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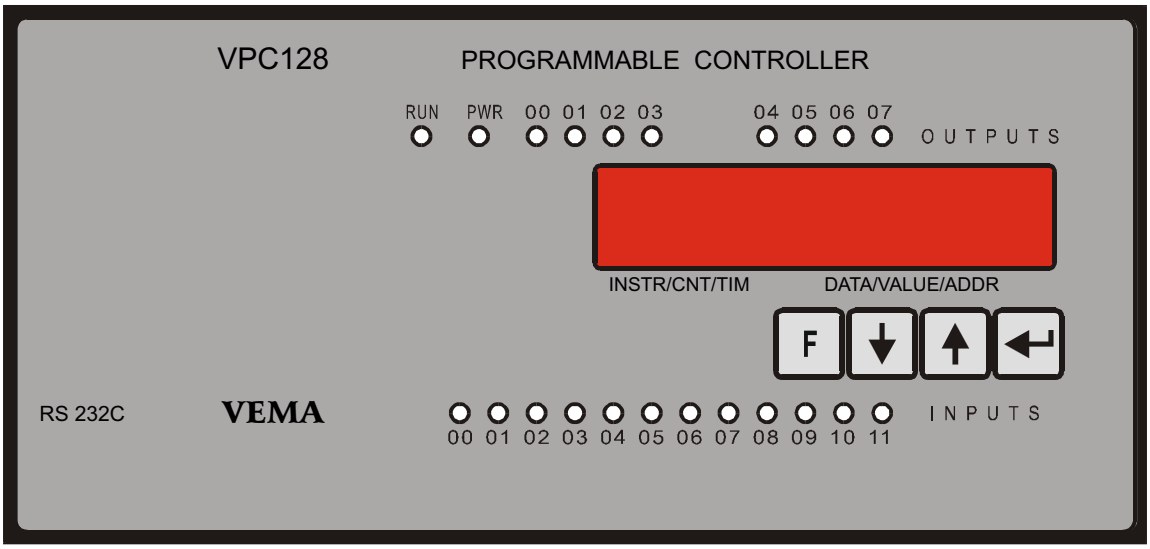
# PROGRAMMABLE CONTROLLER

# VPC 128




12 input and 8 output lines,
inbuilt programming console,
RS-232 interface to PC

# USER'S MANUAL

# I. Introduction

The programmable controller ***VPC 128*** is equipped with 12 input lines 24V/10mA and 8 output lines 24V/2A. The user's program (1000 instructions max.) is stored in the EEPROM type non-volatile memory.

The controllers of this type have an inbuilt programming console for setting the technological parameters in working mode or editing the program in programming mode.

# II. Technical specifications

| | |
|---|---|
| - Discrete inputs optoisolated | - 12 |
| - Input voltage | - from 18 up to 30 VDC |
| - Input current | - 10 mA at 24 V |
| - Discrete outputs optoisolated | - 8 |
| - Maximal output current | - 2 A |
| - Maximal allowed voltage applied on output | - 30 V |
| - Maximal voltage on set output | - 1,4 V at 2 A |
| - Program memory capacity | - 100(1000) instructions |
| - Program memory type | - EEPROM |
| - Programming console | - inbuilt |
| - Indication: - console | - 6 digits 7segment LED |
| - input and output lines | - LED |
| - Communication interface | - RS232 C to PC |
| - Controller modes: | |
| - working | - **RUN** (*"run on"*) |
| - programming | - **PRG** (*"PrG on"*) |
| - communication to PC | - **CON** (*"con on"*) |
| - Supply voltage | - from 187 up to 242VAC |
| - Operating temperature | - 0 up to 50 °C |
| - Storage temperature | - -10 up to 60 °C |

# III. Registers of the Controller

***VPC 128*** has the following registers:

- 12 input lines, designated as *i00,...,i11*;
- 5 output lines - *o00,...,o07*;
- 7 timers with time constant between 0.0 and 99.9 sec. - *t 0,...,t 6*;
- 1 timer with time constant between 0.00 and 9.99 sec. - *t 7*;
- 8 counters to 999 - *c 0,...,c 7*;
- auxiliary registers:
  - user's registers - *r00,...,r15*;
  - system registers:
    - *r16(RUN)* - always *"on"*, setting this register to *"oFF"* will interrupt the working mode **RUN**;
    - *r17(Err)* - indicates alarm condition in the user's program;
    - *r18* - cycle with period of 0.2 sec.;
    - *r19* - cycle with period of 1 sec.

# IV. Use of the Controller

The *VPC 128* Controller has three operating modes - working (**RUN**), programming (**PRG**) and communication with a PC (**CON**). Switching from one mode to another is achieved by pressing the two arrow buttons simultaneously and the display will read "*to run*" ("*to PrG*", "*to con*"), and now the user can select the desired mode using the arrow buttons alone. Upon pressing the button "□" the display shows the selected mode (e.g. "*run on*", "*PrG on*" or *"con on"*) or the type of error if the desired mode could not be selected.

