

Relays

Hameedah Odusanya



What are Relays?



Relays are electrically actuated switches; they are the electrical parts that send the message to an electric or electronic device to start. They are used in millions of modern electrical devices because they are essentially the conduit between the switch and the part of the device that make it run.

The part of the device that is the relay is the white box mounted on the top. The green structure (base) is mainly used for mounting the relay to devices and for connecting the inputs and outputs.

There are several different types of relays including but not limited to control relays, polarized relays, piezoelectric relays, solid-state relays, and electromechanical relays. The most commonly used relays are the solid-state and electromechanical relays.

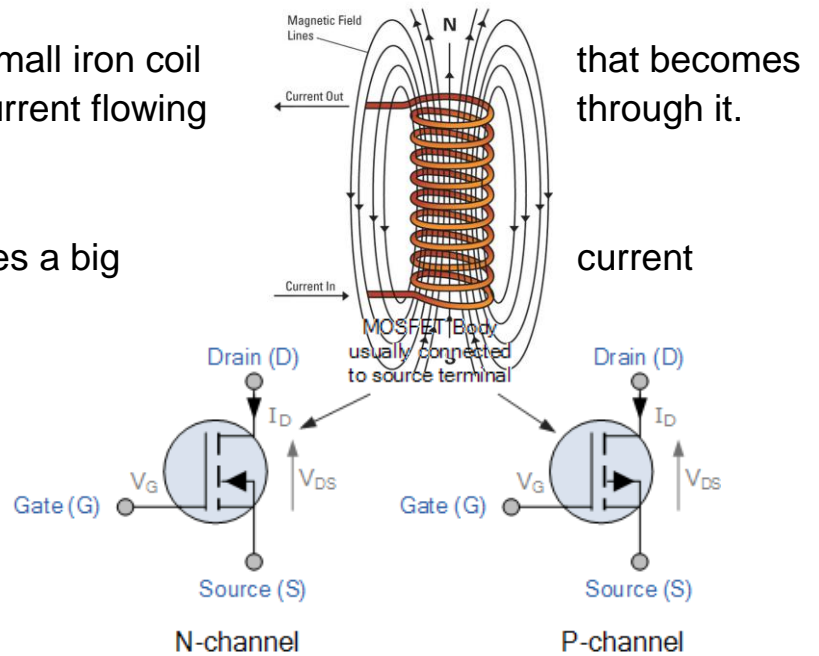
Phoenix contact produces a lot of different relays, but for the purpose of this course, we will be using the 5V and 24V PLC relay modules.

How do relays work?

Relays are used to link two different circuits together. Some electrical components of relays are an electromagnet or a MOSFET.

The electromagnet is comprised of a small iron coil magnetic when there is an electrical current flowing

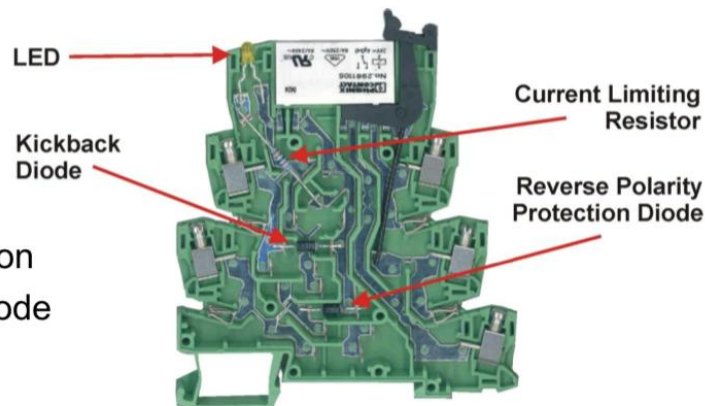
The MOSFET is a transistor that creates a big gap between the source and the drain when a small voltage is applied to the gate.



As mentioned above, this class uses the Phoenix Contact 24V PLC relay, and the inside of a PLC base module is depicted below.

