ARMin

Brief Description

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2 Scope

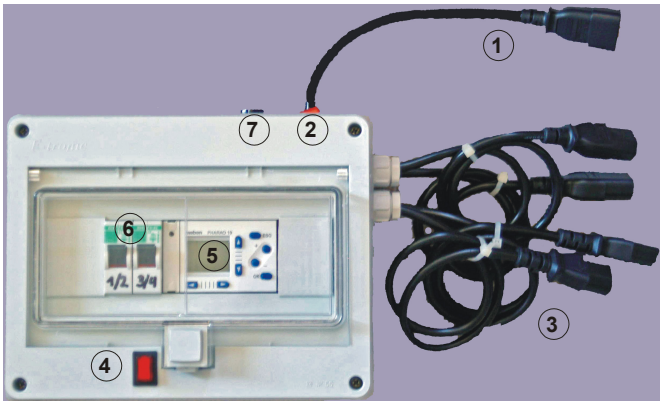
ARMin stands for **A**utomatic **R**egulation of **M**ultiple **In**structions, or for **A**rno **R**eichert and Wolfgang **Min**as those guys that developed the idea.
The different ARMin models are small Programmable Application Controller designed to control up to 6 independed loads. They are building on the family of small micro controllers distributed by THEBEN. Control is initiated by an external trigger signals, either manual or by a limited series of sensors. All I/O signals are digital 'on – off' type signals/functions. The units are programmable either via the keypad or via an object based Windows® based software. ARMins are best suited to control repeating, dependent or non-dependent actions with different length. Timing can be based on actual date and time, or based on process times. The ARMin series can be adapted to your specific needs by increasing the number and type of input triggers and output switches.

3 Introduction

Laboratory experiments often relay on repetitive tasks over period of time. Examples are reaction cycles that need to be initiated once such as cleaning and sterilization of a valve after sampling, or reactions that are repeated several times such as handling liquids and gases for draining, filling and holding in tanks. All of these operations are characterized by on – off type switching actions in a timely fashion, that are best operated automatically to ensure standard operation conditions. ARMin-1 is build for such tasks and can easily be configured to suit a wide array of operations, including interfacing with sensors (motion, light, etc.). The following examples relates to the enzymatic conversion of cephalosporin C to glutaryl-7-aminocephalosporanic acid by action of an immobilized D-aminoacid oxidase. Stability of this enzyme is evaluated by repetitive reaction cycles, and to an application to simulate cephalosporin purification on a column in order to evaluate the resin's half life.

4 General Overview

Picture 1 Technical overview



1 Electrical inlet 100 – 240 V AC, equipped with ICE 320 type C14 male connector
2 Main switch
3 Switched outlets (1 – 4/6) ≤ 250 V AC, equipped with ICE 320 type C13 female connector
4 Trigger (inlet 1)
5 Controller Module
6 Fuses for switched outlets, one for 2 outlets
7 Fuse for the controller

The unit is designed to be operated on 100 – 240 V AC. Also the relay switched outlets are laid out to operate loads of up to 8 A per outlet, but not more the 10 A per two outlets 1 & 2 or 3 & 4 (or 5 & 6). The total load active at any time may never exceed 10 A!

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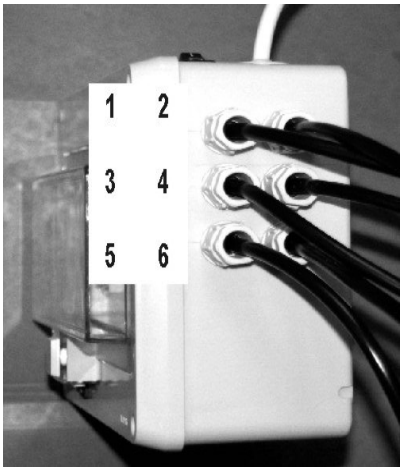
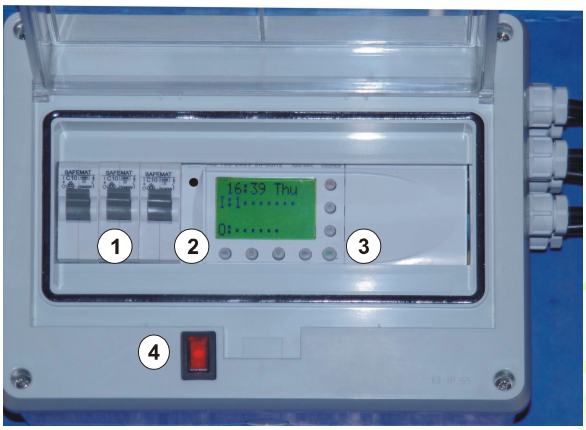
Picture 2 Order of the 4-6 switched outlets



