform the required verifications of the control panel as per IEC 61439-1 & -2
- To offer assistance regarding which documentation the manufacturer requires from the ordering party
- Requirements concerning documentation for the ordering party and internal documentation
- Suggestions for practical documentation that conforms to standards and guidelines
Examples of documentation:

You will receive the following suggestions for documentation conforming to standards and guidelines at the end of this seminar:

- General declaration of conformity
- EC declaration of conformity
- Example of a plant document
- Design verification checklist
- Design verification test report
- Routine verification checklist
The importance of standards

In general, standards are:

- **Standards are not laws** – yet they are followed willingly and strictly. When they are followed they are similar to laws

- **Reflect rules / the state of technology** and are considered a **proven method** in the respective field of application

- **A support function** used to achieve a minimum level of procedure (in different countries, etc.)

- Fulfilling standards is not an achievement – it is the **minimum expected**

- The highest protection objectives of standards are: **the safety of people, livestock, and property**
Organizations
The global use of standards

© Siemens Industry Inc. 2014. All rights reserved.
## Differentiating between the Machinery directive and the Low-voltage directive

<table>
<thead>
<tr>
<th>Machinery directive</th>
<th>Low-voltage directive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety during machine operation</td>
<td>Machine electrical equipment</td>
</tr>
<tr>
<td>- MD 2006/42/EC</td>
<td>- LVD 2006/95/EC</td>
</tr>
<tr>
<td>- IEC/ISO standards</td>
<td>- IEC 60204-1</td>
</tr>
<tr>
<td></td>
<td>- IEC 61439-1</td>
</tr>
<tr>
<td></td>
<td>- Documentation</td>
</tr>
<tr>
<td></td>
<td>- ...</td>
</tr>
</tbody>
</table>

**Main topic of the seminar**
Definitions of the training documents under discussion

IEC 61439 = EN 61439 = DIN EN 61439

Machinery directive = MD

Low-voltage directive = LVD

Low-voltage switchgear and controlgear assembly = control panel
Adoption of IEC standards according to local requirements
Explanation regarding use of prefixes

- **Publisher**: IEC
  - Standard: **61439-1:06/2009**
  - Issue Date: **06/2009**

- **Publisher**: EN
  - Standard: **61439-1:12/2009**
  - Issue Date: **12/2009**
  - **Minor changes/additions acc. to region (EU)**

- **Publisher**: DIN EN
  - Standard: **61439-1:06/2010**
  - Issue Date: **06/2010**
  - **Minor changes/additions acc. to region (EU)**

Diagram:
- European Standards CEN / CENELEC
- **Regional Norms**
- **National Norms** DIN / VDE / DKE
- Factory standards
Standards – Comparison U.S./UL versus IEC
### Differences Between Europe & North America

**Europe**
- Responsibility of the equipment manufacturer
- Responsibility of the operator/user
- Protection targets are defined by directives
- Presumption of conformity with the application of harmonized standards (ISO9000 et seqq., self-certification, self-responsibility)

**USA / North America**
- Responsibility of the operator/user
- Protection targets and requirements are defined by laws
- Certification/listing of products
- Verification by independent NRTL/AHJ (Electrical Inspector) (third-party certification)

---

© Siemens Industry Inc. 2014. All rights reserved.
Industry Sector / IA CE S
Note / exclusion of liability

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not.

The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.
Introduction to European directives

- Overview of European directives
The European Economic Area (EEA)

Europe today

EEA consists of:
- EFTA member states (with the exception of Switzerland)
  - Island
  - Liechtenstein
  - Norwegen
- EU-participating member states

Switzerland:
"Agreement on mutual recognition of conformity assessments" of 6/21/1999
The European directives

Agreements are in place within the EU governing the free movement of goods and safety in the workplace.

Free movement of goods – manufacturers
(Article 114 TFEU - Treaty of Lisbon)

- Product Liability Directive 85/374/EEC
- General Product Safety Directive 2001/95/EC

Safety in the workplace – operators
(Article 153 TFEU - Treaty of Lisbon)

- Workplace Health and Safety Directive 89/391/EEC
- Use of Work Equipment 2009/104/EC
- Other directives at national level

Harmonized standards

- Machinery Directive 2006/42/EC
- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC
- etc. (The manufacturer is obliged to comply with all relevant directives!)

National standards

TFEU = Treaty on the Functioning of the European Union
When applying harmonized standards it can be assumed that the guidelines are being adhered to.

Order based on applicable regulations.

Machinery operators (assumption of responsibility).

Safe machine running.

Declaration of conformity

CE marking.

Safe machine/ control panel.

Cooperation between EU states in social matters:

Workplace Health and Safety Directive 89/391/EEC

EMC legislation

Occupational Safety and Health Act, Ordinance on Industrial Safety and Health

E.g., in Germany: regulations, provisions, rules, and information on industrial accident insurance.

Dismantling of trade barriers within the EU single market:

Low-Voltage Directive 2006/95/EC

Machinery Directive 2006/42/EC

Product Safety Directive 2001/95/EC

EMC Directive 2004/108/EC

When applying harmonized standards it can be assumed that the guidelines are being adhered to.

Mandate from the EU Commission Standards institution for creating safety standards at CEN/CENELEC

Implementing the EN standards without changes; harmonized, if in official journal of EU.

Equipment and Product Safety Act (GPSG)

§ EMC legislation

§ Equipment and Product Safety Act (GPSG)
The European directives

Significance

Directives
- Cover a large number of products (in terms of machines, devices, medicine) which share similar risks

Contents
- Few technical details
- Basic requirements only

Significance
- A single benchmark (almost a "law") for judging whether or not a product may be marketed (brought into circulation)

Verification
- Compliance with the directive must be established and verified (conformity assessment / Declaration of Conformity)

CE marking
Which directive relates to control panel assembly?

A directive needs to be applied to a given product if the product is formally covered by the scope of application (Article 1) of this directive and the product involves risks as described in the requirements under this directive.

The manufacturer is always responsible for deciding which directive(s) they (must) apply to their product.
Note / Exclusion of liability

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.

© Siemens AG 2014. All rights reserved.
Differentiating MD 2006/42/EC from LVD 2006/95/EC

- Introduction to the MD
- Exceptions
- Under which area of application does the individual switchgear and controlgear assembly fall?
- Example cases on conformity assessment and CE marking
- Position documents
Differentiating between the areas of application of the MD and LVD

Why?

**MD 2006/42/EC Excerpt**

1.5. RISKS FROM OTHER HAZARDS

1.5.1. *Electricity supply*

Where machinery has an *electricity supply*, it must be designed, constructed and equipped in such a way that all hazards of an electrical nature are or can be prevented.

*The safety objectives set out in Directive 73/23/EEC shall apply to machinery.* However, the *obligations concerning conformity assessment and the placing on the market and/or putting into service* of machinery with regard to electrical hazards are governed *solely by this Directive.*[MD 2006/42/EC].

**Note:** Directive 73/23/EEC was codified with directive 2006/95/EC of December 12, 2006.
A control panel falls either under the area of application of the MD or the LVD.

This statement primarily refers to the conformity assessment procedure.

→ The directives' higher-level/common protection objectives are not mutually exclusive. This means the protection objectives of the LVD must always be fulfilled.

Key questions:

- When does a control panel fall under the area of application of the MD or the LVD?
- What are the decisive criteria, particularly with regard to the MD?

Consequences of the decision:

- The result influences the manufacturer's conformity assessment process, CE marking, and verification obligations (technical documentation / internal test report)
- The result determines the selection of applicable, harmonized standards (the Official Journal of the European Union)
Differentiating between the areas of application of the MD and LVD

MD scope of validity (general)

**Article 1(1) of the MD 2006/42/EC:**

a) Machines  
b) Replaceable equipment  
c) **Safety components**  
d) Load suspension devices  
e) Chains, ropes, and belts  
f) Removable cardan shafts  
g) Incomplete machines

___

*Is the control panel a safety component in the sense of machinery directive 2006/42/EC?*
Distinguishing between the areas of application of the MD and LVD

According to the MD, a *safety component* is a component:

1. Which is used to guarantee a safety function
2. Which is brought onto the market separately
3. Whose failure and/or malfunctioning threatens people's safety
4. Which is not necessary for the machine to function or which can be replaced by ordinary components for the machine to function

→ 4 important criteria that identify a "safety component" characteristic.

**Exceptions** MD scope of validity (in part):

Safety components that are designated as spare parts for the replacement of identical components and which are supplied by the manufacturer of the original machine (no separate introduction to the market)
Differentiating MD from LVD
Control panel as safety a component?

- Guaranteeing a safety function?
  - Yes
  - No
  - Process control

- Separate introduction to the market?
  - Yes
  - No
  - The machine manufacturer's in-house production

- Installation according to the machine manufacturer's exact specifications?
  - Yes
  - No
  - Control panel builder is an "integrated sub-contractor"

- Would failure risk people's safety?
  - Yes
  - No

- Required for the functioning of the machine?
  - Yes
  - No

- Can be replaced with ordinary components?
  - Yes
  - No

Safety component, MD article 1(1)c

© Siemens Industry Inc. 2014. All rights reserved.
Example cases of various control panels

1. Control panel produced by the machine builder

2. Control panel produced by the control panel manufacturer on behalf of the machine builder

3. The control panel manufacturer sets the functions and sells the control panel as a product – contains process control

4. The control panel manufacturer sets the functions and sells the control panel as a product – without process control

5. The manufacturer of the control panel sells the control panel as a product
   Functions are defined by software

6. The manufacturer of the control panel sells the control panel as a product
   Sensors and operator controls are not a component of the control panel
The definition of a safety component according to the MD

According to the MD, a safety component must fulfill all 4 conditions from article 2c of the MD.

A safety component is a component...
1. which is used to guarantee a safety function
2. which is brought onto the market separately
3. whose failure and/or malfunctioning threatens people's safety
4. which is not necessary for the machine to function
Example case: The machine builder fits the control panel with equipment and thus determines the functions (also safety functions) of the control panel. → In-house production

Fulfilled conditions of art. 2c of the MD:
1. It is used to guarantee a safety function – fulfilled
2. It is brought onto the market separately – not fulfilled
3. Its failure and/or malfunctioning threatens people's safety – fulfilled
4. It is not necessary for the machine to function or can be replaced by ordinary components for the machine to function – fulfilled

→ The control panel is not a safety component and is not covered by the MD.
Control panel produced by the control panel manufacturer on behalf of the machine builder

Example case: The control panel is produced according to the exact specifications of the machine builder. The control panel builder is an integrated sub-contractor → Comparable with in-house production Marking of the whole machine by the machine builder, including the control panel, as per the MD.

Fulfilled conditions of art. 2c of the MD:
1. It is used to guarantee a safety function – fulfilled
2. It is brought onto the market separately – not fulfilled
3. Its failure and/or malfunctioning threatens people’s safety – fulfilled
4. It is not necessary for the machine to function or can be replaced by ordinary components for the machine to function – fulfilled

→ The control panel is not a safety component and is not covered by the MD.
The control panel manufacturer sets the functions and sells the control panel as a product.

