The Secrets of UL.
You have our support.

www.usa.siemens.com/controls
Entering North America –
You Have Our Support with Regards to UL

Product liability laws in the USA are way stricter than in Europe. Whoever plans to export products to North America should have them UL-certified, particularly when it comes to industrial control equipment. This brochure is to explain the meaning of UL certification and to describe the corresponding aspects to be considered. It furthermore provides information on how to benefit from our comprehensive know-how and broad portfolio of UL-certified low-voltage controls and distribution products.

Who or what is UL?

UL (Underwriters Laboratories Inc.®) is one of the world’s leading organizations for testing and certification in the field of product safety. This independent, non-profit US organization was founded in 1894 at the request of American fire insurance companies to analyze the fire hazards posed by electrically operated devices. Today, UL tests and certifies the most varying materials, components and end products for their operational safety, particularly with regard to potential personal injury and fire formation. The organization maintains subsidiaries in numerous European countries. Detailed information on the US organization as well as contact details for the various European subsidiaries are also available on the Internet at www.ul.com.

UL and IEC differ fundamentally. The IEC standards for the IEC market merely specify the minimum safety requirements of a device or system. Technical details of the safety requirements’ constructional implementation are up to the manufacturers. In contrast, the standards for the American market are far more detailed. Depending on the standard, the required process may be monitored from product design to product production down to application, mounting and operation.
Siemens production facility
Amberg – UL partner since 1969

To avoid unnecessary trouble and save time- and cost-intensive expenditures, it is recommendable to rely on a competent partner like Siemens. Our production facility Amberg, where the complete diversity of our low-voltage controls and distribution portfolio is developed and produced, has been closely cooperating with Underwriters Laboratories Inc. already since 1969. We therefore offer comprehensive know-how on the subject of UL certification, ranging from production down to control panel wiring according to UL standards, and we would be pleased to share this knowledge with you within the scope of various training programs. Also the UL competence of our further sites, e.g. the Berlin switching plant and the Regensburg factory for electrical installation technology, should not be forgotten in this context.

Our consideration of both IEC directives as well as UL standards as early as in our products’ development phase results in a broad portfolio of UL-certified products for low-voltage switching and protection technology. Whether circuit breakers SENTRON, switching devices SIRIUS – including manual motor controllers, starters, contactors, and overload relays –, disconnect switches SENTRON, detecting and commanding devices SIRIUS, busbar systems SENTRON, terminals, miniature circuit breakers, fuses or transformers and filters SIRIUS – our portfolio of low-voltage controls and distribution products ensures your being on the safer side in terms of UL and facilitates the easy and fast assembly of control panels according to UL.

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A Small Selection of our Large UL Portfolio

- Transformer 4AM
- Power monitoring device PAC 3200
- Miniature circuit breaker 5SY41
- Circuit breaker 3RV1742 for infeed in combination motor controllers
- Main power distribution 8US
- Door locking main switch (defeatable) 8UC
- Infeed circuit breaker / main switch 3VL (supply line directly connected)
- EMERGENCY-STOP mushroom pushbutton 3SB35
- Indicator light 3SB36
- Busbar system 8US
- Infeed system 3RV29 with type E starters
- Controlled load power supply SITOP 6EP
- RFI suppression filter 4EF15
- Circuit breaker 3RV2711 according to UL 489
- Magnetic motor controllers (3N + 3RT20 + 3RB30)
- Magnetic motor controllers 3RV2711 + 3RT20 + 3RB20
- Reactor 4EY36
- Manual self-protected combination motor controller type E 3RV1041
- Soft starter 3RW44
- Self-protected combination type F compact starter 3RA6
- Terminal blocks 8WH
- Safety relay 3TK28
- Socket outlet 51B 8U4
Efficient construction of Industrial Control Panels

Efficiency

- High solution flexibility through comprehensive and matched product portfolio, from the supply of the industrial control panel to the machine’s smallest actuator
- Easy stock-keeping of switching devices SENTRON and SIRIUS as well as BETA low-voltage circuit protection devices through the products’ universal applicability (IEC-UL/CSA)
- Uniform operation and maintenance concept through our standard system

Professionalism / authoritative

- Comprehensive UL know-how by Siemens through long-standing close cooperation with Underwriters Laboratories Inc.
- Secure UL connection through strong and reliable product and system portfolio which considers UL right from the development phase
- Easier and faster commissioning through competent UL consulting services

Support

- Easy and fast access to approvals, test certificates and technical product details via www.siemens.com/automation/service&support
- Global availability of products through online order placement via www.siemens.de/automation/mall
- On-site support through global presence
- UL training programs

Efficient and safer operation of Industrial Control Panels

Efficiency

- Reduced costs through matched product interfaces
- Easy expandability and retrofitting through modular products and systems
- Minimum space requirements through compact designs
- Comfortable and efficient on-site operation through ease of handling

Professionalism / authoritative

- Comprehensive UL know-how as well as proven UL portfolio through long-standing close cooperation of Siemens with Underwriters Laboratories Inc.
- Easy expandability and retrofitting through globally available products

Support

- Fast and competent product consulting through global presence
- 24/7 service via www.siemens.com/automation/service&support
- Manifold UL training programs
### Our Portfolio for Industrial Control Panels