In the working mode **RUN**("*run on*") the Controller operates according to its program and the controlled machine is working either in automate cycle or manual calibration modes. The technological parameters referred to by the timers or the counters of the Controller can be updated in this mode using the inbuilt console. Thus, in order to change the time value for *t 0... t 7* the button "**F**" is pressed and the left display reads one of the mnemonics *t 0....t 7, cn0....cn7* and the right one - the corresponding time value of the timer or the counting value of the counter. The mnemonics on the left display is blinking, which shows that the user can select the desired parameter (*t 0....t 7, cn0....cn7*) using the arrow buttons. Pressing the button "F" will set the right display in blinking mode indicating that the user now can change the corresponding value of the selected parameter using the arrows. Thus, the button "F" toggles between the left and the right display. The actual update of the new value is performed upon pressing the button "□" and the display goes back to "*run on*".

The inbuilt console can also be used to monitor the current state of the input and output lines, the timers, the counters and the auxiliary registers. This can be done by pressing the button "□" when the display reads "*run on*" uand again using the arrow buttons the desired register can be selected on the left display. The right display shows the current state of the register ( "*on*", "*oFF*", or the value of the timer or the counter if it is not set).

The program of the Controller can be transferred to or from PC using the Windows application ***VPC Host Interface***. This can be done in the communication mode **CON**("*to con*"), if the ***VPC128*** is connected to a PC by RS232C interface cable and the application ***VPC Host Interface*** is running on the computer. If all this is done the display will read *"con on"*, otherwise it will read "*con oFF*".

The programming mode PRG(**"***to PrG*"*)* allows the user to create or edit the program of the Controller using the inbuilt console. After selecting this mode the display reads "*PrG on*". The next pressing of the button "□" will show on the display the number of the first instruction line "*Ln 0*", and now the user can select the desired instruction address (line) by pressing the arrow buttons. After selecting the desired program line, the user can press the button "□" to view the actual instruction on this line. The left display reads the mnemonics of the instruction in blinking mode indicating that this instruction can be changed using the arrow buttons. The blinking mode can be toggled between the left and the right display using the button "**F**". The right display shows the operand of the instruction (if any). The operand can be changed using the same pattern. The button "□" writes the (new) instruction line to the memory of the Controller and the next instruction line is displayed. Following the same pattern, the whole program can be edited. At the end of the program the user must put the "*End*" instruction so that the Controller can perform the closed loop.

Insertion and deletion of program lines is available in the programming mode. In order to insert an instruction the user must be on the instruction which is to be moved one step down, then press and hold the button "F" and press once the down arrow button. The display will now read ***„inS"*** and if the operation is confirmed by pressing the button "□", the display is changing to "*inSErt*" until the insertion is finished. The inserted instruction on this program line will be "*End*"and can be edited. To cancel the insert press the "F" button instead of the "□" button when the***„inS" is displayed.***

The same procedure is used in order to delete a program line. The only difference is that the second button to be pressed, while the "F" is kept pressed, is the upward arrow button. The display readings in this case are "*dEL*" and "*dELEtE*". The insertion and the deletion are designed to be non-conventional because their use could lead to a totally different program flow.

# V. Instructions and operands of VPC 128

The instructions and the operands of the Controller are displayed using a suitable 7-segment indication mnemonics with the following meaning*:

- "*End*" - end of program;
- "*Ld*" (Load) - start of a new block with NO contact in the terms of the relay-contactor analogy;
- "*Ldn*" (Load NOT) - start of a new block with NC contact;
- "*And*" - NO contact in series to the previous block;
- "*Ann*" (AND NOT) - NC contact in series to the previous block;
- "*or*" (OR) -NO contact in parallel to the previous block;
- "*orn*" (OR NOT) - NC contact in parallel to the previous block;
- "*out*" - outputs the circuit to output line;
- "*oun*" (Out NOT) - outputs the inverse value to output line;
- "*Lr*" (Latching Relay) - latching relay of Set-Reset type;
- "*t 0*" -"*t 7*" (Timer) - timers;
- "*cn0*"- "*cn7*" (Counter) - counters;
- "*IL*" (InterLock) - beginning of a new branch;
- "*ILC*" (InterLock Clear) - end of a branch;
- "*JP*" (Jump) - conditional jump. The instructions up to the next "*JPE*" are performed only if the current state is "*on*";
- "*JPE*" (Jump end) -end of the conditional jump;
- "*AnL*" (AND Load) - the last block is AND-ed to the previous one;
- "*orL*" (OR Load) - the last two blocks are in parallel;

# VI. Program errors

The Controller performs a total program checkup upon startup and each time the working mode (**RUN**) is switched to. If the program passes this checkup successfully, the Controller switches to RUN. Otherwise, the first error occurred is displayed and the Controller switches to PRG mode.

