87 P series

Single axis, programmable position controller
Position controller for a single axis
Series 87 P

Important Features
The 87 P controller has been designed to incorporate the following.

Drive control
The drive control is on basis of FAST, SLOW, CREEP, STOP together with 4 auxiliary freely programmable outputs. As an option analogue output +/− 10 v (braking ramp) is available.

Enclosure
This is a compact unit (H: 144 mm, W: 144 mm, D: 54 mm) with large keypad operable with gloved hands.

Input
An essential feature of construction is «Simple two stage programming».

Programming stage 1:
Setting of operating parameters and functions.
These values are set during commissioning based on machine parameters and customer requirements.
They are protected from inadvertent operation by means of a security code.

Programming stage 2
This is designed for ease of operation (cursor principle). A definite contribution to simple use is selection of «single» or «programme» operation.

Memory
180 address lines can be stored, which can be operated by selection of address or as 9 sequential programmes each with 20 addresses.
(Other combinations can be configured on request).
An address comprises a position, a quantity and any required auxiliary function, together with selection of absolute of incremental operation in either + ve or − ve direction.

Communication link
The controller can be supplied with serial interface by means of which full data can be loaded.

Measuring system
The system is based on incremental encoder (0-30 v) with direction sensing of quadrature signal. One, two or four times multiplication of the signal can be effected.

Absolute/incremental
The input, using cursor principle, allows the operator to set dimensions as an absolute position or incremental move in direction + ve or − ve.

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Fig. 1

As standard 4 auxiliary functions are available. Each address can have one of these 4 selected. The output is energised so long as the address is selected, until the start for the next sentence is activated.

Fig. 2

R 50:
Set deceleration distance 0.1 to 999.9 mm by means of keypad
Function of the standard register addresses

R = Register Nr.
Selected by pushbutton «R».

R1 Slow Speed Distance
This is the distance from required position which at which the speed will drop from fast to slow. Its output «Fast Speed» will be deactivated.
NB: Never enter «zero» in this register, even when not using this speed.

R2 Creep speed distance
This is the distance from the required position which at which the speed would drop from slow to creep. Its output «Slow Speed» will be deactivated.
NB: Never enter «zero» in this register, even when not using the speed.

R3 Stop offset distance
The stop offset distance can be set in the register between 0.1 and 9.9 mm. Initially, during commissioning, set the value to 0.0. Note the overrun value. The overrun distance can be seen in the actual value display as a difference between that and the previously preset desired value. Before this can be done, the correct creep speed and creep speed distance must be set. The overrun distance must be consistent on all points in the machine operating range.
Example: The desired position is overrun by 0.2 mm. Enter «2» into register R3.

R4 Backlash compensation overrun distance
If backlash is present in rack or screw then approach to position can be made unidirectional. Selection is by means of R6. The distance by which the position is overrun is preset in Register R4. The direction of overrun in +ve or -ve direction can be selected.

R5 Auto retract distance
Should it be required to retract the backstop this can be achieved by pulsing an external contact. To return the backstop to the original position, pulse the input once more.

R6 Saw blade correction
In this register a correction value (e.g. saw blade thickness) can be preset. This value will be automatically added to the preset demand value when operating in incremental mode.

In incremental mode, the material is fed across the saw line by the length required plus saw width compensation.

R7 Datum value
When the external input «Datum» is given, the preset value in the register R7 is set into the actual value display. This can be effected using a key-switch or a switch on the bed of the machine.

R8 Operating system parameter
In this register the selection of backlash/incremental error compensation and quantity counting format are preset. (See table 2 on page 7).

R9 Time of «in position» Signal
Set the required time of the pulse. (Max 9.9 sec).

R10 Standstill time
Set the delay time when reversing during backlash compensation. The value is dependent on time taken for motor to stop, before start in opposite direction is given. (Max 9.9 sec).

R11 Time of «quantity reached» signal
Set the required time of the pulse, on reaching count zero. (Max 9.9 sec).

R12 Manipulation tolerance
Normal accuracy of this positioning system is +−1 bit. It is when it is required to go to 100.0 mm its possible to stop at 99.9 or 100.1. Also due to different friction at various points in the machine accuracy is not constant, ie in some positions accuracy is −0.1, or 0.0 or +0.1. It is possible to enter a tolerance value such that if the actual position is within this value, the actual display will indicate the required value without the error.