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<th>Product</th>
<th>Order No.</th>
<th>UL standard</th>
<th>Explanation</th>
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<tr>
<td>Air circuit breakers (ACB) SENTRON</td>
<td>3WL5</td>
<td>UL 489</td>
<td>Thanks to their modular design and UL 489 as well as IEC 60947 approvals, the SENTRON 3WL air circuit breakers facilitate global applicability. With only three sizes, they cover a power range from 250 A to 5,000 A. This makes them universally applicable. All models feature the same design, operation and mechanical and electric accessories, which can also be retrofitted thanks to the breakers’ modular design. Result: Unique planning reliability and global applicability – with a single circuit breaker range!</td>
</tr>
<tr>
<td>Molded-case circuit breakers (MCCB) SENTRON</td>
<td>3VL</td>
<td>UL 489</td>
<td>Covering the range from 20 A to 1,600 A, the molded-case circuit breakers SENTRON 3VL provide safety while simplifying operation. As main disconnecting means or as branch circuit protector, they protect systems, motors and generators against short circuit and overload. Their versatile industrial control panel installation options as well as their space-saving design are major advantages.</td>
</tr>
<tr>
<td>Circuit breakers SIRIUS</td>
<td>3RV17, 3RV18 3RV27, 3RV28</td>
<td>UL 489</td>
<td>The circuit breakers SIRIUS 3RV17/18/27/28 are compact circuit breakers with 100% rating. They guarantee secure disconnection in case of a short circuit and protect consumers and system against overload.</td>
</tr>
<tr>
<td>Motor starter protectors / manual motor controllers SIRIUS</td>
<td>3RV10</td>
<td>UL 508</td>
<td>The manual motor controllers SIRIUS 3RV10/20 are compact switching devices. Depending on the application (and on the UL approval), they guarantee secure disconnection in case of a short circuit and protect motors against overload.</td>
</tr>
<tr>
<td>Contactors / magnetic motor controllers SIRIUS</td>
<td>3RT, 3RH</td>
<td>UL 508</td>
<td>Contactors SIRIUS for motor switching as well as contactor relays for the control and auxiliary circuit are particularly rugged and feature a high switching contact reliability. They cover the power range from 3 kW to 250 kW with 400 V for AC or DC actuation and can be connected with minimum time and cost expenditures. Their long service life even under extreme application conditions is a convincing advantage.</td>
</tr>
<tr>
<td>Thermal overload relays SIRIUS</td>
<td>3RU</td>
<td>UL 508</td>
<td>The overload relays of the SIRIUS range, which are available as thermal and solid-state versions, assume the current-dependent overload protection of consumers in the power circuit and other switching and protection devices in the respective load feeder. With minimum variance, they ensure integrated motor protection in numerous applications.</td>
</tr>
<tr>
<td>Solid-state overload relays SIRIUS</td>
<td>3RB</td>
<td>UL 508</td>
<td></td>
</tr>
<tr>
<td>Soft starters SIRIUS</td>
<td>3RW</td>
<td>UL 508</td>
<td>The soft starters SIRIUS 3RW offer a complete portfolio which covers all standard and high-feature applications of soft motor start-up and ramp-down. Their soft start-up and ramp-down behavior facilitates jerk-free motions to protect the motors’ mechanics. The soft starter range can be flexibly adjusted to the various conditions on site and thus allows for the easy and efficient realization of optimum machine concepts.</td>
</tr>
<tr>
<td>Fuseless load feeders SIRIUS</td>
<td>3RA</td>
<td>UL 508</td>
<td>The fuseless load feeder SIRIUS 3RA are assembled from 3RV self-protected combination motor controllers (type E) and 3RT contactors. Thanks to their integrated prewiring, the fuseless load feeders can be rapidly and easily mounted. They are the optimum solution particularly for distributed and wide-spread system structures.</td>
</tr>
<tr>
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<tr>
<td>Busbar system / fast bus system SENTRYON</td>
<td>8US1</td>
<td>UL 508</td>
<td>The busbar system (fast bus system) SENTRYON 8US is ideal for applications in industrial control panels, motor control centers and power distribution systems. The adapters, which are amongst others available for circuit breakers SIRIUS and SENTRYON as well as disconnect switches SENTRYON, facilitate numerous assemblies.</td>
</tr>
<tr>
<td>Manual motor disconnect SENTRYON</td>
<td>3LD2</td>
<td>UL 508</td>
<td>The particularly compact manual motor disconnect units SENTRYON 3LD2 are employed for the switching of power and auxiliary circuits as well as for three-phase motors and other consumers for maintenance and repair cases. Amongst others, they facilitate the cable bending radius specified by UL.</td>
</tr>
<tr>
<td>Disconnect switches SENTRYON (manual motor controllers)</td>
<td>3KA</td>
<td>UL 508</td>
<td>The disconnect switches SENTRYON in three-pole design assume the tasks &quot;disconnecting&quot; and &quot;switching under load&quot; for the stated rated current and guarantee safety disconnection in all low voltage networks. They are thus predestined for use as EMERGENCY-STOP, repair or load transfer switch. (According to UL, only applicable with fuses SITOR – special-purpose fuse.)</td>
</tr>
<tr>
<td>Disconnect switches SENTRYON with fuses (manual motor controllers)</td>
<td>3KL</td>
<td>UL 508</td>
<td>The disconnect switches SENTRYON in three-pole design assume the tasks &quot;disconnecting&quot; and &quot;switching under load&quot; for the stated rated current and guarantee safety disconnection in all low voltage networks. They are thus predestined for use as EMERGENCY-STOP, repair or load transfer switch. (According to UL, only applicable with fuses SITOR – special-purpose fuse.)</td>
</tr>
<tr>
<td>Transformers SIRIUS</td>
<td>4AJ, 4AM, 4AP, 4AW, 4AT, 4BT, 4AP, 4AU, 4BU</td>
<td>UL 506, UL 156</td>
<td>The transformers SIRIUS offer optimum protection through high permissible ambient temperatures up to 40 °C or 55 °C (104 °F or 131 °F), high short-time rating with control transformers, fuseless design and their &quot;safety inside&quot; standard in accordance with IEC 61558. They are employed for the voltage and power supply of systems, controls and series products (medical engineering, machine tool construction, robots and compressors). The power supplies SIRIUS are reliable, rugged, compact and comply with the latest standards.</td>
</tr>
<tr>
<td>Power supplies SIRIUS</td>
<td>4AV</td>
<td>UL 1012</td>
<td>The transformers SIRIUS offer optimum protection through high permissible ambient temperatures up to 40 °C or 55 °C (104 °F or 131 °F), high short-time rating with control transformers, fuseless design and their &quot;safety inside&quot; standard in accordance with IEC 61558. They are employed for the voltage and power supply of systems, controls and series products (medical engineering, machine tool construction, robots and compressors). The power supplies SIRIUS are reliable, rugged, compact and comply with the latest standards.</td>
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<tr>
<td>Reactors SIDAC</td>
<td>4EM, 4ET, 4EP, 4EU, 4Ev</td>
<td>UL 1561, UL 506</td>
<td>The reactors and filters SIDAC can be used as options for variable-speed drives in all sectors and applications. They improve the line quality and efficiency of systems by reducing harmonics, increase the reliability of applications and thus enhance the availability of installations and systems. The portfolio comprises line, commutation, smoothing, output and filter reactors as well as radio interference suppression, dv/dt and sinewave filters.</td>
</tr>
<tr>
<td>Filters SIDAC</td>
<td>4EF11, 4EF15</td>
<td>UL 508, UL 1283</td>
<td>The reactors and filters SIDAC can be used as options for variable-speed drives in all sectors and applications. They improve the line quality and efficiency of systems by reducing harmonics, increase the reliability of applications and thus enhance the availability of installations and systems. The portfolio comprises line, commutation, smoothing, output and filter reactors as well as radio interference suppression, dv/dt and sinewave filters.</td>
