WHITE PAPER I SEPTEMBER 2021

Devices for **protection of control circuits** and equipment

Safe and intelligent power distribution in control circuits

Whether in industry, infrastructure or buildings, every environment is dependent on a reliable supply of electric power. That is why products and systems that offer maximum safety and optimum efficiency are in such demand. A comprehensive portfolio for protecting control circuits covers every requirement from the overall plant to the individual load.

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Contents

Basics

General

Requirements for reliable power supplies in modern plants are ever increasing. Due to the rising number of loads and constant growth in the degree of automation, it is now more important than ever to continually ensure the quality of the power supply for the overall plant, as well as individual devices. Power failures and production outages must be avoided to prevent possible economic losses. This is achieved through well-matched combinations of reliable power supplies and suitable protective devices.

In electrical installations many loads are fed by the same power supply. Under fault conditions the DC voltage supply must be maintained and loads not affected by the fault must remain unaffected.
Circuit breakers for equipment and selectivity modules are used for selective protection of individual devices and equipment in parallel in order to increase plant availability and protect against the consequences of overload and short-circuit. If an overload or short-circuit occurs, these devices disconnect the corresponding circuit.

Under certain operating conditions, overcurrents may occur even in circuits without electrical faults. Overload currents can be caused by blocked drives or high starting currents, for example. Such an overload can cause damage to conductors and equipment if it continues for a prolonged period of time without being disconnected.

Short-circuits in electrical systems can occur abruptly, for example, due to incorrect switching operations, assembly/commissioning errors or faulty installations. These short-circuits carry a large amount of energy, which is released suddenly. The resulting damage to conductors and equipment can endanger plant operation.
Even more common, but no less dangerous, is the gradual development of cable overloads or short-circuits as a result of ageing phenomena on cable insulation, plug-in connectors or cable breaks.

Designs

Requirements for device protection vary, depending on the application. By using a variety of technologies, different designs are produced, each having their own characteristic disconnect behavior, so that optimal protection can be offered for every area of application.

Thermomagnetic circuit breakers for equipment

Thermomagnetic circuit breakers for equipment combine overload and short-circuit protection in one electrical-mechanical device.

Like in the case of miniature circuit breakers, the overload protection is implemented using a thermal tripping unit. The circuit breaker disconnects within the specified limit values as a function of the magnitude of overcurrent and time. The overcurrent shutdown is therefore delayed.

Short-circuit protection is ensured by a magnetic tripping unit. The short-circuit current generates a magnetic field, which actuates the tripping mechanism by means of a coil with armature. The reaction to short-circuit currents occurs within a few milliseconds.

If the circuit breaker is actuated manually or tripped due to an overload or short-circuit, the switching contacts are opened and the circuit is interrupted.

Thermomagnetic circuit breaker for equipment 5SY1

This combination of electrical-mechanical overload and short-circuit protection enables a tripping behavior that prevents unnecessarily premature disconnection in response to temporary operational current surges (e.g. starting currents of motors). Nevertheless, these circuit breakers still protect against lasting overload currents and short-circuits.

Thermomagnetic SENTRON circuit breakers for equipment are additionally characterized by galvanic isolation, a wide voltage range and high breaking capacity for reliable short-circuit protection. Galvanic isolation, in particular, is required in many industries including the process industry to provide safe isolation for maintenance.

Typical applications for thermomagnetic circuit breakers for equipment are therefore found in the mechanical and plant engineering, process technology, infrastructure and rail technology sectors.

Electronic circuit breakers for equipment and selectivity modules

Electronic circuit breakers for equipment are essentially based on semiconductor electronics with integrated software for the analysis and tuning of tripping behavior. Like thermomagnetic circuit breakers, the electronic circuit breakers also detect overload and short-circuits. However, since the electronics reacts dynamically, this means that the measured electrical quantities are used to differentiate between various operating and fault scenarios, enabling quick shutdown even for overload cases.

This rapid disconnection in the event of overload can be especially important for sensitive loads. At the same time, voltage dips in the power supply are limited to a minimum duration. Thus, an overload of the power supply is prevented and equipment in parallel control circuits remains unaffected. Programmable logic controllers, in particular, must be protected from voltage dips in the power supply to ensure reliable production processes.

Due to the semiconductor electronics used in electronic circuit breakers, however, high switching capacities and galvanic isolation are not possible here.

Electronic circuit breakers for equipment are used in combination with 24 V DC power supplies and frequently for the protection of relays, programmable logic controllers, sensors and actuators.

Electronic circuit breaker for equipment

Selectivity module

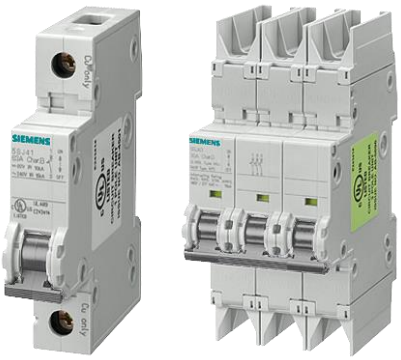
Differences between miniature circuit breakers and circuit breakers for equipment

Miniature circuit breakers

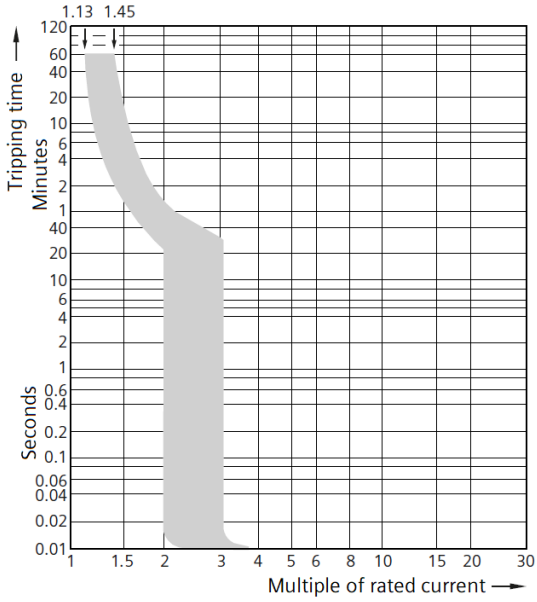
The insulation of cables and conductors provides not only important touch protection, but also short-circuit protection, between the lines. Embrittlement or melting of this insulation due to overtemperatures poses a hazard to both humans and the entire electrical installation.