Positioning accuracy is not impaired, because the control system internally registers the true actual position.

R13 Software limit, minimum
A position can be preset, below which the controller will not accept a start signal.

R14 Software limit, maximum
A position can be preset, above which the controller will not accept a start signal.

R20 Position of decimal point
The position of the decimal point is made physical and in itself does not set the resolution of the system. The resolution must be chosen by means of encoder pulse number to correctly display the resolution, the decimal point must be placed in a visually correct position.
Setting of values in this register, sets the position as follows:

Number of digits after decimal point  | Code
-------------------------------------|-----
0                                    | 3   
1                                    | 0   
2                                    | 1   
3                                    | 2   

R40 Memory block number
The memory for the required data for programme is as standard divided into 9 blocks of 20 addresses.
Using R40 register, the memory block can be selected 1 – 9. Different programmes can be stored in each block and retrieved to suit. Alternative software for different configuration can be provided on request.

R97 Operation module
The controller can be in basic form operate in 2 modes.
This can be selected as follows:
0 = Without multiplication factor
1 = With multiplication factor.
The value of multiplication factor is set in R96.

R98
This parameter provides a security code entry to alter all the above registers.

Optional registers

R96 Multiplication factor
Additional option feature. Select R97, select 1. NB: Feature is not available when R97 is set to 0.
The multiplication factor for encoder pulses can now be entered into register R96. The value can be calculated as in the following example: − The desired distance to be moved = 1000.0 mm actual number of pulses recorded for the movement is 12000.
Set factor to $10000 = 0.83333$

R50 – 55
Registers for operation of analogue output (see following sections).
Display and Keypad assignments

Address number

Sign symbol
(  ON )

Actual position

Required position

Quantity

Absolute/incremental selection

Auxiliary function number

LED indicator
to show
parameter being
programmed

Address number selector

Cursor button

Set programme
end

Field window clear

Input RESET

Selector for registers

Select single position operation

Select programme operation

Start positioning action

Interrupt positioning
Functions of keys an LED's

**LED'S**

**L1:** This lamp is illuminated when the selection «PROG» is made.

**L2:** This lamp is illuminated when the selection «SINGLE» is made.

**L3:** This lamp is illuminated when the last address in a programme is running.

**L4:** Faultlamp. This lamp is illuminated when there is an operating or programming fault.

**SINGLE**

After this button has been pressed, a required position can be immediately entered by means of the keypad. On pressing «start», the machine will move to this position.

**PROG**

After this button has been pressed, the following possibilities are available:
1. Input of new programme or selection of operating block.
2. Check out the programme line by line.
3. Start cycle of operation.

In normal programme mode, operating «START» will move the machine to the first address in the selected block. If operating in address selection mode, operating start will move the machine to the position as selected address number.

**START**

This is only active in operating mode. It is inhibited during programming. Pressing start initiates the positioning cycle.

**STOP**

Pressing «STOP» deactivates all output signals to the motor drive. The positioning process is interrupted. Positioning can only recommence on pressing the start button again. This is not an emergency stop button.

**NR**

This button is only active when «PROG» has been selected (L1 must be illuminated). The following functions can be carried out:

a) Entry of programme.

Pressing the button brings up the next address (address 01 on initial activation) and illuminated cursor LED below the position display. By means of the numeric keypad and cursor button, the rest of the sentence can be entered.

b) Checking of external programme.

Successive pressing of the button will display sequentially all programmed address sentences.

c) Selecting the required address.

When operating in 99 address mode, the display will show the required sentence. The sentence can now be altered by pressing the cursor button. Alternatively, the start can be activated and the machine will run to the preset position.

**E**

This button enters the programme into memory. The unit is now ready to operate.

**R**

This button enables the setting up of all machine constants and internal controller functions. Data is entered into registers.

**T**

This button is used to reset programme to zero, both during programming or checking of programme. The button is inhibited during operation.

**C**

Pressing this button will clear the field, as indicated by cursor.
Programming levels

R-Button
Programming stage 1

A) Programming of basic constants (see register description)

The registers must be set to give the required performance. They can be accessed via a security code, using the keypad.

1) Unlocking of registers
1. Press «PROG»
2. Press (3)
3. Press (5)
4. Enter 98
5. Press (6)
6. Press (7)
7. Enter security code 250565
8. Press (8)
The registers are now unlocked and can be altered.