**Example case:** The control panel manufacturer defines the functions (and safety functions) of the control panel. *The control functions of the machine are not a component of this control panel.* If full safety functions are included in this control panel (sensor on the front, actuator and evaluation inside the control panel), *then the control panel manufacturer produces a declaration of conformity in accordance with the machinery directive and marks the control cabinet with 'CE'.*

**Fulfilled conditions of art. 2c of the MD:**
1. It is used to guarantee a safety function – **fulfilled**
2. It is brought onto the market separately – **fulfilled**
3. Its failure and/or malfunctioning threatens people's safety – **fulfilled**
4. It is not necessary for the machine to function or can be replaced by ordinary components for the machine to function – **fulfilled**

⇒ The control panel is a safety component and falls under the MD.
The control panel manufacturer sets the functions and sells the control panel as a product.

Example case: The control panel manufacturer defines the functions (and safety functions) of the control panel. *The control functions of the machine are a component of this control panel.* Even if full safety functions are included in this control panel (sensor on the front, actuator and evaluation inside the control panel), *then the control panel manufacturer produces a declaration of conformity in accordance with the low-voltage directive and marks the control cabinet with 'CE'.*

Fulfilled conditions of art. 2c of the MD:

1. It is used to guarantee a safety function – fulfilled
2. It is brought onto the market separately – fulfilled
3. Its failure and/or malfunctioning threatens people's safety – fulfilled
4. It is not necessary for the machine to function or can be replaced by ordinary components for the machine to function – not fulfilled

⇒ The control panel is not a safety component and is not covered by the MD.
The manufacturer of the control panel sells the control panel as a product. Functions are defined by software.

Example case: The manufacturer of the control panel fits the control panel with equipment. The functions (and safety functions) are defined by the machine builder through programming / parameterizing. In its delivered condition, the safety functions are not yet defined. The manufacturer of the control panel produces a declaration of conformity in accordance with the low-voltage directive and marks the control cabinet with 'CE'.

Fulfilled conditions of art. 2c of the MD:
1. It is used to guarantee a safety function – not fulfilled
2. It is brought onto the market separately – fulfilled
3. Its failure and/or malfunctioning threatens people's safety – fulfilled
4. It is not necessary for the machine to function or can be replaced by ordinary components for the machine to function – fulfilled

→ The control panel is not a safety component and is not covered by the MD.
The manufacturer of the control panel sells the control panel as a product. Sensors and operator controls are not a component of the control panel.

Example case: The manufacturer of the control panel fits the control panel with equipment. *The functions (and safety functions) are defined by the machine builder through the connection of external sensors and control elements.* In its delivered condition, the safety functions are not yet defined. The manufacturer of the control panel produces a declaration of conformity in accordance with the low-voltage directive and marks the control cabinet with 'CE'.

Fulfilled conditions of art. 2c of the MD:
1. It is used to guarantee a safety function – not fulfilled
2. It is brought onto the market separately – fulfilled
3. Its failure and/or malfunctioning threatens people’s safety – fulfilled
4. It is not necessary for the machine to function or can be replaced by ordinary components for the machine to function – fulfilled

⇒ The control panel is not a safety component and is not covered by the MD.
Position documents

Bringing to market:
Position document of the German Electrical and Electronic Manufacturers' Association (ZVEI) with example cases

Control panel in accordance with machinery directive 2006/42/EC or low-voltage directive 2006/95/EC:
The control panel as a safety component: Position document of the BauA (The German Federal Institute for Occupational Safety and Health in coordination with the German Federal Ministry for Labor and Social Affairs)

Ordering control panels from third-party companies:
Position document from the specialist unit for machine safety

Note: Position documents can be found in the appendix of your training documentation
Any questions?

**Note / exclusion of liability**

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.

© Siemens Industry Inc. 2014. All rights reserved.
Additional information on the machinery and low-voltage directives
Scope of validity

The EU's low-voltage directive applies to introducing electrical equipment onto the market. Bringing products to market and their free movement within the EU may not be hindered by any member state of the EU, provided the requirements of the directive are fulfilled. If this is not the case, then introduction to the market can be prohibited. Recall actions can also be arranged by the responsible authorities.

Equipment affected is that which lies between certain voltage limits: with alternating current between 50 and 1,000 V; with direct current between 75 and 1,500 V. Equipment affected:

- Electrical equipment
- Ready-to-use equipment
- Parts, such as incandescent lamps, switches, etc.

→ As such, whole machines are covered by this directive.

The voltage limits refer to the maximum input and output voltages – not to voltages that exist inside the equipment.
Which aspects have to be considered?

Summary

To protect against hazards that may emanate from electrical equipment, technical measures must be taken so that, in the event of proper use and orderly maintenance:

- People and livestock are suitably protected against the risk of injury or other damage which could be caused through direct or indirect contact
- No temperatures, electric arcs or radiation occur which could result in hazards
- People, livestock and property are suitably protected from non-electric hazards which, from experience, emanate from electrical equipment
- The insulation is appropriate for the intended demands
- Aspects of EMC are covered by the EMC directive
Scope of validity – Exceptions

Equipment and areas that are not covered by the low-voltage directive

- Electrical equipment for use in explosive atmospheres
- Electro-radiological and electro-medicinal equipment
- Electrical parts of passenger and goods lifts
- Electricity meters
- Domestic plug and socket devices
- Devices for supplying power to electric fences
- RFI suppression
- Special electrical equipment that is designated for use on ships, airplanes or railways and which conforms to the safety regulations of international institutions to which the member states belong
Introduction to the MD

- Directive 2006/42/EC is the first revised version of the 1989 machinery directive
- 2006/42/EC is composed of the old machinery directive and the changes made to it
- The new version improved the practical applicability of the directive
- It has been valid and applicable since December 29, 2009

Main objectives
1. Harmonization of requirements for safety and health and environmental protection
2. Guarantee of free movement of machines within the EU
Another reason for revising the MD:

- A clear definition of the boundaries between the areas of application and thus a greater degree of legal certainty

- Machinery directive 2006/42/EC

- Article 1

  - Area of application
    1. Scope of validity for certain products
    2. Exceptions
**Definitions**

**Machine characteristics**

1. Drive system, with no direct human or animal effort
2. Parts or devices connected together, with at least one of these being moveable
3. A combination for a specific application
4. A unit with characteristic 1 and – missing parts which connect the machine with the location of use or power/drive source
5. A unit with characteristics 1 to 2 which is ready for installation, and – ready for operation following installation on transportation or installation in a building / structure
6. A unit with characteristics 1 to 3 or incomplete machines, and – functions as a unit following combination
Definitions

Incomplete machines
1. A unit which almost forms a machine
2. Does not have the function of a machine

Example:
A drive system alone does not constitute a complete machine; only after being combined / installed with additional parts does a unit emerge which is defined as a machine by the MD.
Definitions

Replaceable equipment

- Devices for changing or expanding the functionality of a machine which are attached by the operator following commissioning
- Are not tools
Definitions

Commissioning
- The proper, first-time use of a machine

Bringing to market
- The provision of a machine for the purpose of a sale / usage
- No restriction with regard to the legal / contractual form (sale, rent, leasing, transfer, etc.)

The operating / testing of a machine during assembly, installation or configuration is permitted before it is considered to be commissioned / put on the market. The safety and health protection of the operator and other vulnerable persons must be guaranteed by the machine manufacturer in line with additional guidelines*
Relevance of EMC directive 2004/108/EC to control panels

- Area of application
- Flow chart
- Association with EN 61439-1 for control panels
The EMCD covers how *devices have to function together in a particular environment*

The EMCD *does not cover safety and hazards* (e.g. with regard to people)

The EMCD only covers equipment and *not fields and their consequences*; e.g. for people

**Note:** The EMC directive as an individual directive is *not* safety-related.
Area of application
The EMC directive in relation to control panels

**Fixed installations:** are a combination of devices and additional apparatus. These are connected or installed to be permanently operated in a particular location.

**Note:** for fixed installations:
- *no* CE marking and *no* EC Declaration of Conformity are necessary
  (if commercially requested then it becomes a customer request)
- the appointing of a "responsible party" is necessary

→ The **control panel is a component for a fixed installation**
→ Formalism does not have to be observed
→ CE marking and EC Declaration of Conformity are not required
→ The **requirements of the EMC directive however are relevant – and thus so are the standards**
Flow chart for selection as per the EMC directive

Fixed installations: **no separate**
- CE marking
- EC Declaration of Conformity in the sense of the EMCD **are necessary**!

**Source:** Guide to EMC directive 2004/108/EC
Relationship to the DIN EN 61439-1 for control panels
Annex ZZ of DIN EN 61439-1 (informative)

Relationship to the fundamental requirements of EC directive 2004/108/EC [EMC directive]

This European standard was created under a mandate issued by the European Commission and the European Free Trade Association to CENELEC. This European standard covers all the relevant basic requirements within its area of application that are contained within article 1 of the annex of EC directive 2004/108/EC [the EMC directive].

Compliance with this standard is an opportunity to declare conformity with the defined basic requirements of the EC directive(s) concerned.

WARNING:
Additional requirements and further EC directives may apply to products that fall under this standard's area of application.
Note / exclusion of liability

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.
IEC 61439 for low-voltage switchgear and controlgear assemblies

Composition and concept of the IEC 61439 series of standards

- History and background
- Composition and scope of application of the new IEC 61439 series of standards
- Changes from the previous IEC 60439
### History and background
Milestones in the development of switchgear standards

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1896</td>
<td>1st edition of the VDE &quot;Standards, provisions, and guidelines&quot;</td>
</tr>
<tr>
<td></td>
<td>First safety provisions relating to switchgear and distribution equipment</td>
</tr>
<tr>
<td>1941</td>
<td>VDE 0100 &quot;Low-voltage electrical installations under 1,000 V&quot;</td>
</tr>
<tr>
<td>1958</td>
<td>VDE 0100 Paragraph 29 N: Requirements in terms of isolation, short-circuit resistance, and contact protection</td>
</tr>
<tr>
<td>1967</td>
<td>VDE 0660 Part 5 &quot;Factory-assembled switchgear and controlgear assemblies (FBA)&quot; (IEC 60439)</td>
</tr>
<tr>
<td></td>
<td>VDE 0100 Paragraph 30b: Construction requirements for non-factory-made switchgear and distributors</td>
</tr>
<tr>
<td>1973</td>
<td>VDE 0660 Part 500 (IEC 60439-1)</td>
</tr>
<tr>
<td>1984</td>
<td>Type-tested switchgear and controlgear assemblies (TTA)</td>
</tr>
<tr>
<td></td>
<td>Partially type-tested switchgear and controlgear assemblies (PTTA)</td>
</tr>
<tr>
<td></td>
<td>General construction requirements</td>
</tr>
<tr>
<td>2009</td>
<td>IEC 61439-1/-2 = VDE 0660 Part 600-1/-2 (06/2010)</td>
</tr>
</tbody>
</table>
History and background
Reasons for the radical revision and restructuring

Criticisms of the IEC 60439 series of standards:

The standards are difficult to understand and apply:
- Gray areas are open to subjective interpretations.
- Poorly structured content

TTA/PTTA dilemma: [Type Tested Assemblies / Partially Type Tested Assemblies]
- Categories are incorrectly interpreted.
- Limited applicability
- Classification does not benefit the end client.

