INSTRUCTIONS
FOR
INSTALLATION AND USE
OF
MAGNETOSTRICTIVE TRANSDUCERS

SERIES PC

MODELS: PCS-PCP-PCR-PCM

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REVISION OF DOCUMENTS AND CORRESPONDENCE	
Transducer firmware reference version	**Manual version**
PC 99 V.01.00	V 1.0 Rev 2.
PC 2001 V.01.00	V 1.0 Rev 3.

SUMMARY

IMPORTANT: always bench check the transducer operational performance before installation.

1. INTRODUCTION

NOTE: All series PC have the same measuring head.
The measuring heads contain: a magnetostrictive impulse sensor, an electronics and the push buttons to set the calibration.
Any reference given with regards to the electronics is valid for all models.

This *manual is considered as an integral part of the supply* and is delivered with the material, even if it is not listed in the invoice.

When requested the customer may have a copy sent while purchasing negotiations are being carried out. In this way the Customer can assess the application which our product has been destined for.
Even if several transducers have been supplied, only one copy of the manual may be delivered (unless the customer requests otherwise).

1.1. RESPONSABILITY REGARDING USE

The transducers, even when supplied with external indicators, are only plant or equipment *parts and components*: they are sold in great numbers every year for many different types of use and, likewise, have to satisfy many different regulations, which are often unknown to the Supplier.
It is clear that under these conditions, DS Europe is forced to refuse any responsibility regarding use and thus limits itself to listing some fundamental and elementary precautions to ensure correct use.
In situations where there is a potential risk of damage or injury to people of things, or machine stops and measuring systems, it is the precise obligation of the User to make sure that there is adequate *insurance* cover and to inform the Supplier with regard to such, so that the Supplier is free to renounce the order or the supply.

1.2. INSTALLATION IN DANGEROUS ENVIRONMENTS

The PC series cannot be used in the presence of flammable, explosive, corrosive substances or in the presence of any dangerous materials, liquids or fumes. The transducer head has IP 65 environmental protection but it is not airtight (hermetic).
If there is any doubt concerning compatibility of transducer manufacturing materials, the Customer ought to inquire about the chemical-mechanical nature of the materials used.

1.3. QUALITY

Sturdy top quality transducers, designed to give maximum reliability and safety. The limitations and the precautions listed in the manual were included to help the User understand the importance of correct use and the need to adhere and indeed put into action the requirements of the law in order to avoid damages.

2. WORKING PRINCIPLE

An electrical pulse is injected into the waveguide contained in the probe. This pulse generates a corresponding magnetic pulse, which then links onto the magnetic field of the magnets contained in the cursor and generates a magnetostrictive mechanical torque pulse.
This *mechanical pulse* is generated along the wave guide at the velocity of sound found in metals (about 2800 m/sec) until reaching the *sensor positioned in the head* inside the electronics. The cursor position is caculated by measuring the time lapse between the electrical pulse and the return mechanical pulse

2.1. NOT MEASURING DEAD LENGTH

The dead length refers to the stretch at the very far end of the measuring probe where there is either no measurement or the measurement does not satisfy the technical specifications of the transducer.
Series PC certificates indicate dead length values.
Probe end (A) dead length (see certificate) is generally used for mechanical anchorage of the probe itself.

Should you require an improvement on standard linearity, you are advised to consider an adjunctive “dead length”, of about 20 – 25 mm, positioned near the measuring head.

3. MANUFACTURING MATERIALS

3.1. TRANSDUCER MANUFACTURING MATERIALS

The working principle requires that the manufacturing materials of the probe (cylindrical rod), the hexagonal part and relative fastening nuts of the head and the floats be made of non-magnetic materials.(=NM=diamagnetic).
For models bearing the suffix (-S), the probe and the union are made of AISI 316 L stainless steel. The measuring head casing is made of die-cast aluminium alloy.
For models bearing the suffix (-A), we have aluminium alloy instead of steel.

3.2. MANUFACTURING MATERIALS FOR PARTS NEAR TO THE TRANSDUCER.

In order to have transducer to work correctly, the magnetic field of the cursor must close across the magnetostrictive guide inside the transducer, even in the end areas of the A probe and near the head.