A2) Setting of registers

E.g.: The slow speed distance is required to be set to 20.0 mm. Proceed as follows:
1. Press «PROG»
2. Press (9)
3. Press (0)
4. Enter desired register ie 1
5. Press (1)
6. Enter the desired value ie 20.0
7. press (2)
The register 1 which is the slowdown point, is loaded with a value of 20.0mm.

A3) Locking of registers

When all settings have been made, the registers must be locked up again.
1. Press «PROG»
2. Press (3)
3. Press (4)
4. Enter 98
5. Press (5)
6. Press (6)
7. Press (7)
The controller will operate with R functions unlocked, so that adjustments can readily be made. Unless they are locked, it is possible for the operator to accidentally alter values and cause operating errors. The registers will in any case selflock on switching off the power.

Programming stage 2

B) Operating mode

The controller will operate in accordance with the setting of register R8.

B1) Operating with selected programme block

The unit has 9 blocks of memory, each with a maximum of 20 address lines.

Example:

It is required to operate with block 3.
1. Press (1)
2. Press (2)
3. Enter (register) 40
4. Enter the desired block number 3
5. Press (5)
6. Press (6)
The third block can now be programmed or put into operation.

B2) Programming a sequence of operation

The required block is selected as in B1.
1. Press «PROG»
2. Press (3)
3. Press (4)
4. Enter desired position
5. Press (5)
6. Press (6)
7. Enter desired quantity
8. Press (7)
9. Press (8)
10. Enter required dimensioning mode
   0 = Absolute
   1 = Incremental +
   2 = Incremental -
11. Press (9)
12. Press (0)
13. Enter required auxiliary functions
   0, 1, 2, 3 or 4

The sentence of address 1 is now complete. When the last line has been completed, Press «E». This stores the programme in memory. Should further sentences be added, press (2)
The address number now increases by 1 and programming can be continued by returning to line 3 above.

C) Address selection mode

99 addresses can be programmed and a specified address selected for operation. Register R8 is used to select this mode.

C1) Programming of 99 addresses.
The input is as given in B2).

C2) Operating with 99 addresses.

Example: Address NR 55 is required.
Press (1) (Reset)
Press (4)
Enter desired address ie 55
Press (5)
When start is activated, the machine moves to the position as displayed in address 55.

D) Single position operation

Once the «Single» button has been pressed, it is possible to enter a position and a quantity. The position is an absolute value. (Can be converted to incremental by external connection – see ST. 3).
In this mode, the 87 P acts in exactly the same way as the 85 P.
## Registers / Parameters

**Register addresses at a glance**
NB: The registers (except R40) are locked by means of a security code.

### Table 1

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>slowdown</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R2</td>
<td>Creep</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R3</td>
<td>Step of se</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R4</td>
<td>Overrun</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R5</td>
<td>Auto retract</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R6</td>
<td>Saw blade</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R7</td>
<td>Datum</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R8</td>
<td>System parameter</td>
<td>see table 2</td>
</tr>
<tr>
<td>R9</td>
<td>Time of in position pulse</td>
<td>0.1 sec.</td>
</tr>
<tr>
<td>R10</td>
<td>Standstill time</td>
<td>0.1 sec.</td>
</tr>
<tr>
<td>R11</td>
<td>Time of quantity reached pulse</td>
<td>0.1 sec.</td>
</tr>
<tr>
<td>R12</td>
<td>Manipulation tolerance</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R13</td>
<td>Software limit, minimum</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R14</td>
<td>Software limit, maximum</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>R20</td>
<td>Decimal point</td>
<td>0 - 1 digit alter 1 - 2 digit alter 2 - 3 digit alter 3 - 0 digit alter</td>
</tr>
<tr>
<td>R40</td>
<td>Programme block selection</td>
<td>1-9</td>
</tr>
<tr>
<td>R50-55</td>
<td>Analogue output (option)</td>
<td></td>
</tr>
<tr>
<td>R36</td>
<td>Pulse multiplication factor (option)</td>
<td>0.00001 to 0.0001</td>
</tr>
<tr>
<td>R37</td>
<td>Selection of R36</td>
<td>0-up 1-down</td>
</tr>
<tr>
<td>R98</td>
<td>Security code</td>
<td>2533565</td>
</tr>
</tbody>
</table>

### R 8 Operating system parameters.

On pressing the first digit to be seen represents the operation mode.
0 = sequence programme
1 = 99 address selection

The second digit refers to the following 1st.