Miniature circuit breakers were designed to protect conductors and cables against excess heating of their insulation due to operational overloads and short-circuits. The typical characteristic curves of miniature circuit breakers are based on the temperature load curves of the PVC insulation of cables and conductors. When selecting and dimensioning conductors and conductor protection, it must therefore be ensured that the rated current of the miniature circuit breaker does not exceed the permissible continuous load current of the conductor. The current of the connected loads is not known in this case. The circuit breaker is selected so that the conductor cannot be overloaded.

To constitute an efficient and reliable short-circuit protection, the short-circuit trip of the miniature circuit breaker must react at different speeds, depending on the equipment and operating behavior of the connected loads. This is referred to as tripping characteristics.

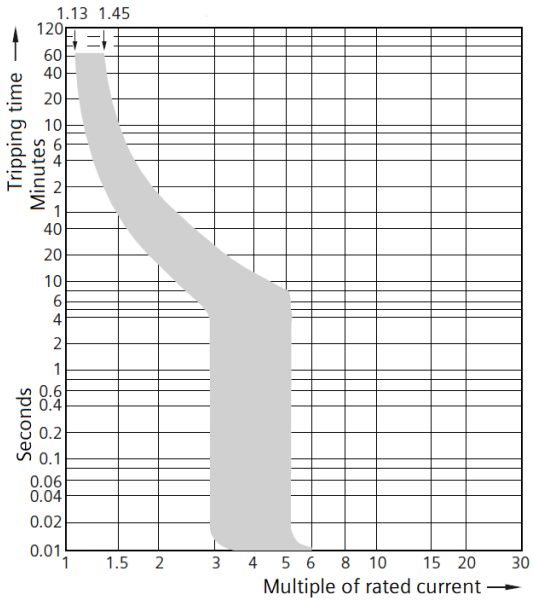


Miniature circuit-breaker 5SJ...-.HG



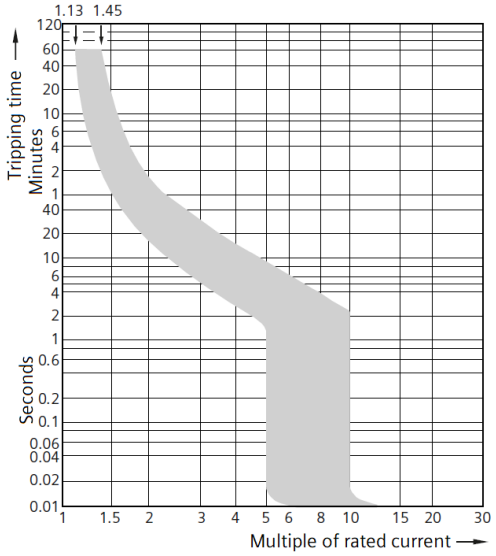
Tripping characteristic A

For limited semiconductor protection, protection of measuring circuits with transformers.

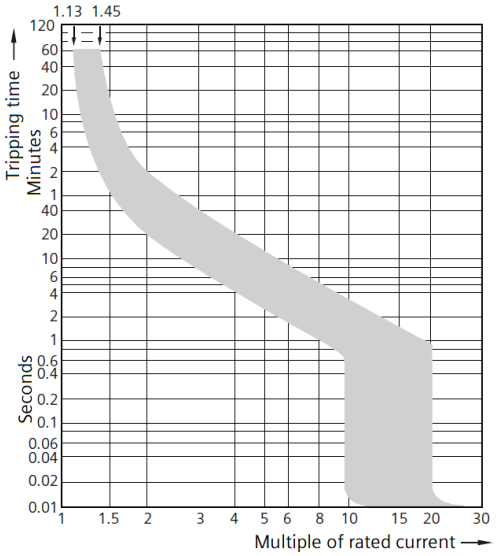


Tripping characteristic B

Suited for use in socket-outlet and lighting circuits, for example.



Tripping characteristic C
Used preferentially in lamp and motor circuits with higher starting currents.



Tripping characteristic D
For circuits with pulse-generating equipment, such as transformers and solenoid valves.

Like thermomagnetic circuit breakers for equipment, miniature circuit breakers are an electrical-mechanical combination of an overload protection device and a short-circuit protective device. In the case of miniature circuit breakers, however, the short-circuit trip is rated such that a high tripping current is needed. For fast short-circuit tripping, a current that is 2 to 20 times the rated current may be required, depending on the characteristics. This current may not be reached, however, depending on the switched-mode power supply or conductor impedance. Consequently, the higher tripping current needed cannot trip the miniature circuit breaker, which causes the system voltage to dip. This results in failure of parallel loads.

The requirements for miniature circuit breakers are described in the IEC 60898 series of process standards.

Thermomagnetic circuit breakers for equipment

These circuit breakers for equipment are described in the IEC / EN 60934 product standard and are used primarily to protect devices and equipment.

Switched-mode power supplies limit the output current for their own self-protection, thereby also limiting potential short-circuit currents in the circuits. Circuit breakers for equipment do not therefore have to handle short-circuit switching capacities as high as those of miniature circuit breakers.

Unlike for miniature circuit breakers, the product standard for circuit breakers for equipment does not specify fixed values for the tripping characteristics. Thus, circuit breakers for equipment have a variety of characteristic curves for describing their tripping behavior. This allows them to cover the requirements of different applications. However, the same principle applies here that the overload tripping (thermal tripping) reacts more sluggishly than the short-circuit tripping (magnetic / instantaneous tripping). The specific characteristic values of the tripping curves are specified in the respective literature of the manufacturer.

Thermomagnetic circuit breakers for equipment are more finely tuned to possible overload and short-circuit currents than miniature circuit breakers. In both overload and short-circuit cases, they react with fast disconnection of the affected circuit in order to protect devices and equipment, while also avoiding or minimizing possible voltage dips in the power supply (see page 23).