IEC 60439 Part 1 has two functions:
- Product standard and general requirements for all standards in the series

→ The standards are disregarded by a number of manufacturers and within certain market segments.

1998: New work item proposal 17D/205/NP from the British national committee: "Radical restructuring and revision of IEC 60439 series of standards"
The new structure of the IEC 61439 series of standards ensures all requirements are listed within the relevant product sections so the switchgear manufactured complies with standards.

<table>
<thead>
<tr>
<th>New IEC 61439 standard</th>
<th>IEC 60364 standard replaced</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61439-1: General rules</td>
<td>IEC 60439-1</td>
<td>Published</td>
</tr>
<tr>
<td>IEC 61439-2: Power switchgear and controlgear assemblies</td>
<td>IEC 60439-1</td>
<td>Published</td>
</tr>
<tr>
<td>IEC 61439-3: Distribution boards</td>
<td>IEC 60439-3</td>
<td>Published</td>
</tr>
<tr>
<td>IEC 61439-4: Particular requirements for assemblies for construction sites</td>
<td>IEC 60439-4</td>
<td>Published</td>
</tr>
<tr>
<td>IEC 61439-5: Assemblies for power distribution in public networks</td>
<td>IEC 60439-5</td>
<td>Published</td>
</tr>
<tr>
<td>IEC 61439-6: Busbar trunking systems</td>
<td>IEC 60439-2</td>
<td>Published</td>
</tr>
<tr>
<td>IEC/TR 61439-0: Requirements manual for specifying switchgear and controlgear assemblies</td>
<td>None</td>
<td>Published</td>
</tr>
</tbody>
</table>
Composition and scope of application of the new IEC 61439 series of standards

Composition and elements

IEC /TR 61439-0
Guide to specifying assemblies

Basic standard

IEC 61439-1 General rules
IEC 61439-2 Power switchgear and controlgear assemblies
IEC 61439-3 Distribution boards
IEC 61439-4 Particular requirements for assemblies for construction sites
IEC 61439-5 Assemblies for power distribution in public networks
IEC 61439-6 Busbar trunking systems

Product standards

Important for machine and plant engineering
Note: For switchgear and controlgear assemblies that do not fall into the area of application of other parts of this series of standards, Part 2 always applies (IEC 61439-2)!

Users of switchgear and controlgear assemblies (OEMs, end clients, planners, etc.)

(Original) manufacturers of switchgear and controlgear assemblies

© Siemens Industry Inc. 2014. All rights reserved.
Composition and scope of application of the new IEC 61439 series of standards
Scope of application of IEC 61439-1 and -2

Parts 1 & 2 apply to switchgear and controlgear assemblies:

- With a rated voltage of up to 1,000 V AC or 1,500 V DC
- Both fixed and movable, with or without enclosure
- For generating, transmitting, distributing, and converting electrical energy and controlling electrical switching devices and components
- To be used under special operating conditions (e.g. on ships, railcars) associated with additional requirements
- For equipping machines with the additional requirements under IEC 60204
- That are individual units or series-produced

The assembly may also be performed by a different manufacturer to the original one

- The standard is intended to lay down definitions and set out the operating conditions, construction requirements, technical properties, and verification requirements.
- Part 1 can only be used in conjunction with the relevant product standard (Parts 2-6).
General rules
Terminology

Low-voltage switchgear and controlgear assembly [e.g. industrial control panel]

- Assembly of **one or several low-voltage switchgears and controlgears** with related equipment for control, measurement, reporting, protection, and regulation, with all the internal electrical and mechanical connections and structural components.
Interface characteristics – new terms, definitions:

**Rated current of the switchgear and controlgear assembly – $I_{nA}$**
- Describes the total current, which a switchgear and controlgear assembly can distribute, limited by main busbars and feeds

**Rated current of an electrical circuit – $I_{nC}$**
- The current that an electrical circuit can carry within a switchgear and controlgear assembly without overheating when it alone is charged

**Definition of the Rated Diversity Factor (RDF)**
- No longer describes the assumed load of electrical circuits, but rather their proven ability to simultaneously channel a percentage of their rated current
- The rated current of the electrical circuits multiplied by the RDF must be greater than or equal to the electrical circuit loads that are to be expected
- The RDF applies to the operation of the switchgear and controlgear assemblies with its rated current (i.e. under the highest load permitted)
General rules
Terminology

Rated short-time withstand current (Icw)
- The effective value of short-time current specified by the manufacturer of the switchgear and controlgear assembly, given as current and time, which can be resisted without damage under certain conditions.

Rated conditional short-circuit current (Icc)
- The value of prospective short-circuit current specified by the manufacturer of the switchgear and controlgear assembly which the electrical circuit, protected by a short-circuit protective device (SCPD), can withstand during the total break time (current flow duration) of the device under defined conditions.

Rated peak withstand current (Ipk)
- The highest instantaneous value of short-circuit current specified by the manufacturer of the switchgear and controlgear assembly that can be withstood under defined conditions.
Prospective short-circuit current (Icp)

- The effective value of current that would flow if the supply line of the electrical circuit is short circuited by a conductor with negligible impedance in direct proximity to the terminals of the switchgear and controlgear assembly

Cut-off current / let-through current

- The highest instantaneous value of current during a switching device or fuse's turn-off time.

- **NOTE:** This term is of particular significance if the switching device or fuse switches off so that the prospective peak current of the electrical circuit is not reached
Changes from the previous IEC 60439

Overview

- Part 1 only contains "General rules" → basic standard. All other parts refer back to this part → product standards.

- Part 2 contains additional requirements applicable to power switchgear and controlgear assemblies. Parts 1 and 2 together correspond to the previous IEC 60439-1.

- IEC 60439-1 no longer has twin role as both product standard (formerly: TTA) and user standard (formerly: PTTA).

- Distinction between TTA and PTTA is replaced by the verification type → There is still only one type-approved switchgear and controlgear assembly

- There are alternative, but equally valid, methods for verifying some of the properties requiring verification: testing – comparison – expert appraisal.
Changes from the previous IEC 60439

Overview

- The entire structure of the standard reflects its new function as a standard based on general requirements.
- The RDF has been set out in greater detail.
- Verification of "compliance with temperature-rise limits". There are significant changes here for the "calculation" verification method.
- Introduction of a "black box" concept for defining interfaces (IEC 61439-0 Guidance to specifying assemblies)
- EMC – compatibility is now properly described and incorporated as a form verification.
- Rules for empty enclosures (IEC 62208) have been incorporated.
Changes from the previous IEC 60439
TTA and PTTA

The concept, classification, and the terms TTA and PTTA were discarded in favor of "type-approved switchgear and controlgear assembly"

For customers, it is only important that the product is proven to be suitable for its application.

→ No further classification is necessary!
Changes from the previous IEC 60439
The definition of "manufacturer"

Product responsibility – shared verification responsibilities

Terms:
"Original manufacturer"
A company that developed the switchgear system [e.g. industrial control panel]
- "An organization which performs the original construction and the associated design verification of the switchgear and controlgear assembly according to this standard"

"Manufacturer of the switchgear and controlgear assembly“ [e.g. industrial control panel]
A manufacturer which uses the switchgear system; e.g. a user of a reproduction system, franchise partners, etc.
- "An organization which assumes responsibility for the finished switchgear and controlgear assembly"
- The manufacturer of the switchgear and controlgear assembly is always responsible for the routine verification!
Changes from the previous IEC 60439

Scenario 1: Product responsibility – shared verification responsibilities

- **Manufacturer of the switchgear and controlgear assembly**
  - The switchgear builder (e.g. system constructor)
  - Own design verifications for changes
  - Routine verification

- **Original manufacturer**
  - Switchgear developer (e.g. Siemens)
  - Design verification

- **Customer**
  - The switchgear operator

"In the case of a switchgear and controlgear assembly that ... was verified by an original manufacturer and ... was manufactured or assembled by another manufacturer, a repetition of the original design verification is not necessary if all the requirements and instructions defined and provided by the original manufacturer have been completely fulfilled."

"If the manufacturer of the switchgear assembly makes changes that are not covered by the verifications of the original manufacturer, the manufacturer of the switchgear and controlgear assembly will be considered the original manufacturer for those changes."
Changes from the previous IEC 60439
Scenario 2: Product responsibility – shared verification responsibilities

- Manufacturer of the switchgear and controlgear assembly
  The builder of the control panel (e.g. control panel shop)

- Original manufacturer
  Switchgear developer, machine builder, System Integrator etc.
  = "Customer"
  The switchgear operator

- Design verification for specifications

  0–100% – specifications

- End user
  The operator, user of the equipment

1. Routine verification
2. Relevant, outstanding design verifications
3. Own design verifications for changes

© Siemens Industry Inc. 2014. All rights reserved.
Changes from the previous IEC 60439
"The black box concept"

Introduction of the "black box concept" for interface definition
The concept is supported by the specifier's guide (IEC/TR 61439-0)

<table>
<thead>
<tr>
<th>Table from Part 1, Annex C</th>
</tr>
</thead>
</table>

Annex C
(informative)

Items subject to agreement between
the ASSEMBLY manufacturer and the user for IEC 61439-2 ASSEMBLIES

C.1 Standard options

Table C.1 compiles information that the standard identifies as subject to an agreement between the ASSEMBLY manufacturer and the user. Unless specified otherwise, the default arrangement will apply. In some cases, information declared by the ASSEMBLY manufacturer may take the place of an agreement.

<table>
<thead>
<tr>
<th>User defined characteristics</th>
<th>Reference class or subclass</th>
<th>Default arrangement(s)</th>
<th>Options listed in standard</th>
<th>User requirement(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical system</td>
<td>5</td>
<td>Manufacturer's standard, selected to suit local requirements</td>
<td>TT / TN-C / TN-C-3 / IT, TN-0</td>
<td></td>
</tr>
<tr>
<td>Earthing system</td>
<td>5.2</td>
<td>Local, according to installation conditions</td>
<td>Max. 1000 V a.c. or 1500 V d.c.</td>
<td></td>
</tr>
<tr>
<td>Nominal voltage of the power supply (V)</td>
<td>5.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transient overvoltages</td>
<td>5.4, 5.5</td>
<td>Determined by the electrical system</td>
<td>Overvoltage category</td>
<td></td>
</tr>
</tbody>
</table>
Changes from the previous IEC 60439
"The black box concept"

- Customers should specify the "interface characteristics" that are important for the application.
- Designing the solution is the responsibility of the manufacturer.
The rated diversity factor

of a switchgear and controlgear assembly, or a part of it (e.g. a section or sub-section), which comprises several main circuits, is the ratio of the highest sum of all currents that are to be expected at a given point in time in the respective main circuits to the sum of the rated currents of all the main circuits of the switchgear and controlgear assembly or the part of the switchgear and controlgear assembly under consideration.