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<tr>
<td>Miniature circuit breakers (MCBs)</td>
<td>5SJ4…-HG</td>
<td>UL 489</td>
<td>Serving as all-round solution for protection tasks, miniature circuit breakers according to UL 489 can be used as branch circuit protector in branches inside distribution boards, control panels and controls in accordance with UL 508A. Furthermore, they are also approved for circuit protection in heating, air-conditioning and ventilation systems as well as for DC applications up to 60 V/125 V. All additional 5ST3…-HG components can be combined with 5SJ4…-HG miniature circuit breakers in accordance with the mounting concept.</td>
</tr>
<tr>
<td>Miniature circuit breakers (MCBs)</td>
<td>5SY4, 5SY6, 5SY7, 5SY8, 5SP4, 5ST30</td>
<td>UL 1077</td>
<td>Within the scope of the UL 1077 standard, we offer a series of miniature circuit breakers for various residential and non-residential buildings as well as industrial applications.</td>
</tr>
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<tr>
<td>Compact starter SIRIUS</td>
<td>3RA6</td>
<td>UL 508 Type E</td>
<td>Using a compact design, the universal motor feeder according to UL 508 Type E combines the functions of circuit breaker/MSP, solid-state overload relay and contactor. The compact starter SIRIUS can be used as direct-on-line and reversing starter for three-phase standard motors up to 32 A (approx. 15 kW/400 V). Advantage: weld-free contacts</td>
</tr>
<tr>
<td>Motor starters SIRIUS</td>
<td>3RK</td>
<td>UL 508</td>
<td>Whether central or distributed assembly in the industrial control panel or in high degree of protection in the field – motor starters SIRIUS are always an optimum and easy solution. The motor starters of the ET 200S system are, for example, suitable for central assembly in the control panel or for distributed solutions directly in the field. The distributed I/O system SIMATIC ET 200pro is ideal for complete solutions in particularly high degree of protection thanks to its modular design.</td>
</tr>
<tr>
<td>Motor management and control devices SIMOCODE pro</td>
<td>3UF7</td>
<td>UL 508</td>
<td>SIMOCODE pro is a flexible and modular motor management system for motors with constant speeds in the low-voltage range. It optimizes the connection between control technology and motor starter, improves the system availability and simultaneously facilitates considerable savings in terms of system construction, commissioning, operation, and maintenance.</td>
</tr>
<tr>
<td>Coupling relays SIRIUS</td>
<td>3TX70, 3RS18</td>
<td>UL 508</td>
<td>The very narrow SIRIUS 3TX70 coupling relays allow for particularly space-saving assemblies in the control panel and offer a large range of input and output coupling links. In addition to combined-voltage devices, the SIRIUS 3RS18 coupling relay range also comprises wide-voltage versions. All 3RS18 versions are consistently available with screw-type or spring-loaded connection system. The optional hard gold-plated contacts ensure maximum contact reliability even with low currents.</td>
</tr>
<tr>
<td>Plug-in relays SIRIUS</td>
<td>LZX</td>
<td>UL 508</td>
<td>The plug-in relays SIRIUS LZX are available both as complete units and as individual modules for self-assembly or spare parts requirements. They are employed as coupling relays for coupling between the inputs and outputs of electronic controls, for contact multiplication, for switching of small loads, and as measuring transducer.</td>
</tr>
<tr>
<td>Power relays SIRIUS</td>
<td>3TG10</td>
<td>UL 508</td>
<td>With a width of only 36 mm, the compact power relays/small contactors SIRIUS 3TG10 are particularly suitable for applications in minimum space, e.g. for air-conditioning units, heatings, pumps, fans – as well as generally for simple electric controls. Thanks to their hum-free operation, they are also ideally suited for application in household appliances or power distributions in office and residential buildings.</td>
</tr>
<tr>
<td>Solid-state switching devices SIRIUS</td>
<td>3RF2, 3RF3</td>
<td>UL 508</td>
<td>The solid-state switching devices SIRIUS are optimized for the frequent switching of resistive loads and motors. They do not feature any mechanically moved parts and therefore facilitate noise-free, wear-free and almost unlimited switching. Their compact design allows for space-saving assemblies in the control panel.</td>
</tr>
<tr>
<td>Timing relays SIRIUS</td>
<td>3RP15, 3RP20, 7PV15</td>
<td>UL 508</td>
<td>The electronic timing relays SIRIUS 3RP15, 3RP20 und 7PV15 are employed for all time-delayed switching operations in control, start-up, protection and regulation circuits. They ensure a high functionality as well as a high repeat accuracy of the set operating time.</td>
</tr>
<tr>
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<tr>
<td>SIRIUS timing relays for mounting on 3RT1 contactors</td>
<td>3RT1916/26</td>
<td>UL 508</td>
<td>The 3RT1916/26 timing relays for mounting on 3RT1 contactors facilitate the easy, rapid and space-saving realization of timing functions in connection with 3RT1 contactors.</td>
</tr>
<tr>
<td>SIRIUS timing relays for mounting on 3RT2 contactors</td>
<td>3RA28</td>
<td>UL 508</td>
<td>The SIRIUS 3RA28 timing relay function modules for mounting on 3RT2 contactors facilitate the space-saving assembly of starters and contactor combinations for direct-on-line and reversing starting without additional wiring of individual components.</td>
</tr>
<tr>
<td>SIRIUS monitoring relays Monitoring Relays</td>
<td>3UG4</td>
<td>UL 508</td>
<td>The SIRIUS 3UG4 solid-state monitoring relays facilitate the maximum protection of machines and systems – particularly in unstable networks, with undesired load states or in case of insulation faults. Faults can be detected and rectified early before leading to far more substantial consequential damage.</td>
</tr>
<tr>
<td>SIRIUS monitoring relays for mounting on 3RT2 contactors</td>
<td>3RR2</td>
<td>UL 508</td>
<td>The SIRIUS 3RR2 current monitoring relays are suitable for the multi-phase monitoring of motors and other consumers for underload, phase sequence, phase failure and fault current. They thus allow for detailed conclusions regarding the connected machines or processes. When mounted on 3RT2 contactors, the monitoring function is directly integrated in the branch.</td>
</tr>
<tr>
<td>Temperature monitoring relays SIRIUS</td>
<td>3RS10, 3RS11</td>
<td>UL 508</td>
<td>The temperature monitoring relays SIRIUS 3RS10/3RS11, which are available as analog and digital versions, offer precise and reliable measurement of temperatures in solid, liquid and gaseous media.</td>
</tr>
<tr>
<td>Thermistor motor protection SIRIUS</td>
<td>3RN1</td>
<td>UL 508</td>
<td>The thermistor motor protection devices SIRIUS 3RN1 offer a professional and reliable temperature-dependent overload protection of three-phase motors.</td>
</tr>
<tr>
<td>SIRIUS safety relays</td>
<td>3TK28</td>
<td>UL 508</td>
<td>SIRIUS safety relays represent essential components of integrated and efficient safety chains. Whether EMERGENCY-STOP disconnection, protective door monitoring or protection of presses or punches – SIRIUS safety relays support the optimum realization of any safety application, both in terms of technology and efficiency. SIRIUS safety relays offer numerous safety-related functions: • Monitoring of the sensors’ safety functions • Monitoring of the sensor lines • Monitoring of the safety relay’s correct function • Monitoring of the actuators for standstill • Safety-related disconnection of hazardous states Depending on the respective device version, SIRIUS safety relays meet the strictest requirements (PL e) in accordance with ISO 13849 – and attain the highest safety integrity level (SIL 3) in accordance with IEC 61508.</td>
</tr>
</tbody>
</table>
### Modular safety systems