Thermomagnetic circuit breaker for equipment 5SY1

Electronic circuit breakers for equipment

In addition to the fast short-circuit cut-off, electronic circuit breakers for equipment also have a quicker overload shutdown. With these types of circuit breakers, overload currents at the level of 1.2 times the rated current are switched off after just 1 second. In this way, an overload of the switched-mode power supply is prevented, the output voltage remains constant and parallel circuits are not affected (see page 24).

Note:
Unlike with thermomagnetic circuit breakers, the circuit is not isolated after tripping.

Electronic circuit breaker for equipment 5SK9

Selectivity modules

Selectivity in 24 V supply circuits is reliably achieved with electronic selectivity modules. A SITOP selectivity module monitors up to four or eight 24 V outputs.

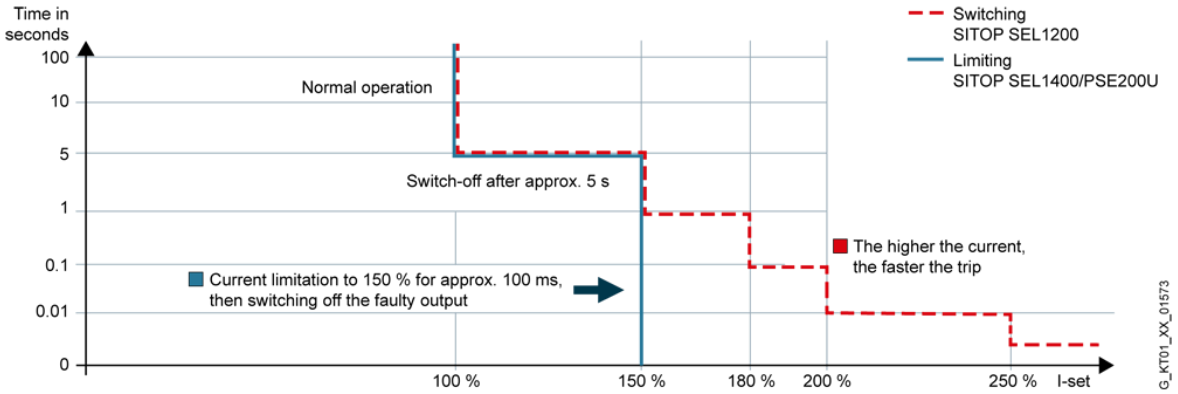
- With SITOP SEL1200, standard applications are reliably protected against short-circuit and overload. It has a switching characteristic. This means that the higher the current, the faster the affected output is switched off. Because the characteristic of the SEL1200 permits high currents to flow temporarily, even loads with high inrush current can be switched on.

SEL1200 8-channel

- SITOP SEL1400 provides a very high level of protection against voltage dips in the power supply resulting from short-circuit or overload. It has a current-limiting switch-off characteristic. That is, each output is limited to 150% of the set current. As a result, there can be no overload, and thus no voltage dip, at the output of the power supply unit, even in the event of a short-circuit. In addition, the electronics monitor the 24 V input voltage continuously. As soon as the input voltage threatens to dip, the path with a higher current than the set current is de-energized immediately. All other circuits continue to be supplied without interruption.

SEL1400 8-channel

The diagnostic functions of the SITOP SEL1200 and S1400 selectivity modules already enable fault localization and reaction from a central location. On site at the control panel, the channel-specific LED displays help to quickly locate the source of the fault. Total plant failures are avoided, and partial outages are kept to a minimum duration. Additional benefits include the remote reset, manual switch-on/off and sequential switch-on of the individual 24 V feeders.



Tripping characteristics of SITOP SEL1400/PSE200U and SEL1200: Current limiting and switching

Selective protection of control circuits

General

In modern machine and plant construction, many loads are jointly supplied by a single switched-mode power supply. The supply circuit is divided into individual feeders and selectively protected in parallel. This avoids disruptions to the overall system and ensures that operating resources remain unaffected.

Miniature circuit breakers are often used for this purpose. Other protective devices in addition to miniature circuit breakers is also possible in control circuits.

In particular, SITOP selectivity modules and SENTRON circuit breakers for equipment are designed for and, thus, especially well-suited to the selective protection of 24 V load feeders in parallel. The particularities related to this and the different protection scenarios are described in the following.

Requirements for the protection of programmable logic controllers

The equipment requirements for programmable logic controllers are defined in the IEC / EN 61131-2 product standard. Two essential requirements are noted here in connection with the power supply:

- A controller in a non-battery-powered system must withstand and remain unaffected by a voltage dip lasting up to 10 milliseconds
- The operating voltage range must be between 19.2 V and 30 V DC

To avoid malfunctions, these parameters must be adhered to and the power supply for the PLC must be secured in such a way that there are no voltage drops.

Particularities of switched-mode power supplies

When it comes to supplying the 24 V level of automated systems, switched-mode power supply units have long since gained widespread use in place of unregulated transformer power supplies.

Switched-mode power supplies are dimensioned, together with their components, to a certain nominal value of the output power. To protect devices against damage from overload, the output current is limited electronically. The point at which the current limitation is applied is usually 1.1 to 1.5 times the nominal value.

This limited maximum current also impacts the tripping behavior of the protective devices utilized. Due to the current limitation of the switched-mode power supply, the output current in the event of overload or short-circuit is limited to a value that is not always sufficient for a fast short-circuit tripping. This must be taken into account during configuration, especially when selecting and using miniature circuit breakers.

If a short-circuit is not cut off quickly, the 24 V voltage can collapse. All loads would be under-supplied and disruptions to operation may result. An effect that must be avoided at all costs in the manufacturing and process industries.

Miniature circuit breakers for the protection of control circuits

In the simplest case, the tripping of miniature circuit breakers with higher current ratings can be achieved by using a power supply with higher output power. Some power supplies have an integrated power boost feature. The switched-mode power supply is then temporarily able to supply an output current up to several times the rated current.

In practice, however, this is not always a sufficient solution, because the possible output current cannot always flow properly. That is because the ohmic resistances in the outgoing and return conductors up to the fault location act to limit the maximum possible current and may prevent the short-circuit tripping of the miniature circuit breaker. Another important thing to consider during configuration is that the tripping curves are generally shown for AC voltages. If miniature circuit breakers are used with DC voltages, a correction factor of approximately 1.4 must be taken into account within the short-circuit tripping range.