Note: If no details are available the table may be used.
Terms / definitions
The Rated Diversity Factor (RDF) according to DIN EN 61439-1

The definition is unchanged in content (§ 5.3.3)
Now determined by exact knowledge of the load conditions
Can now also be determined at the field or section level

Field B example:
load conditions: 800, 320, 320 A → 0.9

The RDF during intermittent operation

\[ I_{\text{rms}} = \sqrt{\frac{i_1^2 \cdot t_1 + i_2^2 \cdot t_2 + i_3^2 \cdot t_3}{t_1 + t_2 + t_3}} \]
Changes to design and performance requirements

- **Changes concerning protection against electric shock**
  - New terminology of the basic safety standards was adopted and the requirements adjusted
  - Changed: "Protection against direct contact" and "protection against indirect contact" were replaced by the new terms "basic protection" and "fault protection"
Changes to design and performance requirements

- **8.6.1 Main circuits**
  - Minimum cross-section for N conductor: 50% of the phase conductor (but no smaller than 16 mm²)
    - Previously: at least 30% of the phase conductor cross-section – DIN EN 60439-1

- **9.3.4 Coordination of protective equipment**
  - If "back-up" protection is used, then a warning is required on a sign on the system or in the operating instructions stating that no replacement of one of the short-circuit protective devices with a different type of device is permitted.
<table>
<thead>
<tr>
<th></th>
<th>Structure of the IEC 61439-1</th>
<th>Overview and organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Area of application</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Normative references</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Terms and definitions</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Symbols and abbreviations</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Identifying characteristics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of interfaces</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Details</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Operating conditions</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Construction requirements</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Behavioral requirements</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Design verifications</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Routine verifications</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Appendices</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Tables</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Figures</td>
<td></td>
</tr>
</tbody>
</table>

- A revision of the operating conditions in section 7
  New: Consideration of excessive harmonics in the supply voltage or in the load current.

- Numerous changes concerning the verification methods in section 10

- Change to the routine verification regarding creepage and clearance distances (see 11.3);
  new: compliance with the specifications regarding creepage distances (see 8.3.3) must be verified
  with a visual inspection. If this is not apparent from a visual inspection, verification must be provided
  via physical measurements.

- Revision of the EMC requirements in Annex J

- New Annex O with a guide for verifying temperature rises

- New Annex P with a verification method for the short-circuit strength of busbars (integration of the
  content from IEC/TR 61117)
Note / Exclusion of liability

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.
IEC 61439 Parts 1 & 2 low-voltage switchgear and controlgear assemblies

Carrying out and documenting verification

- Introduction to verification tests
- Design verifications
- Routine verifications
- Documentation
Design verification:
Verification of specimens of a switchgear and controlgear assembly or parts of switchgear and controlgear assemblies to show the design meets the requirements of the relevant switchgear and controlgear assembly standard

Objective:
Verification of compliance with the general requirements of the IEC 61439-1 standard and the relevant IEC 61439–2….6 product standard

IEC 61439-1 §10
Design verifications are to be performed by the original manufacturer of the switchgear and controlgear assembly or their performance should be agreed upon.
Introduction to verification tests

Terminology

Design verification via:

- **Testing**: Tests on a specimen of a switchgear and controlgear assembly or parts of switchgear and controlgear assemblies
- **Comparison**: Structured comparison of the planned design or parts of a switchgear and controlgear assembly with a reference design, verification via testing
- **Assessment**: Design verification of set design rules or calculations based on a specimen or parts of a switchgear and controlgear assembly
Introduction to verification tests

Terminology

Routine verification

Verification process to which each switchgear and controlgear assembly is subjected during and/or after its manufacture to ensure it meets the requirements of the relevant switchgear and controlgear assembly standard

Objective:

- To identify material and manufacturing defects
- Ensure operability

DIN EN 61439-1 §11

Routine verifications are to be performed by the manufacturer of the switchgear and controlgear assembly.
Design verifications
Verification options in accordance with IEC 61439-1 Annex D

- There are alternative processes for some design verifications.
- Alternative processes are treated as being equivalent.
- The original manufacturer makes the choice.

Design verification via:

- Testing
- Comparison
- Assessment
## Design verifications
Verification options in accordance with IEC 61439-1 Annex D

<table>
<thead>
<tr>
<th>Property requiring verification</th>
<th>Verification options</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Testing</td>
<td>Comparison</td>
<td>Assessment</td>
</tr>
<tr>
<td>Strength of materials</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Degree of protection of the enclosure</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Clearances</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Creepage distances</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Protection against electric shock and integrity of protective circuits</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Incorporation of switching devices and components</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Internal electrical circuits and connections</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Terminals for external conductors</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Dielectric properties</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td><strong>Temperature rise limits</strong></td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td><strong>Short-circuit withstand strength</strong></td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Electromagnetic compatibility (EMC)</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Mechanical function</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

**Exceptions:**

1.) UV radiation / resistance to exceptional heat and fire
2.) Short-circuit withstand strength of the protective conductor
3.) Surge voltage strength
### 13 design verifications to be performed in accordance with IEC 61439-1

<table>
<thead>
<tr>
<th></th>
<th>Design</th>
<th></th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strength of materials and parts</td>
<td>2.1</td>
<td>Dielectric properties</td>
</tr>
<tr>
<td>1.1</td>
<td>Degree of protection of the enclosure</td>
<td>2.2</td>
<td>Verification of temperature rise</td>
</tr>
<tr>
<td>1.2</td>
<td>Clearances and creepage distances</td>
<td>2.3</td>
<td>Short-circuit withstand strength</td>
</tr>
<tr>
<td>1.3</td>
<td>Protection against electric shock and integrity of protective circuits</td>
<td>2.4</td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td>1.4</td>
<td>Incorporation of switching devices and components</td>
<td>2.5</td>
<td>Mechanical function</td>
</tr>
<tr>
<td>1.5</td>
<td>Internal electrical circuits and connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td>Terminals for external conductors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Design verifications – design
1.1 Strength of materials

**Verification objective:**
Verification of the mechanical, electrical, and thermal suitability of materials and parts

**Generally speaking:**
If an enclosure in accordance with IEC 62208 is used, no further "strength of materials" tests will be required!

**Note:**
IEC 62208 – Empty enclosures for low-voltage switchgear and controlgear assemblies – General requirements

**SIEMENS example:**
IEC Alpha Box wall-mounted distribution board in accordance with IEC 62208

© Siemens Industry Inc. 2014. All rights reserved.
Design verifications – design
1.1 Strength of materials

If no IEC 62208 enclosure is being used:

- **Corrosion resistance;** for ferrous metal enclosure
- **Properties of insulating materials;** thermal stability and resistance against exceptional heat
- **Resistance against ultraviolet (UV) radiation;** only for enclosure installed outdoors coated with insulating material
  
  **Exception:** This test does not need to be performed if the original manufacturer can provide data from the material supplier showing the material satisfies the requirements in the same type and thickness or thinner.
- **Lifting;** optional, if requested
- **Impact testing;** optional for power switchgear and controlgear assemblies in accordance with IEC 61439-2, if requested
- **Labels;** only for labels manufactured by molding, injection, engraving
Design verifications – design
1.2 Degree of protection of enclosure

**Generally speaking:**
The degree of protection (IP) does not need to be tested for enclosure already tested to IEC 62208!

**Assessment:**
- If an empty enclosure is used in accordance with IEC 62208, a verification in the form of an expert appraisal must be performed to ensure that all external changes made do not impair the degree of protection. In this case, no additional test is necessary.

**Test:**
- If no IEC 62208 enclosure is being used:
  → Performance of IEC 60529 testing (degree of protection offered by enclosure – IP Code)
**Design verifications – design**
1.3 Clearances and creepage distances

**Objective:**
To ensure dielectric properties are appropriate for installations where contamination (creepages) and excess voltage levels (clearances) are an issue.

**Generally speaking:**
Clearances and creepage distances need to be measured in line with Annex F for IEC 61439-1!

<table>
<thead>
<tr>
<th>Pollution degree</th>
<th>Minimum values of width $x$ of grooves $\text{mm}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0,25</td>
</tr>
<tr>
<td>2</td>
<td>1,0</td>
</tr>
<tr>
<td>3</td>
<td>1,5</td>
</tr>
<tr>
<td>4</td>
<td>2,5</td>
</tr>
</tbody>
</table>

Pollution degree 3 is the standard industry value!
**Objective:** Effectiveness of protective function in the event of a fault

- For internal faults in the switchgear cabinet (1)
- For external faults within electrical circuits supplied by the switchgear cabinet (2)

(1) **Continuous connection of the protective conductor to the conductive parts in the switchgear cabinet (protection in the event of internal faults)**

- All conductive parts must be connected to the protective conductor.
- Max. resistance $R \leq 0.1\Omega$ of the electrical circuit
- Verification using a resistance meter (AC or DC) at a minimum of 10A; current flows from any component to the terminal for the external protective conductor.
Design verifications – design
1.4 Protection against electric shock and integrity of protective circuits

(2) Short-circuit withstand strength of the protective circuit (protection in the event of external faults)

a) Verification via comparison with a tested reference design –
   I. Based on a checklist (Table 13 IEC 61439-1)
      Satisfaction of Points 1-6 and 8-10
   II. Based on a calculation
      - Equivalent to "verification of the short-circuit withstand strength of busbar arrangements via comparison with a tested reference design"
      - Plus satisfaction of Points 6-10 in the checklist (Table 13 IEC 61439-1)

b) Verification by testing short-circuit withstand strength to IEC 61439-1 paragraph 10.11.5.6 Testing the protective circuit

Note: There is no need to test electrical circuits which can be discounted in terms of short-circuit withstand strength – the relevant condition is described under Point 2.3 of the design verification section.
Design verifications – design  
1.5 Incorporation of switching devices and components

**Generally speaking:**
Verification is based on an assessment of constructional requirements (IEC 61439-1 Chapter 8). The manufacturer specifications need to be followed at the time of installation!

**Electromagnetic compatibility:**

a) Testing by inspecting the environment defined (A or B) with the incorporated switching devices and components which are relevant from an EMC perspective

b) Or, if necessary, confirmation via EMC testing
Construcational requirements for electrical circuits and connections inside switchgear cabinets:

- Main circuit
- Auxiliary circuit
- Bare and insulated conductors
- Selecting and laying non-protected, active conductors to reduce the likelihood of short circuits
- Marking of conductors in main and auxiliary circuits
- Marking of the protective conductor (PE, PEN) and neutral conductor (N) in main circuits

**Objective:** Testing by inspecting the internal electrical circuits and connections based on the constructional requirements (IEC 61439-1 Chapter 8)
Selecting and laying non-protected, active conductors
Overcurrent Protection Layout (Example)

- Q20 assumes
  - Short-circuit protection
  - Overload protection
- Q21 assumes
  - Short-circuit protection
  - Overload protection
- Q22 assumes
  → Overload protection of the line to Q22 only by Q20

- Routing of cable / line
to Q22 in conduit
  and
  max. 3 m and short circuit proof selected
Design verifications – design
1.7 Terminals for external conductors – Chapter 8

- Indication of whether terminals for copper and/or aluminum
- Unless agreed otherwise, copper cross sections (min. and max. terminal sizes) must be devised as per Annex A (does not apply to circuits where Icn ≤ 1A and Udc ≤ 120V or Uac ≤ 50V).
- If aluminum terminals are being used, agreement needs to be reached on the type, size, and terminal technology.
- N-conductor at least 50% of the external conductor cross section, but no less than 16mm²
  N-conductor cross-section reduction only permitted from 16mm² of the phase conductor
- Marking of terminals for external PE conductors with ; not necessary if there is green/yellow marking
- Terminal cross section for external copper PE conductors as per Table 5

Objective: Testing by inspecting the terminals for external conductors (IEC 61439-1 Chapter 8)
Generally speaking:

a) Each circuit must be designed for the following kinds of excess voltage.
   - Temporary excess voltages  → tested based on power-frequency withstand voltage
   - Transient excess voltages  → tested based on surge voltage strength

b) All electrical switching devices and components must be connected.