Position and numbering of the switched outlets. See also Installation section.
ARMin-1 series has 4 switched outlets;
ARMin-2 series has up to 6 switched outlets

Picture 3 Control elements



1 10 A automatic fuse for the outlets 1 & 2, 3 & 4 (, and 5 & 6 Armin-2 only)
2 Cover for serial connection to PC or modem – option. A black dot indicates the site to lift off the cover
3 Control module display and keypad
4 Trigger, 1nput 1

The controller has:

- Integrated display field
- Integrated key control panel (8 keys)
- Integrated basic and special functions (very complex)
- Integrated memory-EEPROM (1500 Bytes) for saving the control program
- EEPROM cassette port for optional memory card
- The controllers use a simple method of programming called „Function Block Programming“
- The overall control task is broken down into various stages which can be represented by a number of function blocks
- The function blocks have been preprogrammed to perform certain task
- To achieve the overall control task the function blocks are connected together.
- In this way a function block diagram (FBD) is built
- Simple setting of preprogrammed function blocks
- Each function block carries out one special function occupies a number of in-/outputs
- Program size up to 64 modules (or up to 1,500 Bytes)
- Each module can be used as often as needed

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4.1 Programming directly on the controller

- Graphic LCD-Display
- 8 Operation keys
- Menu guide, 5 languages available (D, E, F, I, SP)
- All information of one function block are available on the display

4.2 Programming with PC

- Very efficient and comfortable software under
- Windows (95, 98, NT, 2k, XP)
- Access protection over a four digit number possible
- Password protects the entrance to the editing and monitor mode

4.3 AC Inputs

- Input Voltage 0 - 240V AC
- Switch Status Change to OFF <= 40 V AC
- Switch Status Change to ON >= 80 V AC
- Maximum Signal Input Frequency 5 Hz
- Digital signal status of the inputs (OFF or ON) is displayed on the LCD display

4.4 Relay Outputs

- Nominal Voltage per Circuit <= 250 V AC or <= 30 V DC
- Maximum current per circuit 8 A (250 V AC) or 10 A (110 V AC)
- Maximum Switching Frequency 5 Hz at ohmic load
- Digital signal status of the Outputs (OFF or ON) is displayed on the LCD display

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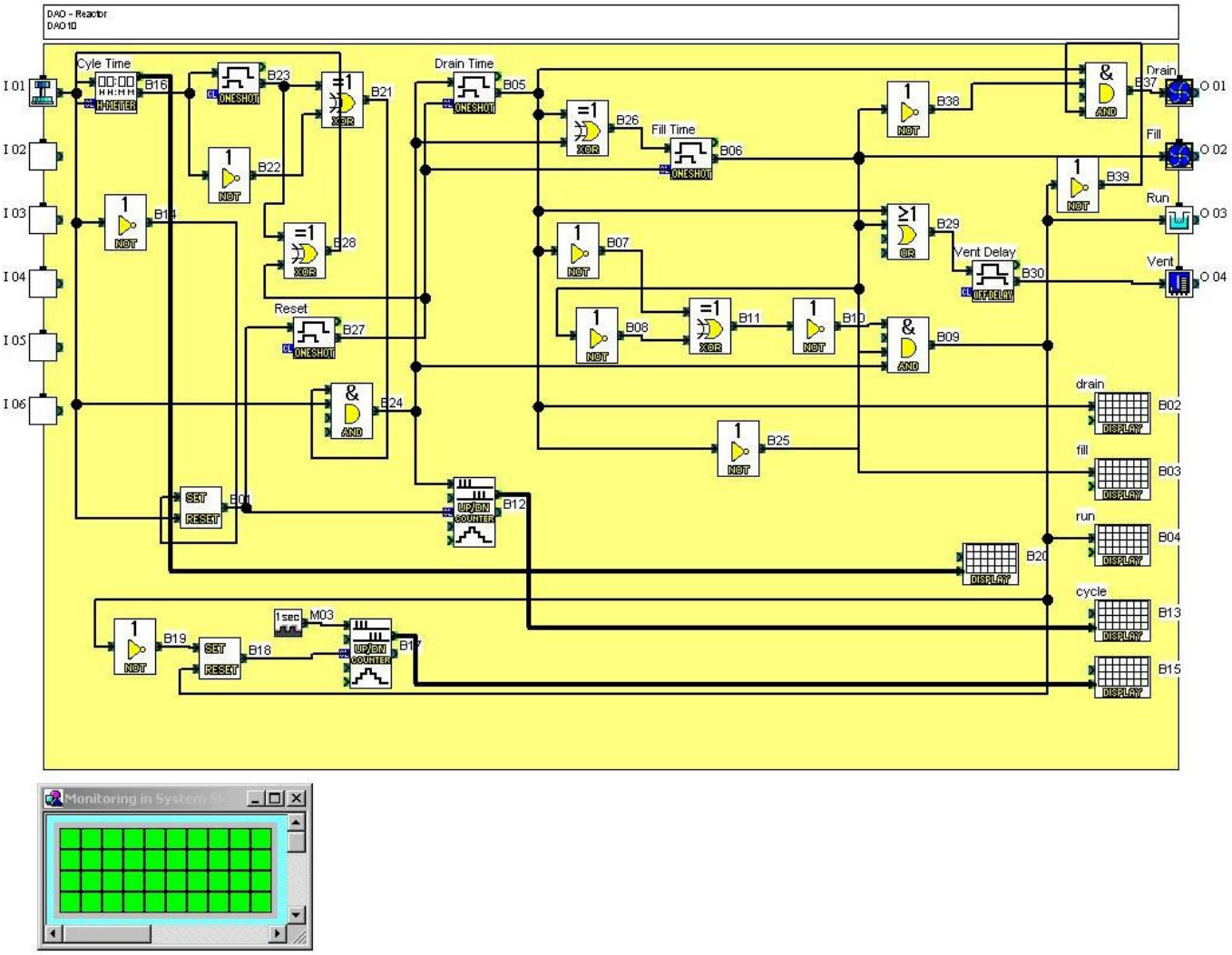
5 Program example for testing an enzyme

Picture 4 Overview: Input on the left; Outputs on the right.



Input is the illuminated switch (4 Trigger, Picture 1). For this particular project the outputs were connected to:

- Drain (outlet 1) connecting to a drain valve;
- Fill (outlet 2) connecting to the fill pump and the fill valve;
- Run (outlet 3) connecting to the Stirrer and Titrino;
- Vent (outlet 4) connecting to the vent valve.

Every cycle starts with draining, followed by a filling and running the reaction. Any interruption will reinitiate the cycle, starting with draining.

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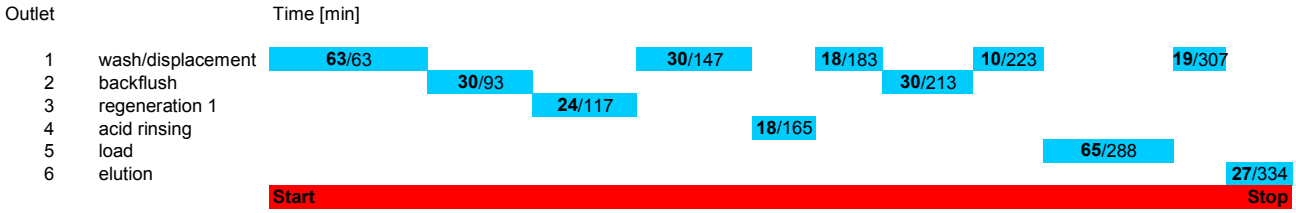
6 Program example for operating a chromatographic column

6.1 The Cycle Program

The following program has been designed according to BFM TC requirements for the TDA column purification process.
The cycle begins with Washing and Regeration. This ensures a Fail – Safe operation as after interruption of operation, either by switching off the trigger or after power disruption, the column will be regenerated before a new sample is loaded.
The duration of the entire cycle is 410 minutes. The graphic below details the sequence of the respective steps their duration (in bold) and their end time. The outlet numbers specified correspond to the position and number of the electrical outlets.



At the end of the cycle the system timer undergoes a reset and the cycle counter is incremented by one. The program continues until the Trigger (Picture 3, 4) is switched off.

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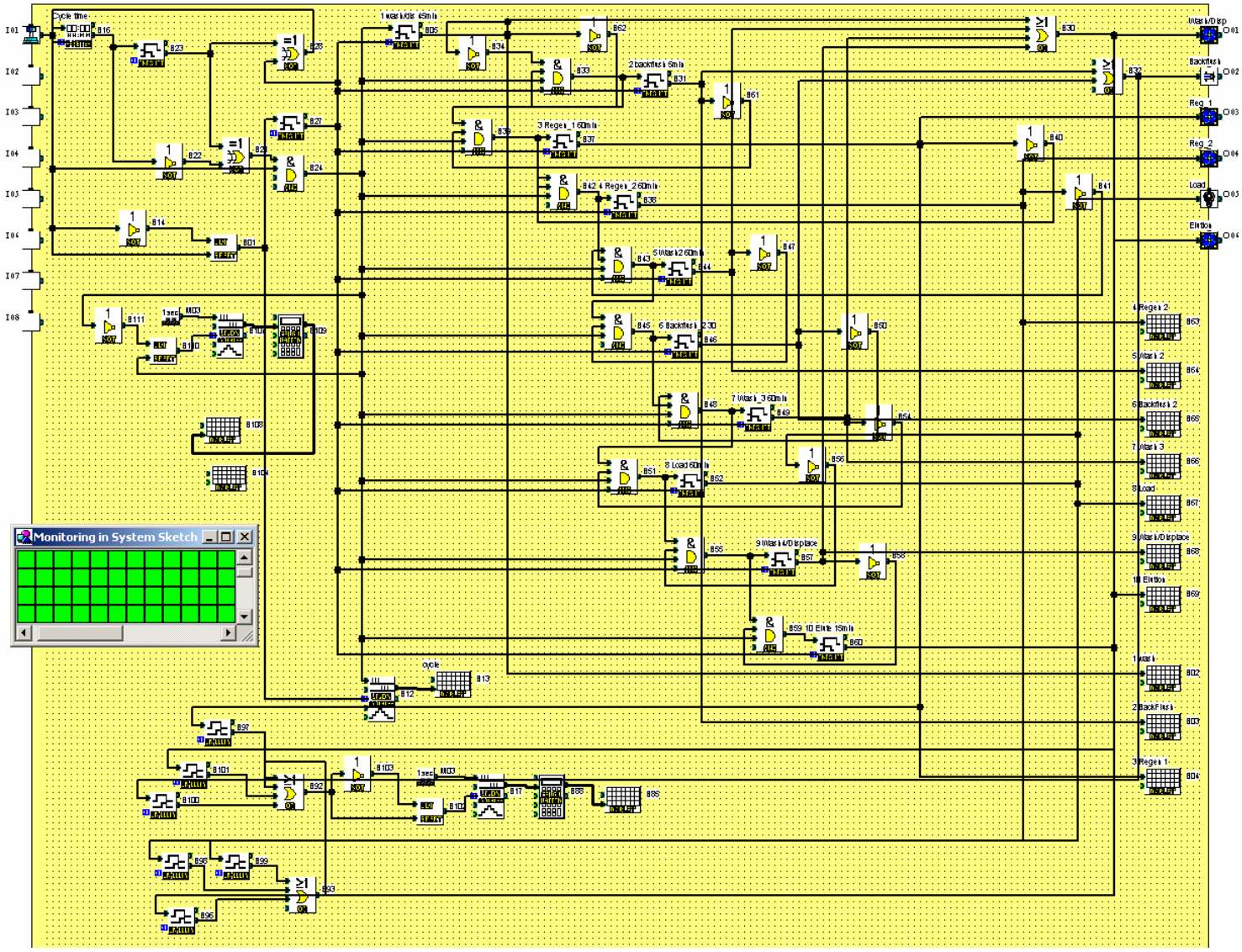
6.2 The Program Overview

Picture 5 Overview: Input on the left; Outputs on the right.



Input is the illuminated switch ((Picture 3, 4 Trigger);

- Wash/Disp (outlet 1) connecting to the pump of the washing solution;
- Back Flush (outlet 2) connecting to the pump for reverse flow and possibly to the N_2 supply;
- Reg_1 (outlet 3) connecting to the pump for regeneration solution 1;
- Acid Rinse (outlet 4) connecting to the pump for acidic regeneration solution;
- Load (outlet 5) connecting to the pump loading the sample;
- Elution (outlet 6) connecting to the pump for the eluent.

Every cycle starts with Washing, followed by regeneration. Any interruption will reinitiate the cycle, starting with draining.

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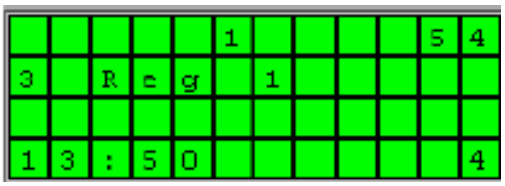
6.3 The Display

Picture 8 Displays corresponding to steps in the two program examples.



The Controller display provides information on the cycle stage (left):
The actual cycle number is indicated in the centre of the top line, here cycle 2; next is displayed the total elapsed time, here 19 min; the next two lines indicate the stage of the current cycle, here Reaction Running; the last line is only active if the reaction is running, indicating the elapsed time in seconds of the reaction, here 949 s.
The cycle number and counters are all reset when the operation is interrupted.

Note: Opening the Input Trigger or a power failure will reset the display and the cycle. Upon resumption of power, a new cycle will start from a safe state.

7 Installation

The controller and its electrical connections are mounted in a protective housing (IP55). While protecting against water, this housing is NOT watertight. There are no serviceable parts inside so do Not open the housing.
Connect the Outlets according to your experimental design:
ARMin is fitted with standard European ICE 320 type C13/14 connectors to connect to the mains and to have equipment connected to the switched outlets.

8 Disclaimer, Copyright and Trademarks