Order No.: 3RK
UL standard: UL 508

The 3RK3 (MSS) modular safety system represents a freely parameterizable and modular safety relay. Depending on the external circuitry, safety-related applications up to Category 4 in accordance with EN 954-1, Performance Level e in accordance with ISO 13849-1 or SIL 3 in accordance with IEC 62061 can be realized. The modular safety relay supports the interconnection of multiple safety applications. A graphical parameterization tool facilitates the safety functions' easy PC-based creation. Amongst others, disconnection areas can be specified and other dependencies defined. The system can be flexibly adjusted to the required safety applications by means of additional safety-related extension modules.

The MSS consists of the following system components:
- Central module
- Extension modules
- Interface module
- Diagnostics module
- Parameterization software
- Accessories

The comprehensive fault and status diagnostics allows for troubleshooting in the system and for the localization of sensor signals, resulting in reduced system downtimes. Optional interface modules transmit diagnostics data to superior bus systems (e.g., PROFIBUS DP). These data are then available in the automation system for further processing.

### Interface converters

**SIRIUS**

Order No.: 3RS17
UL standard: UL 508

The interface converters SIRIUS 3RS17 assume the coupling function for analog signals, both on the input and the output side. They are indispensable for the processing of analog values with electronic controls.

### Position switches

**SIRIUS**

Order No.: 3SE5
UL standard: UL 508

The standard position switches SIRIUS 3SE5 with and without solenoid interlocking convert the mechanical positions of moved machine parts to electronic signals. They are available with a multitude of different drive variants.

### Magnetically operated switches

**SIRIUS**

Order No.: 3SE6
UL standard: UL 508

The magnetically operated switches SIRIUS 3SE6 are designed for attachment to mobile protective devices. Evaluation is realized via a safety relay or connection to a bus system. The touch-free, magnetically operated 3SE6 safety switches are characterized by their closed design and high degree of protection IP67.