Base contains:

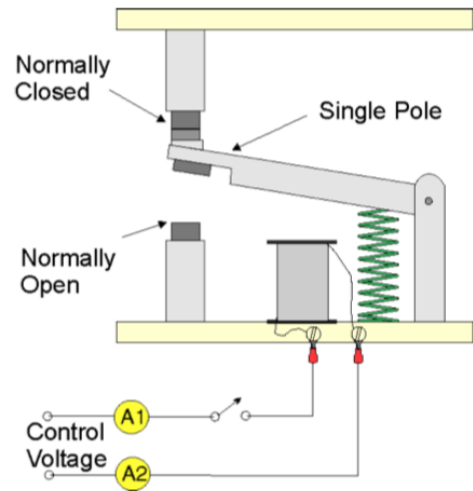
- LED
- Operation indication
- Reverse polarity diode
- Kickback diode
- Bridge rectifier



The side of the base with the two terminals is the input, and the side with the three terminals is the output. The user connects the input voltage (ex. 24V) which activates the relay, and once the relay is activated, the LED comes on, indicating that it is operational. The user connects the output terminals to the device that is to be signaled. Once the circuit is completed, by receiving an input, a connection is created between the top and middle terminals on the output side, and if the circuit is not completed, there is a connection between the bottom and middle terminals of the output.

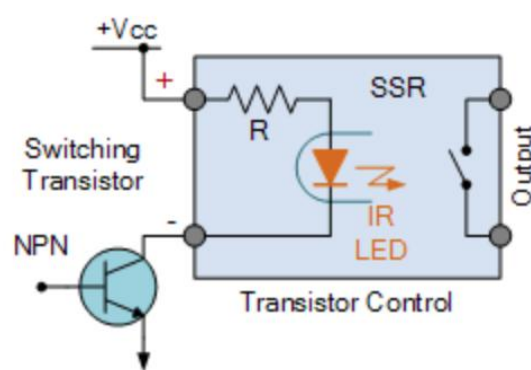
Electromechanical Relays

Electromechanical Relays are a switching device with moving contacts which are energized by a magnetic field. Meaning, when there is current into the coils, it creates a magnetic field. The magnetic force then pulls on the moving contact causing it to change states.



Solid-state Relays (SSR)

Solid state relays, unlike most relays, have no moving parts and provides for faster switching than electromechanical relays. SSR's use transistors such as MOSFETs (Metal Oxide Semiconductor Field Effect Transistor) to control the currents through a device, turning it on or off, and due to its lack of moving parts, has no physical contacts wear out.



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to

For more information on solid state relays: <https://www.electronics-tutorials.ws/power/solid-state-relay.html>

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

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PLC-INTERFACE, consisting of DIN rail-mountable basic terminal block with screw connection and plug-in miniature relay with power contact, 2 PDTs, input voltage: 24 V DC, UL/cUL: approved for use in Ex Zone Class I, Div. 2 and ATEX (Zone 2)



Key Commercial Data

| | |
|--------------------------------------|---|
| Packing unit | 1 pc |
| Minimum order quantity | 10 pc |
| GTIN |  4 046356 051262 |
| GTIN | 4046356051262 |
| Weight per Piece (excluding packing) | 78.000 g |
| Custom tariff number | 85364190 |
| Country of origin | Germany |

Technical data

Note

| | |
|-------------------------|---|
| Utilization restriction | EMC: class A product, see manufacturer's declaration in the download area |
|-------------------------|---|

Dimensions

| | |
|--------|-------|
| Width | 14 mm |
| Height | 80 mm |
| Depth | 94 mm |

Ambient conditions

| | |
|---------------------------------|---------------------------------|
| Ambient temperature (operation) | -20 °C ... 60 °C (UL) |
| | -40 °C ... 60 °C (ATEX / IECEx) |

