

A photograph of two men in a server room. The man on the left is wearing a white shirt and holding a smartphone, gesturing with his hand. The man on the right is wearing a blue and white checkered shirt and glasses, holding a stack of papers. They are standing in front of server racks with blue lighting.

SIEMENS

Ingenuity for life

Type "1" and Type "2" coordination

for contactors and motor starters
acc. to UL 60947-4-1

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Due to market requirements in North America for more harmonization, the standard UL 508 for industrial control equipment has been symphonized with selected sections of the IEC 60947 standard for low-voltage switchgear and controlgear. UL published the new harmonized standards for North America in 2007: UL 60947-1. This standard addresses coordination between the branch circuit protective device and the motor starter and differentiates between Type "1" and Type "2" coordination types.

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What's behind Type "1" and Type "2" coordinated equipment?

Introduction

For many years, the UL 508 Standard for Industrial Control Equipment has been the U.S. standard for control products such as contactors, self-protected combination motor controllers and overload relays.

To fulfill the demand for stronger harmonization on the North American market, the UL certification organization collaborated with members of industry to harmonize UL 508 with selected sections of the IEC 60947 series of standards for low-voltage switchgear and controlgear.

UL published the new harmonized standards for North America in 2007:

- **UL 60947-1: Low-Voltage Switchgear and Controlgear** – Part 1: General Rules
- **UL 60947-4-1: Electromechanical Contactors and Motor-Starters** – Part 4-1

The latter is harmonized to the greatest extent possible with the IEC 60947-4-1 standard (Contactors and Motor-Starters - Electromechanical Contactors and Motor-Starters), whereby the deviations for North America are set out in UL 60947-4-1. This standard is a tri-national standard for the USA, Canada and Mexico.

UL 60947-4-1 addresses coordination between the branch circuit protective device and the motor starter, and differentiates between Type "1" co-ordination and Type "2" co-ordination. It also provides a method for evaluating the short-circuit performance of these devices.

According to UL 60947-4-1, the coordination type defines the permissible degree of damage for a device if a short circuit occurs. Component combinations must be selected according to the desired coordination Type "1" or Type "2".

Coordination Type "1"

Definition as per UL 60947-4-1: Type "1" coordination requires that under short-circuit conditions the contactor or starter shall cause no danger to persons or installations and does not need to be suitable for further service without repair and replacement of parts.

Consequence: After a short-circuit, it is permissible for the starter to be inoperative. In particular, damage to the contactor, solid-state switching devices and overload relay is permissible.

Coordination Type "2"

Definition as per UL 60947-4-1: Type "2" co-ordination requires that under short-circuit conditions the contactor or

starter shall cause no danger to persons or installations and shall be suitable for further use. There is a risk of contact welding.

In this case, the manufacturer shall indicate the measures to be taken as regards the maintenance of the equipment. The starter is still operative. There must be no signs of damage to the devices, with the exception of slightly welded contactor contacts that can be easily separated again without any noticeable deformation.

Consequence: After a short-circuit, the starter must still be suitable for further operation. There risk of contact welding (e.g. on a contactor) is acceptable. In this case, the manufacturer's instructions must be followed in order to easily separate the welded contacts.

Regardless of the selected coordination type, a short-circuit will be reliably and safely cleared and disconnected. Since coordination Type "2" assemblies are often instantly available for further operation after a short-circuit, they can be regarded as higher-quality modules.

Note:

Combinations of coordination Type "1" are generally the more favorably priced combinations.

Combinations of coordination Type "2" automatically fulfill the requirements of coordination Type "1".

Testing

All of the specified combinations in the available tables are tested in compliance with UL 60947-4-1 by the original manufacturer Siemens. You can download official UL certificates (Certificates of Compliance) from the Siemens Industry Online Support Portal:

[siemens.com/industry/online-support](https://www.siemens.com/industry/online-support)

Origin and background of the introduction of coordination types

The concept of Type "1" and "2" coordinated equipment originally came from Europe. Users of industrial control equipment wanted the manufacturer of the short-circuit protective device to specify the protective device to be used for the individual starter. And they wanted to know how a short-circuit would affect the further usability of the industrial control equipment. For this reason, manufacturers performed short-circuit tests with selected short-circuit protective devices. Based on the test results, the degree of damage for the respective starter in combination with specified short-circuit protective devices at a defined voltage was determined.

The associated short-circuit protective device had to be specified since equipment devices based on IEC standards is usually designed very close to their maximum capacities. This leads to different electrical ratings between various manufacturers. The NEMA standards used in North America specify NEMA sizes for fuses for switchgear and starters that are generally larger than the values for similarly rated IEC components. The ratings from different NEMA manufacturers are therefore more likely to be similar.

These variations in products and performance are the reason why each manufacturer specifies the starter and the associated short-circuit protective device.

What are the benefits of Type "2" coordinated equipment?

Increased productivity

High reliability and availability along with continuous motor operation play major roles in many manufacturing processes. When equipment is damaged, for instance due to a short-circuit current, components need to be either repaired or replaced. In the case of starters, the motors need to be shut down, which brings the manufacturing process to a standstill. Starters which comply with Type "2" coordination significantly reduce downtimes significantly since they do not need to be replaced. The result is higher productivity.