Exception:
   - Devices designed for a small test voltage
   - Devices which induce a current flow (windings, measuring instruments, devices protecting against excess voltages, etc.)
Design verifications – performance
2.1 Dielectric properties

I. Power-frequency withstand voltage (verification must be based on testing!)

a) Main, auxiliary, and control circuits connected to the main circuit
   → tested based on Table 8

b) AC / DC control circuits not connected to the main circuit
   → tested based on Table 9

c) Test voltage created at max. 50% of the final test value; increased simultaneously
   and maintained for at least 5 s and up to 7 s

Result:
- There must be no flashover (insulation fault).
- The overcurrent relay must not be triggered.
Design verifications – performance
2.1 Dielectric properties

II. **Surge voltage strength** (verification based on testing or expert appraisal!)
   
a) **Verification via testing:**
   
   - Surge voltage generator with test voltage as per Table 10
   - 1.2/50 µs surge voltage
   - Five times for each polarity at intervals of at least 1 s

   **Alternative power-frequency voltage testing:**
   
   - Sinusoidal test voltage, output current ≥ 200 mA
   - Test voltage level as per Table 10
   - Created once for at least 15 ms

   **Alternative testing using DC voltage:**
   
   - Test DC voltage, output current ≥ 200 mA
   - Test voltage level as per Table 10
   - Created once for each polarity; 15 ms ≥ t ≤ 100 ms

**Result:**

- There must be no flashover (insulation fault).
- The overcurrent relay must not be triggered.
b) Verification via expert appraisal:

- Clearances must be at least 1.5 times the Table 1 value.
- Rather than measuring clearances, the dimensions in the design drawings can be checked instead.
- Switching devices and components must be appropriate for the rated surge voltage strength $U_{\text{imp}}$ defined.

Table 1 – Minimum clearances in air $^a$ (8.3.2)

<table>
<thead>
<tr>
<th>Rated impulse withstand voltage $U_{\text{imp}}$ kV</th>
<th>Minimum clearance mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 2.5$</td>
<td>1.5</td>
</tr>
<tr>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>6.0</td>
<td>5.5</td>
</tr>
<tr>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>12.0</td>
<td>14.0</td>
</tr>
</tbody>
</table>

$^a$ Based on inhomogeneous field conditions and pollution degree 3.
3 Verification options: testing, comparison, assessment

a.) Testing
b.) Comparison
c.) Assessment

*) Restrictions

Different InA for the switchgear and controlgear assembly
Verification via testing

- Verification option for all switchgear and controlgear assemblies where InA > 1,600 A
- Rules for selecting test items (worst-case testing)
- Rules for testing complete switchgear and controlgear assemblies
- Rules for separate testing of main busbars, distribution bars, and functional units
Selecting a representative arrangement

Testing of main busbars
- Least suitable versions under worst-case conditions
- Regardless of field type but valid for all fields

Testing of field types
- Least suitable versions under worst-case conditions
- Valid for all versions of the field type

Testing of field distribution bars
- Least suitable versions under worst-case conditions
- Regardless of versions and arrangement of functional units but valid for all versions

Testing of functional units
- Least suitable versions under worst-case conditions
- Valid for all versions of functional units
## Table 6, IEC 61439 – applies with a max. ambient temperature ≤ 35°C

<table>
<thead>
<tr>
<th>Parts of the switchgear and controlgear assembly</th>
<th>Temperature-rise limit [K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-built switching devices and components</td>
<td>As per specifications</td>
</tr>
<tr>
<td>Terminals for incoming/outgoing insul. conductors</td>
<td>70 K (e.g. 35 + 70 = 105°C)</td>
</tr>
</tbody>
</table>
| Current bars, conductors, plug-in contacts, replaceable parts | Limited by:  
  - Mechanical strength  
  - Influence on adjacent switching devices and components  
  - Limit temperature of insulating materials  
  - Connected switching devices and components  
  - Contact material for isolating contacts |
| Controls                                          | 15 K (e.g. 35 + 15 = 50°C)  
  | Insulating material                             | 25 K (e.g. 35 + 25 = 60°C) |
| Exterior surfaces exposed to the touch            | 30 K (e.g. 35 + 30 = 65°C)  
  | Metal                                           | 40 K (e.g. 35 + 40 = 75°C) |
| Insulating material                              |                             |
| Plug connections                                  | Limited by incoming switching devices and components |

Within switchgear and controlgear assemblies, higher temperatures may occur at grounded metal parts if damage involving built-in switching devices and components can be ruled out.
Design verification – performance
2.2 Verification of temperature rise – testing

- Ambient temperature must be between +10°C and +40°C
- Use of thermocouples and thermometers
- The temperature-rise limit values in Table 6 must not be exceeded
- The devices within the switchgear and controlgear assembly must work perfectly
Design verification – performance
2.2 Verification of temperature rise – comparison

- Verification is based on a comparison with a **tested reference design**.

- Can be used for:
  1. Switchgear and controlgear assemblies
  2. Busbars
  3. Functional units
Design verification – performance
2.2 Verification of temperature rise – comparison with a switchgear and controlgear assembly

- The functional units must belong to the same group as the functional unit selected for testing.
- The design must be the same as that used for the test.
- The overall dimensions must be greater than or equal to those tested.
- Ventilation must be identical to or better than the test ventilation (forced ventilation or natural convection, identical or larger ventilation openings).
- The number of internal partitions (if there are any) must not exceed the number during testing.
- Power loss within the same field must not exceed that during testing.
Design verification – performance

2.2 Verification of temperature rise – comparison with busbars

- Rated values for aluminum bars also apply to copper bars, but not vice versa.

- Comparison with test items based on the following criteria: reduction of one or more of the height, width, number of bars per conductor, but with
  1. The same bar arrangement
  2. The same distances between centers of conductors
  3. The same enclosure and
  4. The same busbar compartment (if there is one)

- If the cross section which has been tested is also smaller than the one to be derived, the rated values for the versions in between may be determined via interpolation.
2.2 Verification of temperature rise – comparison with *functional units*

- Rated currents must be calculated for all functional units within the group.
- The reduction factor must be determined for each functional unit.
- The rated current for each untested functional unit within the group is the highest possible current for this functional unit multiplied by the reduction factor for the tested version for the group.

**Functional units - replacing devices**

A device may be replaced by a similar device from a different series than the one used for the original verification, providing

- The power loss and temperature rise for the terminals of the device during testing are less than or equal to its product standard.
- Also, the physical arrangement within the functional unit and the rating for the functional unit must remain the same.
2 calculation methods are allowed:

1. $I_{nA} \leq 630 \, A$
   Comparing the resulting power loss with the power loss associated with the enclosure

2. $I_{nA} \leq 1600 \, A$
   Calculating the power loss and radiation via the enclosure in accordance with IEC 60890
   for switchgear and controlgear assemblies $I_{nA} > 630 \, A$ to $1600 \, A$ (maximum of 3 internal partitions)

**Generally speaking:**
- The rated current for the circuits may not exceed 80% of the conventional thermal rated currents for switchgear and electrical switching devices and components in free air within the circuit.
- All conductors must have a minimum cross section equivalent to 125% of the permissible rated current.
Verification of short-circuit withstand strength

Verification of rated currents for short circuits via
- Comparison with a reference construction (checklist or calculation)
- Testing

Verification of the short-circuit withstand strength of circuits is not required for:

a) Switchgear and controlgear assemblies with a rated short-term withstand current $I_{cw}$ or a conditional rated short-circuit current $I_{cc}$ with a root mean square value of 10 kA at the most;

b) Switchgear and controlgear assemblies or circuits of switchgear and controlgear assemblies, protected by current-limiting devices, whose peak-let through current at the highest permissible uninfluenced short-circuit current at the in-feed terminals of the switchgear and controlgear assembly does not exceed 17 kA;

c) For auxiliary circuits: $U_N \geq 110$ V, $P_N \leq 10$ kVA and $u_k \geq 4$
   $U_N < 110$ V, $P_N \leq 1.6$ kVA and $u_k \geq 4$
2.3 Verification of short-circuit withstand strength is not required – case a.)

A rated short-term current tolerance $I_{cw}$
or conditional rated short-circuit current $I_{cc}$

$\leq 10 \text{kA}$

$I_{cp} \leq 10 \text{kA}$
Design verification – performance
2.3 Verification of short-circuit withstand strength is not required – case b.)

Overcurrent protection devices:

$I_{\text{peak}} \leq 17\text{kA}$
at $I_{\text{cp}} \geq 10\text{kA}$
Design verification – performance
2.3 Verification of short-circuit withstand strength is not required – case c.)

Auxiliary circuits:

\[ U_N \geq 110 \text{ V}, \quad P_N \leq 10 \text{ kVA} \]
and \( u_k \geq 4\% \)

\[ U_N < 110 \text{ V}, \quad P_N \leq 1.6 \text{ kVA} \]
and \( u_k \geq 4\% \)
Design verification – performance
2.3 Verification of short-circuit withstand strength

Example with SIMARIS curves:
- NH fuse 3NA..., 200 A,
  \( I_{cu} = 120 \text{ kA} \)
- \( I_{cp} = 50 \text{ kA} \rightarrow I_{peak} = 16.2 \text{ kA} \)

\( \rightarrow I_{peak} \leq 17 \text{ kA} \)

\( \rightarrow \) No verification of the short-circuit withstand strength necessary!
Example with SIMARIS curves:

- Circuit breaker 3RV1042, 50 A, 
  \( I_{cu} = 100 \text{ kA} \)
- \( I_{cp} = 30 \text{ kA} \rightarrow I_{peak} = 16.2 \text{ kA} \)

\( I_{peak} \leq 17 \text{ kA} \)

\( \rightarrow \) No verification of the short-circuit withstand strength necessary!
2.3 Verification of short-circuit withstand strength – comparison

1. **Comparison based on a checklist**
   - Comparison using 10 questions in the IEC 61439 checklist
   - If an element in the checklist is not satisfied, then comparison based on calculations or testing

2. **Comparison using calculation (only for busbars!)**
   - Verification of the short-circuit withstand strength of busbar arrangements via comparison based on calculations (Annex P IEC 61439) and
   - Points 6, 8, 9, and 10 in the checklist also need to be satisfied

**Notice:** Comparison may only be based on a reference design which has been tested already!
Verification via testing:

- Where the design is the same, only one functional unit needs to be tested.
- Only one bar needs to be tested if the rest have a similar configuration.
- Circuits must be tested to the highest thermal and dynamic standards.
- Testing of main circuits
- Testing of neutral conductors (at least 60% of external conductor current)
- Testing of protective circuit (at least 60% of external conductor current)
- ...
2.4 Electromagnetic compatibility (EMC)

**Generally speaking:**

Verification is based on

- Assessment (of constructional requirements – Chapter 8)
- Tests as per Annex J

Verification based on **tests** is not required if an **Assessment** finds that:

- Switching devices and components are designed for the specified environment.
- Installation and wiring have respected manufacturer specifications.

In all other cases → testing as per Annex J.10.12

→ The requirements of EMCD 2004/104/EC for the control panel are thus fulfilled.
EMC withstand testing on finished switchgear and controlgear assemblies may only be forgone if the following conditions are met:

- The installed equipment is manufactured for the respective environment in accordance with the applicable EMC standards.
- The installation and wiring of the components has been performed in accordance with the specifications of the relevant manufacturer (arranged with respect to mutual interference, shielded cable, grounding, etc.).

2 ambient conditions are considered:

- **Environment A**: industrial networks / areas / devices (including strong sources of interference)
  → Equates to class A devices
- **Environment B**: public networks such as residential areas, businesses, small industry. Strong sources of interference (arc welding machines) are not covered here
  → Equates to class B devices

The switchgear and controlgear assembly manufacturer must specify which ambient condition its switchgear and controlgear assembly is suited to.
Design verification – performance
2.4 Electromagnetic compatibility (EMC)

**Interference immunity**
Switchgear and controlgear assemblies without installed electronic equipment are considered immune to interference under normal operating conditions.

→ No verification necessary for this
→ Furthermore these devices do not usually have any specification on the environment to which they are best suited

**Emitted interference**
Switchgear and controlgear assemblies without installed electronic equipment only produce electromagnetic interference during switching operations. However, this is only for a few milliseconds. It is also a part of the normal electromagnetic environment.

→ No verification necessary for this
→ Furthermore these devices do not usually have any specification on the environment to which they are best suited
Design verification – performance
2.5 Mechanical function

Verification via testing

- There is no need to test previously type-tested arrangements or switchgear and controlgear assembly parts (e.g. slide-in circuit breakers).
- Testing of any mechanical locking devices
- The energy used before and after testing must remain practically unchanged.
- Parts to be tested need to undergo at least 200 activation cycles.

The parts to be tested are:
- Enclosure or partition walls
- Hinges and locking devices for doors
- Removable parts including encoding devices
- Matching demands (see also 10.13)
- The mechanical function of removable parts, including any encoding device
### Routine verifications to be performed in accordance with IEC 61439-1

<table>
<thead>
<tr>
<th>1</th>
<th>Constructional requirement</th>
<th>2</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Degree of protection of the enclosure</td>
<td>2.1</td>
<td>Dielectric properties</td>
</tr>
<tr>
<td>1.2</td>
<td>Clearances and creepage distances</td>
<td>2.2</td>
<td>Wiring, operating performance, and function</td>
</tr>
<tr>
<td>1.3</td>
<td>Protection against electric shock and integrity of protective circuits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>Incorporation of switching devices and components</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>Internal electrical circuits and connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td>Terminals for external conductors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td>Mechanical function</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Routine verifications – constructional requirements**

1.1 Degree of protection of enclosure

**Verification is based on visual inspection.**

→ Verification of protection against mechanical effects (if required) as per test documentation

→ Verification that the prescribed IP degree of protection for the enclosure or enclosure parts has been achieved

   1. Protection against touching live parts and ingress of solid foreign bodies
   2. Protection against the ingress of water

   Checks based on visual inspection of the switchgear cabinet and documentation

→ As far as removable parts and the associated loss of prescribed protection are concerned, the measures, marking, or agreements need to be checked in the documentation.
Routine verifications – constructional requirements
1.2 Clearances and creepage distances

Clearances:

→ Visual inspection of clearances;

→ If clearances are visibly smaller than required in Table 1, a surge voltage test must be performed. (See Design verification 2.1 Dielectric properties.)

Creepage distances:

→ Visual inspection of creepage distances;

→ If nothing revealed during visual inspection, verification must be provided via physical measurements.
Routine verifications – constructional requirements

1.3 Protection against electric shock and integrity of protective circuits

Visual inspection of required measures in terms of:

- Basic protection (protection against direct touching)
- Error protection (protection against indirect touching)

Verification is based on:

1. Visual inspection of the protective circuits; specifications for protective circuits must be met.
2. Screw-in connections must undergo spot checks (correct torque, etc.).
Routine verifications – constructional requirements

1.4 Incorporation of switching devices and components

**Visual inspection** to establish whether switching devices and components have been installed and marked in line with manufacturer documentation

- Inserts and removable parts (e.g. removal only when not live)
- Selection of switching devices and components in line with applicable IEC standards
- Installation in accordance with manufacturer specifications
- Accessibility as specified in standards or agreements
- Covers (excluding operator hazards)
- Direction of actuation and displays of switch positions (marking)
- Indicator lights and pushbuttons (colors)
1.5 Internal electrical circuits and connections

- Spot checks of connections to see whether these are tight enough
- Special priority should be given to screw-in connections.
- Checking conductors are in line with manufacturer documentation

To be precise, this applies to:
- Main circuits (busbars, cross section of N and PEN conductors)
- Auxiliary circuits
- Bare and insulated conductors
- Selecting and laying non-protected, active conductors in terms of the probability of short circuits (\textit{max. 3 m} conductor length before the next form of short-circuit protection)
- Marking of conductors in main and auxiliary circuits
- Marking of PE, PEN, and N connectors in main circuits
Routine verifications – constructional requirements

1.6 Terminals for external conductors

Checking of

- Number
- Type
- Marking

of terminals based on manufacturer documentation for the switchgear and controlgear assembly

Examples of checks:

- Number: of connectors which can be connected to one terminal
- Type: aluminum connectors and/or copper connectors
- Marking: and/or green/yellow markings within the switchgear cabinet assembly
Routine verifications – constructional requirements
1.7 Mechanical function

Checking

- Effectiveness of mechanical actuation elements, locking devices, and locks

- Also in conjunction with removable parts, where applicable (module installed on a supporting structure)
2.1 Dielectric properties

**Generally speaking:**
- Testing of power-frequency insulation strength must be performed for all circuits.
- Duration 1 s (not min. 5 s to max. 7 s as with design verification)
  → see Design verification 2.1 Dielectric properties.

**Exceptions:** Auxiliary circuits
- With up to 16 A protection
- Which undergo a function test at the rated voltage do not need to be tested

**Alternative** to testing for switchgear cabinets with a protective device *up to max. 250 A* at the infeed:
- Measurement of insulation resistance at 500 V DC at least
- Insulation resistance must ≥ 1000 Ω/V between the circuits and components.
Ensuring the marking and documentation of the switchgear and controlgear assembly

With complex switchgear and controlgear assemblies it is recommended that the wiring be checked and an electrical function check be performed. The test method and the number of tests depends on whether the switchgear and controlgear assembly has complicated locking devices, sequence controls, etc..

→ Decision of the manufacturer or an agreement between the manufacturer and the user
A test report must be created for the conducting of verifications as per DIN EN 61439-1.

Chapter 10.1

"The reference design, the number of switchgear and controlgear assemblies used for the verifications, or parts of these, the choice of verification methods, providing they are applicable, and the sequence of verifications are the responsibility of the original manufacturer.

The data used, the calculations, and the comparisons conducted when verifying the switchgear and controlgear assemblies are to be documented in a test report."
Note / Exclusion of liability

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.
Switchgear and controlgear assembly documentation

Requirements of the documentation in accordance with:

IEC 60204-1 – Electrical equipment of machines

IEC 61439-1 – Low-voltage switchgear and controlgear assemblies
Requirements according to DIN EN 60204-1

The *information that is required for setting up, operating, and servicing a machine's electrical equipment* must be supplied *in a suitable format*. The information must be *in an agreed language*. The form of information provided may vary depending on the complexity of the electrical equipment delivered. For very simple equipment, the corresponding information may be contained within a single document, provided that this document shows all the devices of the electrical equipment and enables connections to be established to the power supply.

**REMARK:** The technical documentation that is provided with parts of the electrical equipment can form part of the documentation for the machine's electrical equipment.
Switchgear and controlgear assembly documentation

Requirements according to DIN EN 60204-1

- Comprehensive description of the equipment
- Operating manual, manual for servicing
- Parts list
- Notes on setup / mounting / connecting to the power supply
- Where applicable: details on the physical environment, overview (block) circuit diagrams, programming, monitoring intervals, for example
- Circuit diagram
- Description of protective equipment (locked functions for machines coordinated to work together, etc.)
- Technical protective measures
- Information on handling, transport and storage
Switchgear and controlgear assembly documentation

Requirements according to DIN EN 61439-1

- All identifying characteristics of the switchgear and controlgear assembly must be contained within the technical documentation
- Notes on transport, handling, installation, operation, and servicing
- Identification of devices, components, electrical circuits (parts lists, assembly drawings, circuit diagrams, and terminal diagrams)

Note: No separate requirements for power switchgear and controlgear assemblies (DIN EN 61439-2)
Switchgear and controlgear assembly documentation

Selection of identifying characteristics of a switchgear and controlgear assembly according to DIN EN 61439-1

- Rated values of voltages – such as the rated voltage of a switchgear and controlgear assembly, the rated operating voltage of electrical circuits of a switchgear and controlgear assembly, the rated insulation voltage of a ...
- Rated values for currents (I_nA, I_nc, I_pk, I_cw, I_cc)
- Rated Diversity Factor (RDF) (also for groups of electrical circuits)
- Rated frequency f_N
- Pollution degree, degree of protection (IP code)
- System after ground connection (line system configuration)
- Classification according to EMC (environmental condition A or B)
- **Type of short-circuit protective device(s)**
- Protection against electric shock
- Overall dimension, weight, etc.
(1) A brief excursion covering the type of short-circuit protective device(s) according to DIN EN 61439-1

For switchgear and controlgear assemblies *with* a short-circuit protective device in the infeed, *the user should specify the value of the prospective short-circuit current* which can arise at the input connections of the switchgear and controlgear assembly.

**Result:**

*The manufacturer must provide a marking or documentation* which *specifies the short-circuit withstand strength of the switchgear and controlgear assembly* for which the short-circuit protective device on the infeed provides protection.
(2) A brief excursion covering the type of short-circuit protective device(s) according to DIN EN 61439-1

For switchgear and controlgear assemblies **without** an installed short-circuit protective device on the infeed, **the manufacturer of the switchgear and controlgear assembly** must specify the short-circuit withstand strength in one or more of the following ways:

a) The **rated short-time withstand current (Icw)** together with the **associated duration** and the **rated peak withstand current (Ipk)**

b) The **rated conditional short-circuit current (Icc)**
(2) A brief foray covering the type of short-circuit protective device(s) according to DIN EN 61439-1

<table>
<thead>
<tr>
<th>Technical specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards</td>
</tr>
<tr>
<td>Swatches</td>
</tr>
<tr>
<td>Rated insulation voltage $U_i$</td>
</tr>
<tr>
<td>Rated operational voltage $U_e$</td>
</tr>
<tr>
<td>Rated frequency</td>
</tr>
<tr>
<td>Rate impulse withstand voltage $U_{imp}$</td>
</tr>
<tr>
<td>Rated short-time withstand current (1 s current, rms value)</td>
</tr>
<tr>
<td>Short-circuit protection, max. back-up fuse (gL)</td>
</tr>
<tr>
<td>Rated conditional short-circuit current with upstream fuses at AC 50/60 Hz, 690 V</td>
</tr>
<tr>
<td>Maximum permissible let-through $i^2t$ value</td>
</tr>
<tr>
<td>Permissible let-through current of the fuse</td>
</tr>
</tbody>
</table>

SIEMENS catalog extract LV10.1
Note / exclusion of liability

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.

© Siemens Industry Inc. 2014. All rights reserved.
Documentation in line with LVD

Documentation requirements in line with the Low Voltage Directive 2006/95/EC
Documentation in line with the low-voltage directive

- Process for the CE – Declaration of Conformity and marking in line with LVD 2006/95/EC
  1. Method
  2. Declaration of Conformity
  3. CE marking
- Example for the Declaration of Conformity and the CE marking
Path to CE marking
Conformity assessment procedure

Conformity must be assessed by the manufacturer or someone authorized by them and based within the Community. The conformity assessment procedure incorporates 3 main steps.

1. Compiling the technical documentation

2. Declaration of Conformity

3. CE marking

These obligations (methods) do not apply to the importer, who will generally have no detailed knowledge regarding which directives have been taken into account or which technical specifications have been applied.
1. Compiling the technical documentation

Scope (corresponding to Annex IV of the LVD – internal production monitoring)

The technical documentation incorporates the following:

- General description of the electrical switching devices and components
- Design and production plans and circuit diagrams showing how components, modules, and circuits, etc. are arranged
- Descriptions and explanations to help people understand these plans and circuit diagrams and operate the electrical switching devices and components (Objective: third-parties must be able to understand)
- A list of standards applied (in full or in part) or, if no standards have been applied, a description of the means by which the safety requirements of the directive have been satisfied
- The results of the design calculations, tests performed, etc.
- **Test reports** (available test reports from the manufacturer or third parties)

**Before a product is brought into circulation** the manufacturer needs to compile the various technical documentation verification that the products satisfies the directive.
1. Compiling the technical documentation

Retention of technical documentation:

- For at least 10 years by the manufacturer or authorized party
- Readily accessible (e.g. in electronic form too)
- Importer or party bringing product into circulation is responsible for documentation retention if the manufacturer or their authorized party is not based within the Community.
- Must be made available within a reasonable period of time if requested by the authorities (e.g. within 2 weeks)
2. Declaration of Conformity

Content

The Declaration of Conformity must contain:

- Name and address of the manufacturer or someone authorized by them and based within the Community
- Description of the electrical switching devices and components
- The harmonized standards applied
- Reference to the specifications on which conformity is based where no harmonized standards have been applied
- Identity of the manufacturer or their authorized signatory based within the Community
- The last two digits of the year when the CE marking was applied
2. Declaration of Conformity

Retention

The Declaration of Conformity must be made available and retained by the

- **Manufacturer** or
- someone **authorized by them**

Based with the Community (EEA)

If *neither are based within the Community*, a copy needs to be retained by

- The **importer** or
- For the **party responsible for bringing the product into circulation**

The authorities responsible for supervising the market can request a copy of the Declaration of Conformity at any time if necessary.

The Declaration of Conformity must be drafted in at least one of the official European languages.

**Official languages within the EU: 23**   **Working languages: 3** (English, French, German)
3. CE marking

- **Marking** of electrical switching devices and components with CE marking before it is brought into circulation by *the manufacturer* only or someone *authorized* by them and based within the Community.

- **CE marking applied to the electrical switching devices and components** themselves or, if this is not possible, to the packaging, the user instructions, or the warranty certificate.

- Marking must be clearly visible, legible, and permanent.

- **Minimum height 5mm** with *proportions* retained if enlarged.
3. CE marking

The **CE marking** indicates that an electrical switching device or component:

- **Satisfies the main requirements**
- Has been through the conformity assessment process as defined in the Low Voltage Directive and the other directives applicable to the product
- And whose **free movement within the EEA** may only be limited/denied if there are well grounded suspicions (presumption of effectiveness)

It is forbidden to apply markings whose meaning or design may be confused with the meaning or design of CE marking.
Examples of the declaration of conformity, rating plate, and the CE marking

- Declaration of conformity for a SIVACON power distribution board

- Example rating plate of a low-voltage switchgear and controlgear assembly – according to DIN EN 61439-2

Manufacturer: Musterschaltschrankbau GmbH

Serial number: Power distribution board: 12345

Date of manufacture: September 2012

Switchgear and controlgear assembly complies with IEC 61439-2
Any questions?

**Note / Exclusion of liability**

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.

© Siemens Industry Inc. 2014. All rights reserved.
Switchgear and controlgear assembly marking

- Requirements according to IEC 60204-1
- Requirements according to IEC 61439-1
Switchgear and controlgear assembly marking

General

Markings, rating plates, and warning signs must:

- be of sufficient durability
- attached so as to be legible

**Standards: (assorted samples)**
- IEC 60445 - terminals, conductor terminations and conductors
- IEC 60417 - graphical symbols for use on equipment
Additional requirements according to IEC 60204-1 (16.4)

A rating plate is to be put on the control panel which should be easily recognizable following installation. The rating plate must be attached to the enclosure around the infeed.

- Name or company sign of the manufacturer / supplier
- If necessary, approval symbols
- Serial number / type designation
- Rated voltage, number of phases, frequency (with alternating voltage), full load current for the infeed(s)
- Short-circuit coordination of the equipment
- Number of the main documentation

**Note:** Full load current under normal operating conditions (be aware of the rated diversity factor (RDF))
Switchgear and controlgear assembly marking

Requirements according to IEC 61439-1

The manufacturer of the control panel must place one or several permanent inscriptions on each control panel so that these are legible when the control panel is connected and in operation:

- Name or trademark of the manufacturer of the control panel
- Type designation / identification number, with which necessary information can be requested from the manufacturer of the control panel
- Marking for determining the date of manufacture
- IEC 61439-X (the applicable part is to be specified)

Note:
The applicable control panel standard may determine whether further details must be specified on the identification plate
Switchgear and controlgear assembly marking

Requirements according to IEC 61439-2
Details on the identification plate for power switchgear and controlgear assemblies

- Name or trademark of the manufacturer of the control panel
- Type designation / identification number, with which necessary information can be requested from the manufacturer of the control panel
- Marking for determining the date of manufacture
- IEC 61439-2

Example:

Manufacturer: Musterschaltschrankbau GmbH
Serial number: Power distribution board: 12345
Date of manufacture: September 2012
Switchgear and controlgear assembly complies with IEC 61439-2
Marking of Conductors
IEC 60204-1

Marking of conductors

<table>
<thead>
<tr>
<th>Marking of conductors</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective conductor</td>
<td>Green / yellow</td>
</tr>
<tr>
<td>AC &amp; DC power circuits</td>
<td>Black</td>
</tr>
<tr>
<td>AC control circuits (operating voltage &lt; line voltage)</td>
<td>Red</td>
</tr>
<tr>
<td>DC control circuits (operating voltage &lt; line voltage)</td>
<td>Blue</td>
</tr>
<tr>
<td>excluded circuits (circuits which remain energized)</td>
<td>Orange</td>
</tr>
<tr>
<td>Grounded conductor of an AC line voltage circuit (Neutral)</td>
<td>Light Blue</td>
</tr>
</tbody>
</table>

Where color-coding is used for identification of conductors (other than the protective conductor and the neutral conductor), the following colors may be used:
BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE (including LIGHT BLUE), VIOLET, GREY, WHITE, PINK, TURQUOISE.
Switchgear and controlgear assembly marking

The ASSEMBLY manufacturer shall provide *in documents or catalogues* the conditions, if any, for the handling, installation, operation and maintenance of the ASSEMBLY and the equipment contained therein.

Example for a marking concerning the EMC environment:

```
CAUTION

This product has been designed for environment A. Use of this product in environment B may cause unwanted electromagnetic disturbances in which case the user may be required to take adequate mitigation measures.
```
Any questions?

Note / exclusion of liability

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.
Planning efficiency, helpful tools for CAD/CAE systems and documentation

- SIMARIS software tools
- "My Documentation Manager"
- CAx download manager

www.usa.siemens.com/planning-efficiency
SIMARIS software tools

**SIMARIS design:**
- Network calculations and calculating short-circuit currents

**SIMARIS curves:**
- Visualizing and evaluating characteristic curves

Download: www.siemens.com/simaris
SIMARIS design
Functionality

- **Dimensioning electrical networks** based on real products from medium-voltage through to consumer-level, including an automatic selection of suitable equipment.
- Dimensioning is conducted according to the recognized rules of technology and applicable standards (VDE, IEC).
- Open definition of the types of mains operation and switching states.
- Calculation of the short circuit current, load flow, voltage drop and energy balance.
- Consideration of the required personal, short-circuit, and overload protection.
- Consideration of the required lightning and surge protection possible.
- Representation of the busbar trunking systems for power transmission and distribution.
- Different output versions for documentation.
## SIMARIS design

### Versions

<table>
<thead>
<tr>
<th>Function</th>
<th>SIMARIS design Professional</th>
<th>SIMARIS design</th>
</tr>
</thead>
<tbody>
<tr>
<td>All functions for the dimensioning of the electrical power distribution</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Special electrotechnical functions</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Online registration</td>
<td>For a nominal charge</td>
<td>Free of charge</td>
</tr>
</tbody>
</table>
SIMARIS curves
Functions

- Visualization and evaluation of the *tripping characteristics* of low-voltage protective devices and fuses (IEC), including an option for the *simulation of device settings*
- Visualization of *cut-off current and cut-off energy characteristics*
- Product selection overview per order number or selection guide
- Saving of selected devices as *favorites*
- Saving of several characteristic curves including settings as a complete project
- Consideration of *country-specific product portfolios*
- User-friendly *documentation*
SIMARIS curves
SIMARIS curves 2.x characteristic curves display

Product search using order number or catalog

Display of tripping, cut-off current, and cut-off power characteristics

Simulation of device settings
CAX download manager – Your information archive

• With the **CAX-Download-Manager** you have a simple access to up-to-date product data for your CAD or CAE system.

• Configure **your own download cart with a few clicks**.

• You can choose among
  1. product images, 2-dimensional drawings, 3-dimensional models,
  2. circuit diagrams, EPLAN macro files
  3. manuals, characteristics, operating instructions, certificates and product master data

**Benefit:** Searching for product-specific Cax data can be very time-consuming. Now, you can configure your product-specific CAX-Download-Manager cart with only a few mouse-clicks.

*We compile your individual download package for you!*

[www.siemens.com/cax](http://www.siemens.com/cax)
C Ax download manager – Your information archive
C Ax data types – Types of information

Product graphic
Operating travel diagram (only relevant for position switches)
Terminal connection diagram
2D dimension drawing
Internal circuit diagram
3D model
EPLAN macros
Product data sheet
Operating instructions
Commercial data
Technical data
Product: C Ax data

Characteristic curves
Manual
Certificates/approvals
My Documentation Manager – Call up options

Compile Your Individual Documentation

Description
My Documentation Manager offers you to compile your own documentation from our standard documents (manuals) available in the Product Support section.

Start My Documentation Manager

My documentation manager
Example for a customized manual

www.siemens.com/mydocumentationmanager
"My documentation Manager" is an online service for customizing existing manuals to your individual requirements by combining or rearranging manuals, chapters or text blocks even in different languages.

Benefits
1. You can compile your manual to include all information in all available languages that you have selected at random.
2. You can give the manual a customized layout.
3. You can subscribe to an update service so that all parts of the documents you have incorporated into your personalized manual will be updated automatically in case of changes.
Any questions?
Example of internal documentation in accordance with the LVD and DIN EN 61439-1 using a sample panel

- Sample panel and specification
- Verifications acc. to IEC 61439-1-2
- Documentation notes in accordance with IEC 61439-1
- Documentation notes in accordance with LVD 2006/95/EC
These obligations (methods) do not apply to the importer, who will generally have no detailed knowledge regarding which directives have been taken into account or which technical specifications have been applied.
Chapter 10.1

"The reference design, the number of switchgear and controlgear assemblies used for the verifications, or parts of these, the choice of verification methods, providing they are applicable, and the sequence of verifications are the responsibility of the original manufacturer.

The data used, the calculations, and the comparisons conducted when verifying the switchgear and controlgear assemblies are to be documented in a test report."
Examples of documentation:

You will receive the following suggestions for documentation conforming to standards and directives at the end of this seminar:

<table>
<thead>
<tr>
<th>General declaration of conformity</th>
<th>EC declaration of conformity</th>
<th>Example of a plant document</th>
<th>Design verification checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="General declaration of conformity" /></td>
<td><img src="image2.png" alt="EC declaration of conformity" /></td>
<td><img src="image3.png" alt="Example of a plant document" /></td>
<td><img src="image4.png" alt="Design verification checklist" /></td>
</tr>
</tbody>
</table>

- **Design verification test report**
- **Routine verification test report**
Specification

Low-voltage switchgear and controlgear assemblies in accordance with IEC 61439-1 & -2
Project: Siemens example project PLC 2012

- Rated current: InA = 100 A
- Installation altitude ≤ 1,000 m
- Pollution degree: 3
- Overvoltage category: 3
- Ambient temperature: T = 20°C
- IP degree of protection: IP54
- Prospective short-circuit current on the input terminals: Icp ≤ 10 kA

...
Sample panel – specification
A declaration of conformity from a supplier is a form of confirmation of conformity, which:

- fulfills the requirements of the market and
- government bodies

in a way that inspires confidence.

Acceptance of a supplier's declaration of conformity could be further assisted if the details

- on which the supplier bases his declaration
- are kept ready in the form of a document and
- are made available upon request

Recommendation if there is an export outside the EEA (European Economic Area).
Example of an EC Declaration of Conformity:

- In accordance with **low-voltage directive 2006/95/EC**
- In accordance with **EMC directive 2004/104/EC**
- In accordance with **IEC 61439-1 & -2/EN 61439-1 & -2/ VDE 0660 parts 600-1 & -2**
Circuit diagrams
Data sheets, characteristic curves, certificates, etc.

Characteristic curves
Manual
Certificates/approvals
Product data sheet
Operating instructions

CAx – Shopping basket for the SIEMENS sample panel PLC 2012

Quick and simple gathering of necessary technical data with the CAx online generator from SIEMENS
**Data sheet**

Example with the compact starter 3RA6

---

**Technical data**

### 9.1 3RA6 compact starter

#### General technical data

<table>
<thead>
<tr>
<th>Order number</th>
<th>3RA61</th>
<th>3RA64</th>
<th>3RA62</th>
<th>3RA65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of poles</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Permissible ambient temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>According to IEC 60721-3-1</td>
<td>°C</td>
<td>-55 to +100</td>
<td></td>
</tr>
<tr>
<td>Shipping</td>
<td>According to IEC 60721-3-2</td>
<td>°C</td>
<td>-55 to +10</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>According to IEC 60721-3-3</td>
<td>°C</td>
<td>-20 to +100</td>
<td></td>
</tr>
<tr>
<td>Internal control cabinet temperature: up to +40°C</td>
<td>%</td>
<td>100 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal control cabinet temperature: up to +55°C</td>
<td>%</td>
<td>80 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 The permissible operating current of the compact starter depends on the design version and the ambient temperature. For additional information, please refer to General data (Page 12).

| Relative atmosphere humidity | % | 19 to 30 |
| Max. nominal voltage | V | 230/400 |

<table>
<thead>
<tr>
<th>Adjustment range overload release and rated operational current L1</th>
<th>A</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 0.1...34</td>
<td>A</td>
<td>0.1</td>
</tr>
<tr>
<td>+ 0.32...1.05</td>
<td>A</td>
<td>1.25</td>
</tr>
<tr>
<td>+ 1...4</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>+ 3...12</td>
<td>A</td>
<td>12</td>
</tr>
<tr>
<td>+ 6...32</td>
<td>A</td>
<td>32</td>
</tr>
</tbody>
</table>

---

© Siemens Industry Inc. 2014. All rights reserved.
Data sheet
Example with the SINAMICS G120 converter

Technical specifications

Common performance ratings of the Power Module

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line operating voltage</td>
<td>3 AC 380 V ... 480 V ± 10%</td>
</tr>
<tr>
<td>Input frequency</td>
<td>47 Hz ... 63 Hz</td>
</tr>
<tr>
<td>Modulation depth</td>
<td>87% (The maximal output voltage is 87% of the input voltage)</td>
</tr>
<tr>
<td>Power factor α</td>
<td>0.9</td>
</tr>
<tr>
<td>Overload capability (HO)</td>
<td>1.5 x Nominal output current (150% overload) for 57 s every 300 s</td>
</tr>
<tr>
<td></td>
<td>5.5 kW ... 75 kW</td>
</tr>
<tr>
<td>Overload capability (LO)</td>
<td>1.1 x Nominal output current (110% overload) for 57 s every 300 s</td>
</tr>
<tr>
<td></td>
<td>7.5 kW ... 90 kW</td>
</tr>
<tr>
<td>Inrush current</td>
<td>Less than rated input current</td>
</tr>
<tr>
<td>Pulse frequency</td>
<td>4 kHz standard</td>
</tr>
<tr>
<td>Electromagnetic compatibility</td>
<td>Power Modules with integrated class A filters according to EN 55011 available</td>
</tr>
</tbody>
</table>

© Siemens Industry Inc. 2014. All rights reserved.

Example of internal documentation using a sample panel
Data sheet
Example with the TS8 control panel enclosure

Rittal – The System.
Faster – better – worldwide.

© Siemens Industry Inc. 2014. All rights reserved.
Individual creation of system documentation for end customers with the SIEMENS tool "My Documentation Manager"
Tests, calculations (verifications acc. to DIN EN 61439-1 & -2)

Design verifications

according to IEC 61439-1 and IEC 61439-2

Test report for low-voltage switchgear and controlgear assemblies

Original manufacturer: ________________________________
Manufacturer of the switchgear and controlgear assembly: ________________________________
Project: ________________________________
Customer: ________________________________
Place, date: ________________________________

Routine verifications

according to IEC 61439-1 and IEC 61439-2

Test report for low-voltage switchgear and controlgear assemblies

Original manufacturer: ________________________________
Manufacturer of the switchgear and controlgear assembly: ________________________________
Project: ________________________________
Customer: ________________________________
Place, date: ________________________________

Standard:
- IEC 61439-1, 2011
- IEC 61439-2, 2011

The routine verifications listed below have been conducted in accordance with IEC 61439-1 and IEC 61439-2.
### Checklists for design and routine verifications

#### CHECKLIST FOR DESIGN VERIFICATIONS
as per IEC 61439-1-2 for power switchgear and controlgear assemblies

<table>
<thead>
<tr>
<th>Ordering party/Customer:</th>
<th>Project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear and controlgear assembly:</td>
<td></td>
</tr>
<tr>
<td>Date, location:</td>
<td></td>
</tr>
<tr>
<td>Remarks:</td>
<td></td>
</tr>
</tbody>
</table>

#### A.) Verification of constructional requirements

<table>
<thead>
<tr>
<th></th>
<th>Performed / Comment</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.)</td>
<td>Strength of materials and parts</td>
<td></td>
</tr>
<tr>
<td>2.)</td>
<td>Degree of protection of the enclosure</td>
<td></td>
</tr>
<tr>
<td>3.)</td>
<td>Clearances and creepage distances</td>
<td></td>
</tr>
<tr>
<td>4.)</td>
<td>Protection against electric shock and integrity of protective circuits</td>
<td></td>
</tr>
</tbody>
</table>

#### CHECKLIST FOR ROUTINE VERIFICATIONS
as per IEC 61439-1-2 for power switchgear and controlgear assemblies

<table>
<thead>
<tr>
<th>Ordering party/Customer:</th>
<th>Project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear and controlgear assembly:</td>
<td></td>
</tr>
<tr>
<td>Date, location:</td>
<td></td>
</tr>
<tr>
<td>Time of testing:</td>
<td></td>
</tr>
<tr>
<td>After manufacture</td>
<td>During manufacture</td>
</tr>
</tbody>
</table>

#### A.) Checking constructional requirements

<table>
<thead>
<tr>
<th></th>
<th>Comment</th>
<th>Result</th>
<th>Tested by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.)</td>
<td>Degree of protection of enclosure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.)</td>
<td>Clearances and creepage distances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.)</td>
<td>Protection against electric shock and integrity of protective circuits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.)</td>
<td>Incorporation of switching devices and components</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Any questions?

Note / Exclusion of liability

The typical circuit diagrams and interpretations of the standard are not binding and do not claim to be complete regarding configuration, equipment or any other eventuality. They do not represent any client-specific solutions and are only intended to offer assistance for typical tasks.

Each person viewing this presentation is responsible for the correct operation of the products described. This presentation does not relieve you of your responsibility regarding safe handling when using, installing, operating, and maintaining the equipment.

By viewing this presentation you agree that Siemens cannot be made liable for possible damage beyond the above mentioned liability clause.

We reserve the right to make changes and revisions to this informational documentation without prior announcement.

When writing these guidelines, a lot of tables and texts were lifted straight from the relevant standards. All users of this documentation must always check whether the items quoted are still up to date or not. The final decision about the appropriateness of applying the applicable standards must be made by the user of this documentation.

The reproduction of this presentation and its distribution, utilization or the dissemination of its contents to third parties is not permitted.