Permanent external magnetic fields generated by other magnets or residual magnetic fields, generated from the cursor coming into occasional contact or proximity of magnetizable materials (paramagnetic materials), can effect the measurement.

3.3. INSTALLATION IN CYLINDERS

Installation inside cylinders (Fig. 1 - 2). You are advised to use system shown in Figure 1. The one given in Fig. 2, where the surrounding parts are made of magnetic material (= M: soft metal, usually steel), should be considered very carefully and possibly avoided if we want to respect all the aforementioned conditions (section. 3.2).
The recommended distances (= limit) are indicated in Fig. 2 (mm).

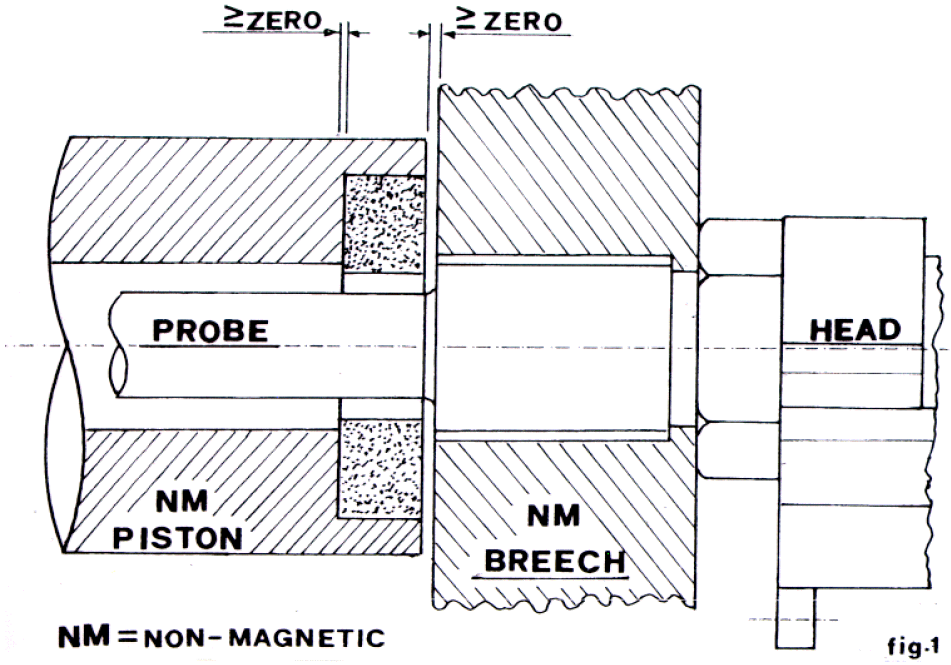


fig.1

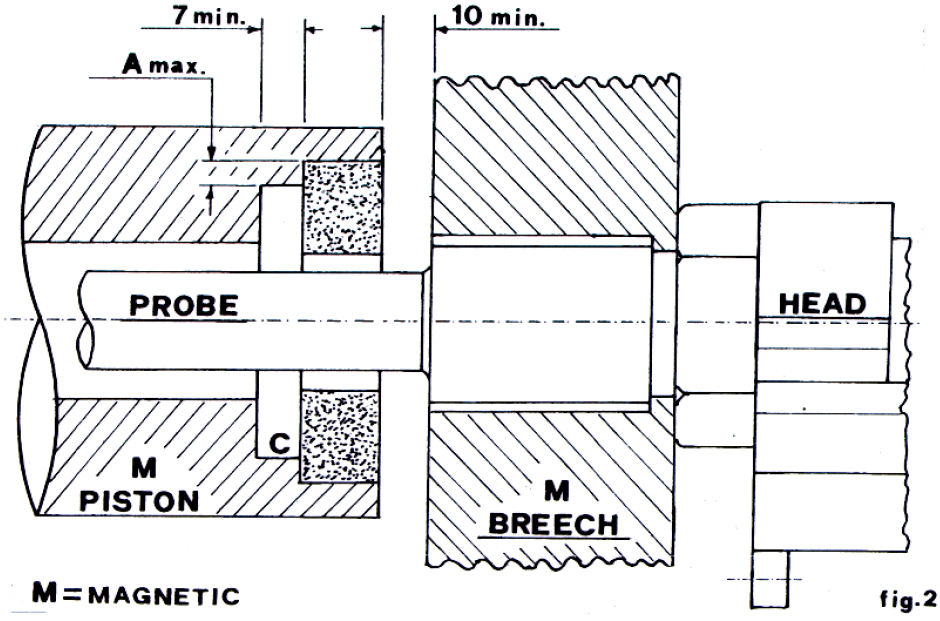


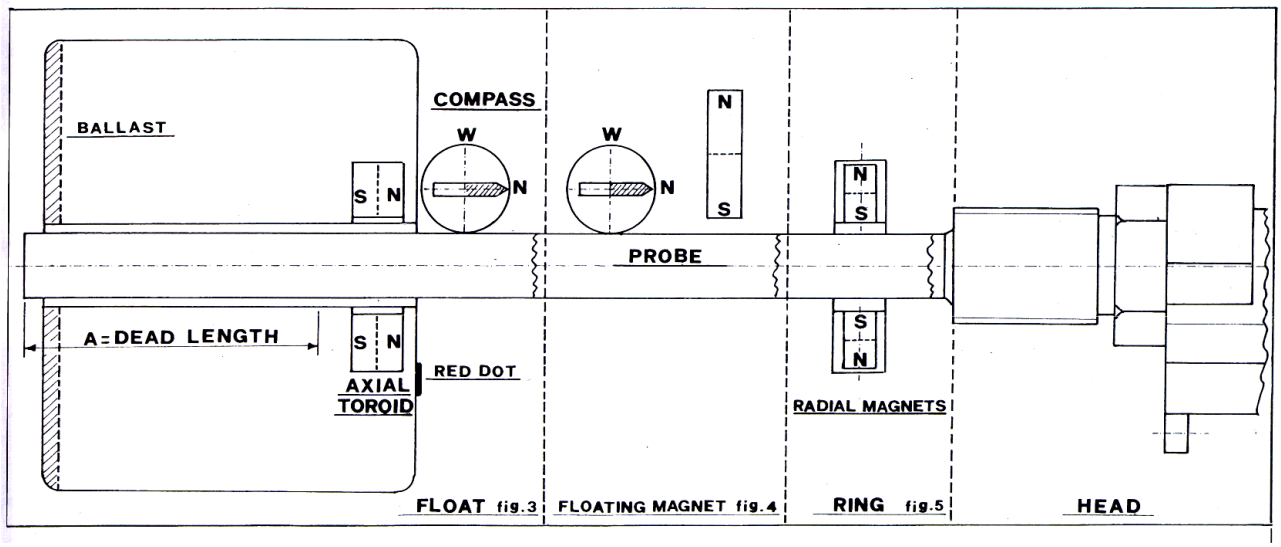
fig.2

A max. = 1/8 of the diameter (outside) of the cursor

3.4. EXTERNAL INSTALLATION

Installed with brackets, clamps etc.: all the brackets and the hexagonal head fastening nut must be made of non -magnetic material (=NM = non-magnetic: aluminium, brass, AISI 300 series stainless steel).

4. MAGNETIC CURSORS



Figures 3, 4 and 5

4.1. DIFFERENT MODELS

They include: magnetic rings, floats, slides (Mod. PCR).
All these models include: built-in magnets whose magnetic field may be radial or axial with reference to the magnetostrictive waveguide axis.
In order to work, it is essential that their magnetic field is sufficiently high and it is entirely coupled along the waveguide.

4.2. POLARITY OF MAGNETIC FIELD

Magnetic field polarity is established by the Manufacturer of the Transducers. No other polarity values are permitted as they might jeopardise performance. For this reason, be sure to follow indications in Figures 3-4-5.

4.3. HOW TO RECOGNISE POLARITY OF A MAGNET

The needle of a common compass is a magnet. The needle end, attracted by the Earth's North Pole is defined as "North".
According to the laws of physics regarding attraction of opposing poles, the North pole of a magnet attracts the South pole of a compass.
When necessary the North pole is marked with a coloured dot.

