# Zelio Logic

## Applications Examples Guide

**Original instructions**

**EIO0000002600.01**
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www.se.com

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The information provided in this document contains general descriptions, technical characteristics and/or recommendations related to products/solutions.

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# Safety Information

## Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

**⚠ DANGER**

**DANGER** indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

**⚠ WARNING**

**WARNING** indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

**⚠ CAUTION**

**CAUTION** indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

***NOTICE***

***NOTICE*** is used to address practices not related to physical injury.

## Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

## Before You Begin

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

**⚠WARNING**

**UNGUARDED EQUIPMENT**

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine and, therefore, can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, you should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

**NOTE:** Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

# Start-up and Test

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check are made and that enough time is allowed to perform complete and satisfactory testing.

**⚠WARNING**

**EQUIPMENT OPERATION HAZARD**

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

**Software testing must be done in both simulated and real environments.**

Verify that the completed system is free from all short circuits and temporary grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

# Operation and Adjustments

The following precautions are from the NEMA Standards Publication ICS 7.1-1995:

(In case of divergence or contradiction between any translation and the English original, the original text in the English language will prevail.)

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer’s instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer’s instructions and the machinery used with the electrical equipment.
- Only those operational adjustments required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

# About the Document

## Document Scope

This document describes a number of example projects for Zelio Logic smart relay in the Ladder and FBD programming languages.

The examples described in this document are intended for learning purposes only. They must not be used directly on products that are part of a machine or process.

**⚠WARNING**

**UNINTENDED EQUIPMENT OPERATION**

Do not include any wiring information, programming or configuration logic, or parameterization values from the examples in your machine or process without thoroughly testing your entire application.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

This document and its related Zelio Soft 2 project files focus on specific functions and function blocks provided with Zelio Soft 2, and on specific features available in Zelio Soft 2. They are intended to help you understand how to develop, test, commission, and integrate applicative software of your own design in your control systems.

The examples are intended for Zelio Soft 2 users who already have some degree of expertise in the design and programming of control systems.

## Validity Note

This document has been updated for the release of Zelio Soft 2 V5.4.3.

# Product Related Information

## ⚠WARNING

**LOSS OF CONTROL**

- Perform a Failure Mode and Effects Analysis (FMEA), or equivalent risk analysis, of your application, and apply preventive and detective controls before implementation.
- Provide a fallback state for undesired control events or sequences.
- Provide separate or redundant control paths wherever required.
- Supply appropriate parameters, particularly for limits.
- Review the implications of transmission delays and take actions to mitigate them.
- Review the implications of communication link interruptions and take actions to mitigate them.
- Provide independent paths for control functions (for example, emergency stop, over-limit conditions, and error conditions) according to your risk assessment, and applicable codes and regulations.
- Apply local accident prevention and safety regulations and guidelines.[1]
- Test each implementation of a system for proper operation before placing it into service.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), *Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control* and to NEMA ICS 7.1 (latest edition), *Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems* or their equivalent governing your particular location.

## ⚠WARNING

**UNINTENDED EQUIPMENT OPERATION**

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

# General Cybersecurity Information

In recent years, the growing number of networked machines and production plants has seen a corresponding increase in the potential for cyber threats, such as unauthorized access, data breaches, and operational disruptions. You must, therefore, consider all possible cybersecurity measures to help protect assets and systems against such threats.

To help keep your Schneider Electric products secure and protected, it is in your best interest to implement the cybersecurity best practices as described in the Cybersecurity Best Practices document.

Schneider Electric provides additional information and assistance:

- Subscribe to the Schneider Electric security newsletter.
- Visit the Cybersecurity Support Portal web page to:
  - Find Security Notifications.
  - Report vulnerabilities and incidents.
- Visit the Schneider Electric Cybersecurity and Data Protection Posture web page to:
  - Access the cybersecurity posture.
  - Learn more about cybersecurity in the cybersecurity academy.
  - Explore the cybersecurity services from Schneider Electric.

# Available Languages of the Document

The document is available in these languages:

- English (EIO0000002600)
- French (EIO0000002601)
- German (EIO0000002602)
- Spanish (EIO0000002603)
- Italian (EIO0000002604)
- Portuguese (EIO0000002605)

# Related Documents

| Title of Documentation | Reference Number |
|---|---|
| Zelio Logic Smart Relay - User Manual | EIO0000002690 (ENG)<br>EIO0000002691 (FRE)<br>EIO0000002692 (GER)<br>EIO0000002693 (SPA)<br>EIO0000002694 (ITA)<br>EIO0000002695 (POR) |
| Zelio Logic - Programming Guide | EIO0000002612 (ENG)<br>EIO0000002613 (FRE)<br>EIO0000002614 (GER)<br>EIO0000002615 (SPA)<br>EIO0000002616 (ITA)<br>EIO0000002617 (POR) |
| SR2A••••• / SR2B••••• - Instruction Sheet | 1724026_01A55 |
| SR2D••••• / SR2E••••• - Instruction Sheet | 1724028_01A55 |
| SR3B••••• - Instruction Sheet | 1724027_01A55 |

To find documents online, visit the Schneider Electric download center (www.se.com/ww/en/download/).

# Information on Non-Inclusive or Insensitive Terminology

As a responsible, inclusive company, Schneider Electric is constantly updating its communications and products that contain non-inclusive or insensitive terminology. However, despite these efforts, our content may still contain terms that are deemed inappropriate by some customers.

# Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in the information contained herein, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

| Standard | Description |
|---|---|
| IEC 61131-2:2007 | Programmable controllers, part 2: Equipment requirements and tests. |
| ISO 13849-1:2023 | Safety of machinery: Safety related parts of control systems.<br>General principles for design. |
| EN 61496-1:2020 | Safety of machinery: Electro-sensitive protective equipment.<br>Part 1: General requirements and tests. |
| ISO 12100:2010 | Safety of machinery - General principles for design - Risk assessment and risk reduction |

| Standard | Description |
|---|---|
| EN 60204-1:2006 | Safety of machinery - Electrical equipment of machines - Part 1: General requirements |
| ISO 14119:2013 | Safety of machinery - Interlocking devices associated with guards - Principles for design and selection |
| ISO 13850:2015 | Safety of machinery - Emergency stop - Principles for design |
| IEC 62061:2021 | Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems |
| IEC 61508-1:2010 | Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements. |
| IEC 61508-2:2010 | Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems. |
| IEC 61508-3:2010 | Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements. |
| IEC 61784-3:2021 | Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions. |
| 2006/42/EC | Machinery Directive |
| 2014/30/EU | Electromagnetic Compatibility Directive |
| 2014/35/EU | Low Voltage Directive |

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

| Standard | Description |
|---|---|
| IEC 60034 series | Rotating electrical machines |
| IEC 61800 series | Adjustable speed electrical power drive systems |
| IEC 61158 series | Digital data communications for measurement and control – Fieldbus for use in industrial control systems |

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive* (*2006/42/EC*) and *ISO 12100:2010*.

**NOTE:** The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

# Getting Started

# Running the Example Programs

## Locating the Example Programs

The example programs are located in the Zelio Soft 2 installation folder:

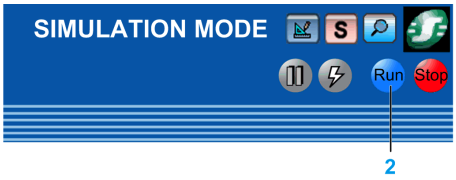
*Zelio Soft 2\Z2user\examples*

The example programs are:

| File name | Description |
|---|---|
| **Ladder language** | |
| *gestion_serre_ladder.zm2* | Greenhouse ventilation pane control, page 15. |
| *eclairage_habitation_ladder.zm2* | Home lighting, page 18. |
| *Portail_ladder.zm2* | Automatic gate control, page 19. |
| *Parking Souterrain ladder.zm2* | Underground car park control, page 20. |
| *regulation_température_ladder.zm2* | Room temperature regulation, page 22. |
| *Chaudiere_ladder.zm2* | Boiler control, page 25. |
| **FBD language** | |
| *gestion_serre_fbd.zm2* | Greenhouse ventilation pane control, page 27. |
| *eclairage_habitation_fbd.zm2*<br>*eclairage_habitation_fbd_grafcet.zm2* | Home lighting, page 30. |
| *Portail_fbd.zm2* | Automatic gate control, page 32. |
| *regulation_temperature_fbd.zm2* | Room temperature regulation, page 34. |
| *Chaudiere_fbd.zm2* | Boiler control, page 36. |
| *Sonnerie fbd.zm2* | School bell, page 37. |
| *Heating_PWM_fbd.zm2* | Central heating system with PWM valve, page 39. |
| *Heating_analog_fbd.zm2* | Central heating system with analog valve, page 41. |

# Launching an Example in Zelio Soft 2 Programming Software

To launch an example program, proceed as follows:

| Step | Action |
|---|---|
| 1 | Start the Zelio Soft 2 software. |
| 2 | Select **Open an existing program**. |
| 3 | Choose the example program to be launched. |
| 4 | Select **Simulation** mode (1).<br> |
| 5 | Execute the program by clicking **Run** (2).<br>  |

Floating pop-ups are available to change and view the input/output status. To display/hide them, use the icon bar at the bottom of the screen:

# Applications in Ladder Language

## Greenhouse Ventilation Panes

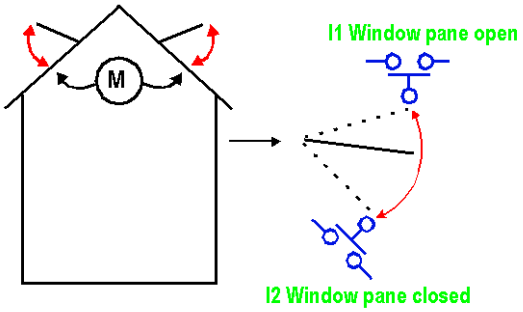
### Description

This example describes how greenhouse ventilation panes can be managed automatically.

### Specifications

The owner of a greenhouse would like to acquire an installation to manage the opening and closing of the ventilation window panes located on the greenhouse roof.

The greenhouse has two window panes to provide ventilation. The opening of these window panes is controlled by a motor and 2 sensors that indicate whether the window panes are open or closed:




During the day, the window panes open to ventilate the structure from 12:00 to 15:00, at the time of day when, in principle, the temperature is the highest. However, if the temperature is less than 10 °C, the window panes do not open, or when they are already open, they close.