Disconnection of faulty load feeders with a combination of switched-mode power supplies and miniature circuit breakers can thus only be achieved by taking into account the correct configuration and selection of the miniature circuit breaker. The short-circuit current that is actually possible must be capable of reaching at least the tripping current of the short-circuit trip of the miniature circuit breaker. Attention must be given to the output power of the power supply, the conductor cross-sections and lengths, the rated current of the miniature circuit breaker and, in particular, the correct selection of tripping characteristics of the miniature circuit breaker. It is precisely for such applications that miniature circuit breakers with tripping characteristic A were developed.

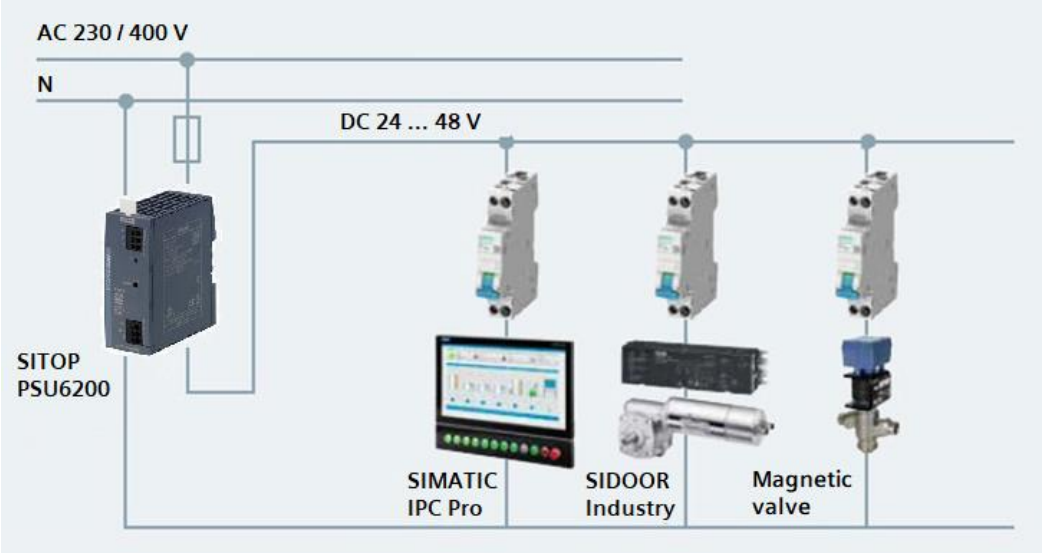
For loads that are insensitive to voltage dips, switched-mode power supplies with miniature circuit breakers offer a cost-effective solution, provided they are configured correctly.

In the case of sensitive loads or limited short-circuit currents, or for the protection of programmable logic controllers, SENTRON circuit breakers for equipment or SITOP selectivity modules are suitable.

Circuit breakers for equipment for protection of control circuits

Circuit breakers for equipment are designed for the protection of control circuits and equipment. In comparison to miniature circuit breakers, these do not always feature galvanic isolation and a high short-circuit switching capacity, but the tripping characteristics are designed specifically for the possible current and voltage ratios in 24 V control circuits. They respond to both short-circuits and overloads with fast and precise interruption of the affected circuit in order to protect devices and equipment, while also avoiding or minimizing possible voltage dips in the power supply. This enables reliable protection of even long thin conductors on which the short-circuit current is limited by the high ohmic resistance.

In addition to this characteristic, circuit breakers offer additional possibilities in use. For example, SENTRON circuit breakers for equipment have an integrated auxiliary switch, which can be used as a signaling contact, for example. The devices can be combined with terminal blocks using busbars and connectors.



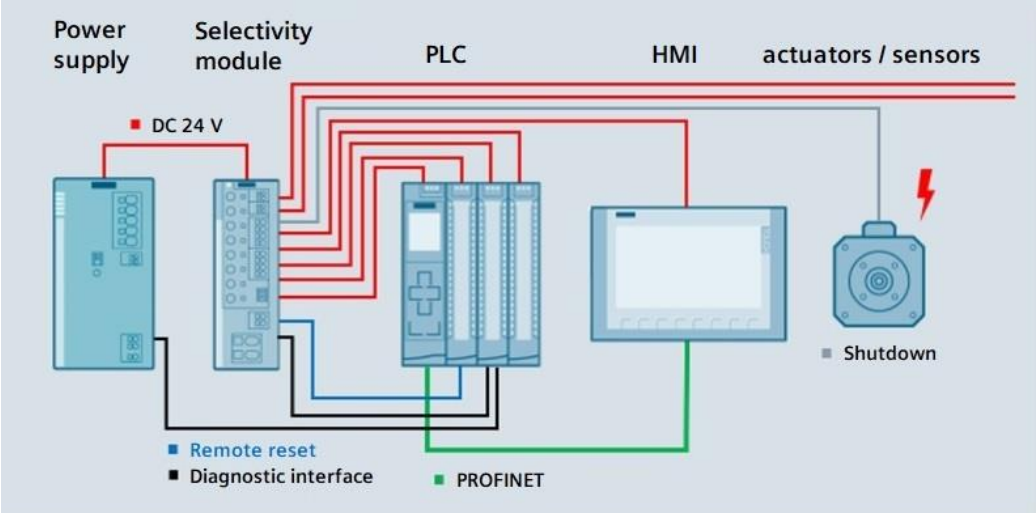
Application example of SENTRON circuit breakers for equipment 5SY1 in control circuits

Selectivity modules for protection of control circuits

Electronic selectivity modules are especially designed for the behavior of switched-mode power supply units and the 24 V DC feeders they supply. With their special switching characteristic, they react to overcurrents and short-circuits in faulty feeders, even if these only slightly exceed the rated current only.

In particular, the requirement for break times as short as 10 milliseconds in connection with programmable logic controllers can be reliably met with SITOP selectivity modules.

In addition to the specially adjusted shutdown behavior, the modules offer other functions such as an individually adjustable limiting output current characteristic and even an individually adjustable tripping current.