IMPORTANT:

Cursors, magnets or float, not produced by DS Europe and chosen by the Customer must be sent to DS Europe in order to be checked. DS Europe, if possible, will custom calibrate the transducer with them.
Customer must tell to DS Europe the application conditions: used materials , pole position, distance between magnets and probes etc..
For further supplies it is advisable to always have DS Europe keep a sample.

5. MAGNETIC CURSORS SUPPLIED BY DS EUROPE

5.1. WITH RADIAL MAGNETIC FIELD

These are ring models: ARR-1E; ARR-2E; ARR-3E.
They consist of rare earth cylindrical magnets, radial to the probe and contained inside polyamide plastic or aluminium rings.
Polarities are shown in Fig. 5.

The ring works correctly regardless of which side of the ring is pointed towards the measuring head.
The cursor can be fixed with glue or non-magnetic screws (AISI 300 series stainless steel, brass, etc..)
Take care to apply instructions given in figure Fig. 1 – 2. The space “C” in Fig. 2 can be filled with a non-magnetic material. (e.g. aluminium).

5.2. WITH AXIAL MAGNETIC FIELD

Ring toroids (Fig. 3): They are from ARA-5F models to ARA-10E models.
Toroid Cursors with opposing poles on the two base planes.
Important: in order to work correctly it is necessary that the polarity towards the measuring heads corresponds to the one indicated in Figure 3.

The material (ferrite (= F) or rare earth (=E)) is hard and delicate. It cannot be drilled and must be fixed with glue, preferably inside the relative housing or with an adapter made by the User.

5.3. FREE FLOATING CURSOR

Mod. AFR-1E –(*Figure 4A*):
It contains two parallel magnets arranged in radial fashion on a plate made of non-magnetic material, supplied with central fixing holes.
The distance from the AFR-1E cursor and the measuring probe must be 5mm with a ±1mm tolerance.
After having clamped the cursor within the above mentioned tolerancy, when moving along the probe, It must nonetheless mantain a ±0,2 mm maximum fluctuation from the probe.
These distances must be constant along all the measuring stroke onto the mod. PCR transducers.
Whenever the distance is bigger than 6mm , there is not enough magnetic field magnitude to recognise the magnetic cursor position.

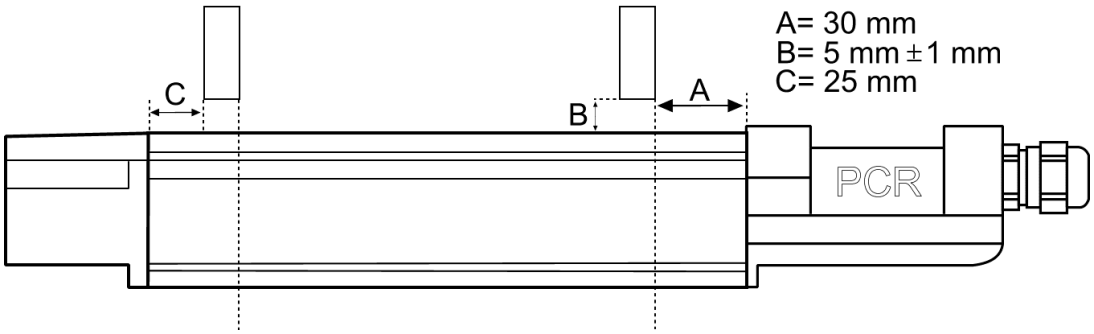


Figure 4A

Whenever the distance is shorter than 4mm (in any case remaining constant) there would be a constant measure error that would be easily recovered by recalibrating the transducer mod. PCR (either by means of the push buttons or the RS485 with an external computer).
When Mod. PCR is used together with AFR-1E floating cursor, It is calibrated in order to have a measuring stroke in the middle of two death zones A= 30mm and B= 25mm (*Figure 4A*).
The mod. AFR-1E can pass over these two “A” and “B” death zones without causing any damage but It will not generate any signal (analog outputs will be positively or negatively saturated while the RS485 will give a “9999999” output).
For performance optimisation, the Customer must supply DS Europe with all the installation conditions

5.4. MAGNETS CHOSEN BY THE USER

It must have a high magnetic field, invariable throughout time and with a high maximum working temperature. The lobe of the magnetic flow must be wide enough to interest the magnetostrictive waveguide. Polarity must be as indicated in Fig. 4.
Mark the North Pole with a coloured dot.
You are advised to use permanent rare earth magnets for temperatures up to 120°C, with diameters of 5÷8 mm and lengths of 10÷20 mm.