### Cable-operated switches

**SIRIUS**

Order No.: 3SE7
UL standard: UL 508

The cable-operated switches SIRIUS are employed for monitoring applications or as EMERGENCY-STOP device in particularly hazardous system components.

### Pushbutton units and indicator lights

**SIRIUS**

Order No.: 3SB
UL standard: UL 508

The pushbuttons and indicator lights SIRIUS are characterized by maximum functionality, their modern and flat design as well as particular ease of mounting.
<table>
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<td>Signaling columns SIRIUS</td>
<td>8WD4</td>
<td>UL 508</td>
<td>The signaling columns SIRIUS 8WD4 are employed for checking complex machine functions or in automated processes and serve as visual or acoustic warning device.</td>
</tr>
<tr>
<td>ALPHA FIX Termination blocks</td>
<td>8WA, 8WH</td>
<td>UL 1059</td>
<td>A complete range of terminal blocks is available in all conventional connection technologies for the secure connection of wires, conductors and lines.</td>
</tr>
<tr>
<td>LV HRC fuse bases</td>
<td>3NH3, 3NH4</td>
<td>UL 512</td>
<td>In combination with the SITOR fuse link, the LV HRC fuse bases of the BETA low-voltage circuit protection portfolio ensure the reliable protection of power semiconductors.</td>
</tr>
<tr>
<td>Cylindrical fuse holders and Class CC fuse holder</td>
<td>3NW7 0xx/1</td>
<td>UL 512</td>
<td>Our range of cylindrical fuses is particularly characterized by a high switching capacity, high current limiting and minimized design.</td>
</tr>
<tr>
<td>Cylindrical fuse links</td>
<td>3NW7 5x3-0HG</td>
<td>UL 248-4</td>
<td></td>
</tr>
<tr>
<td>SITOR Semiconductor fuses and fuse holders</td>
<td>3NE, 3NC3 3NC1 0, 3NC1 4, 3NC2 2</td>
<td>UL 248-13 UL 512</td>
<td>The particularly compact and flexible fuses SITOR for semiconductor protection are suitable for a multitude of industrial applications.</td>
</tr>
<tr>
<td>Overvoltage protection devices</td>
<td>5SD7 424-1</td>
<td>UL 1449</td>
<td>Surge arresters protect the low-voltage systems against overvoltages and high currents that can be triggered by direct lightning strikes.</td>
</tr>
<tr>
<td>Switch disconnectors</td>
<td>5TE1</td>
<td>UL 508</td>
<td>The switch disconnectors STE1 from 100 A to 200 A in 3- and 4-pole design can be employed as motor disconnect switch, repair switch, outgoing isolator and emergency disconnector unit.</td>
</tr>
<tr>
<td>Power monitoring devices</td>
<td>/KM</td>
<td>UL 61010-1 UL 50, enclosure type 5</td>
<td>The innovative SENTRON PAC3100, PAC3200 and SENTRON PAC4200 power monitoring devices, which can be connected to various consumers, facilitate precise energy consumption detection. The devices provide measured values for assessment of the system state and line quality. These values are displayed on the device or centrally evaluated with an energy management software such as SENTRON Powermanager, SIMATIC WinCC powerrate or SIMATIC PCS 7.</td>
</tr>
</tbody>
</table>

For further UL-approved devices, refer to [www.siemens.com/lowvoltageul-europe](http://www.siemens.com/lowvoltageul-europe) or our UL catalog LV16.

"Controls and Components for Applications according to UL."
Application Examples
Mechanical engineering

Circuit breakers and contactors with UL certification in tunnel boring machines

Requirements
Herrenknecht AG, leading manufacturer of tunnel boring machines, was looking for a new supplier for its switching and protection technology. The project comprised the equipment of two so-called hydro-shields, which were to bore a wastewater tunnel spanning a length of 10 km and a diameter of 5.33 m in Seattle, USA.

Project name: Brightwater Conveyance System

The most important requirements included:
- UL-certified low-voltage protection and switching devices for the 480 V on-board power supply system with 60 Hz and a max. short-circuit current of 65 kA
- Switching devices for wye-delta starter
- Protective devices for protection of the entire tunnel boring machine
- High supply and product quality, comprehensive consulting services and documentation

Solution
- All pumps and drive motors are protected with molded-case circuit breakers SENTRON 3VL; they facilitate extended distances through air and over surface, are available for nominal currents from 150 A to 1,600 A with thermal-magnetic or electronic trip units and feature a switching capacity of up to 100 kA at 480 V AC
- UL-certified contactors SIRIUS 3RT realize wye-delta starter
- Protection of the entire hydro-shield is ensured by air circuit breakers SENTRON 3WL (3,000 A) with approval according to UL 489
- As manual self-protected combination motor controller type E, motor controllers SIRIUS 3RV, integrated disconnect, overload protection and short-circuit protection as well as extended distances through air and over surface are employed in the terminal area

Added value
- Structured device documentation which considerably eased UL-compliant dimensioning compared to the previous competitor product
- Reliable UL conformity: the order specifications were accurately complied with
- Comprehensive consulting services: Siemens provided its broad expertise for dimensioning according to all relevant UL standards
- Easy retrofitting of circuit breakers with electronic trip units or communication module for direct PROFIBUS connection
- Uniform design through identical construction of IEC/UL devices

Automotive

Renowned automotive manufacturer relies on Siemens quality worldwide

Requirements
To reduce the costs for the planning and commissioning of new systems and ease maintenance, a well-known international automotive manufacturer opted for a worldwide standardization of its entire production equipment. The objective: less product diversity, fewer product suppliers. Siemens soon turned out to be the ideal partner for meeting this challenge. Compared to other manufacturers, Siemens offers one of the market’s most comprehensive product portfolio, which is furthermore matched to the country specifics of international automotive markets and operates on the basis of a unique global network.