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Technical data

Ambient conditions

| | |
|---|------------------|
| Ambient temperature (storage/transport) | -40 °C ... 85 °C |
|---|------------------|

Coil side

| | |
|---|--|
| Nominal input voltage U_N | 24 V DC |
| Typical input current at U_N | 18 mA |
| Typical response time | 8 ms |
| Typical release time | 10 ms |
| Protective circuit | Reverse polarity protection Polarity protection diode Free-wheeling diode Damping diode |
| Operating voltage display | Yellow LED |
| Power dissipation for nominal condition | 0.43 W |

Contact side

| | |
|---------------------------------------|---|
| Contact type | 2 PDT |
| Type of switch contact | Single contact |
| Contact material | AgNi |
| Maximum switching voltage | 250 V AC/DC (The separating plate PLC-ATP should be installed for voltages larger than 250 V (L1, L2, L3) between identical terminal blocks in adjacent modules. Potential bridging is then carried out with FBST 8-PLC... or ...FBST 500...) |
| Minimum switching voltage | 5 V (at 10 mA) |
| Min. switching current | 10 mA (At 5 V) |
| Maximum inrush current | 15 A (300 ms) |
| Limiting continuous current | 6 A |
| Interrupting rating (ohmic load) max. | 140 W (at 24 V DC) 85 W (at 48 V DC) 60 W (at 60 V DC) 44 W (at 110 V DC) 60 W (at 220 V DC) 1500 VA (for 250 V AC) |
| Switching capacity | 2 A (at 24 V, DC13) 0.2 A (at 110 V, DC13) 3 A (at 24 V, AC15) 3 A (at 120 V, AC15) 3 A (at 250 V, AC15) |

General

| | |
|--|------------------------|
| Test voltage relay winding/relay contact | 4 kV (50 Hz, 1 min.) |
| Test voltage PDT/PDT | 2.5 kV (50 Hz, 1 min.) |
| Operating mode | 100% operating factor |

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Technical data

General

| | |
|---------------------------------|---------------------------------------|
| Degree of protection | RT III (Relay) |
| | IP20 (Relay base) |
| Mechanical service life | 3x 10 ⁷ cycles |
| ATEX | # II 3G Ex ec nC IIC T4 Gc |
| EU-type examination certificate | IBExU16ATEXB015 X |
| IECEX | Ex ec nC IIC T4 Gc |
| IECEX certificate | IECEX IBE 16.0029X |
| UL, USA | Class I, Zone 2, AEx nA nC IIC T6 |
| UL, USA/Canada | Class I, Div. 2, Groups A, B, C, D |
| UL, Canada | Class I, Zone 2, Ex nA nC IIC Gc T6 X |
| Mounting position | any |
| Assembly instructions | In rows with zero spacing |

Connection data input side

| | |
|----------------------------------|---|
| Connection name | Coil side |
| Connection method | Screw connection |
| Stripping length | 8 mm |
| Screw thread | M3 |
| Conductor cross section solid | 0.14 mm ² ... 2.5 mm ² |
| Conductor cross section flexible | 0.14 mm ² ... 2.5 mm ² |
| | 0.2 mm ² ... 2.5 mm ² () |
| | 2x 0.5 mm ² ... 1.5 mm ² () |
| Conductor cross section AWG | 26 ... 14 |
| Torque | 0.6 Nm ... 0.8 Nm |
| | 5 lb _f -in. ... 7 lb _f -in. |

Connection data output side

| | |
|----------------------------------|---|
| Connection name | Contact side |
| Connection method | Screw connection |
| Stripping length | 8 mm |
| Screw thread | M3 |
| Conductor cross section solid | 0.14 mm ² ... 2.5 mm ² |
| Conductor cross section flexible | 0.14 mm ² ... 2.5 mm ² |
| | 0.2 mm ² ... 2.5 mm ² () |
| | 2x 0.5 mm ² ... 1.5 mm ² () |
| Conductor cross section AWG | 26 ... 14 |
| Torque | 0.6 Nm ... 0.8 Nm |
| | 5 lb _f -in. ... 7 lb _f -in. |