Application example with a power supply unit (e.g. SITOP PSU6200) and SITOP SEL1400 selectivity module

Criteria for selecting the components for protection of control circuits

When selecting protective devices for the parallel selective protection of control circuits, not only the nominal voltage and rated current must be taken into account, but especially also the requirements of the respective application. Key considerations include the type of loads, the installation in which the loads are integrated and the requirements for additional functions, such as diagnostics.

The following overview is intended to provide assistance for the correct selection of components for the protection of control circuits:

	Miniature circuit breakers	**Thermomagnetic circuit breakers for equipment**	**Electronic circuit breakers for equipment**	**Selectivity modules**
Loads with high inrush currents	++	++		+
High short-circuit breaking capacity	++	+		
Galvanic isolation required	++	++		
Compact size	+	+	++	+
Modularity	+	+	++	++
Integrated auxiliary switch	+	++	++	++
Fast tripping at short-circuits		+	++	++
Fast tripping at overload		+	++	++
Long conductor lengths in the installation			++	++
Protection of loads in circuits next to PLCs			+	++
Diagnostic functions			+	++

++ Especially well-suited

+ : Well-suited/partially suited

Dimensioning and protection of control circuits in accordance with UL

All switching equipment in the USA is checked by the competent AHJ inspector (Authority Having Jurisdiction) and approved for its intended operation and use based on the relevant standards. The following differences must kept in mind:

NEC – National Electrical Code

The NEC (National Electrical Code) is the legally binding standard for electrical equipment in the USA. It describes the safe installation of electrical conductors and equipment and is published by the National Fire Protection Association (NFPA). This standard is the only one that has a legal status and is therefore recognized by government agencies as being similar to a law.

UL - Underwriters Laboratories

UL is an independent testing organization that inspects and certifies products in terms of their safety. UL tests products, components, materials and systems to determine whether they satisfy specific demands. After testing, these products may carry the UL Mark as long as they meet the specified standards. As a unique selling point, UL has the privilege of producing recognized product testing standards themselves. This means that other recognized testing organizations must perform tests according to the UL product test standards.

Relevant standards for switchgear construction

The relevant requirements for devices for use in control panels are contained in the application standard UL508A "Industrial Control Panels". For successful acceptance of the switching equipment, manufacturers of control panels for export to the USA must take into account the following: When using UL-certified components, a distinction must be made between "UL-listed" components whose use is approved based on test standards, and "UL-recognized" components whose conditions of acceptability must be observed for their individual use in an overall system.

Main circuits (feeder circuits/branch circuits)

The NEC, NFPA 79 and UL 508A generally differentiate between the following two main circuits in the electric circuit:

- Feeder circuits
- Branch circuits

Feeder circuits

According to NEC, NFPA 79 and UL 508A, a feeder circuit refers to all conductors and circuits on the feed-in side of the last branch circuit protective device before the load.

To protect conductors and components in the feeder circuit appropriately against short-circuit, the following feeder circuit protective devices must be used according to UL 508A, Chapter 32:

- Inverse-time circuit breakers in accordance with UL 489 or
- Fuses in accordance with UL 248-4...12 and -15

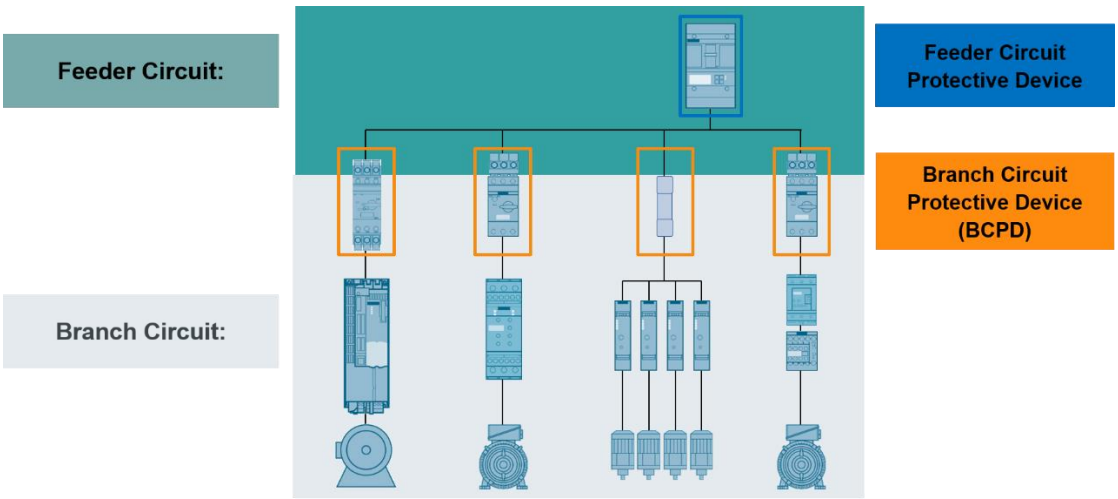
SENTRON miniature circuit breakers 5SJ4...-.HG have been tested as inverse-time circuit breakers in accordance with UL 489 and can be used as full-fledged protection anywhere in feeder circuits, in branch circuits and in control circuits (see also page 6).

Note:
The breaking capacity must be taken into account for calculating the overall SCCR of the installation.

The terminals conform to the "field wiring" class. This means that devices may not only be installed in factory-built distribution boards and control panels, but may also be incorporated on-site in the installation (wiring led out from the control panel).

Branch circuit

Outgoing load feeders starting from the branch circuit protective device are designated as a branch circuit.



Feeder circuit and branch circuit according to NEC, NFPA 79 and UL 508A

Control circuits

According to UL 508A, Chapter 2.11, NEC, Chapter 409.2 and NFPA 79, Chapter 3.3.21, a control circuit is a circuit that carries the signals for the function and the controller. It does not carry the electrical power for the connected loads.
UL 508A usually limits the control circuit to 15 A. This is a recommendation. A mandatory maximum value is not specified.

Protection of control circuits

The protection of control circuits is described in UL 508A, Chapter 40. The following devices are approved without restrictions for protecting a control circuit:

- Inverse-time circuit breakers in accordance with UL 489
- Fuses "Fuse, Class CC, Class J..." in accordance with UL 248-4...12, -15

Devices with restricted approval:

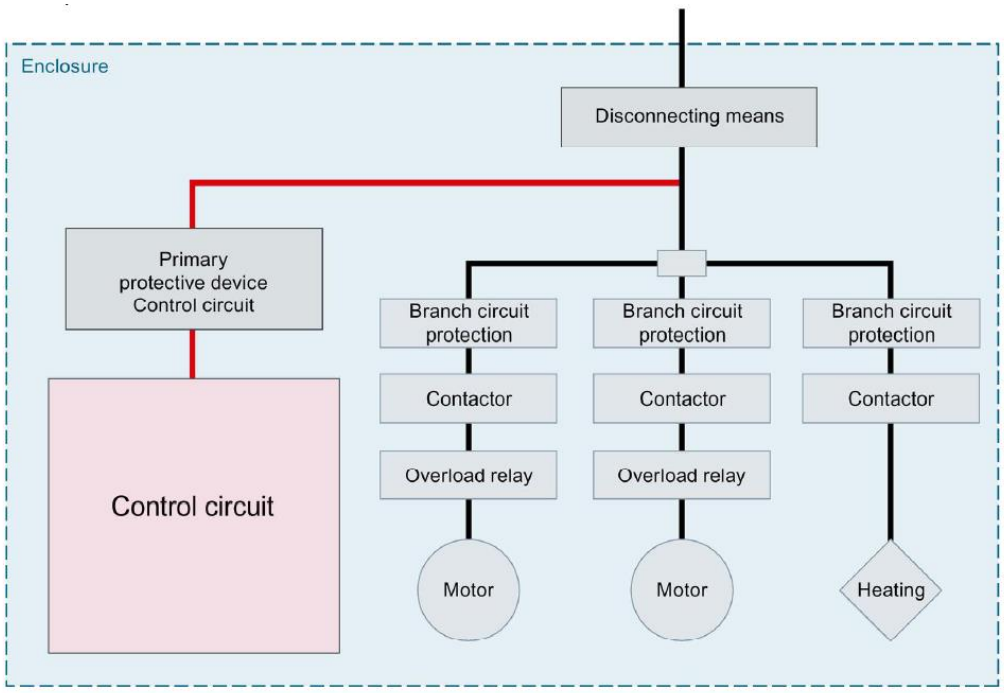
- Supplementary protectors in accordance with UL 1077
- Supplemental fuses in accordance with UL 248-14

Control circuit tapped downstream of the branch circuit protection of the loads

SENTRON miniature circuit breakers 5SJ4...-.HG in accordance with UL 489 can be used without restrictions for protection of control circuits (see page 6).

Because these protective devices can be used universally for protection of control circuits in all main circuits, like feeder and branch circuits, they are an all-round solution for protection against overcurrent and short-circuit in accordance with UL.

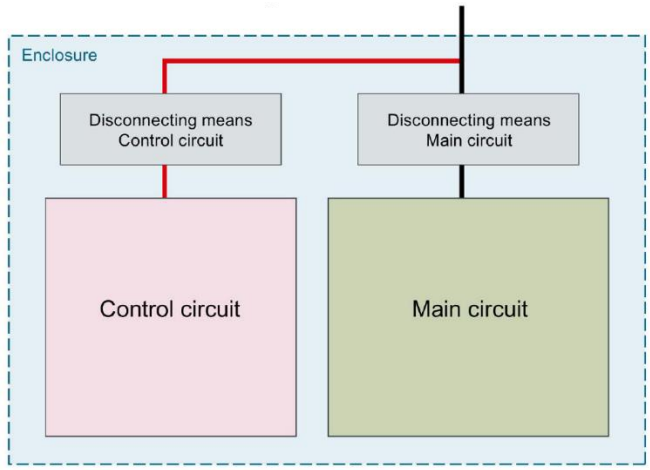
Note:
The breaking capacity must be taken into account for calculating the overall SCCR of the installation.



Example: Control circuit tapped downstream of the main disconnecting means and upstream of the load branch circuits

Control circuit tapped upstream of the main switch (excepted circuit)

A control circuit can also be tapped upstream of the main disconnecting means. Here, only circuit breakers in accordance with UL 489 or branch circuit fuses in accordance with UL 248-4 ... 12. -15 can be used as protection.

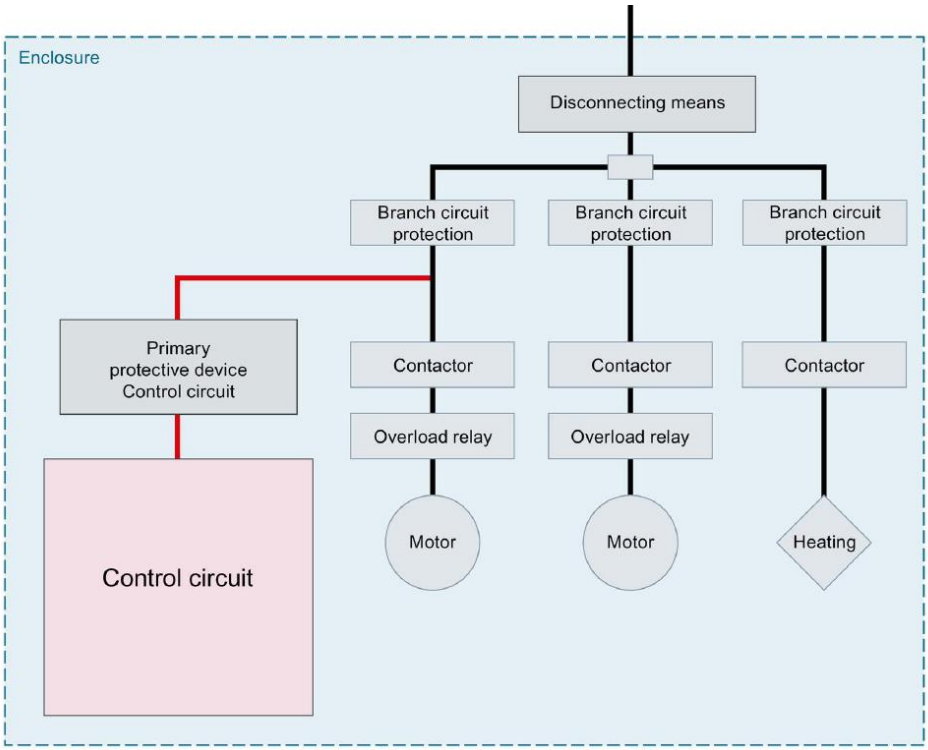


Example: Control circuit tapped upstream of the main switch (excepted circuit)

Control circuit downstream of the branch circuit protective device

Supplementary protectors in accordance with UL 1077 are only approved as a primary protective device for the control circuit if the control circuit was tapped downstream of a branch circuit protective device.

SENTRON miniature circuit breakers 5SY4 and SENTRON thermomagnetic circuit breakers for equipment 5SY1 (see page 4 and page 23) have been tested in accordance with UL 1077 and can be used as supplementary protectors in control circuits that are tapped directly downstream of the branch circuit protection protective device.



Example: Control circuit tapped downstream of the branch circuit protective device

Note:
Even if these devices are installed in compliance with the standards, it is possible that the "Authority Having Jurisdiction" (AHJ) in the USA and Canada may not accept these devices. For planning certainty we recommend using devices approved without restrictions "such as the inverse-time circuit breaker" 5SJ... In this case, the control circuit can also be tapped upstream of the branch circuit protection.

The following control circuits are defined in UL 508A:

1. Class 1 control circuit
2. Class 2 control circuit
3. Low-voltage limited energy circuit

The NEC and NFPA 79 define only Class 1 and Class 2 circuits. This means if a low-voltage limited energy circuit according to UL 508A exits the control panel, it is treated outside the control panel as a Class 1 circuit. Output terminals of a low-voltage limited energy circuit must be marked "Class 1 circuit".

Class 1 control circuit
According to the definition in UL 508A, Chapter 2.6, a Class 1 control circuit is a control circuit with the following properties:

- On the load side of a short-circuit protective device
- On the output side of a transformer or power supply unit
- With max. 600 V control voltage (regardless of whether AC or DC)

In Chapter 9.1.2.1 and 9.1.2.2, NFPA 79 limits the voltage to 120 V AC or 250 V DC.

Class 2 control circuit

A Class 2 control circuit must always be established when components are approved only for a Class 2 control circuit. Such components are marked "For use in class 2 circuits only" or similarly.

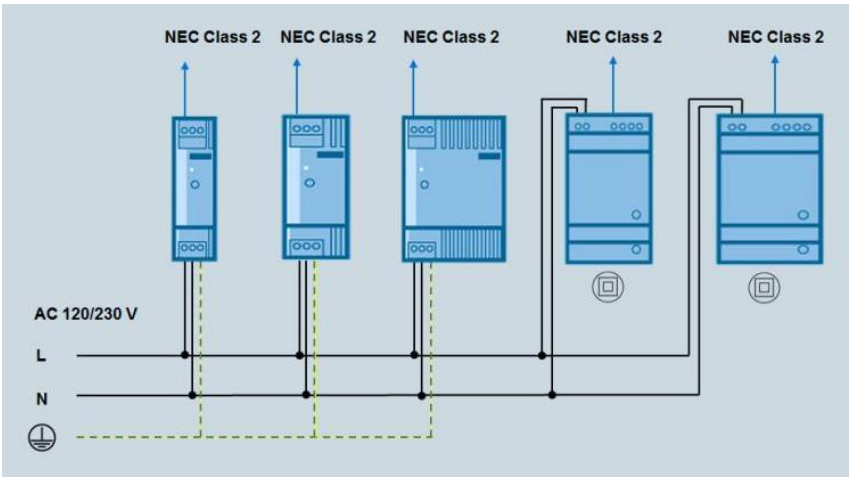
Definition according to UL 508A, Chapter 2.8:

A Class 2 control circuit is a control circuit with the following properties:

- Supplied from a source with a limited voltage of 30 V_{rms} or less
- Supplied from a class 2 power supply unit tested by the product standard UL 1310 or a listed class 2 transformer

NFPA 79 includes the Class 2 control circuit but does not describe it in more detail since it is defined in the NEC, Chapter 725, as follows:

- Circuit on the load side of a listed Class 2 power supply
- Offers fire safety and protection against electric shock due to the limited energy

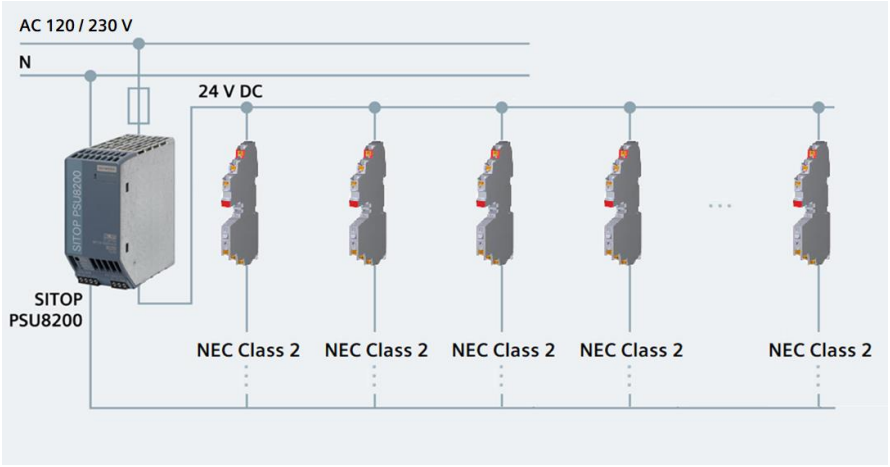


Example of a Class 2 control circuit with multiple NEC Class 2 control circuits, each supplied by one SITOP NEC Class 2 power supply

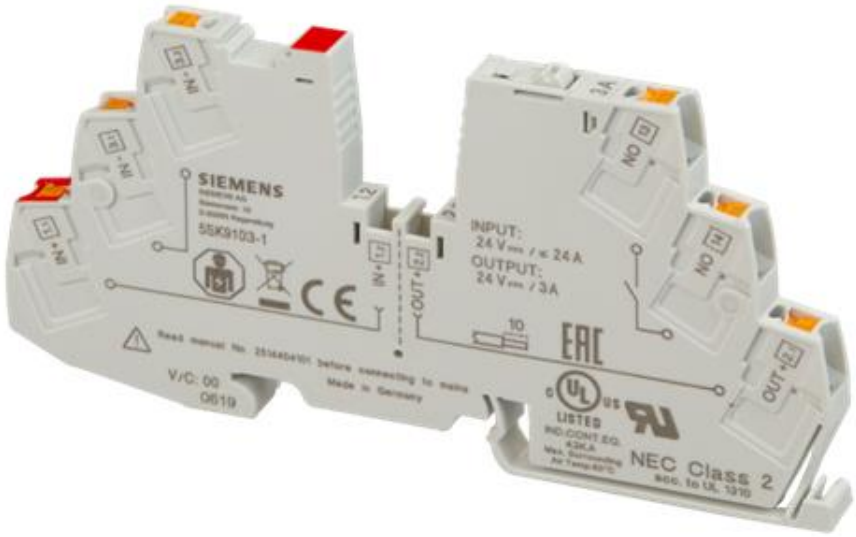
Components and conductors located completely within a Class 2 control circuit do not require acceptance by the inspector. As a result, even unlisted components and conductors can be used.

However, despite this exception, use of UL approved components and conductors is recommended if this is possible. This exception is primarily intended to the use of components available on the market that do not have UL approval. In special purpose machine manufacturing, for example, use of components without UL approval (e.g. proprietary control boards) may be essential.

For parallel selective protection of individual components downstream of a standard power supply, SENTRON circuit breakers for equipment 5SK9 (NEC Class 2 according to UL 1310 Class 2 power unit – see figure below) or the two SITOP PSE200U selectivity modules (NEC Class 2 according UL 1310 Class 2 power unit) 6EP1961-2BA51/...-2BA61 can be used to build an NEC Class 2 circuit with a max. load of 100 watts.



Example of multiple NEC Class 2 control circuits, each supplied by one power supply without NEC Class 2



Circuit breaker for equipment 5SK9 (NEC Class 2 according to UL 1310)

Product overview of devices for protection

Thermomagnetic circuit breakers for equipment 5SY1

Circuit breakers for equipment 5SY1 offer the optimal protection in AC and DC control circuits for every application in industry and the plant engineering sector. Thermomagnetic circuit breakers for equipment 5SY1 are used to protect solenoid valves, servo motors and indicator lights and even PLC inputs. In fact anywhere that protection of loads from overload and short-circuit is required.

Highlights

- Protection of AC and DC circuits
  - Operating voltage: Up to 250 V AC (IEC)
  - Operating voltage: Up to 277 V AC (UL 1077)
  - Operating voltage: 12 V ... 60 V DC
- Switching capacity at least 3 kA
- UL 1077
- Thermal tripping range of 1.05 ... 1.35 x I_n
- Magnetic tripping range of 2.5 ... 4 x I_n (F1 curve) and 4 ... 7 x I_n (F2 curve)
- Galvanic isolation for safety-relevant applications
- Integrated auxiliary switch

Accessories

- Auxiliary switches/fault signal contacts (AS+FC) with/without communication
- Remote control mechanism (RC mech.)

For more information, see Catalog LV 10, Miniature circuit breakers section.

Electronic circuit breakers for equipment 5SK9

Electronic circuit breakers for equipment 5SK9 are optimally suited for protection of relays, programmable controllers, motors, sensors and actuators, valves and other equipment. The combination of a current analysis and fast tripping under fault conditions avoids the risk of overloading the switched-mode power supply.

Highlights

- Rated voltage 24 V DC
- Combinable with terminal blocks 8WH and accessories
- NEC Class 2 according to UL 1310
- ANSI/UL 2367 solid state overcurrent protectors
- Transparent operating status (LED with pre-warning stage)
- Slim, space-saving design
- Yellow LED warns at 0.8 x I_n → prewarning stage before disconnection
- Integrated auxiliary switch

Accessories

- Combinable with terminal blocks 8WH and accessories

For more information, see Catalog LV 10, Miniature circuit breakers section.

SITOP selectivity module 6EP

In connection with 24 V power supplies, the selectivity module serves to distribute load current among several branch circuits and to monitor the individual partial currents. Faults in individual branch circuits caused by an overload or a short-circuit are detected and selectively disconnected, so that the remaining load current paths remain unaffected. The version with single-channel signaling allows remote channel-granular fault localization.

Highlights

- Protection against overload or short-circuit in 24 V circuits
- Reliable tripping, irrespective of conductor resistance
- SEL1200: Disconnecting characteristic for standard protection and high inrush currents
- SEL1400/PSE200U: Current-limiting for increased protection requirements through stabilization of 24 V supply
- Sequential connecting reduces total inrush current
- Common signaling contact or single-channel evaluation (PSE200U)
- SEL1200/1400: 4 or 8 outputs, infinitely adjustable threshold up to 5 A or 10 A, with diagnostics for voltage, current, threshold setting and, if applicable, disconnect cause
- PSE200U 6EP1961-2BA51/...-2BA61: 4 outputs with voltage measuring point for current (1 V ≙ 1 A), versions with NEC Class 2

For more information see Catalog KT 10.1.

More information

Siemens Industry Online Support

- www.siemens.com/lowvoltage/product-support

Integrated Control Panels

- Information on standards and engineering of industrial control panels
  https://new.siemens.com/global/en/markets/panel-building.html
- Practical tip: "Dimensioning and protection of control circuits according to UL"
  https://new.siemens.com/global/en/markets/panel-building/forms/control-circuits-usa.html
- A Guide for Practical Use: "Industrial Control Panels and Electrical Equipment of Industrial Machinery for North America"
  https://new.siemens.com/global/en/markets/panel-building/forms/ul-guideline.html

Product information

- SENTRON miniature circuit breakers and circuit breakers for equipment
  https://new.siemens.com/global/en/products/energy/low-voltage/components/sentron-protection-devices/miniature-circuit-breakers.html
- SITOP selectivity modules
  https://new.siemens.com/global/en/products/automation/power-supply/add-on-modules.html

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Siemensstrasse 10
93055 Regensburg
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