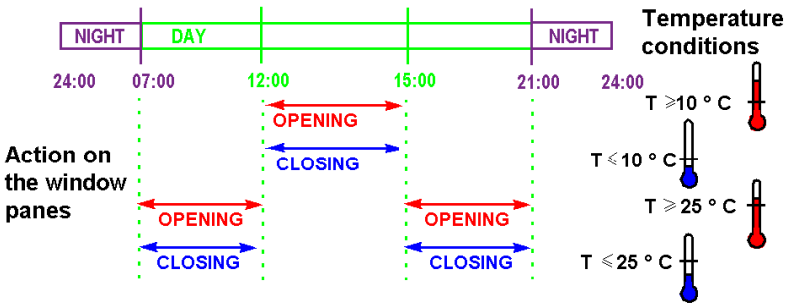
In addition, the window panes open during the day when the temperature reaches 25 °C. If the temperature falls below 25 °C, the window panes must close again.

Finally, at night, the window panes remain closed regardless of the temperature.

Program description, 3 time ranges are used:

- Range 1: Night, from 21:00 to 07:00
- Range 2: Day, from 07:00 to 12:00 and from 15:00 to 21:00
- Range 3: Noon, from 12:00 to 15:00

Summary:



# Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Window panes open (Discrete) |
| **I2** | Window panes closed (Discrete) |
| **IB** | Temperature (Analog) |

Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | Opening of the window panes (Discrete) |
| **Q2** | Closing of the window panes (Discrete) |

The temperature is supplied by a sensor with output voltage of 0 to 10 V.

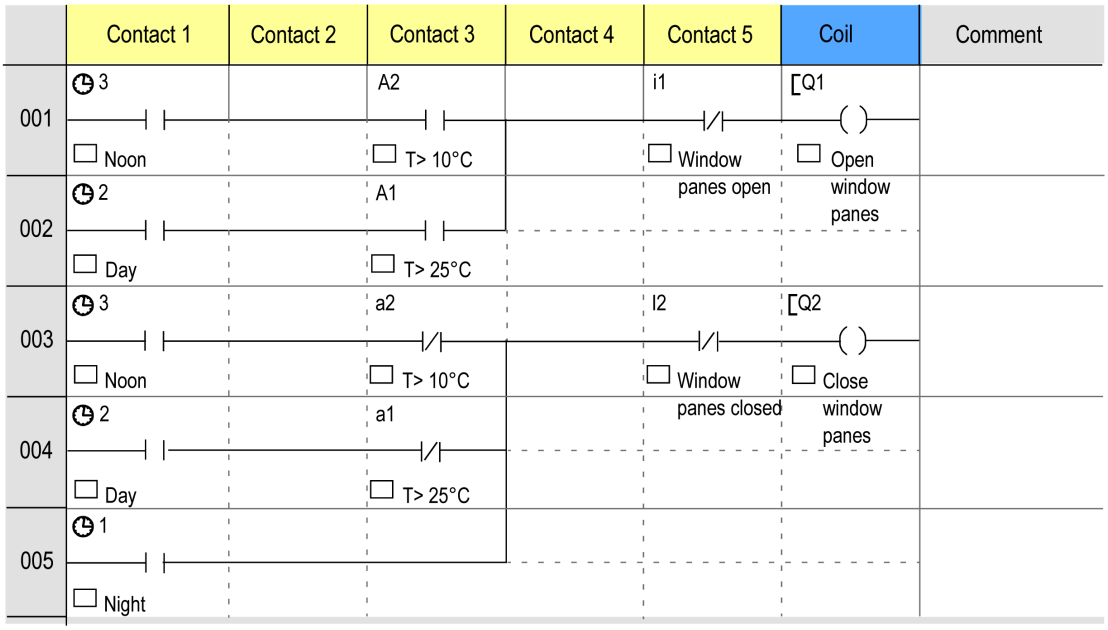
# Required Reference

For this application, a smart relay with a clock and analog inputs is required:

- **SR2B121BD** (24 Vdc),
- **SR2B122BD** (24 Vdc),
- **SR2B121JD** (12 Vdc).

# LD Wiring Sheet

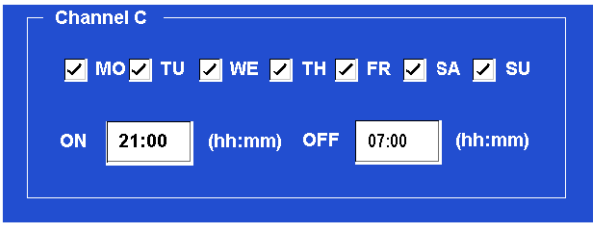
This figure shows the example with Ladder symbols display:



# Description of the Parameters

**Daily programmer H1**

Channel C:




The other channels (A, B, D) are not configured.

**Daily programmer H2**

Channel C:

- ON: 07:00 OFF 12:00,
- The other parameters are the same as for programmer H1.

Channel D:

- ON: 15:00 OFF 21:00,
- The other parameters are the same as for programmer H1.

The other channels (A, B) are not configured.

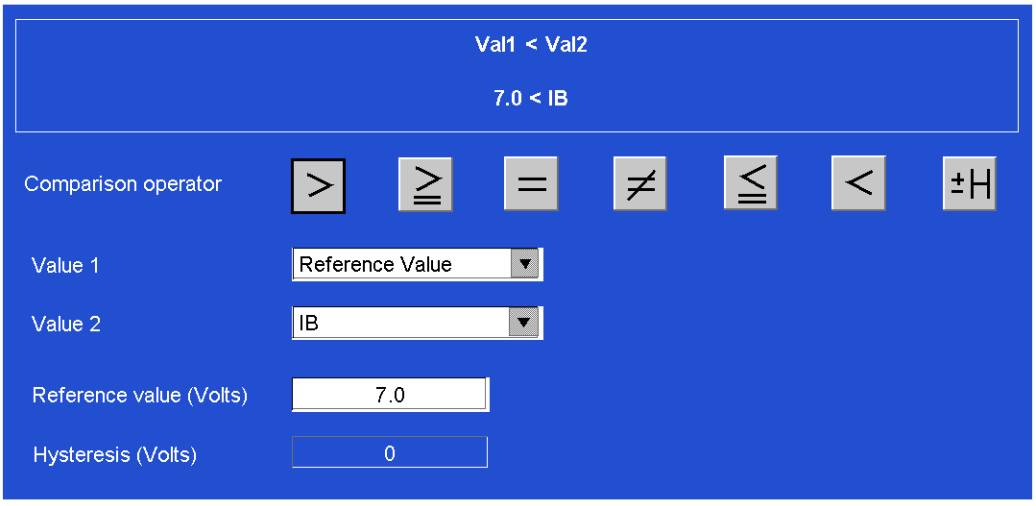
**Daily programmer H3**

Channel C:

- ON: 12:00 OFF 15:00,
- The other parameters are the same as for programmer H1.

The other channels (A, B, D) are not configured.

**Analog comparator a1**




**Analog comparator A2**

- Reference value: 3 Volts.

The other parameters are the same as for Analog comparator a1.

# Home Lighting

## Specifications

A homeowner would like to install a system capable of controlling the lighting of a stairway and outdoor entrance providing access to the house.

Program features:

- *Outdoor lighting:* The circuit is activated at night by a twilight switch. A sensor detects any motion and activates the outdoor lighting for 2 minutes.
- *Indoor lighting:* Two pushbuttons are located in the stairwell; one in the entrance and other at the top of the stairs. Their function is identical. Time-delayed (2 minutes) lighting is obtained by pressing one of the buttons.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Motion sensor |
| **I2** | Twilight switch |
| **I3** | Pushbutton |
| **I4** | Pushbutton |

Description of the outputs:

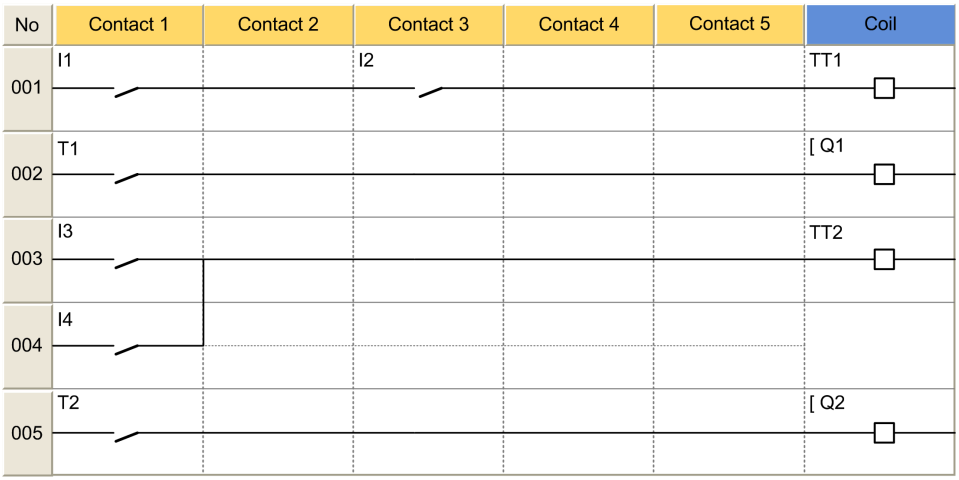
| Output | Description |
|---|---|
| **Q1** | Outdoor lighting |
| **Q2** | Indoor lighting |

## Required Reference

For this application, no specific conditions are required.

## LD Wiring Sheet

This figure shows the example with electrical symbols:



# Automatic Gate Control

## Specifications

A homeowner wants to control access to his residence by an automatic gate equipped with a dual direction (opening and closing) motor.

Program features:

- *Opening:* Whether the gate is closed or in an intermediate position, the remote control signal causes the full opening of the gate. During the opening process, any new action on the remote control stops or restarts the motor.