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Technical data

Standards and Regulations

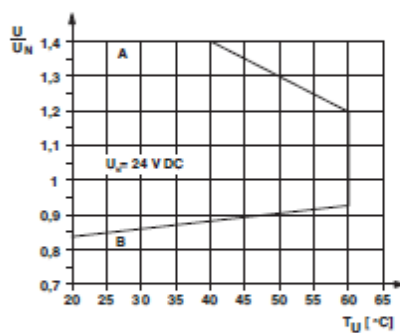
| | |
|--|---|
| Designation | Standards/regulations |
| Standards/regulations | IEC 60664 |
| | EN 50178 |
| | EN 60079-0, -7, -15 |
| Rated surge voltage | 6 kV |
| Insulation | Safe isolation: Control side / contact side |
| Degree of pollution | 2 |
| Overvoltage category | III |
| Flammability rating according to UL 94 | V0 |
| Conformance | CE-compliant |
| ATEX | # II 3G Ex ec nC IIC T4 Gc |
| IECEX | Ex ec nC IIC T4 Gc |
| UL, USA | Class I, Zone 2, AEx nA nC IIC T6 |
| UL, USA/Canada | Class I, Div. 2, Groups A, B, C, D |
| UL, Canada | Class I, Zone 2, Ex nA nC IIC Gc T6 X |

Environmental Product Compliance

| | |
|------------|---|
| REACH SVHC | Lead 7439-92-1 |
| China RoHS | Environmentally Friendly Use Period = 50 |
| | For details about hazardous substances go to tab "Downloads", Category "Manufacturer's declaration" |

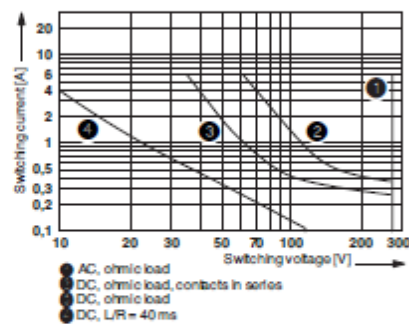
Drawings

Diagram



Curve A

Diagram



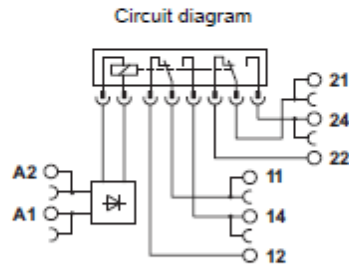
Interrupting rating

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Maximum permissible continuous voltage U_{max} with limiting continuous current on the contact side (see relevant technical data)

Curve B

Minimum permissible operate voltage U_{op} after pre-excitation (see relevant technical data)



Classifications

eCl@ss

| | |
|------------|----------|
| eCl@ss 5.0 | 27371601 |
| eCl@ss 5.1 | 27371600 |
| eCl@ss 6.0 | 27371600 |
| eCl@ss 7.0 | 27371601 |
| eCl@ss 8.0 | 27371601 |
| eCl@ss 9.0 | 27371601 |

ETIM

| | |
|----------|----------|
| ETIM 2.0 | EC001437 |
| ETIM 3.0 | EC001437 |
| ETIM 4.0 | EC001437 |
| ETIM 5.0 | EC001437 |
| ETIM 6.0 | EC001437 |

UNSPSC

| | |
|---------------|----------|
| UNSPSC 6.01 | 30211916 |
| UNSPSC 7.0901 | 39121515 |
| UNSPSC 11 | 39121515 |
| UNSPSC 12.01 | 39121515 |
| UNSPSC 13.2 | 39122334 |

Approvals

Approvals

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Approvals

Approvals

EAC

Ex Approvals

IECEX / ATEX / UL Listed / cUL Listed / cULus Listed

Approval details

| | | |
|-----|---|--------------------------|
| EAC |  | RU C- DE.A*30.B.01082 |
|-----|---|--------------------------|

Accessories

Accessories

Bridge

Continuous plug-in bridge - FBST 500-PLC RD - 2966786



Continuous plug-in bridge, length: 500 mm, color: red

Continuous plug-in bridge - FBST 500-PLC BU - 2966692



Continuous plug-in bridge, length: 500 mm, color: blue

Continuous plug-in bridge - FBST 500-PLC GY - 2966838



Continuous plug-in bridge, length: 500 mm, color: gray

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Accessories

Single plug-in bridge - FBST 6-PLC RD - 2966236



Single plug-in bridge, length: 6 mm, number of positions: 2, color: red

Single plug-in bridge - FBST 6-PLC BU - 2966812



Single plug-in bridge, length: 6 mm, number of positions: 2, color: blue

Single plug-in bridge - FBST 6-PLC GY - 2966825



Single plug-in bridge, length: 6 mm, number of positions: 2, color: gray

Single plug-in bridge - FBST 6-PLC RD - 2966236



Single plug-in bridge, length: 6 mm, number of positions: 2, color: red

Single plug-in bridge - FBST 6-PLC RD - 2966236



Single plug-in bridge, length: 6 mm, number of positions: 2, color: red

Controller board

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Accessories

System connection - PLC-V8L/FLK14/OUT - 2299660



V8 adapter for 8 x PLC-INTERFACE (14 mm); Controller: PLC system cabling of output cards; connection 1: Plug connection (Can be snapped onto 8x PLC-INTERFACE terminals); connection 2: 1x IDC/FLK pin strip (14-position); number of channels: 8; control logic: positive switching

System connection - PLC-V8L/FLK14/OUT/M - 2304306



V8 adapter for 8 x PLC-INTERFACE (14 mm); Controller: PLC system cabling of output cards; connection 1: Plug connection (Can be snapped onto 8x PLC-INTERFACE terminals); connection 2: 1x IDC/FLK pin strip (14-position); number of channels: 8; control logic: negative switching

DIN rail

DIN rail, unperforated - NS 35/ 7,5 V2A UNPERF 2000MM - 0801377



DIN rail, unperforated, Standard profile, width: 35 mm, height: 7.5 mm, acc. to EN 60715, material: Stainless steel V2A, uncoated, length: 2000 mm, color: silver

DIN rail perforated - NS 35/ 7,5 PERF 2000MM - 0801733



DIN rail perforated, Standard profile, width: 35 mm, height: 7.5 mm, acc. to EN 60715, material: Steel, galvanized, passivated with a thick layer, length: 2000 mm, color: silver

DIN rail, unperforated - NS 35/ 7,5 CU UNPERF 2000MM - 0801762



DIN rail, unperforated, Standard profile, width: 35 mm, height: 7.5 mm, acc. to EN 60715, material: Copper, uncoated, length: 2000 mm, color: copper-colored

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Accessories

DIN rail, unperforated - NS 35/15 UNPERF 2000MM - 1201714



DIN rail, unperforated, Standard profile, width: 35 mm, height: 15 mm, similar to EN 60715, material: Steel, galvanized, passivated with a thick layer, length: 2000 mm, color: silver

DIN rail, unperforated - NS 35/15 CU UNPERF 2000MM - 1201895



DIN rail, unperforated, Standard profile, width: 35 mm, height: 15 mm, similar to EN 60715, material: Copper, uncoated, length: 2000 mm, color: copper-colored

DIN rail, unperforated - NS 35/15-2,3 UNPERF 2000MM - 1201798



DIN rail, unperforated, Standard profile 2.3 mm, width: 35 mm, height: 15 mm, acc. to EN 60715, material: Steel, galvanized, passivated with a thick layer, length: 2000 mm, color: silver