Cost savings

Components affected by a short-circuit current require replacement in most cases. Starters, such as contactors and overload relays, which comply with Type "2" coordination requirements, remain fully functional after short-circuit currents occur, and can therefore continue to be used for further operation without repair or renewal of parts. This can reduce labor and material costs significantly compared to repairing or replacing parts.

Only fuses have to be replaced when they are used as a short-circuit protective device instead of a motor starter protector in the branch circuit. The downtime of the equipment is reduced because components do not have to be replaced. This is especially important in industries like automotive, food & beverage or chemical, where downtimes have a major impact on the overall costs and need to be reduced as much as possible.

Notes

1) Example for Type "2" coordination equipment in IEC standards for machines

Some standards require that power contactors and the associated short-circuit protective devices shall be selected so that they satisfy the requirements of IEC 60947-4-1 for Type "2" coordination, e.g. IEC/EN

60204-32 Electrical equipment of machines – Part 32: Requirements for hoisting machines.

2) Marking requirements for UL 508A-listed industrial control panels

The current edition of UL 508A (April 2018) requires a specific marking for industrial control panels with a high Short Circuit Current Rating (SCCR above the default SCCR of the individual components)

WARNING

Risk of Fire or Electric Shock – The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. All current-carrying parts and other components protected by this device should be examined and replaced if damaged. If burnout of a current element of an overload relay occurs, the complete overload relay must be replaced.

These markings are addressed to the service and maintenance personnel. With Type "2" coordinated equipment, the starter can be examined to check whether it is damaged and if it can be used for further operation. Type "1" coordinated equipment, however, should be replaced as recommended in the standard, since a thorough inspection of the components is generally not possible.

Siemens Type "2" coordination rated equipment

Siemens has tested a series of combinations for Type "2" coordination according to UL 60947-4-1. Since this is an ongoing process and there are constantly new ratings available, please visit our website to obtain the latest data: [siemens.com/northamerican-standards](https://www.siemens.com/northamerican-standards)

Can IEC 60947-4-1 based ratings be used instead of UL 60947-4-1 based ratings for Type "1" and Type "2"?

The test results vary, so this is not recommended for several reasons.

- 1) Type coordination ratings based on IEC standards sometimes differ significantly from the rated values according to UL 60947-4-1. For instance, the achieved short-circuit current rating I_q for the individual combinations varies significantly.
- 2) In cases where fuses are used, the characteristics of the short-circuit protective devices are different in regards to the interrupting rating I_{cu} , the peak-let through current I_p and the peak-let through energy I_{2t} . IEC 60269 certified fuses are different in design, size and electrical ratings in comparison to UL 248 certified fuses e.g. Class CC, J, G, T, RK1 or RK5 fuses.
- 3) Tests according to IEC and UL are conducted at different voltage levels. IEC tests are usually performed at 400 V, 500 V and 690 V. UL standards typically require tests at 480V and 600V.

Is there a transition period between the UL 508 and UL 60947-4-1 standards for industrial control equipment?

Yes, there is a transition period for certification of equipment according to UL 508.

Manufacturers of industrial control equipment designed according to UL 508 had until November 2017 to renew the relevant UL 508 certificates according to the new UL 60947-4-1 standard. After November 2017, existing UL 508 certifications may only be retained if there are no changes to the products which would necessitate re-evaluation by UL. If any changes are made that would require re-evaluation, the products will be subject to UL 60947-4-1.

Even after the transitional period, UL 508 and UL 60947-4-1 certified equipment can be used and will be accepted according to the latest North American standards and codes.

How can users of contactors and motor starters find out whether components already comply with the UL 60947-4-1 standard?

It is possible to differentiate between products approved according to UL 508 and UL 60947-4-1 with the "guide card" for that specific product. The guide card, which belongs to the individual CCNs (Category Control Number), was revised and also contains references to the new UL 60947-4-1 standard. Within the individual UL listings of a manufacturer, UL 508 approved products are segregated from those which already comply with the new UL 60947-4-1.

The following CCNs are affected by the transition: NLDX, NRNT, NLRV, NKJH und NKCR (overload relays only). You can find further information on individual listings in the UL database at: ul.com/database

Additional references

➤ UL standards

www.ul.com

www.ul.com/database

UL 60947-1 Low-Voltage Switchgear and Controlgear – Part 1: General rules

UL 60947-4-1 Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters

UL 508A Standard for Industrial Control Panels

➤ Siemens products

usa.siemens.com/controls

Further information from Siemens

Siemens keeps you up-to-date.

Whether you are looking for reference works, web-based training courses, helpful engineering tools or useful information on panel building, you will find comprehensive information on "expert know-how", "tools and data for digitalization in engineering" and "aligned product and system portfolio" on our market portal for panel building:

usa.siemens.com/controlpanels

Still have questions or need additional support?

Siemens supports panel builders with free consulting and training on standards. Get in contact with one of our experts by sending us an email to:

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