### Table 2

<table>
<thead>
<tr>
<th>No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>with backlash compensation with incremental error compensation with automatic quantity counting</td>
</tr>
<tr>
<td>1</td>
<td>without backlash compensation with incremental error compensation with automatic quantity counting</td>
</tr>
<tr>
<td>2</td>
<td>with backlash compensation without incremental error compensation with automatic quantity counting</td>
</tr>
<tr>
<td>3</td>
<td>without backlash compensation without incremental error compensation with automatic quantity counting</td>
</tr>
<tr>
<td>4</td>
<td>with backlash compensation with incremental error compensation without automatic quantity counting</td>
</tr>
<tr>
<td>5</td>
<td>without backlash compensation with incremental error compensation without automatic quantity counting</td>
</tr>
<tr>
<td>6</td>
<td>with backlash compensation without incremental error compensation without automatic quantity counting</td>
</tr>
<tr>
<td>7</td>
<td>without backlash compensation without incremental error compensation without automatic quantity counting</td>
</tr>
</tbody>
</table>

**Example:**
It is required to set: sequence programme operation with backlash compensation without incremental error compensation.

1. Unlock Registers with security code
2. Press \( \text{R}_1 \)
3. Press \( \text{R}_2 \)
4. Press \( \text{R}_3 \)
5. Press \( \text{R}_4 \) (for programme operation)
6. Press \( \text{R}_5 \) (see table 2)
7. Press \( \text{R}_6 \)
8. Lock registers
Adjustment of the Multi Edge Counter

Encoder pulse multiplication

It is possible to operate with three pulse resolutions from a 2 channel encoder. The unit can be selected to give multiplication factors of x1, x2 or x4.

To select, proceed as follows:
1. Remove back of unit
2. Remove top PC board (plug connected),
3. green jumpers are exposed (see plan)

The relevant jumpers are:
J1 x 1
J6 x 2
J7 x 4

NB.: Only one of these jumpers must be made. The other two must be left open.

<table>
<thead>
<tr>
<th>ST 1/ST 2</th>
<th>Channel A</th>
<th>Channel B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder connection</td>
<td>9 V 900 mA dc</td>
<td>24 V 600 mA dc</td>
</tr>
<tr>
<td>(from external source)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ST 9</th>
<th>Power supply</th>
<th>24 V dc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>(from external source)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ST 3</th>
<th>Control and selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN(0)</td>
<td>npn</td>
</tr>
<tr>
<td>PIN(23)</td>
<td>pnp</td>
</tr>
<tr>
<td>PIN(11)</td>
<td>pnp</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ST 5</th>
<th>Control output</th>
</tr>
</thead>
<tbody>
<tr>
<td>+24V</td>
<td>nnp</td>
</tr>
<tr>
<td>0V</td>
<td>nnp</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ST 8</th>
<th>External position input (option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CODE</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>DECADE</td>
<td>6, 5, 4, 3, 2, 1</td>
</tr>
</tbody>
</table>
Connections

**Encoder connection**
- PIN 1 zero OV
- PIN 2 power + 24 VDC
- PIN 3 input A
- PIN 4 input B
- PIN 5 screen

**Power supply unit**
- PIN 1 power input + 24 VDC
- PIN 2 zero for 24 V OV
- PIN 3 screen
- PIN 4 power input + 9 VDC
- PIN 5 zero for 9 V OV

**Input signals/selection**
- PIN 1 system reset
- PIN 4 start
- PIN 5 incremental operation in single mode
- PIN 6 incremental positive in single mode
  (Pin 5 must also be selected)
- PIN 8 datum
- PIN 9 screen
- PIN 10 screen
- PIN 11 internal ± 24 V supply for input signals
- PIN 14 stop
- PIN 16 quantity decrement
- PIN 18 auto retract
- PIN 20 free run
- PIN 23 zero voltage

**Output signals**
- PIN 1 creep speed
- PIN 2 slow speed
- PIN 3 fast speed
- PIN 4 reverse
- PIN 9 screen
- PIN 10 screen
- PIN 11 zero voltage
- PIN 14 position reached
- PIN 16 quantity reached
- PIN 18 auxiliary 1
- PIN 19 auxiliary 2
- PIN 20 auxiliary 3
- PIN 21 auxiliary 4
- PIN 23

To activate signals, pull input down to zero volts. By changing internal optocoupler, positive logic is available if pull input up to 24 V dc.