DIN rail, unperforated - NS 35/15 AL UNPERF 2000MM - 1201756



DIN rail, unperforated, Standard profile, width: 35 mm, height: 15 mm, similar to EN 60715, material: Aluminum, uncoated, length: 2000 mm, color: silver

DIN rail perforated - NS 35/15 PERF 2000MM - 1201730



DIN rail perforated, Standard profile, width: 35 mm, height: 15 mm, similar to EN 60715, material: Steel, galvanized, passivated with a thick layer, length: 2000 mm, color: silver

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Accessories

DIN rail, unperforated - NS 35/ 7,5 UNPERF 2000MM - 0801681



DIN rail, unperforated, Standard profile, width: 35 mm, height: 7.5 mm, acc. to EN 60715, material: Steel, galvanized, passivated with a thick layer, length: 2000 mm, color: silver

Labeled terminal marker

Zack marker strip - ZB10,LGS:FORTL.ZAHLEN - 1053014



Zack marker strip, Strip, white, labeled, can be labeled with: CMS-P1-PLOTTER, printed horizontally: consecutive numbers 1 ... 10, 11 ... 20, etc. up to 991 ... 1000, mounting type: snap into tall marker groove, for terminal block width: 10.2 mm, lettering field size: 10.15 x 10.5 mm

Partition plate

Separating plate - PLC-ATP BK - 2966841



Separating plate, 2 mm thick, required at the start and end of a PLC terminal strip. Furthermore, it is used for: visual separation of groups, safe isolation of different voltages of neighboring PLC relays in acc. with DIN VDE 0106-101, isolation

Power module

Power terminal block - PLC-ESK GY - 2966508



Power terminal block, for the input of up to four potentials, for mounting on NS 35/7.5

Screwdriver tools

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Accessories

Screwdriver - SZF 1-0,6X3,5 - 1204517



Actuation tool, for ST terminal blocks, also suitable for use as a bladed screwdriver, size: 0.6 x 3.5 x 100 mm, 2-component grip, with non-slip grip

Terminal marking

Zack marker strip - ZB10/WH-100:UNBEDRUCKT - 5060883



Zack marker strip, Strip, white, unlabeled, can be labeled with: CMS-P1-PLOTTER, PLOTMARK, mounting type: snap into tall marker groove, for terminal block width: 10.2 mm, lettering field size: 10.15 x 10.5 mm

Zack marker strip - ZB 10:UNBEDRUCKT - 1053001



Zack marker strip, Strip, white, unlabeled, can be labeled with: PLOTMARK, CMS-P1-PLOTTER, mounting type: snap into tall marker groove, for terminal block width: 10.2 mm, lettering field size: 10.5 x 10.15 mm

Marker for terminal blocks - UC-TM 12 - 0819194



Marker for terminal blocks, Sheet, white, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, BLUEMARK CLED, PLOTMARK, CMS-P1-PLOTTER, mounting type: snap into tall marker groove, for terminal block width: 12 mm, lettering field size: 11.45 x 10.5 mm

Marker for terminal blocks - UCT-TM 12 - 0829144



Marker for terminal blocks, Sheet, white, unlabeled, can be labeled with: TOPMARK NEO, TOPMARK LASER, BLUEMARK ID COLOR, BLUEMARK ID, BLUEMARK CLED, THERMOMARK PRIME, THERMOMARK CARD 2.0, THERMOMARK CARD, mounting type: snap into tall marker groove, for terminal block width: 12 mm, lettering field size: 10.8 x 9.6 mm

Relay Module - PLC-RSC- 24DC/21-21/ATEX - 2980461

Accessories

Spare parts

Single relay - REL-MR-24DC/21-21/ATEX - 2906213



Plug-in miniature power relay, RT III sealed with power contacts, 2 changeover contacts, input voltage: 24 V DC, in connection with the corresponding PLC base approved in accordance with ATEX/IECEX (zone 2) and Ex zone class I, div. 2.