Solution
- Together with the engineers of the automotive manufacturer, the Siemens engineering team developed the layout of standardized control panel types for typical automation processes in automotive production, e.g. paint, press and body shop
- The tried-and-tested switching technology by Siemens is part of the globally available product portfolio: e.g. molded-case circuit breakers SENTRON 3VL, manual motor controllers SIRIUS 3RV, load feeders SIRIUS 3RA, overload relays SIRIUS 3RB/3RU as well as transformers SIRIUS
- In addition, Siemens supplied the distributed I/O SIMATIC ET 200, HMI panels as well as RFID identification systems
- The control panels are globally produced at three production sites in Germany, USA and China in high and tested quality and are directly delivered to the automotive factories

Added value
- Optimum solutions through comprehensive, high-performance and flexible product portfolio on maximum quality level
- Comprehensive know-how of the automotive production sector and country specifics
- Easy order and project implementation process as well as stock-keeping due to a high degree of standardization
- Fast and high product availability through global production
- Easy product tracking and high quality reliability through concentration of the control panel production to three sites
- Fast service and support through global Siemens network
As previously mentioned, the IEC (International Electrotechnical Commission) and UL (Underwriters Laboratories Inc.) standards differ significantly. IEC standards specify the minimum device safety requirements. UL standards, in contrast, specify comprehensive technical details in terms of product safety and application.

With IEC applications or configurations, it is largely sufficient to ensure that the device characteristics (utilization category) comply with the load. With UL standards, also the application in which the devices are employed is important. Various applications are subject to various standards.

Example: According to UL 508, the decisive standard for industrial control equipment, devices for control transformer protection must be classified as "suitable for control transformer protection".

The IEC and UL organizations also differ greatly in terms of their general approach. In addition to standards development, the UL is also responsible for certification (general third-party certification) as well as field acceptance. Compliance with the standards is monitored more strictly, for example through factory inspections of device manufacturers, to ensure that the framework conditions specified together with the certification are met. Of course, UL inspectors also regularly visit our factories, e.g. in Amberg, Berlin and Regensburg, to control the impeccable production of UL-conforming products. Product adjustments have to be approved by the UL prior to production start.
In addition to the UL, there is a whole series of further organizations dedicated to promoting technical safety in the USA. Which standards and directives are relevant in the individual case can only be safely determined in connection with the respective application.

The following directives/standards are of essential importance for mechanical engineers:

- **The UL standard** for products and applications
- **the NFPA 79** – Electrical Standard for Industrial Machinery
- **the NFPA 70 (NEC, National Electrical Code)** for electrical on-site installations

The NFPA 79 and the NFPA 70 (NEC) were specified by the NFPA (National Fire Protection Association), an organization which publishes a comprehensive set of regulations for fire protection.

The NFPA 70 (NEC) is considered state-of-the-art technology by the US legal system. In addition, the local conditions have to be considered.

These local conditions are specified by the OSHA (Occupational Safety and Health Administration), one of the most important organizations for the enforcement of safety-technical requirements. It ensures safe and healthy occupational conditions and the protection of persons at their workplace by law, which became effective in 1970. In this context, the OSHA also publishes various standards on safety technology pertaining to machines and systems, which are to be considered for the respective application case.

Example: When it comes to the equipment of a liquid filling system, the FDA (Food and Drug Administration) has to be consulted if it is for foodstuff. Additionally, the conditions for hazardous locations may be observed if there is alcohol processed (danger of inflammable liquids or explosive gases).
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<td>UL XXX</td>
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<td>Further codes for devices used can be found under <a href="http://www.ul.com">www.ul.com</a></td>
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1) The IEC standards stated here serve as orientation. A one-to-one comparison of IEC and UL standards is not possible.
The UL Marks in Detail

For the marking of UL-certified products, a general differentiation is made between listed devices and recognized components. Further variants exist for the Canadian market.

**UL Listing Mark:** This is one of the most common UL marks. If a product carries this mark, it means UL found that representative samples of this product met UL’s safety requirements. These requirements are primarily based on UL’s own published standards for safety. This type of mark is seen commonly on appliances and computer equipment, furnaces and heaters, fuses, electrical panelboards, smoke and carbon monoxide detectors, fire extinguishers and sprinkler systems, personal flotation devices like life jackets and life preservers, bullet resistant glass, and thousands of other products.

**C-UL Listing Mark:** This mark is applied to products for the Canadian market. The products with this type of mark have been evaluated to Canadian safety requirements, which may be somewhat different from U.S. safety requirements. You will see this type of mark on appliances and computer equipment, vending machines, household burglar alarm systems, lighting fixtures, and many other types of products.

**C-UL US Listing Mark:** UL introduced this new Listing Mark in early 1998. It indicates compliance with both Canadian and U.S. requirements. The Canada/U.S. UL mark is optional. UL encourages those manufacturers with products certified for both countries to use this new, combined mark, but they may continue using separate UL marks for the United States and Canada.

**Recognized Component Mark:** This mark consumers rarely see because it is specifically used on component parts that are part of a larger product or system. These components may have restrictions on their performance or may be incomplete in construction. The Component Recognition marking is found on a wide range of products, including some switches, power supplies, printed wiring boards, some kinds of industrial control equipment and thousands of other products. They shall only be installed by experts of the manufacturer according to the so-called "Conditions of Acceptability (CoA)" apply to these devices. Amongst others, our portfolio contains the following products with UR mark: miniature circuit breakers according to UL 1077, time switches according to UL 917 and fuses SITOR.

**Canadian Recognized Component Mark:** Similar as the Recognized Mark (see above). Products intended for Canada carry the Recognized Component Mark "C."

**Recognized Component Mark for Canada and the United States:** This new UL Recognized Component Mark, which became effective April 1, 1998, may be used on components certified by UL to both Canadian and U.S. requirements. Although UL had not originally planned to introduce a combined Recognized Component Mark, the popularity of the Canada/U.S. Listing and Classification marks among clients with UL certifications for both Canada and the United States has led to the new mark.

Certifications such as [UL](#) and [C-UL](#) are issued by the so-called NRTLs (Nationally Recognized Testing Laboratories) after successful testing. The OSHA (Occupational Safety and Health Administration) has accredited Underwriters Laboratories Inc. as NRTL.

Test Privileges of the Production Facility Amberg

In 1995, the production facility Amberg was granted the authorization of implementing certifications in accordance with the Client Test Data Program (CTDP). As CTDP customer of UL, the production facility is entitled to carry out tests and independently prepare test as well as UL reports which contain the product description. UL merely verifies the compliance of the test and UL report with the UL standards. This way, the production facility Amberg has acquired a way higher degree of autonomy for the testing and certification process.

To ensure the products' compliance with the UL standards, UL inspectors regularly audit our factory within the so-called follow-up service. Follow-up service means that one or several devices are compared with the UL-certified documents, which are described in detail in a report. UL inspectors regularly visit the production plants to verify that the product is produced as described (example: SIRIUS contactors). With some devices, repeat tests are additionally implemented in regular intervals.
Every electrical machine or system in the USA is investigated by an inspector, the so-called AHJ (Authority Having Jurisdiction) prior to commissioning. The NEC (National Electrical Code, also called NFPA 70), the respective application-specific standards such as NFPA 79 as well as local standards and specifications form the basis for acceptance. Acceptance is required by law in the USA. Operators failing to have their machines or systems inspected by an AHJ both risk loss of insurance as well as power supply. For successful field acceptance, a correct configuration according to the applicable standards is of the essence. The illustration above shows four possible acceptance methods.

Conclusion
For manufacturing UL-conforming industrial control panels, the employment of UL-certified products alone is not sufficient. Also the interaction of devices in accordance with the respective application standard as well as the acceptance of the industrial control panel in its actual application environment are critical.
Particularities of the UL Market

Low-voltage networks in the USA

The network types used in the USA significantly differ from European networks. Other than in the IEC, also corner-grounded delta networks as well as solidly grounded wyes, which closely resemble the TN-S network, are employed.

In the United States of America / UL / NEC, all voltages used in the respective network type are stated (see table). As regards device selection, close attention must be paid to checking the network type used at the application site and the network types for which the individual devices are approved.

The common network types used in industrial and functional building applications are 3-phase networks with 240 V and 480 V as well as 3- and 4-wire systems with 480Y/277 V. Furthermore, the single-phase system with 120/240 V can be frequently found particularly in residential buildings, but also in offices in industrial and functional buildings.

### Circuits with straight and slash voltages

In the USA, the voltages are classified from the power utility or the secondary side of the power transformers. The circuit type (wye or delta) as well as the grounding method are very important.

In circuits with grounded wye, the circuit breaker only switches the full voltage between the phases (e.g. 480 V). The voltage phase-ground merely amounts to e.g. 277 V here, resulting in a 480Y/277 V slash voltage. Industrial control panels accommodating such devices must be marked with the following label: “**For use on a solidly grounded wye source only**” (UL 508A, Art. 54.12).

In ungrounded or high-resistance grounded wye or delta circuits as well as in corner-grounded delta circuits, only devices (e.g. circuit breakers) marked with a straight voltage, e.g. 240 V, 480 V or 600 V, shall be used. These devices must be able to switch the full voltage between the phases and one phase to ground.

### Short-circuit current rating of the control panel power circuit

An industrial control panel must be marked with a so-called SCCR (short-circuit current rating). In the IEC, this approximately corresponds to the \( f_{\text{CS}} \) value of the switchboard. The NEC 2008 Art. 409 describes the specifications of short-circuit current rating mark on industrial control panels (with reference to the UL 508A, SB4). For short-circuit rating, not only the short-circuit breaking capacity, e.g. of the circuit breaker, but also the short-circuit rating of every individual device in the power circuit is relevant. The SCCR-relevant components in the power circuit include circuit breakers, contactors, overload relays, solid-state switching devices, terminals, busbars, the line side of control transformers and frequency converters, however, no internal wiring of the industrial control panel.

The lowest value is applicable to the entire industrial control panel. No higher short-circuit current shall occur on the industrial control panel’s supply terminals.
**Feeder circuit**
The conductors and circuitry on the supply side of the branch circuit overcurrent protective device.

**Branch circuit**
The conductors and components following the last overcurrent protective device protecting the load.

**Power circuit**
Conductors and components of branch and feeder circuits. The power circuit can both be connected directly to the supply or via power transformers. Motor-driven loads are mostly classified as power circuits. Here, respective protective devices are to be used, e.g. circuit breakers according to UL 489.

**Control circuit**
A circuit that carries the electric signals directing the performance of a controller, and which does not carry the main power circuit. A control circuit is, in most cases, limited to 15 amperes. There are various ways of realizing control circuits:
- Direct tap-off upstream the branch circuit protective device. Here, respective protective devices are to be used, e.g. circuit breakers according to UL 489.
- Direct tap-off downstream the branch circuit protective device. Here, also so-called supplementary protectors can be used, e.g. miniature circuit breakers according to UL 1077.
- Via control transformers or DC power supply units. Caution: Various protective devices may not be approved for this application.