**General hints**

**Inputs**
It is necessary always to activate one input at a time. The inputs must be pulsed with minimum time of 0.75 sec.

»Datum« input: An external switch is required.

**Outputs**
To set the drive control outputs one must ensure that the »FREE TO RUN« input is permanently activated. A sequence of control can be established with relays, PLC or PC.
Technical data

| **Power supply requirement**       | +24 V/600 mA and +9 V/900 mA galvanically isolated. Use Elgo NG 13.0. If using any other, make sure it is compatible. |
| **Encoder power supply**           | 24 V DC 130 mA |
| **Input signals:**                 | Negative logic: connect to zero volts. (Option: positive logic: connect to +24 volts.) Input 0.75 Sec min. 10 mA/pin max. |
| **Output signals:**                | Open collector PNP (NPN on request). Output current 30 mA/output. Freewheel diodes integrated. |
| **Memory:**                        | Battery backed for about 5 years. |
| **Indicators:**                    | Red LED 8 mm. |
| **Connectors:**                    | O type. |
| **Hardware:**                      | Elgo counter chip plus 8 bit CMOS microprocessor with 32 kbyte EPROM and 16 kbyte RAM. |
| **System accuracy:**               | ±1 bit. |
| **Positioning speed:**             | 10 KHZ (60 m/min with 0.1 mm resolution). |
| **Enclosure:**                     | Black polycarbonate, for fitting into control panel. Can be mounted in any attitude. |
| **Dimensions:**                    | 144 mm H, 144 mm W, 54 mm D. Cut out 138 x 138 mm. |

Hints for integration into electrical panels

The 87 P position controller is designed and constructed for use in arduous industrial applications and as immune to electrical interference as possible. Care should however be taken when fitting electronic equipment into machinery.

1. Electronic units should be mounted away from inductive and capacitive interference.
2. Protect against overvoltage.
3. Protect against overtemperature.
4. Run low voltage cables separate to high voltage/high power cables.
5. Screen encoder cables and input signal cables. Tie screen to zero (terminal 20) at controller; leave insulated at other end.
6. Suppress all relays, contactors, solenoids, brakes and other coils in cabinet and on machine. Fit diodes across dc coils. Fill 0.1 μF + 100 ohms across ac coils.

Failure to follow the above simple instructions could lead to malfunction of the electronic unit.
Options and Accessories

Option relay module RP8 (RK 984.0)

Compatibility to 85 P
A special adaptor relay board type RK985.0 is available. This plugs into the back of the 87P and has connectors directly compatible to the 85P plugs.

Terminal arrangement A (output contacts)

Terminal arrangement B (coils)

Terminal 1 R8 Connect to Pin 1 of ST5 = creep
Terminal 2 R7 Connect to Pin 2 of ST5 = slow
Terminal 3 R6 Connect to Pin 3 of ST5 = fast
Terminal 4 R5 Connect to Pin 4 of ST5 = reserve
Terminal 5 R4 These relays may be used for:
Terminal 6 R3 Position reached
Terminal 7 R2 Quantity reached
Terminal 8 R1 AUX Auxiliary functions
Terminal 9 NC
Terminal 10 Zero voltage common for all coils

Standard power supply NG 13.0

It is best to mount the power supply close to the position controller, to avoid voltage drop in long cables.
Use screened cable for dc connections.

Connect ST 11 on PSU to ST 5 on controller:
Terminal 1 OV Pin 5
Terminal 2 +9 V Pin 4
Terminal 3 Pin 3
Terminal 4 OV Pin 2
Terminal 5 +24 V Pin 1

ST 10 in mains input
Terminal 1 N
Terminal 2 Earth
Terminal 3 220 V or 110 V
   +/- 5% 50 Hz
Liability exclusion / Guarantee

We have checked the contents of this instruction manual carefully, to the best of our knowledge and belief for conformity with the described hardware and software. Nevertheless errors, mistakes or deviations can not be excluded, therefore we do not guarantee complete conformity. Necessary corrections will be included in the subsequent editions. We appreciate your ideas and improvement suggestions very much.

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