  When the gate is fully open, there is a 4-second time delay before closing can start.
- *Closing:* During the closing process, if the remote control is activated or if the sensor detects motion, the gate is opened. As long as the sensor is activated (for example, a vehicle stopped in the passage way), the gate remains fully open.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Remote control |
| **I2** | Gate closed position |
| **I3** | Gate opened position |
| **I4** | Motion sensor |

Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | Gate opening |
| **Q2** | Gate closing |

## Required Reference

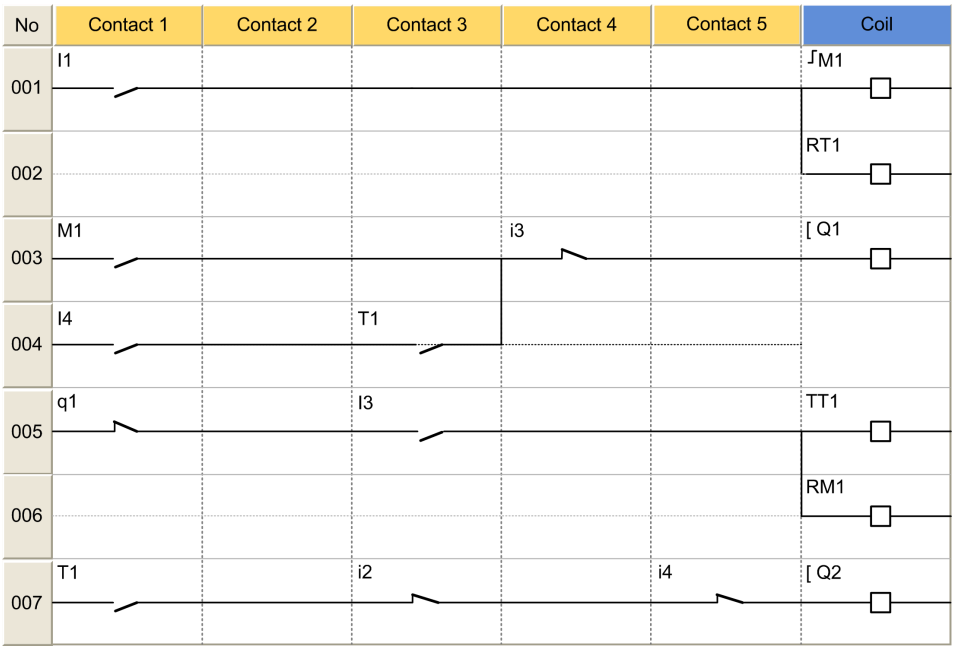
For this application, no specific conditions are required.

## Advantages of the Application

The feature of being able to stop the gate opening or closing when the remote control signal is detected is an advantage for this type of application.

## LD Wiring Sheet

This figure shows the example with electrical symbols:




# Underground Car Park Control

## Specifications

This example completes and centralizes the control of the underground car park of an administration building.

Program features:

- *Vehicle entrance/exit control:* Access is allowed by an automatic barrier. Users can access the car park during business hours: Monday to Friday from 8:30 to 17:30, Saturday from 09:30 to 12:00. However, it is possible to manually inhibit the closing of the barrier by pressing **Z4** (function restored by pressing **Z2**), in case of an exceptional event.
- *Counting:* The car park capacity is limited to 93 vehicles. A counter blocks access to the car park if it is full and controls a light panel indicating Car Park Full. It is also possible to manually increment or decrement the number of vehicles present in the car park (using **Z1** and **Z3**).
- *$CO_2$ level:* A carbon dioxide ($CO_2$) sensor indicates when the level exceeds the defined limit and controls the operation of a fan (10 minutes).
- *Light:* The lighting switches on for 2 minutes each time a vehicle enters the car park or whenever a pedestrian presses the switch.

# Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Vehicle entry |
| **I2** | Vehicle exit |
| **I3, I4** | Pushbuttons at pedestrian access points |
| **IB** | Carbon dioxide ($CO_2$) level sensor |
| **Z1** | Manually increments the number of vehicles |
| **Z2** | Resumes automatic entry control |
| **Z3** | Manually decrements the number of vehicles |
| **Z4** | Manual release of entry barrier |

Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | Indicates when the car park is full. |
| **Q2** | Locks the entry barrier |
| **Q3** | Lighting |
| **Q4** | Fan control |

# Required Reference

For this example, a clock and analog inputs are required:

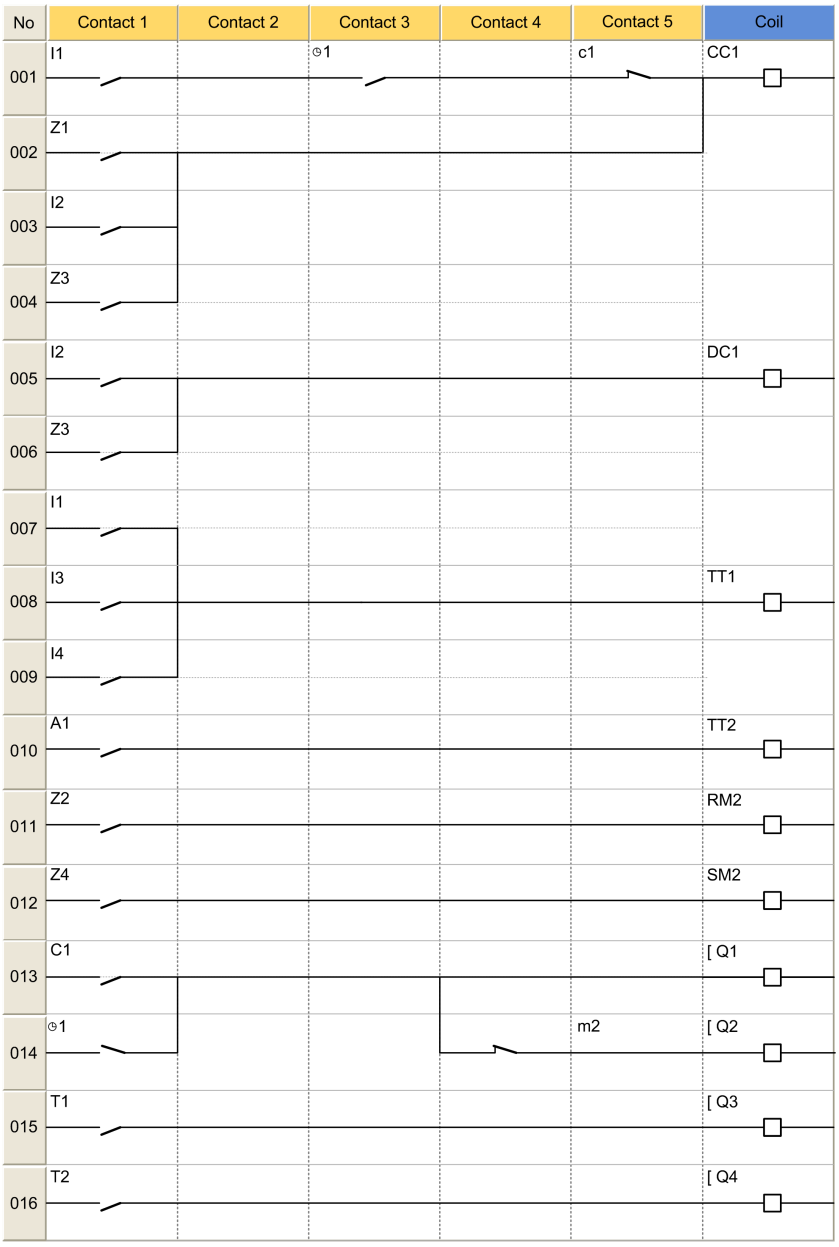
- **SR2B121BD** (24 Vdc),
- **SR2B121JD** (12 Vdc).

# Advantages of the Application

Full car park control using one smart relay.

## LD Wiring Sheet

This figure shows the example with electrical symbols:




# Room Temperature Regulation

## Specifications

The ambient temperature of a room is controlled in heating mode by a heater and a fan, and in cooling mode by a fan only. A heat sensor provides a 0…10 V signal. A switch is used to deactivate temperature regulation.

Changes of input and output values can be monitored in a supervision window.

Program Description:

- Input **I1** = 0: Temperature regulation is off
- Input **I1** = 1: Temperature regulation is on
- Input **I2** = 0: Cooling mode
- Input **I2** = 1: Heating mode

# Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | On/Off switch |
| **I2** | Mode selection |
| **IB** | Ambient temperature (analog input) |
| **IC** | Setpoint (analog input) |

Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | Heater |
| **Q2** | Fan |

The temperature is supplied by a sensor with output voltage of 0...10 V.

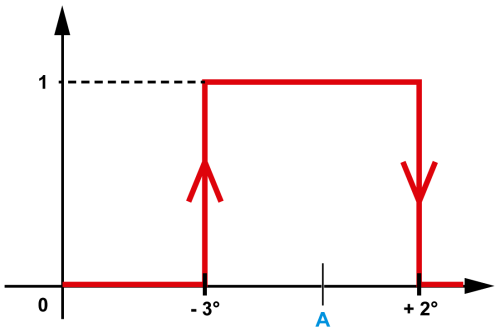
**NOTE:** To simulate this program, first adjust the setpoint using analog input **IC** and then switch on the temperature regulation (**I1** = 1, click on **I1**). If the cooling mode is selected (**I2** = 0), the fan is activated as soon as the temperature exceeds 3 ºC above the setpoint and will stop when it drops 2 ºC below the setpoint; and conversely for the heating mode.

# Required Reference

For this application, Zelio Logic smart relay with analog inputs is required:

- **SR2B121BD** (24 Vdc),
- **SR2B121JD** (12 Vdc).