The following errors can be detected by the Controller:

- '*Epr Err*' - EEPROM fault;
- '*cnt Err*' - communication problems while connecting to the PC in CON mode;
- '*duP Err*' - more than one output circuits for single output line (register);
- '*Prg Err'* - syntax error, unknown instruction;
- '*End Err*' - missing "*END*" instruction to indicate the end of the program;
- '*JPE Err*' - "*JPE*" instruction has no corresponding "*JP*" instruction;
- '*ILC Err*' - "*ILC*" instruction has no corresponding "*IL*" instruction;
- '*blc Err*' - incorrect interaction between the flows "*IL*"-"*ILC*" and "*JP*"-"*JPE*".

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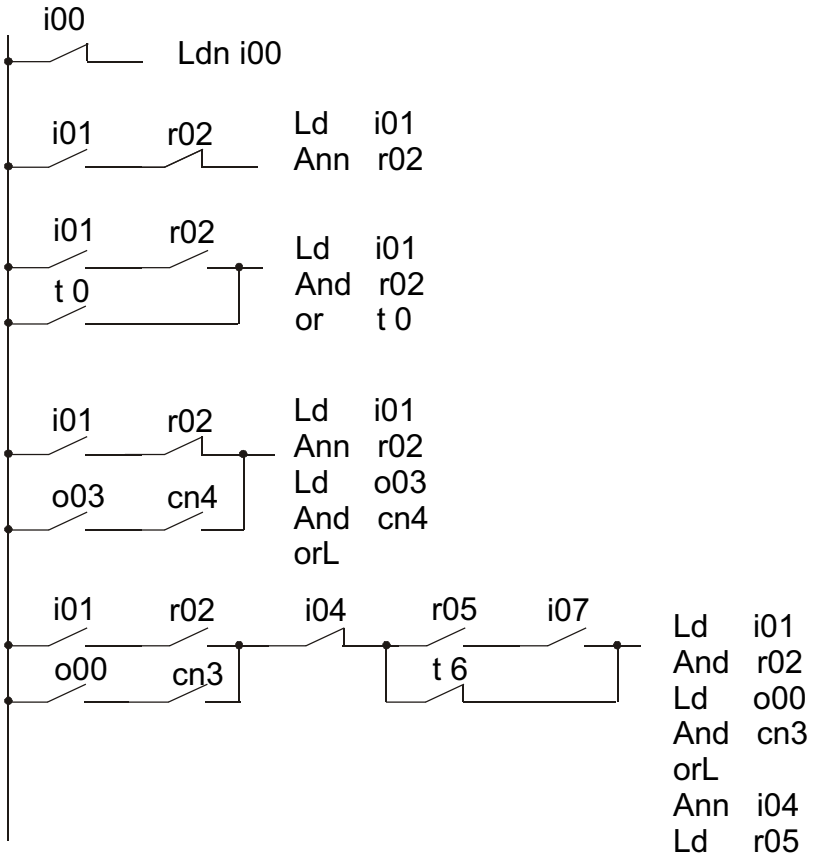
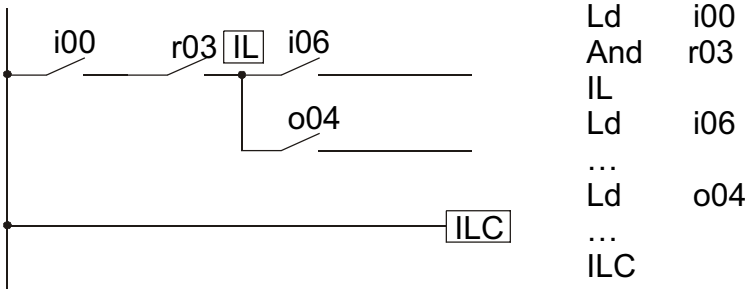
**See Chapter VII. for examples.*

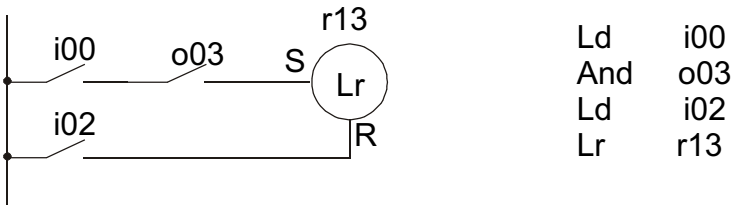
# VII. Relay-contactor analogy and Ladder diagrams

Instructions: *Ld* (LOAD); *and*; *ann* (AND NOT); *or*; *orn* (OR NOT); *orL* (OR LOAD);*anL* (AND LOAD):




Instructions: *IL* (INTERLOCK) and *ILC* (INTERLOCK CLEAR) beginning and end of a branching:




Instruction: *Lr* (Latching Relay) equivalent to RS triger: