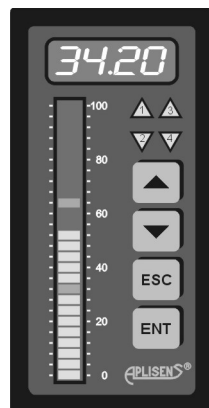


# PMS970T, PMS970P

programmable panel meters



PMS970T



PMS970P

## Operating manual

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| <b>SYMBOL</b>   | <b>DESCRIPTION</b>   |
|---|--|
|  | CAUTION or WARNING: Tells you about the risk of electrical shock.  |
|  | CAUTION, WARNING or IMPORTANT: Tells you of circumstances or practices than can effect the instrument's functionality and must refer to technical documentation. |
|  | INFORMATION: Helpful information.  |

# 1. INTRODUCTION

## 1.1 General information

PMS970T and PMS970P are precision panel meters for a wide range of industrial applications. Provides measurement of voltage and current process signals, analog signal retransmission, ON/OFF relay control and serial interface communication. Two versions are available: PMS970T with dual digital/analog display and PMS970P with single, big digit display.

## 1.2 Features

### Measurement

User programmable 4-digit read-out of voltage or current signals is provided. Filtering time-constant, read-out rounding and decimal point position may be also programmed. The unit features also a 16 point linearisation routine.

### Bargraph indication

26 point, tricolour LED bargraph (PMS970T version) allows easy judgement of levels and threshold values.

### Control outputs

Depending on version, 2 or 4 relay outputs are available. Threshold levels with individual hysteresis and ON/OFF function are user programmed. The special function called „alternate output control” allows optimal control of cascaded pumps.


### Analog output

The instrument has optional 4-20mA fully isolated output for analog retransmission.

### Serial interface


The isolated RS-485 optional interface allows system connection.

## 1.3 Safety

 *Hazardous voltage exist within enclosure. Only trained personnel should perform installation and service. Electrical wiring should be performed in accordance with all applicable national standards and regulations. Instrument is protected in accordance with Class II of EN-61010 for 230VAC version and Class III for 24AC/DC supply version.*

- read the manual carefully before installation,
- disconnect power supply before installation and wiring,
- do not touch the terminals while power is being supplied,
- do not attempt to operate the instrument if any damage is found,
- do not operate the unit in aggressive or explosive environment,
- do not expose the instrument to condensing moisture,
- provide sufficient air circulation to keep the temperature in specified range.

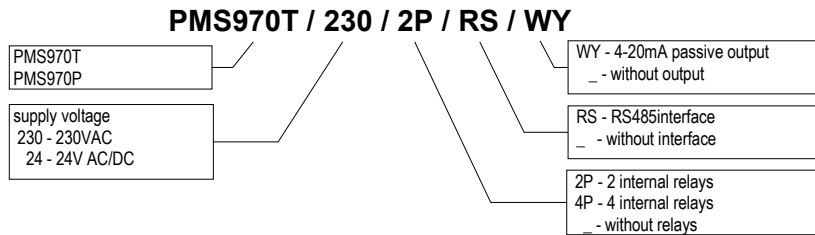
## 1.4 Electromagnetic compatibility

 Instrument meets EN-61326 EMC requirements for industrial environment.

Follow listed below instructions to provide proper operation in real conditions:

- Do not install the product near devices generating strong electromagnetic fields,
- wire the lines connected to the meter separately from power lines carrying high voltages or currents,
- use twisted or shielded signal lines in noisy environment,
- always apply functional grounding,
- apply external surge protectors close to the unit if long lines are connected,
- apply additional filtering in noisy environment.

## 1.5 Product marking



## 2. INSTALLATION

### 2.1 Unpacking

The shipping carton should contain:

|                          |        |
|--------------------------|--------|
| PMS970T or PMS970P meter | 1 pcs, |
| fixing clip              | 2 pcs, |
| operating manual         | 1 pcs. |

Unpack the instrument and check it for obvious signs of damage. If any damage occur notify the supplier and do not attempt further use. If the unit appears to be in good condition read the Operating Manual before installation and use.

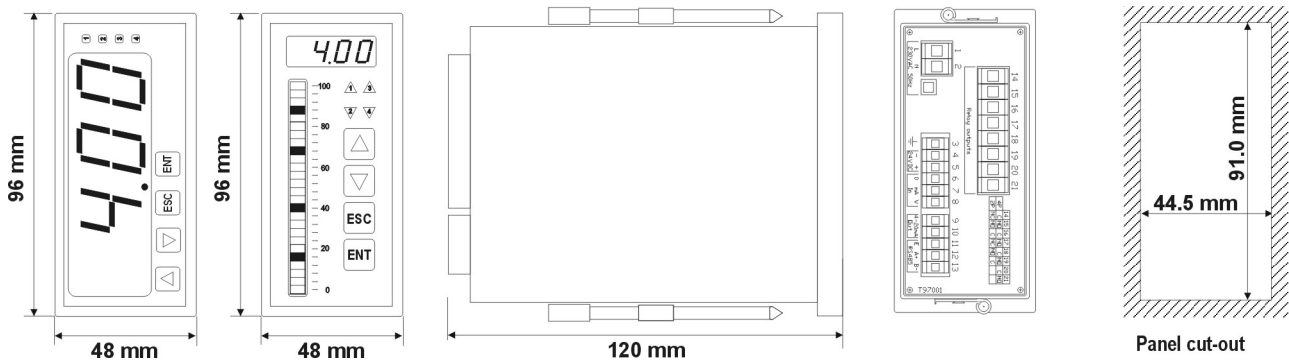


Fig.1 PMS970T / PMS970P basic dimensions.


### 2.2 Mechanical assembly


The unit is designed for front panel mounting. It requires panel cut-out according to the specification with proper distance to other devices.

Mounting procedure:

- put the meter from the front side into the panel cut-out,
- attach 2 fixing clips on brass rivets,
- tighten the screws just enough to hold the housing firmly in place.

## 2.3 Electrical connections

 *Disconnect power supply before installation and wiring. Check power supply voltage on instrument's label.*

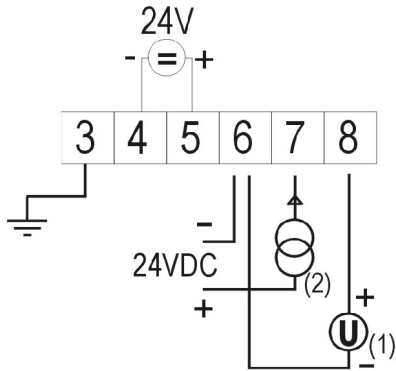
 *Terminal 3 is functional ground terminal. It should be grounded as short as possible to provide proper noise rejection. Signal line shields should be also connected here.*

Electrical connection procedure:

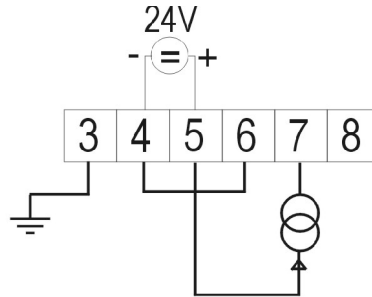
- check proper mechanical installation of the unit,
- unplug terminal blocks on the rear wall,
- make required connections according to wiring table and diagrams,
- replug terminal blocks,
- check the connections before applying power **INCORRECT CONNECTIONS CAN DAMAGE YOUR METER!**

| <b>Connector</b>                   | <b>Pin number</b> | <b>Symbol</b> | <b>Terminal description</b> | <b>Rating</b> |
|------------------------------------|-------------------|---------------|-----------------------------|---------------|
| POWER SUPPLY<br>230VAC version     | 1                 | L             | supply                      | AC 230V 50Hz  |
|                                    | 2                 | N             | supply                      |               |
| POWER SUPPLY<br>24VAC/DC version   | 1                 |               | supply                      | 24V AC/DC     |
|                                    | 2                 |               | supply                      |               |
| SIGNAL INPUT,<br>EXCITATION OUTPUT | 3                 |               | functional ground           | DC 24V        |
|                                    | 4                 | -             | excitation output           |               |
|                                    | 5                 | +             | excitation output           |               |
|                                    | 6                 | 0             | signal ground               | 20mA          |
|                                    | 7                 | mA            | current input               |               |
|                                    | 8                 | V             | voltage input               |               |
| ANALOG OUTPUT,<br>SERIAL INTERFACE | 9                 | 4-20mA        | analog output               | 4-20mA        |
|                                    | 10                | 4-20mA        | analog output               |               |
|                                    | 11                | E             | RS485 ground                |               |
|                                    | 12                | A+            | RS485 line                  |               |
|                                    | 13                | B-            | RS485 line                  |               |
| RELAY OUTPUT<br>2P version         | 14                | C             | AL1 relay common            | 1A / 250VAC   |
|                                    | 15                | NO            | AL1 relay NO                |               |
|                                    | 16                | C             | AL2 relay common            |               |
|                                    | 17                | NO            | AL2 relay NO                |               |
|                                    | 18                | C             | AL3 relay common            |               |
|                                    | 19                | NO            | AL3 relay NO                |               |
|                                    | 20                | C             | AL4 relay common            |               |
|                                    | 21                | NO            | AL4 relay NO                |               |

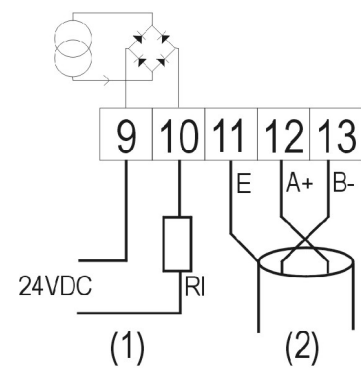
| Connector                  | Pin number | Symbol | Terminal description | Rating      |
|----------------------------|------------|--------|----------------------|-------------|
| RELAY OUTPUT<br>4P version | 14         | NC     | AL1 relay NC         | 1A / 250VAC |
|                            | 15         | NO     | AL1 relay NO         |             |
|                            | 16         | C      | AL1 relay common     |             |
|                            | 17         | NC     | AL2 relay NC         |             |
|                            | 18         | NO     | AL2 relay NO         |             |
|                            | 19         | C      | AL2 relay common     |             |
|                            | 20         |        | not connected        |             |
|                            | 21         |        | not connected        |             |



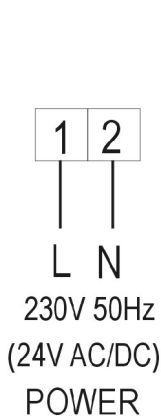
ANALOG INPUT  
(1) voltage source  
(2) current source  
(external supply) .



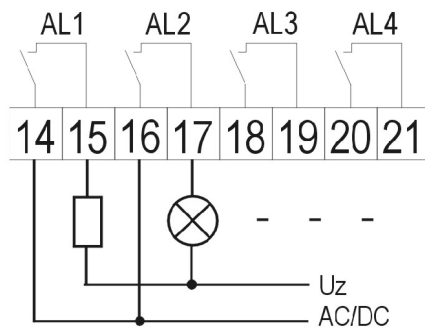
ANALOG INPUT  
current source  
local supply



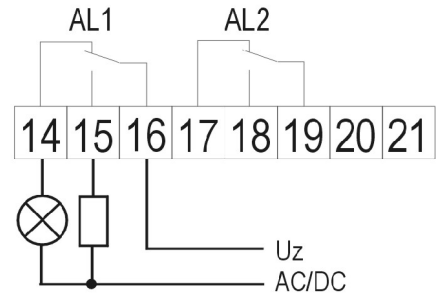
(1) ANALOG OUTPUT  
(2) RS485 INTERFACE



POWER



RELAY OUTPUTS  
4 x NO relay



RELAY OUTPUTS  
2 x NO/NC relay

Fig. 2 Wiring diagrams.

### 3. Meter operation.

#### 3.1 Programming

 *Incorrect programming may cause incorrect read-out and uncontrolled output relay operation!*

The meter has many user-selected programme settings. All settings may be done with front panel push-buttons. Set-points levels are programmed directly in normal mode. Other settings require entering programme mode. Programming menu is code protected.

*Button function in programming mode.*

| <b>Button</b> | <b>Description</b>   | <b>Comments</b> |
|---------------|--|-----------------|
| ▲             | - scrolling up through menu functions and options<br>- increasing numerical values   |                 |
| ▼             | - scrolling down through menu functions and options<br>- decreasing numerical values |                 |
| ESC           | - ESCAPE<br>- go to previous menu level  |                 |
| ENT           | - ENTER, access to function<br>- selected value/option confirmation                  |                 |

**I** To enter programming mode press **ESC** key for 2 seconds until „Code” message appear. Then press **ESC, ▲, ▲, ENT** combination. „Fn00” message should appear.

In programming menu several functions are available. Detailed function description is given in the table.

Use cursor buttons to navigate through the functions and ENT button to enter selected function. Numerical values should be set digit by digit. Flashing digit should be adjusted using cursor buttons and stored with ENT button.

All the settings are stored in non-volatile memory while leaving the programming menu.

*Programming menu.*

| <b>Menu function</b> | <b>Description</b>   | <b>Available options</b>  | <b>Factory setting</b>   | <b>Comments</b>  |
|----------------------|----------------------|---|--|--|
| Fn00                 | input selection      | I-0-20mA current input active,<br>U-0-10V voltage input active  | I  |  |
| Fn01                 | linearization points | 2 – 16  | 2  | 2 - linear scale   |
| Fn02                 | display scaling      | <b>P01 - Pnn</b> scaling points   | <b>P01 : 00.00 : 0000</b><br><b>P02 : 20.00 : 2000</b>                               | Define input value and display value for each scaling point-(1)          |
|                      |                      | <b>-9.99 - 99.99</b> input value (with DP)  |  |  |
|                      |                      | <b>-999 - 9999</b> display value  |  |  |
| Fn03                 | decimal point        | <b>0000; 0.000; 00.00; 000.0</b>  | <b>00.00</b>   | Leading zeros are suppressed   |
| Fn04                 | display rounding     | <b>1, 2, 5, 10</b>  | <b>1</b>   | 1 - without rounding   |
| Fn05                 | filter time-constant | <b>0 – 0, 1 - 60ms, 2 - 120ms, 3 - 240ms, 4 - 480ms, 5 - 960ms, 6 - 1.92s, 7 - 3.84s, 8 - 7.68s, 9 - 15.36s</b> | <b>0</b>   |  |
| Fn06                 | bargraph mode        | <b>3C</b> – three colour (green, yellow, red)<br><b>1C</b> - single colour (green)                              | <b>3C</b>  | (2)  |
| Fn07                 | set-point mode       | <b>AL1, AL2, AL3, AL4</b>   | <b>AL1 : H : 1</b><br><b>AL2 : L : 1</b><br><b>AL3 : H : 1</b><br><b>AL4 : L : 1</b> | (3)  |
|                      |                      | <b>H</b> - high <b>L</b> - low <b>A</b> - alternate   |  |  |
|                      |                      | <b>1 – 9999</b> hysteresis [display divisions]  |  |  |
| Fn08                 | output scaling       | <b>P01</b> - zero (low) <b>P02</b> - full scale   | <b>P01 : 0000 : 4.00</b><br><b>P02 : 2000 : 20.00</b>                                | Define meter's display value and output current for both scaling points. |
|                      |                      | <b>-999 - 9999</b> meter's display value  |  |  |
|                      |                      | <b>03.00 - 21.00</b> [mA] output current  |  |  |
| Fn09                 | all reset            | <b>Code (4)</b>   |  | Reset to factory setting   |

| Menu function | Description          | Available options                            | Factory setting | Comments |
|---------------|----------------------|--|-----------------|----------|
| Fc01          | serial comm. address | 01h -F7h - address (001-247)                 | 01              |          |
| Fc02          | serial comm. speed   | 1.2, 2.4, 4.8, 9.6, 14.4, 19.2 kbps          | 9.6             |          |
| Fc03          | serial comm. parity  | no-no parity even-even parity odd-odd parity | even            |          |

Remarks:

(1) - The meter is factory set to linear scale with two scaling points. If non-linear scale is needed the required number of scale points should be set in Fn01 function at first. Then, the input and display values for each point should be set. Doubled input values are automatically rejected. Scaling point values are automatically sorted by input values in ascending order, after each Fn02 function access.

(2) - In 1 colour mode the bargraph is green with red set-points.

In 3 colour mode the central zone between AL3 and AL4 is green. Zones AL1 - AL3 and AL2 - AL4 are yellow. Zones above AL1 and below AL2 are red. Relation  $AL2 \leq AL4 \leq AL3 \leq AL1$  should be true for proper colour zone display.

Bargraph 0% indication corresponds to the lowest scaling point, while 100% corresponds to the highest scaling point of the digital display analog.

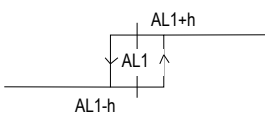
(3) - The set-point number is equal to relay number, excluding alternate mode. Overall hysteresis is equal to twice the value set in Fn07 function.

(4) - While „code” message appears, press ENT button four times.

*Meter's programming example*

| Parametr                                    | Zadana wartość | Numer funkcji | Nastawy            |
|---|----------------|---------------|--------------------|
| input type                                  | current        | Fn00          | 1                  |
| scaling points number                       | 2              | Fn01          | 2                  |
| input range                                 | 4-20mA         | Fn02          | P01 : 04.00 : 0000 |
| display range                               | 0-3000         |               | P02 : 20.00 : 3000 |
| decimal point position                      | 000.0          | Fn03          | 000.0              |
| rounding                                    | none           | Fn04          | 1                  |
| filter time constant                        | 240ms          | Fn05          | 3                  |
| AL1 „ON” level                              | >2500          | (1)           | AL1 : 2500         |
| AL2 „ON” level                              | <1000          | (1)           | AL2 : 1000         |
| AL1 hysteresis                              | 10             | Fn07          | AL1 : H : 0005     |
| AL2 hysteresis                              | 20             |               | AL2 : L : 0010     |
| output current at zero display              | 5mA            | Fn08          | P01 : 0000 : 05.00 |
| output current at full scale (3000) display | 19mA           |               | P02 : 3000 : 19.00 |

(1) - settings available in normal mode



AL1=2500 - set-point value  
 AL1+h=2505 - turn-on level  
 AL1-h=2495 - turn-off level  
 h=5 - programmed value  
 H=2xh - overall hysteresis

Fig.3 Hysteresis definition.



### 3.2 Set-point programming

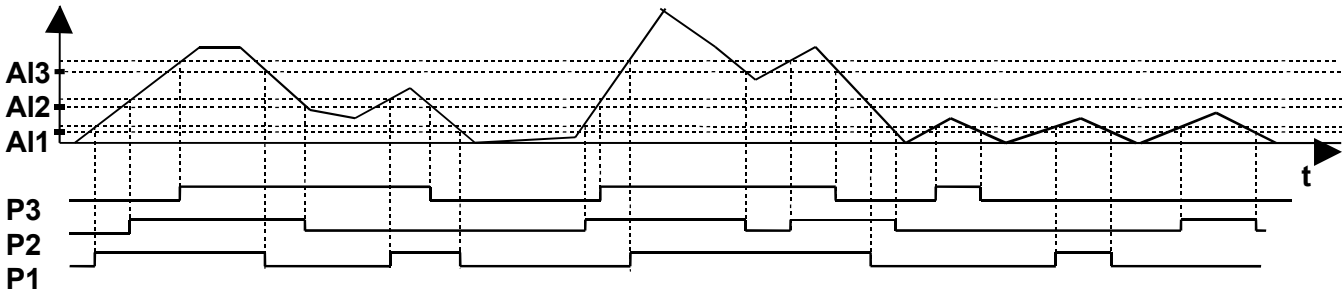
Set-points are programmed in normal mode of the meter using front panel buttons. Press ▲ button for 3 seconds to enter AL1 or AL3 programming. Choose AL1 or AL3 with cursors and press ENT button. Adjust each flashing digit using ▲ ▼ buttons and store the value with ENT button. Similarly AL2 and AL4 are programmed while activated with ▼ button.

**I** *The relation  $AL2 \leq AL4 \leq AL3 \leq AL1$  should be true in 3 colour bargraph mode for proper colour zone display.*

### 3.3 Alternate output control

PMS970 has built-in “alternate output control” function, called also “alternate lead/lag control”. While “A” option in Fn07 menu function is set, corresponding set-point belongs to “alternate output group”. The group may consist of 2, 3 or 4 set-points and relays but the relays are not dedicated to certain set-points. Relays in the group are activated with special queue algorithm. After each ON/OFF sequence the relay is assigned to be the last in the queue. In this way the ON time of the grouped relays is equally shared. In the case of the failure of one of the controlled devices, remaining devices still work on all grouped set-points. The diagram below illustrates the principle of 3 level group operation.

Alternate output control is typically used for level control applications with cascaded pumps.



### 3.4 Error codes

| <i>Error code</i> | <i>Description</i>                | <i>Possible reasons</i>   | <i>Operation</i>  |
|-------------------|-----------------------------------|---|---|
| ErrF              | calibration memory error          | -abnormal EMC condition<br>-internal fault                                  | Turn off the meter for 5 s. If message reappears after power-up contact the service.  |
| InIF              | calibration memory initialization |   | Turn off the meter for 5 s. If message reappears after power-up contact the service.  |
| ErrU              | user memory error                 | -abnormal EMC condition<br>-internal fault                                  | Turn off the meter for 5 s. If message reappears after power-up press ENT button. Meter reads factory settings with momentarily displayed InIU message. |
| InIU              | user memory initialization        |   | If the message appears after each power-up contact the service.   |
| display flashing  | input under/overrange             |   | -check signal source<br>-check input circuitry  |
| 9999 (flashing)   | display overrange                 | -incorrect meter settings<br>-incorrect input connection<br>-internal fault | -check signal source<br>-check meter's scaling<br>-check input circuitry  |
| -999 (flashing)   | display underrange                | -incorrect meter settings<br>-incorrect input connection<br>-internal fault | -check signal source<br>-check meter's scaling<br>-check input circuitry  |

### 3.5 Serial communication

PMS-970 has serial communication option with RS-485 internal module installed. The meter works with Modbus RTU protocol as slave device. Function 3 (register read) and function 16 (multiple registers write).

The data exchanged with the meter are variable type "V" or parameters "P". Parameters are also accesible from programming menu.

Variables are read-only (R). Parameters are read-only type (R) or read/write type (R/W).

Variables and parameters are grouped for simplicity and functionality:

| <b>Group</b> | <b>Register range</b> | <b>Description</b>   |
|--------------|-----------------------|--|
| 1            | 400002-400003         | digital read-out, decimal point position, general status, set-point status |
| 2            | 400004-400008         | set-point values, output current   |
| 3            | 400009-400015         | bargraph read-out  |
| 4            | 400033-400084         | programming menu settings without serial port settigs                      |
| 5            | 400097-400099         | serial port settings   |
| 6            | 418435                | Modbus firmware identification   |

Data blocks exchanged with PMS970 should contain only registers specified in tables below. In other case 0x02 exception code (ILLEGA\_DATA\_ADDRESS) is returned.

Modbus Function 16 limitations:

1. In response to (R) specified register write attempt, 0x02 exception code (ILLEGA\_DATA\_ADDRESS) is returned.
2. Registers from the range 40048-40080 must be sent in one frame. Register 40048 must contain the number of scaling points used. Following registers contain scaling points data. Each point definition requires two registers with input and read-out values. For two-point scaling next to 40048 register four registers and no more must be sent. Excessive data in the range of 40048-40080 causes 0x02 exception return. Unused set-point data fields in the meter are automatically cleared (filled with 25000 (0x61A8) control value). Signal values in scaling data must be unique. In other case exception code 0x03 (ILLEGA\_DATA\_VALUE) is returned. Scaling data transmitted to the meter must be sorted by input value in ascending order. In other case exception code 0x03 is returned.

Example - 2-point scaling - 4-20mA input with 0-1000 read-out.

Data to be sent in one frame:

|         |      |
|---------|------|
| 40048 : | 2    |
| 40049 : | 400  |
| 40050 : | 0    |
| 40051 : | 2000 |
| 40052 : | 1000 |

During manual programming with front keys the meter returns exception code 0x06 (SLAVE\_DEVICE\_BUSY) and no other data. The same exception is returned during internal EEPROM write process.

## PMS-970 Modbus register assignment:

| Register number/<br>address | Variable/parameter       | Type    | Value range                           | Default value        | Comments  |
|-----------------------------|--------------------------|---------|---------------------------------------|----------------------|---|
| 40002/<br>0x0001            | <i>digital read-out</i>  | V (R)   | <b>-999 - 9999 (0xFC19-0x270F)</b>    | -                    |   |
| 40003/<br>0x0002            | <i>Status</i>            | V (R)   | <b>0-65535 (0x0000-0xFFFF)</b>        | -                    | bit0 (LSB): PP=1 - manual programming in progress<br>bit1: EAL=1 - set-point programming in progress<br>bit2: WEE=1 - memory write in progress<br>bit3: MIG=1 - display flashing<br>bit4: UND=1 - input underrange<br>bit5: OVR=1 - input overrange<br>bit6: MBAR1=1- bargraph LED01flashing<br>bit7: MBAR26=1 - bargraph LED01flashing<br>bit8: ALR1=1 - AL1 relay ON<br>bit9: ALR2=1 - AL2 relay ON<br>bit10: ALR3=1 - AL3 relay ON<br>bit11: ALR4=1 - AL4 relay ON<br>bit13,bit12:DPH,DPL - DP position (Fn03):<br><b>00</b> - „0000”<br><b>01</b> - „0.000”<br><b>10</b> - „00.00”<br><b>11</b> - „000.0”<br>bit14: Input type :<br><b>0</b> - current<br><b>1</b> - voltage<br>b15: - not used |
| 40004/<br>0x0003            | <i>Set-point 1 level</i> | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>    | <b>1800 (0x0708)</b> | AL1   |
| 40005/<br>0x0004            | <i>Set-point 2 level</i> | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>    | <b>200 (0x00C8)</b>  | AL2   |
| 40006/<br>0x0005            | <i>Set-point 3 level</i> | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>    | <b>1500 (0x05DC)</b> | AL3   |
| 40007/<br>0x0006            | <i>Set-point 4 level</i> | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>    | <b>500 (0x01F4)</b>  | AL4   |
| 40008/<br>0x0007            | <i>Output current</i>    | V (R)   | <b>-32768 - 32767 (0x8000-0x7FFF)</b> | -                    | *10 <sup>-3</sup> mA  |
| 40009/<br>0x0008            | <i>Mnimum read-out</i>   | P (R)   | <b>-999 - 9999 (0xFC19-0x270F)</b>    | <b>0 (0x0000)</b>    |   |
| 40010/<br>0x0009            | <i>Maximum read-out</i>  | P (R)   | <b>-999 - 9999 (0xFC19-0x270F)</b>    | <b>2000 (0x07D0)</b> |   |
| 40011/<br>0x000A            | <i>Bargraph height</i>   | V (R)   | <b>0-27 (0x0000-0x001B)</b>           | -                    | <b>0</b> - Display underrange (LED01 flashing)<br><b>27</b> - Display overrange (LED26 flashing)  |

| Register number/address | Variable/parameter                  | Type    | Value range   | Default value     | Comments   |
|-------------------------|-------------------------------------|---------|---|-------------------|--|
| 40012/<br>0x000B        | <i>Bargraph colour 0108</i>         | V (R)   | <b>0-65535 (0x0000-0xFFFF)</b>                                      | -                 | Colour codes:<br>00 - off<br>01 - green<br>10 - red<br>11 - orange<br>bit1,bit0: LED01(lowest)<br>bit3,bit2: LED02<br>bit5,bit4: LED03<br>bit7,bit6: LED04<br>bit9,bit8: LED05<br>bit11,bit10: LED06<br>bit13,bit12: LED07<br>bit15,bit14: LED08 |
| 40013/<br>0x000C        | <i>Bargraph colour 0916</i>         | V (R)   | <b>0-65535 (0x0000-0xFFFF)</b>                                      | -                 | Colour codes: see above<br>bit1,bit0: LED09<br>bit3,bit2: LED10<br>bit5,bit4: LED11<br>bit7,bit6: LED12<br>bit9,bit8: LED13<br>bit11,bit10: LED14<br>bit13,bit12: LED15<br>bit15,bit14: LED16  |
| 40014/<br>0x000D        | <i>Bargraph colour 1724</i>         | V (R)   | <b>0-65535 (0x0000-0xFFFF)</b>                                      | -                 | Colour codes: see above<br>bit1,bit0: LED17<br>bit3,bit2: LED18<br>bit5,bit4: LED19<br>bit7,bit6: LED20<br>bit9,bit8: LED21<br>bit11,bit10: LED22<br>bit13,bit12: LED23<br>bit15,bit14: LED24  |
| 40015/<br>0x000E        | <i>Bargraph colour 2532</i>         | V (R)   | <b>0-65535 (0x0000-0xFFFF)</b>                                      | -                 | Colour codes: see above<br>bit1,bit0: LED25<br>bit3,bit2: LED26<br>bit15-bit4: -   |
| ...                     |                                     |         |   | -                 |  |
| 40033/<br>0x0020        | <i>Identification number</i>        | P (R)   | <b>0-65535 (0x0000-0xFFFF)</b>                                      | -                 | 0 - no number available  |
| 40034/<br>0x0021        | <i>Actual scaling points number</i> | P (R)   | From <b>2 (0x0002)</b> to Fn01 setting                              | <b>2 (0x0002)</b> | Actually defined in Fn02 number of scaling points.   |
| 40035/<br>0x0022        | <i>Input type</i>                   | P (R/W) | <b>0 (0x0000)</b> - current [mA]<br><b>1 (0x0001)</b> - voltage [V] | <b>0 (0x0000)</b> | Fn00   |

| Register number/<br>address | Variable/parameter            | Type    | Value range  | Default value         | Comments                                |
|-----------------------------|-------------------------------|---------|--|-----------------------|---|
| 40036/<br>0x0023            | <i>Decimal point position</i> | P (R/W) | <b>0x0000</b> - 0000<br><b>0x0001</b> - 0.000<br><b>0x0002</b> - 00.00<br><b>0x0003</b> - 000.0                | <b>2 (0x0002)</b>     | Fn03                                    |
| 40037/<br>0x0024            | <i>Read-out rounding</i>      | P (R/W) | <b>1 (0x0001)</b> - do 1<br><b>2 (0x0002)</b> - do 2<br><b>5 (0x0005)</b> - do 5<br><b>10 (0x000A)</b> - do 10 | <b>1 (0x0001)</b>     | Fn04                                    |
| 40038/<br>0x0025            | <i>Filetring level</i>        | P (R/W) | <b>0 - 9 (0x0000 - 0x0009)</b>   | <b>0 (0x0000)</b>     | Fn05                                    |
| 40039/<br>0x0026            | <i>Brgraph colour mode</i>    | P (R/W) | <b>1 (0x0001)</b> - single colour<br><b>3 (0x0003)</b> - tricolour   | <b>3 (0x0003)</b>     | Fn06                                    |
| 40040/<br>0x0027            | <i>AI 1 mode</i>              | P (R/W) | <b>0x0000</b> - H (high)<br><b>0x0001</b> - L (low)<br><b>0x0002</b> - A (alternating)                         | <b>0 (0x0000)</b>     | Fn07 - AI1 set-point mode setting       |
| 40041/<br>0x0028            | <i>AI 2 mode</i>              | P (R/W) | - " -  | <b>1 (0x0001)</b>     | Fn07 - AI2 set-point mode setting       |
| 40042/<br>0x0029            | <i>AI 3 mode</i>              | P (R/W) | - " -  | <b>0 (0x0000)</b>     | Fn07 - AI3 set-point mode setting       |
| 40043/<br>0x002A            | <i>AI 4 mode</i>              | P (R/W) | - " -  | <b>1 (0x0001)</b>     | Fn07 - AI4 set-point mode setting       |
| 40044/<br>0x002B            | <i>AI1 hysteresis</i>         | P (R/W) | <b>1 - 9999 (0x0001 - 0x270F)</b>  | <b>1 (0x0001)</b>     | Fn07 - AI1 set-point hysteresis         |
| 40045/<br>0x002C            | <i>AI1 hysteresis</i>         | P (R/W) | - " -  | <b>1 (0x0001)</b>     | Fn07 - AI2 set-point hysteresis         |
| 40046/<br>0x002D            | <i>AI1 hysteresis</i>         | P (R/W) | - " -  | <b>1 (0x0001)</b>     | Fn07 - AI3 set-point hysteresis         |
| 40047/<br>0x002E            | <i>AI1 hysteresis</i>         | P (R/W) | - " -  | <b>1 (0x0001)</b>     | Fn07 - AI4 set-point hysteresis         |
| 40048/<br>0x002F            | <i>Scaling points number</i>  | P (R/W) | <b>2-16 (0x0002 - 0x0010)</b>  | <b>2 (0x0002)</b>     | Fn01                                    |
| 40049/<br>0x0030            | <i>P01 input value</i>        | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>   | <b>0 (0x0000)</b>     | Fn02:P01                                |
| 40050/<br>0x0031            | <i>P01 read-out value</i>     | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>   | <b>0 (0x0000)</b>     | Fn02:P01                                |
| 40051/<br>0x0032            | <i>P02 input value</i>        | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>   | <b>2000 (0x07D0)</b>  | Fn02:P02                                |
| 40052/<br>0x0033            | <i>P02 read-out value</i>     | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>   | <b>2000 (0x07D0)</b>  | Fn02:P02                                |
| 40053/<br>0x0034            | <i>P03 input value</i>        | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>   | <b>25000 (0x61A8)</b> | Fn02:P03 Initial value for unused point |
| 40054/<br>0x0035            | <i>P03 read-out value</i>     | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>   | <b>25000 (0x61A8)</b> | Fn02:P03                                |
| 40055/<br>0x0036            | <i>P04 input value</i>        | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>   | <b>25000 (0x61A8)</b> | Fn02:P04                                |
| 40056/<br>0x0037            | <i>P04 read-out value</i>     | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>   | <b>25000 (0x61A8)</b> | Fn02:P04                                |

| Register number/<br>address | Variable/parameter                    | Type    | Value range                 | Default value     | Comments |
|-----------------------------|---------------------------------------|---------|-----------------------------|-------------------|----------|
| 40057/<br>0x0038            | <i>P05 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P05 |
| 40058/<br>0x0039            | <i>P05 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P05 |
| 40059/<br>0x003A            | <i>P06 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P06 |
| 40060/<br>0x003B            | <i>P06 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P06 |
| 40061/<br>0x003C            | <i>P07 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P07 |
| 40062/<br>0x003D            | <i>P07 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P07 |
| 40063/<br>0x003E            | <i>P08 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P08 |
| 40064/<br>0x003F            | <i>P08 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P08 |
| 40065/<br>0x0040            | <i>P09 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P09 |
| 40066/<br>0x0041            | <i>P09 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P09 |
| 40067/<br>0x0042            | <i>P10 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P10 |
| 40068/<br>0x0043            | <i>P10 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P10 |
| 40069/<br>0x0044            | <i>P11 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P11 |
| 40070/<br>0x0045            | <i>P11 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P11 |
| 40071/<br>0x0046            | <i>P12 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P12 |
| 40072/<br>0x0047            | <i>P12 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P12 |
| 40073/<br>0x0048            | <i>P13 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P13 |
| 40074/<br>0x0049            | <i>P13 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P13 |
| 40075/<br>0x004A            | <i>P14 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P14 |
| 40076/<br>0x004B            | <i>P14 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P14 |
| 40077/<br>0x004C            | <i>P15 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P15 |
| 40078/<br>0x004D            | <i>P15 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P15 |
| 40079/<br>0x004E            | <i>P16 input value</i>                | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P16 |
| 40080/<br>0x004F            | <i>P16 read-out value</i>             | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 25000<br>(0x61A8) | Fn02:P16 |
| 40081/<br>0x0050            | <i>Read-out for low linear output</i> | P (R/W) | -999 - 9999 (0xFC19-0x270F) | 0 (0x0000)        | Fn08:P01 |

| Register number/<br>address | Variable/parameter                            | Type    | Value range   | Default value        | Comments                   |
|-----------------------------|---|---------|---|----------------------|----------------------------|
| 40082/<br>0x0051            | <i>Read-out for linear output</i>             | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>  | <b>2000 (0x07D0)</b> | Fn08:P02                   |
| 40083/<br>0x0052            | <i>Low linear output value</i>                | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>  | <b>400 (0x0190)</b>  | Fn08:P01 (default 4.00mA)  |
| 40084/<br>0x0053            | <i>High linear output value</i>               | P (R/W) | <b>-999 - 9999 (0xFC19-0x270F)</b>  | <b>2000 (0x07D0)</b> | Fn08:P02 (default 20.00mA) |
| ...                         |   |         |   |                      |                            |
| 40097/<br>0x0060            | <i>Serial communication<br/>slave address</i> | P (R)   | <b>1 - 247 (0x0001-0x00F7)</b>  |                      | Fc01                       |
| 40098/<br>0x0061            | <i>Communication speed</i>                    | P (R)   | <b>3 (0x0003)</b> - 2400bps<br><b>4 (0x0004)</b> - 4800bps<br><b>5 (0x0005)</b> - 9600bps<br><b>6 (0x0006)</b> - 19200bps | <b>5 (0x0005)</b>    |                            |
| 40099/<br>0x0062            | <i>Parity</i>                                 | P (R)   | <b>0 (0x0000)</b> - no parity<br><b>1 (0x0001)</b> - even parity<br><b>2 (0x0002)</b> - odd parity                        | <b>1 (0x0001)</b>    |                            |
| ...                         |   |         |   | -                    |                            |
| 418435/<br>0x4802           | <i>Modbus Firmware ID</i>                     | P(R)    | <b>10000 (0x2710)</b>   | -                    |                            |

### 3.6 Display test.

PMS970 has special test procedure for LED display, relays and version check. The test is initiated when the meter is powered-up with ▲ key pressed. LED segments are lighted-up in following cycle:

- four digit meter version code,
- digital display (all segments simultaneously),
- alarm leds with output relays activation,
- bargraph green (all segments simultaneously),
- bargraph red (all segments simultaneously).

The ENT key toggles between simultaneous and single segment activation during test. ESC key closes the test.



#### 4. TECHNICAL SPECIFICATION

| CATEGORY                | PARAMETER                            | VALUE                                | COMMENTS        |
|-------------------------|--------------------------------------|--------------------------------------|-----------------|
| INPUT                   | Accuracy                             | +/-0.1% FS                           |                 |
|                         | Temperature coefficient              | +/- 100ppm / °C                      |                 |
|                         | Internal resolution                  | 15 bit                               |                 |
|                         | Sampling rate                        | 16,6Hz                               |                 |
|                         | Filter time constant                 | 0-15,36s                             |                 |
|                         | Noise rejection                      | >=65dB                               | f=50Hz          |
| CURRENT INPUT           | Range                                | 0..20mA                              | -0.1 .. +21mA   |
|                         | Input resistance                     | <56om                                |                 |
|                         | Max. input current                   | internally limited                   |                 |
|                         | Overvoltage protection level         | -0.6...+36V=                         | transil         |
| VOLTAGE INPUT           | Range                                | 0...10V                              | -0.05 .. +10.5V |
|                         | Input resistance                     | >=50kom                              |                 |
|                         | Overvoltage protection level         | -0.6...+36V=                         | transil         |
| CONTROL RELAY<br>OUTPUT | Rating                               | 1A / 250VAC                          |                 |
|                         | Contact configuration (2P version)   | 2 x NO/NC                            |                 |
|                         | Contact configuration (4P version)   | 4 x NO                               |                 |
|                         | Open contact withstand voltage       | 1000VAC                              |                 |
|                         | Contact life mechanical / electrical | 15x10 <sup>6</sup> / 10 <sup>6</sup> |                 |
|                         | Load capacity                        | 250VA                                | resistive load  |
| ANALOG OUTPUT           | Range                                | 3..21mA                              |                 |
|                         | Output voltage range                 | 10-30VDC                             |                 |
|                         | Accuracy                             | +/- 0.1%                             |                 |
|                         | Resolution                           | 12 bit                               |                 |
|                         | Temperature coefficient              | +/- 100ppm / °C                      |                 |
|                         | Output voltage effect                | +/-20ppm / V                         |                 |
|                         | Overvoltage protection level         | 36V                                  | transil         |
|                         | Refresh rate                         | 30Hz                                 |                 |
| SERIAL<br>INTERFACE     | Type                                 | RS485                                |                 |
|                         | Protocol                             | Modbus RTU                           |                 |
|                         | Transmission speed                   | 2.4, 4.8, 9.6, 19.2kbps              |                 |
|                         | Data bits                            | 8                                    |                 |
|                         | Overvoltage protection level         | +7 / -12V                            | transil         |
| SENSOR<br>EXCITATION    | Voltage                              | 24VDC, +5/-10%                       |                 |
|                         | Current max                          | 25mA                                 |                 |
|                         | Current limit                        | continuous                           |                 |
|                         | Overvoltage protection level         | 36V                                  |                 |
| POWER SUPPLY            | Voltage - AC 230V version            | 230VAC +10/-20%                      |                 |
|                         | - AC/DC 24V version                  | 20-35VDC 18-26VAC                    |                 |
|                         | Power consumption                    | <6W                                  |                 |

| CATEGORY           | PARAMETER                          | VALUE        | COMMENTS           |
|--------------------|------------------------------------|--------------|--------------------|
| DISPLAY            | Digits                             | 4            | Green LED          |
|                    | Digit height                       | 7mm          | (PMS970T)          |
|                    |                                    | 20mm         | (PMS970P)          |
|                    | Bargraph resolution                | 26           | (PMS970T)          |
| ENVIRONMENTAL      | Operating temperature              | 5..40°C      |                    |
|                    | Storage temperature                | -10 .. +70°C |                    |
|                    | Humidity (relative)                | 10-95%       | without condensing |
|                    | Enclosure protection (front)       | IP-65        |                    |
|                    | Enclosure protection (rear)        | IP-20        |                    |
|                    | Pollution degree                   | 2            |                    |
|                    | Overvoltage category               | II           |                    |
| ELECTRIC ISOLATION | Power supply - other circuits      | 2300VAC      |                    |
|                    | Relay outputs - other circuits     | 2300VAC      |                    |
|                    | Signal input - functional ground   | 1000VDC      |                    |
|                    | Excitation output - other circuits | 1000VDC      |                    |
|                    | Analog output - signal input       | 1000VAC      |                    |
|                    | RS485 - signal input               | 1000VAC      |                    |
| MECHANICAL         | Dimensions                         | 48x96x120mm  |                    |
|                    | Panel cut-out                      | 44.5x91mm    |                    |
|                    | Panel thickness                    | 0..15mm      |                    |
|                    | Horizontal spacing                 | >70mm        | axis to axis       |
|                    | Vertical spacing                   | >120mm       | axis to axis       |
| COMPLIANCE         | Electrical safety                  | EN 61010     |                    |
|                    | EMC                                | EN 61326     |                    |

## 5. REVISION HISTORY

| VERSION | MODBUS FIRMWARE ID | DATE    | CHANGES INFO                      |
|---------|--------------------|---------|-----------------------------------|
| 2.01    |                    | 05.2004 |                                   |
| 3.00    |                    | 12.2004 | serial communication added        |
| 3.05    |                    | 04.2005 | 3.00 fixed, display test added    |
| 3.06    | 10000              | 05.2005 | Modbus Firmware ID register added |
|         |                    |         |                                   |