# Hysteresis

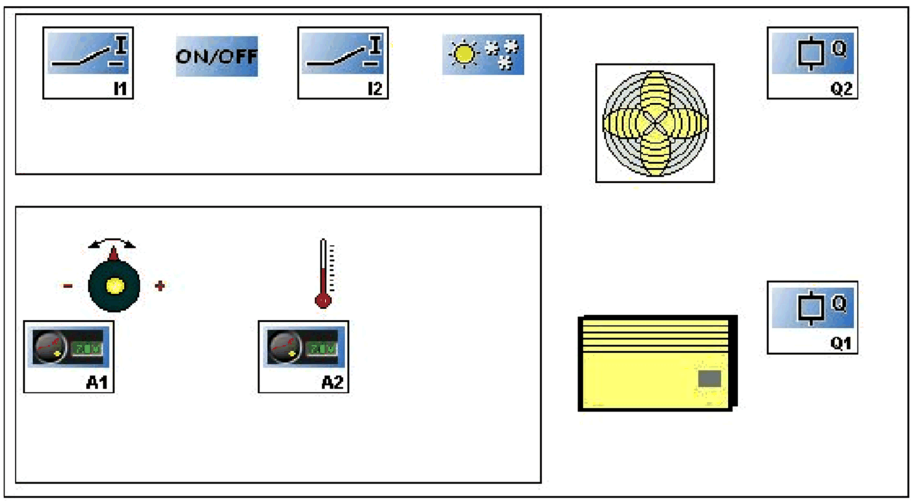



**A** Setpoint

# Advantages of the Application

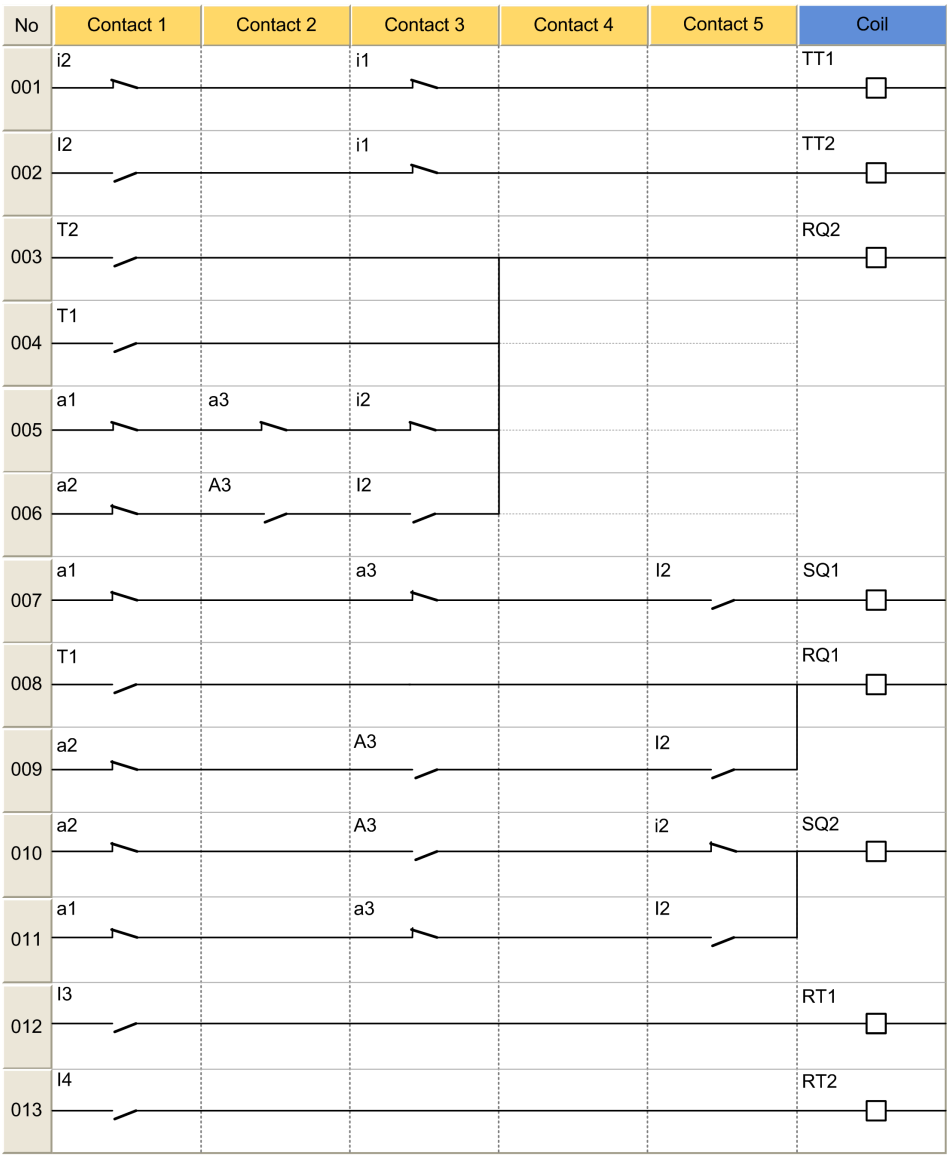
1. Use of 0...10 V analog inputs

2. The supervision window:




## LD Wiring Sheet

This figure shows the example with electrical symbols:

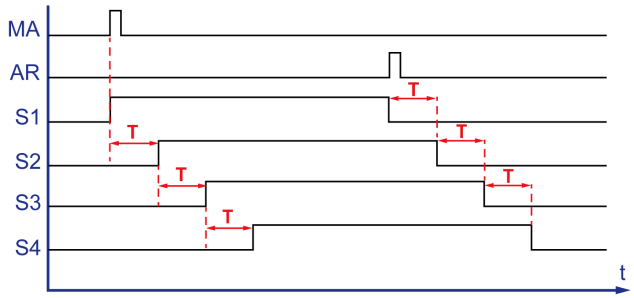


# Boiler Control

## Specifications

To avoid over-consumption of electricity on boiler start-up, the heating elements are heated progressively, and stopped progressively when the boiler is stopped.

This operating principle is shown by the following timing diagram:




An On (**MA**) signal authorizes the activation of the first heating element (*S1*). After a time delay *T*, the second element (*S2*) starts. After the same time delay, the third element starts (*S3*), then the fourth element (*S4*) after time-delay *T*. An Off (**AR**) signal deactivates *S1*. The three other elements are progressively deactivated after time delay *T*.

Program description:

- Inputs: The program includes six *TIMER* function blocks. The function requires entering the same time delay value *T* in the six function blocks.
- As a result, if you modify one of the function blocks, you must enter the modification in the five other function blocks.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | On button |
| **I2** | Off button |

Description of the outputs:

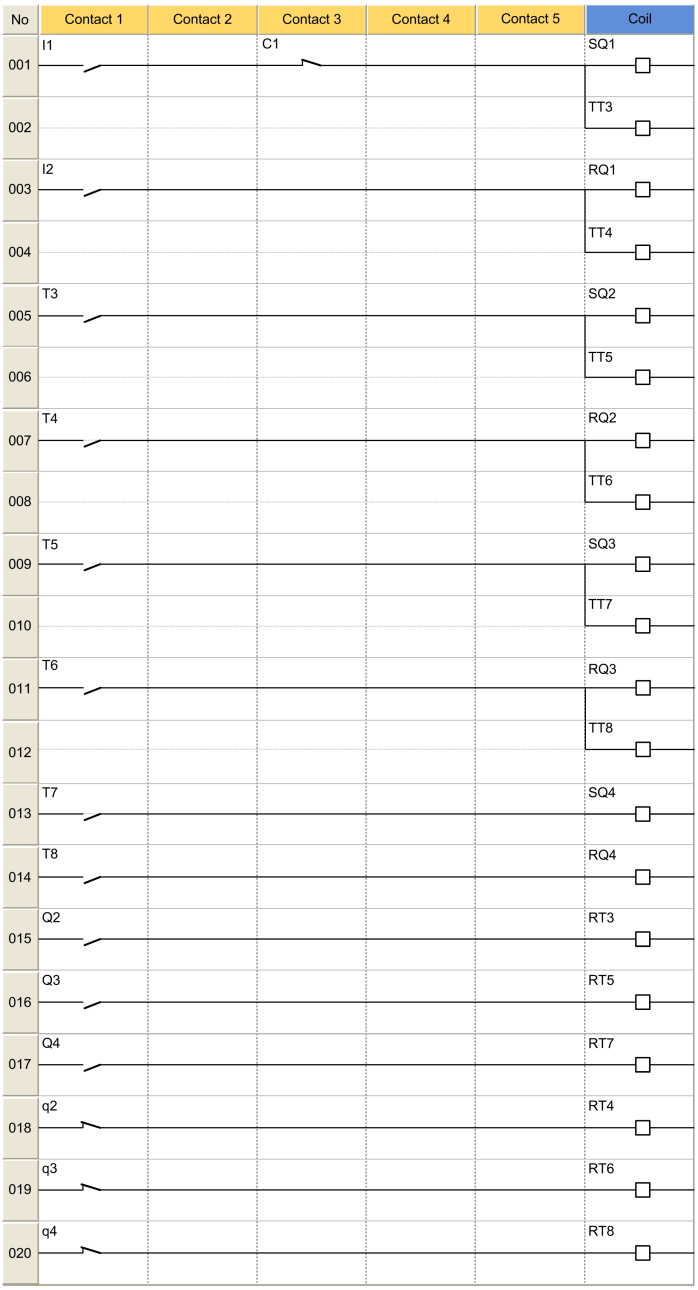
| Output | Description |
|---|---|
| **Q1** | First heating element *S1* |
| **Q2** | Second heating element *S2* |
| **Q3** | Third heating element *S3* |
| **Q4** | Fourth heating element *S4* |

## Required Reference

For this example, no specific conditions are required.

# LD Wiring Sheet

This figure shows the example with electrical symbols:



# Applications in FBD Language

## Greenhouse Ventilation Panes

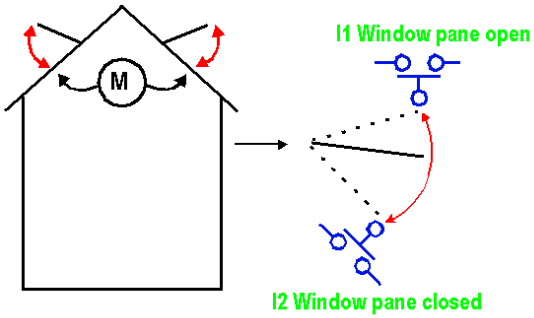
### Description

This example describes how greenhouse ventilation panes can be managed automatically.

### Specifications

The owner of a greenhouse would like to acquire an installation to manage the opening and closing of the ventilation window panes located on the greenhouse roof.

The greenhouse has two window panes to provide ventilation. The opening of these window panes is controlled by a motor and 2 sensors that indicate whether the window panes are open or closed:




During the day, the window panes open to ventilate the structure from 12:00 to 15:00, at the time of day when, in principle, the temperature is the highest. However, if the temperature is less than 10 °C, the window panes do not open, or when they are already open, they close.

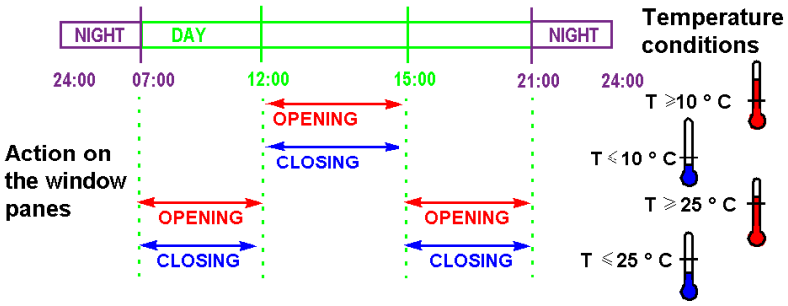
In addition, the window panes open during the day when the temperature reaches 25 °C. If the temperature falls below 25 °C, the window panes close again.

Finally, at night, the window panes remain closed regardless of the temperature.

Program description, 3 time ranges are used:

- Range 1: Night, from 21:00 to 07:00
- Range 2: Day, from 07:00 to 12:00 and from 15:00 to 21:00
- Range 3: Noon, from 12:00 to 15:00

Summary:



# Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Window panes open (Discrete) |
| **I2** | Window panes closed (Discrete) |
| **IB** | Temperature (Analog) |

Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | Opening of the window panes (Discrete) |
| **Q2** | Closing of the window panes (Discrete) |

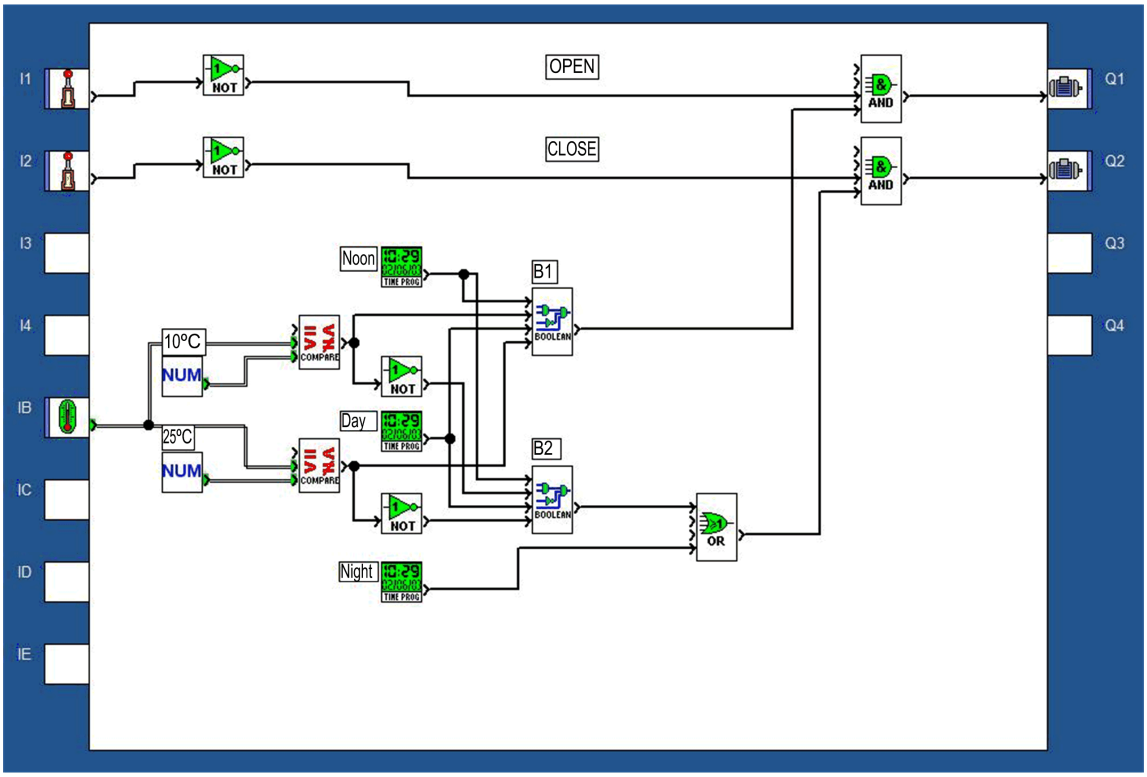
The temperature is supplied by a sensor with output voltage of 0 to 10 V.

# Required Reference

For this application, a smart relay with a clock and analog inputs is required:

- **SR2B122BD** (24 Vdc),
- **SR2B121JD** (12 Vdc).

# FBD Wiring Sheet



# Parameters

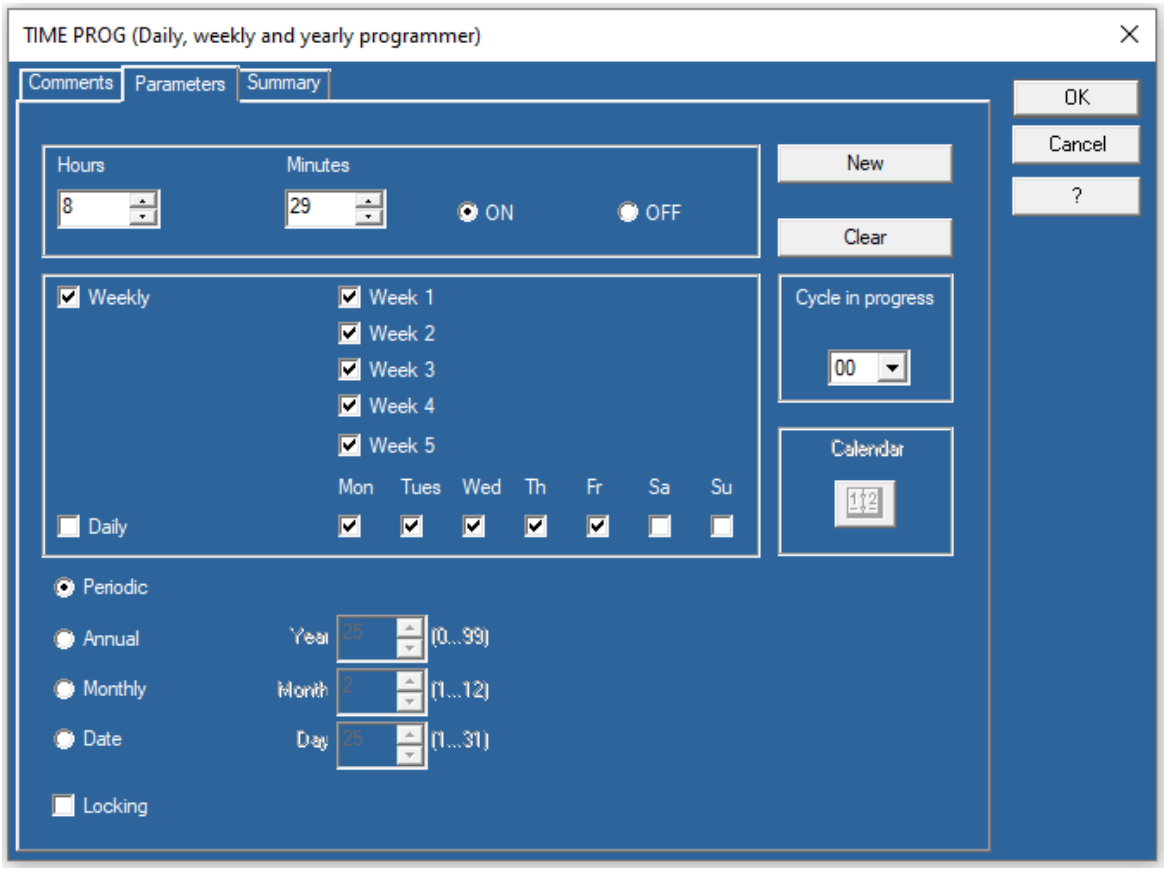
**Analog comparator B12**

Value1 > Value2

**Analog comparator B18**

Value1 > Value2

**Daily programmer B11**




Cycle in progress: 00

- Hour: 15,
- Minute: 00,
- OFF is selected,
- The other parameters are the same as for ON.

**Daily programmer B13**

Cycle in progress 00

- Hour: 07,
- Minute: 00,
- ON is selected,
- The other parameters are the same as for programmer B11.

Cycle in progress 01

- Hour: 12,
- Minute: 00,
- OFF is selected,
- The other parameters are the same as for programmer B11.

Cycle in progress 02

- Hour: 15,

- Minute: 00,
- ON is selected,
- The other parameters are the same as for programmer B11.

Cycle in progress 03

- Hour: 21,
- Minute: 00,
- OFF is selected,
- The other parameters are the same as for programmer B11.

**Daily programmer B19**

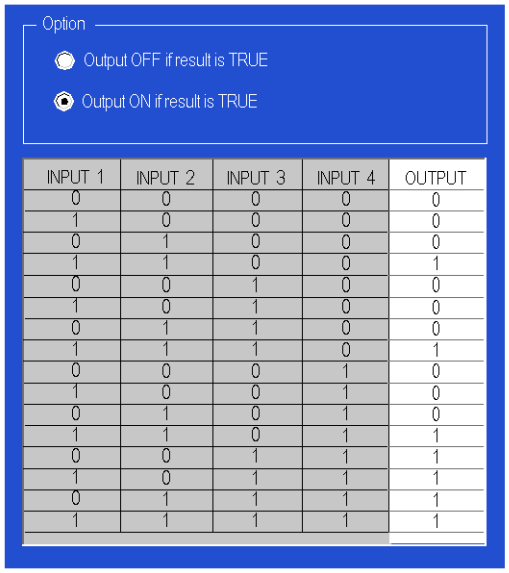
Cycle in progress 00

- Hour: 21,
- Minute: 00,
- ON is selected,
- The other parameters are the same as for programmer B11.

Cycle in progress 01

- Hour: 7,
- Minute: 00,
- OFF is selected,
- The other parameters are the same as for programmer B11.

**Boolean functions**




| INPUT 1 | INPUT 2 | INPUT 3 | INPUT 4 | OUTPUT |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 |

# Home Lighting

## Specifications

A homeowner would like to install a system capable of controlling the lighting of a stairway and outdoor entrance providing access to the house.

Program features:

- *Outdoor lighting:* The circuit is activated every year from June 1st to October 1st and at night by a twilight switch. A sensor detects any motion and activates the outdoor lighting for 2 minutes.

- *Indoor lighting:* Two pushbuttons are located in the stairwell; one in the entrance and another at the top of the stairs. Their function is identical.
  - Time-delayed (30 seconds) lighting is obtained by pressing one of the buttons. The timer can be reset by renewed action on one of the buttons.
  - Permanent lighting is activated if one button is pressed for at least 2 seconds. A quick press stops it.

Program description, programming is possible at two levels:

- Level 1: Program with FBD and logic functions only.
- Level 2: Program with SFC functions in addition to FBD and logic functions.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Motion sensor |
| **I2** | Twilight switch |
| **I3** | Pushbutton |
| **I4** | Pushbutton |

Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | Outdoor lighting |
| **Q2** | Indoor lighting |

## Required Reference

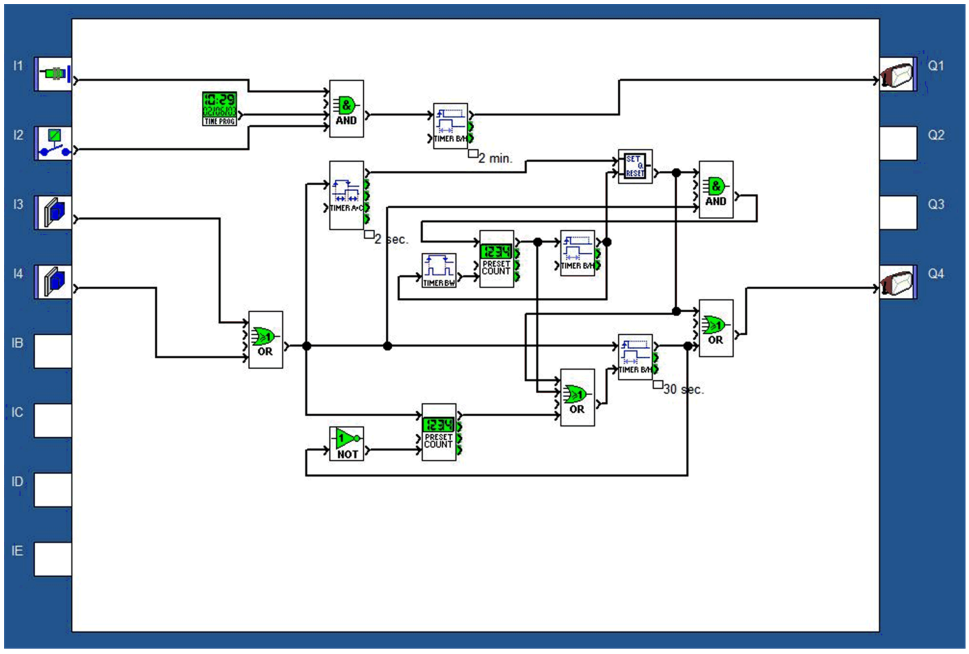
For this application, a Zelio Logic smart relay with a clock input is required. For example, **SR2B121BD** (24 Vdc).

## Advantages of the Application

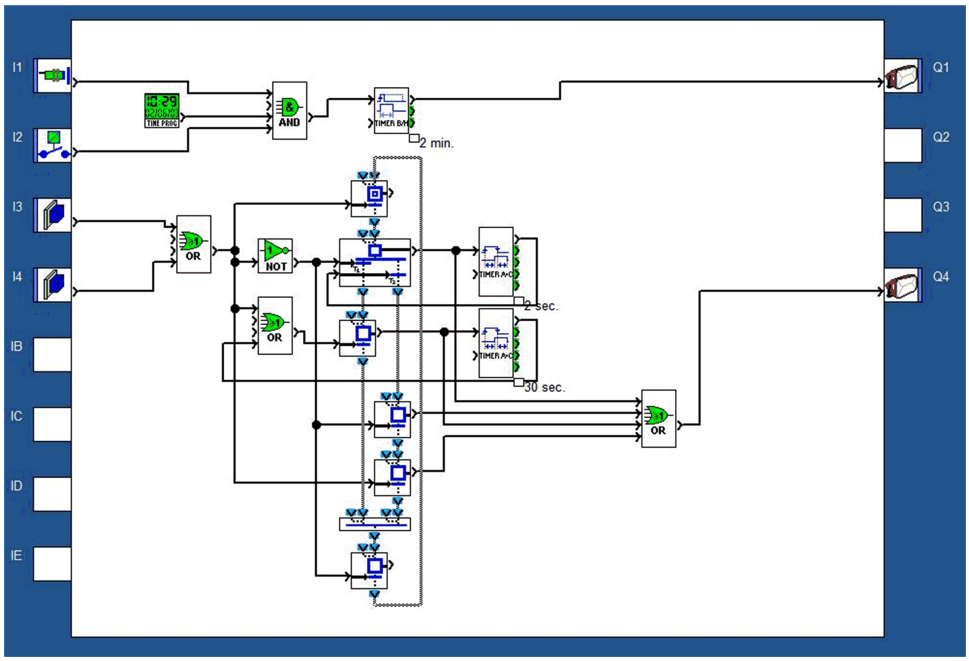
It is possible to handle the application with sequential functions.

## FBD Wiring Sheet

This figure shows an example (level 1) in FBD:




This figure shows level 2 (SFC/Grafcet) example in FBD:




# Automatic Gate Control

## Specifications

A homeowner wants to control access to his residence by an automatic gate equipped with a dual direction (opening and closing) motor.

Program features:

- *Opening:* Whether the gate is closed or in an intermediate position, the remote control signal causes the full opening of the gate. During the opening process, any new action on the remote control stops or restarts the motor.

  When the gate is fully open, there is a 4-second time delay before closing can start.
- *Closing:* During the closing process, if the remote control is activated or if the sensor detects motion, the gate is opened. As long as the sensor is activated (for example, a vehicle stopped in the passage way), the gate remains fully open.

Program description:

- The *T1* timer (*Timer A/C*) is used to switch the motor in the opening direction 0.5 seconds after the inhibition of closing. This helps avoid short-circuits and mechanical jerks.
- The *T2* timer (*Timer A/C*) fulfills two simultaneous functions:
  - The 4-second triggering delay maintains the gate in the open position before beginning the closing motion.
  - The 0.2 second triggering delay allows the activation conditions of the *AND* logic block output to be verified.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Remote control |
| **I2** | Gate closed position |
| **I3** | Gate opened position |
| **I4** | Motion sensor |

Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | Gate opening |
| **Q2** | Gate closing |

## Required Reference

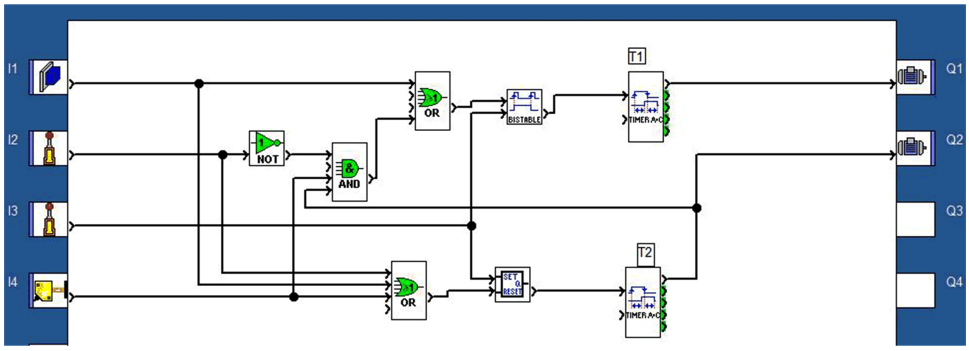
For this application, no specific conditions are required.

## Advantages of the Application

The feature of being able to stop the gate opening or closing when the remote control signal is detected is an advantage for this type of application.

The parallel connection to the motor terminals allows the addition of a light signal indicating any movement of the gate.

## FBD Wiring Sheet




# Room Temperature Regulation

## Specifications

The ambient temperature of a room is controlled in heating mode by a heater and a fan, and in cooling mode by a fan only. A temperature sensor through a converter provides a 0…10 V signal. A switch is used to deactivate temperature regulation.

Screen display:

- The heating or cooling mode is displayed.
- The ambient temperature and setpoint are displayed.
- A trigger function is provided to set up regulation that takes into account a hysteresis of +2 ºC from start to stop and –3 ºC from stop to start.

Program description:

- Input **I1** = 0: Temperature regulation is off.

  Display example:

  ```
  ***********
  OFF
  ***********
  0017.2
  ```

- Input **I1** = 1: Temperature regulation is on.

  Display example:

  ```
  heat mode.
  0020.0 (setpoint display)
  0017.2 (temperature display)
  ```

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | On/Off switch |
| **I2** | Mode selection |
| **IB** | Ambient temperature (analog input) |
| **IC** | Setpoint (analog input) |

Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | Heater |
| **Q4** | Fan |

The temperature is supplied by a sensor with output voltage of 0...10 V.

**NOTE:** When the smart relay is on, select **FBD DISPLAY** in the main menu of the front panel to view the active text blocks on the screen. In a simulation, it is possible to call up the front panel by selecting **3 Front Panel** in the **Window** menu.

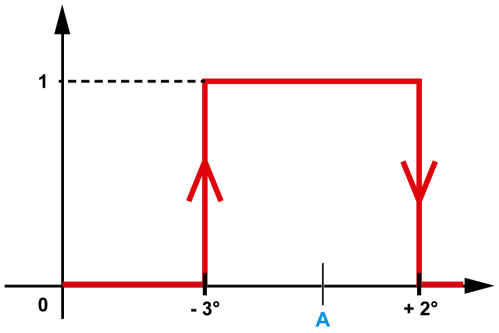
**NOTE:** It may be necessary to wire additional gain functions after inputs **IB** and **IC**.

## Required Reference

For this application, a Zelio Logic smart relay with analog inputs is required:

- **SR2B121BD** (24 Vdc),
- **SR2B121JD** (12 Vdc).

## Hysteresis

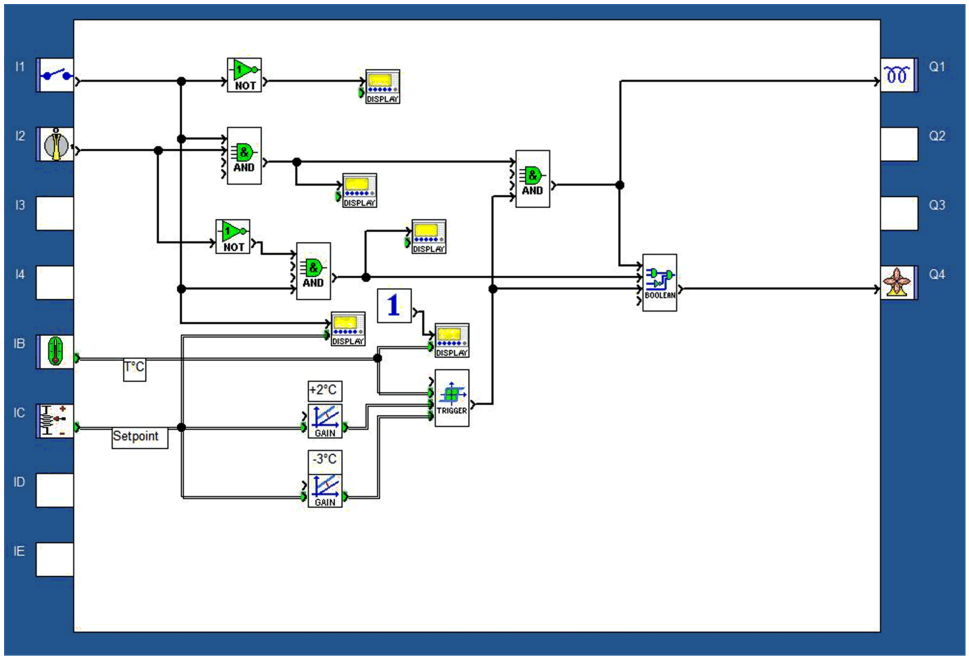



**A** Setpoint

## Advantages of the Application

Use of 0...10 V analog inputs.

## FBD Wiring Sheet

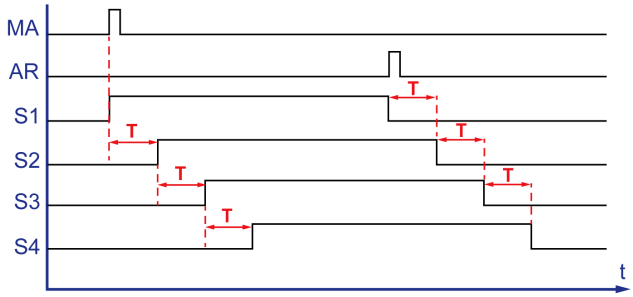



# Boiler Control

## Specifications

To avoid overconsumption of electricity on boiler start-up, the heating elements are heated progressively, and stopped progressively when the boiler is stopped.

This operating principle is shown by the following timing diagram:




An On (**MA**) signal authorizes the activation of the first heating element (*S1*). After a time-delay *T*, the second element (*S2*) starts. After the same time-delay, the third elements starts (*S3*), then the fourth element (*S4*) after time-delay *T*. An Off (**SR**) signal deactivates (*S1*). The three other elements are progressively deactivated after time-delay *T*.

Program description:

- In principle, time delay *T* is identical for the activation/deactivation of all the heating elements. The program includes three *TIMER A/C* function blocks. The function to perform according to the specifications requires entering the same time-delay value in the three function blocks.
- As a result, if you modify one of the function blocks, you must enter the modification in the other two *TIMER A/C* function blocks.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | On button |
| **I2** | Off button |

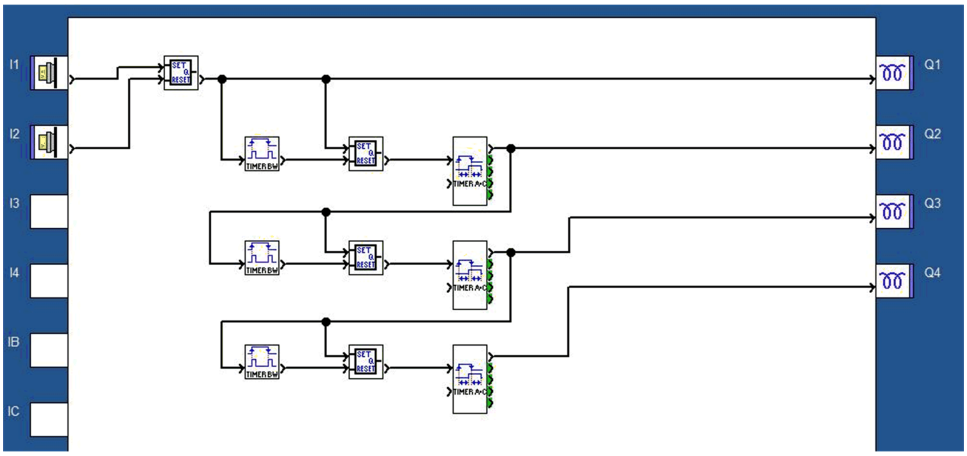
Description of the outputs:

| Output | Description |
|---|---|
| **Q1** | First heating element *S1* |
| **Q2** | Second heating element *S2* |
| **Q3** | Third heating element *S3* |
| **Q4** | Fourth heating element *S4* |

## Required Reference

For this example, no specific conditions are required.

## FBD Wiring Sheet




# School Bell

## Specifications

A school wants to control both the daily school bell and an alarm system using the same device. The bell rings according to a programmed schedule from Monday to Friday for one minute, except during the holidays. The **Alarm** mode is active during the holidays, on weekends, and at night from Monday to Friday.

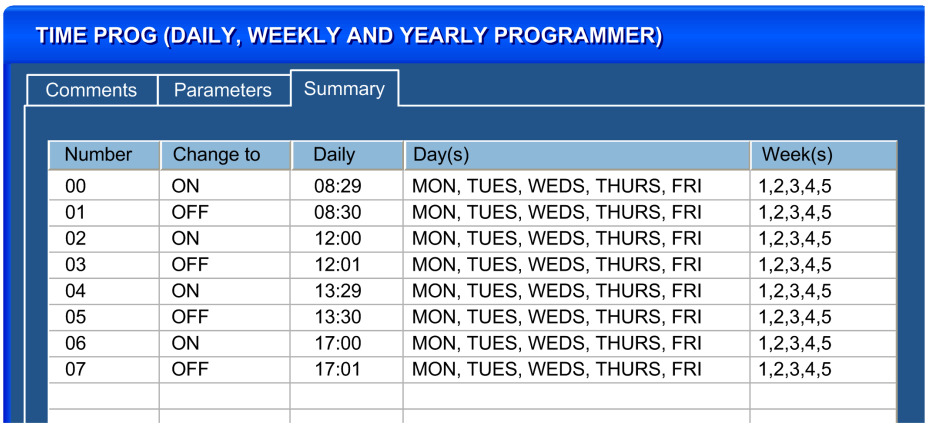
The alarm sounds for 1 minute as an audio signal alternating 2 seconds on, 1 second off, and by an indicator light activated by a motion detector. It must be possible to reset the alarm.

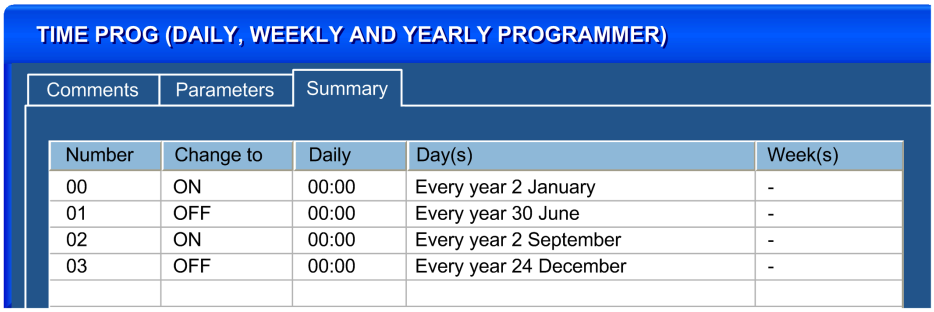
Program description:

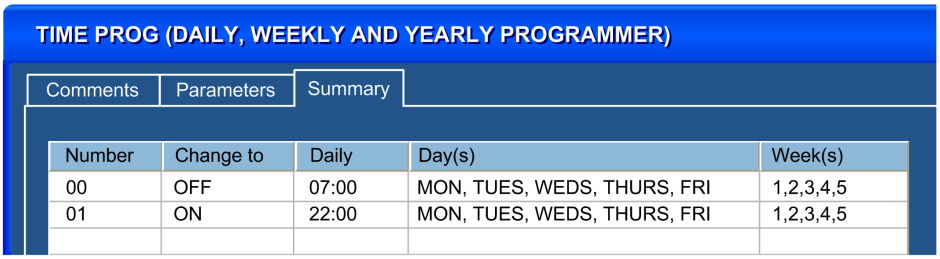
To program the three clocks, copy or adapt the parameters of the three figures below.

The logic block unites the activation conditions of the **Alarm** mode according to the equation:

| Input | | | | Output |
|---|---|---|---|---|
| Time 2 | **I1** | **I2** | Time 3 | – |
| 0 | 1 | 1 | 1 | 1 |




## Advantages of the Application

The annual clock, available in FBD, allows holidays to be configured.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Alarm: On/Off |
| **I2** | Motion detector |
| **I3** | Alarm: Reset |

Description of the outputs:

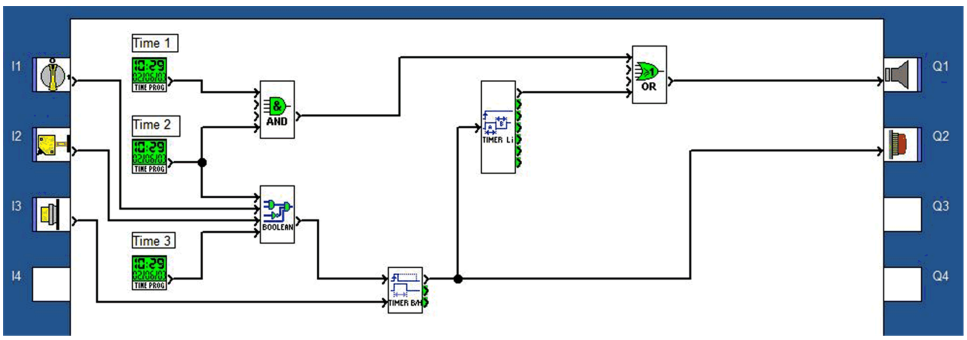
| Output | Description |
|---|---|
| **Q1** | Ringing |
| **Q2** | Indicator light |

## Required Reference

For this example, an annual clock is required:

- **SR2B121BD** (24 Vdc),
- **SR2B121JD** (12 Vdc).

## FBD Wiring Sheet




# Central Heating System with PWM Valve

## Specifications

A boiler is used to heat the different parts of a house by hot water circulation.

The house temperature is measured by a sensor providing a 0…10 V signal. The desired temperature is set by the homeowner on the smart relay front panel.

A 2-way valve adjusts the temperature in the room by regulating the flow of hot water coming from the boiler. The hot water flow is adjusted according to the difference between the desired and the measured temperatures.

The regulation parameters can be adjusted directly on the smart relay front panel. The access to these parameters is protected by a key switch to help prevent parameter modifications by unauthorized persons.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Key switch |
| **IB** | Temperature sensor (0...10 V) |

Description of the outputs:

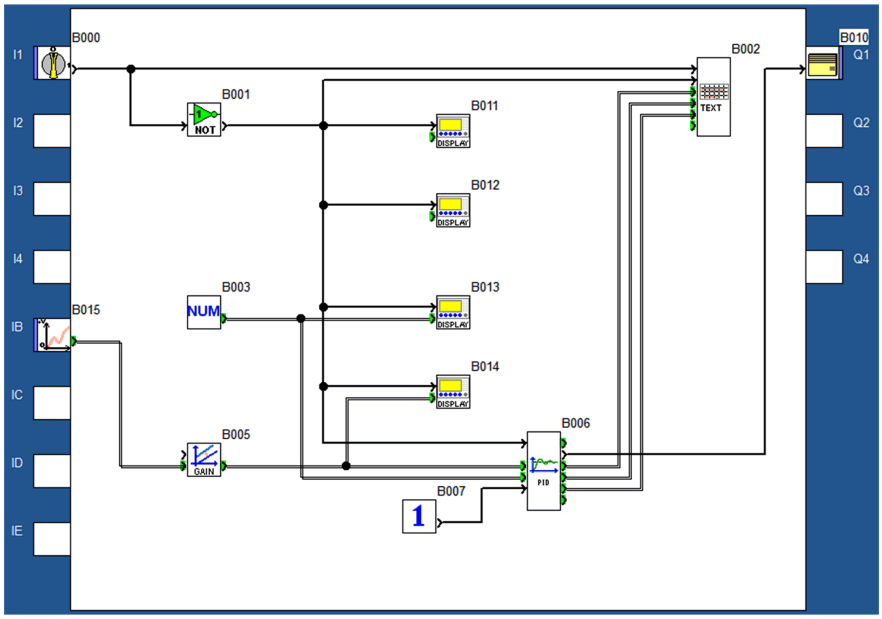
| Output | Description |
|---|---|
| **Q1** | 2-way valve (PWM output) |

## Required Reference

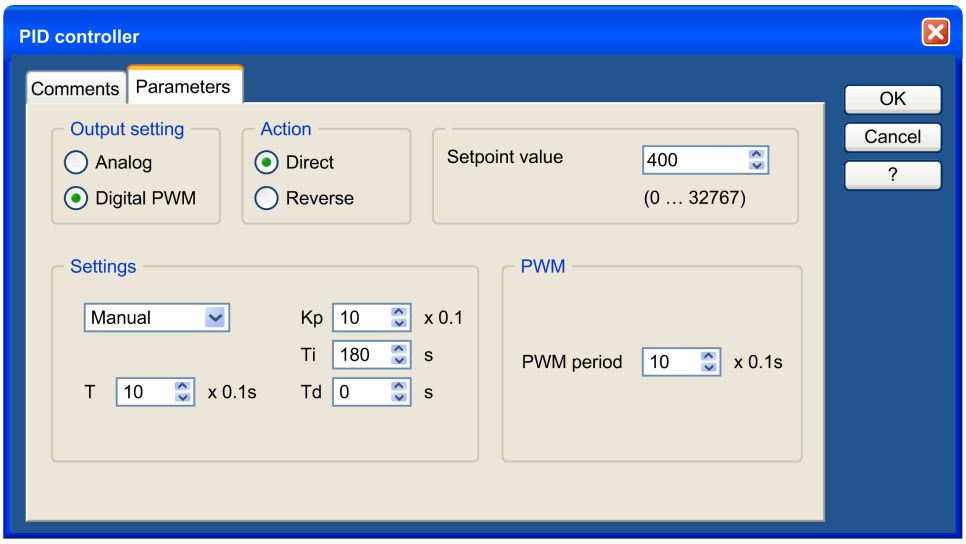
For this application, as **Q1** is used in PWM output, a smart relay with transistor outputs is required:

- **SR2B122BD** (24 Vdc),
- **SR2B202BD** (24 Vdc),
- **SR3B102BD** (24 Vdc),
- **SR3B262BD** (24 Vdc).

## FBD Wiring Sheet

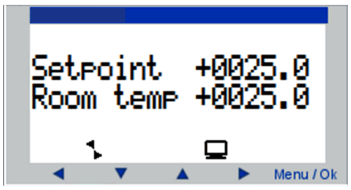



## PID Parameters



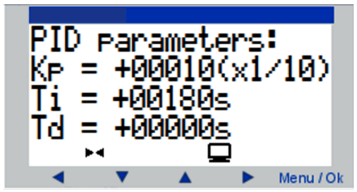
## Set Temperature Display

This figure shows the display where the homeowner can set the desired temperature:




## Commissioning Display for Parameters Regulation

This figure shows the display that is protected by a key switch, where the regulation parameters can be adjusted:




# Central Heating System with Analog Valve

## Specifications

A boiler is used to heat the different parts of a house by hot water circulation.

The house temperature is measured by a Pt100 sensor. The desired temperature is set by the homeowner on the smart relay front panel.

The temperature in the room is controlled by the variation of temperature of water coming from the boiler. A 3-way valve is used to control the variation of temperature, by mixing the hot water from the boiler with cold water from the water supply, using analog control.

The regulation parameters can be adjusted directly on the smart relay front panel. The access to these parameters is protected by a key switch to help prevent parameter modifications by unauthorized persons.

## Input/Output Table

Description of the inputs:

| Input | Description |
|---|---|
| **I1** | Key switch |
| **IJ** | Temperature sensor (Pt100) |

Description of the outputs:

| Output | Description |
|---|---|
| **QB** | 3-way valve (Analog output) |

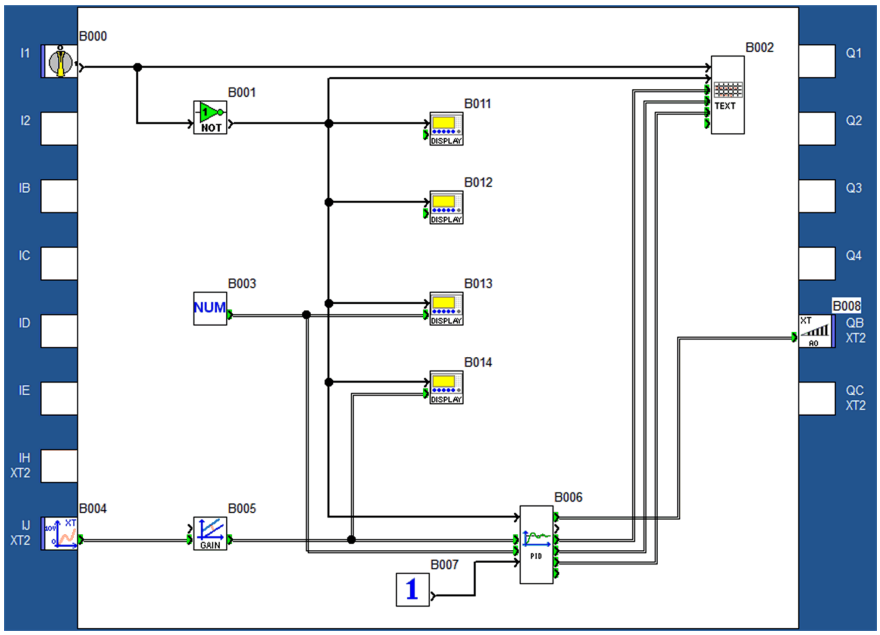
# Required Reference

For this application, a smart relay with analog extension for the control of the 3-way valve is required. For example, **SR3B101BD** (24 Vdc) with **SR3XT43BD** analog extension.

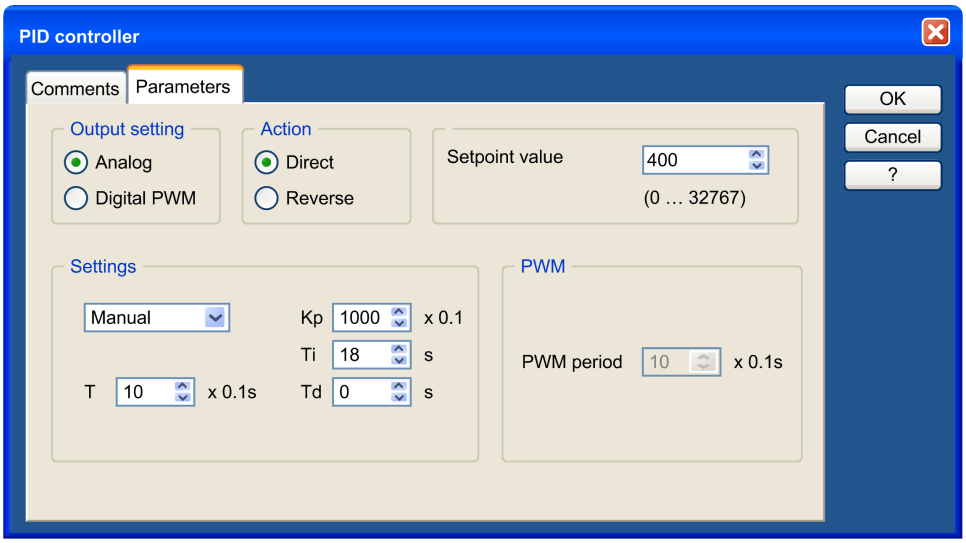
The Pt100 temperature sensor input is linked to the analog input of the analog extension module.

The PID function output is linked to the analog output of the analog extension module.

# FBD Wiring Sheet

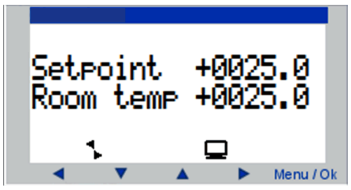



# PID Parameters



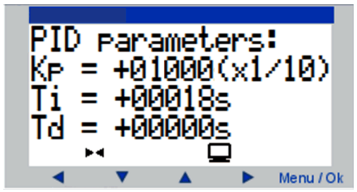
# Set Temperature Display

This figure shows the display where the homeowner can set the desired temperature:




# Commissioning Display for Parameters Regulation

This figure shows the display that is protected by a key switch, where the regulation parameters can be adjusted:



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