**Class 2 control circuit**
A control circuit supplied from a source having limited voltage (30 V<sub>nom</sub> or less) and current capacity, such as from the secondary of a Class 2 transformer, and rated for use with Class 2 remote-control or signaling circuits.

**Class 1 control circuit (acc. to UL 508A)**
A control circuit on the load side of an overcurrent protective device where the voltage does not exceed 600 volts, and where the power available is not limited, or a control circuit on the load side of a power limiting supply, such as a transformer.

**Branch circuit protection**
Overcurrent protection with an ampere rating selected to protect the branch circuit. For a motor branch circuit, the overcurrent protection is required for overcurrents due to short circuits and faults to ground only.

**Field wiring**
Conductors to be installed by others to connect the industrial control panel to source(s) of supply, remote control devices, and loads.

**Power circuit internal wiring/Factoy wiring**
The devices shall only be connected by the factory.

**Overcurrent protection**
A device designed to open a circuit when the current through it exceeds a predetermined value. The ampere rating of the device is selected for a circuit to terminate a condition where the current exceeds the rating of conductors and equipment due to overloads, short circuits and faults to ground.
Combination Motor Controller Examples

Assembly options of motor branch circuits

The assembly options of combination motor controllers within the IEC greatly differ from those for the UL market. Combination motor controllers according to IEC may cause UL inspectors or the AHJ to impose the so-called “red flag”, which means that the machine can only be put into operation after a significant change.

Motor branch functions:
- Disconnect
- Short-circuit protection / branch circuit protection
- Motor overload protection
- Motor control

Motor branch configuration types:
- Magnetic or manual motor controller
- Magnetic or manual motor controller in group installation
- Manual motor controller in group installation suitable for tap conductor protection
- Manual self-protected combination motor controller type E
- Magnetic / manual self-protected combination motor controller type F

Magnetic motor controller

Application:
- With decentrally installed single motors (e.g. fans in factory hall)
- For few motors in the machine
- Motor branches for high voltages

Assembly:
- 1 short-circuit protective device
- 1 magnetic motor controller (contactor for remote motor switching)
- 1 overload relay

### Devices

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<th>Device functions</th>
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<td></td>
<td>Disconnect</td>
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<td>Magnetic motor controller</td>
<td>UL 508</td>
<td></td>
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<tr>
<td>Overload relay</td>
<td>UL 508</td>
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</table>

Supply circuit

[Diagram of supply circuit and assembly options]
Manual motor controller (optionally magnetic with contactor)

Application:
- With decentrally installed single motors (e.g. fans in factory hall)
- For few motors in the machine
- Motor branches for high voltages

Assembly:
- 1 short-circuit protective device
- 1 manual motor controller (motor controller for manual motor switching and overload protection)
- Optional: 1 control device (contactor for remote motor switching)

Magnetic or manual motor controller in group installation

Application:
- For systems comprising several motors

Assembly:
- 1 short-circuit protective device as group protection
- 1 magnetic motor controller per motor (contactor for remote motor switching)
- 1 overload relay per motor

Note:
- Conventional assembly type if no certification as "type E" or "suitable for tap conductor protection in group installation" is available
- Often inefficient in practical applications due to the cable/wire size dimensioning rule

Magnetic motor controller in group installation

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<tr>
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<tr>
<td>Manual motor controller</td>
<td>UL 508</td>
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<tr>
<td>Contactor (optional)</td>
<td>UL 508</td>
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<td>Magnetic motor controller</td>
<td>UL 508</td>
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<tr>
<td>Overload relay</td>
<td>UL 508</td>
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Magnetic or manual motor controller in group installation

Or: Manual motor controller in group installation (optionally magnetic with contactor)

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<td>UL 508</td>
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Manual motor controller in group installation suitable for tap conductor protection

Application:
- For systems comprising several motors
- Assembly:
  - 1 short-circuit protective device as group protection
  - 1 manual motor controller per motor with certification “suitable for tap conductor protection in group installation” (motor controller for manual motor switching)
  - Optional: 1 control device (contactor for remote motor switching) per motor

Note:
- Smaller line cross-sections permitted than with standard group installation
- No adapter required as opposed to type E
- As opposed to manual motor controllers in group installation, line protection is not realized by the upstream short-circuit protective device here, but by the devices themselves

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Manual self-protected combination motor controller type E

Application:
- For systems comprising one or several motors
Assembly:
- 1 manual self-protected combination motor controller type E per motor

Note:
- Upstream circuit breakers or fuses are not required
- Smaller cross-sections for motor supply line permitted than with group installation
- Type E controllers are only certified for motor protection
- Type E controllers require 1 inch through air and 2 inch over surface (for 251 V and higher) on the line side to comply with UL

<table>
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<tr>
<th>Devices</th>
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<tr>
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<td>UL 508</td>
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Magnetic/manual self-protected combination motor controller type F

Application:
- For systems comprising one or several motors
Assembly:
- 1 manual self-protected combination motor controller per motor
- 1 magnetic motor controller per motor

Note:
- Upstream circuit breakers or fuses are not required
- Smaller cross-sections for motor supply line permitted than with group installation
- Type F controllers are only certified for motor protection
- Type F controllers require 1 inch through air and 2 inches over surface (251 V or higher) on the line side to comply with UL

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<tr>
<th>Devices</th>
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<tr>
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<tr>
<td>Contactor</td>
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Notes:
For further information,
please contact your local Siemens sales partner.

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