The magnetic field is considered to be sufficient when the measurement, controlled in the factory, occurs near the dead length “A” of the probe end and at all the points along the measuring stroke.

The magnets must be sent to the factory for performance optimisation, indicating all the methods of use.

6. FLOATS

6.1. INSTALLATION ADVICES

- The magnet inside the float (usually in the middle or on the top) is placed towards the measuring head: in order to reduce or cancel (Fig. 3) the dead length (A) of the probe end.
  The top of the float closer to the magnet is marked by a coloured dot.

- When the float is used in the liquid, it must remain upright in order to reduce probe contact friction and avoid possible measuring errors resulting from different positions that may be taken up, with respect to the measuring probe.

6.2. BALLAST

For measurement (Fig. 3) of two liquids with different specific gravities, in a tank with two floats, be sure that the float has been “sunk”.
Drill a tiny hole (1÷1,2 mm max). Introduce as much lead or heavy liquid that is required. Then weld the hole close.

7. TRANSDUCER INSTALLATION

NOTE 1): Radial movements of the probe with respect to the cursor or vice versa, due to vibration, shocks or not good axiality of the probe, do not have a great effect on measuring.

NOTE 2): The PCS and PCP models are supplied in two versions: in one version the parts which come into contact with liquid are made of stainless steel and welded to one another (suffix: – S) and in the other version these parts are made of aluminium and glued to one another (suffix: - A).

In the aluminium version (-A), great attention must be taken to prevent vibration, shocks or overpressure that could damage the transducer.

7.1. MOD. PCS (S = Standard)

The measuring probe is fitted with a threaded union.
The thread is: M 18 x 1,5. The thread on the fixed side (on the base of the hydraulic actuator, on the tank) can have cylindrical or conical sealing.
The sealing must be effected with an O-Ring inserted in the union or in the fixed part.

When the *probe is very long* (more than one metre), It is advisable to take special constructive provisions to prevent undesired excessive probe wavering (more than 1-2 mm) or swinging due to vibration and shocks.
It is to be considered the possibility of using a magnetic cursor with a radial slotting system (Mod. ARR-2E) through which It can pass the probe anchorage.

7.2. MOD. PCP (P = flanged well)

The probe (well) and the threaded union connected to it are previously installed in the hydraulic cylinder or in the tank so that there is no need to disassemble them should the transducer need servicing.

The waveguide (together with the measuring head) is inserted in the well and the head is clamped to the hexagonal flange of the well union.
Assembly of PCP model is similar to PCS model (section. 7.1).

IMPORTANT: the waveguide must be always kept straight and any bending on the axis exceeding 10 mm per metre will irreversibly damage the wave guide. This kind of damage can be easily found out by DS Europe and is not covered by the warranty.

NOTE: during installation or removal of a transducer equipped with threaded union (PCS, PCP, PCM), use only the hexagon for clamping.

NO CLAMPING TORQUE MUST BE APPLIED TO THE CASE CONTAINING THE ELECTRONICS. *USE THE HEXAGON.*

7.3. MOD. PCR (with slide)

The transducer is supplied with two fixing bases with plastically insulated suspensions. Remember to ground measuring head pin.

8. PRESSURE ACTION ON THE MEASURING PROBE

The outside pressure has a radial direction on the external wall of the probe itself and axial on the tip of the probe (A) (fig. 3).
Radial action tends to reduce (= press) the circular walls of the probe but has no significant effect on the measurement.
The axial action of the pressure on the tip of the measuring probe (A) tends to reduce its length. This is also generally negligible.

9. ELECTRICAL SPECIFICATIONS.

9.1. POWER SUPPLY

Serie PC electronics is equipped with built-in voltage regulators that allow transducers to receive a power supply of 24 VDC, ±15%.
To guarantee correct operation, the supply voltage must be stabilised and filtered *at 24 VDC*.
Calibration and testing are done in the factory at 24 VDC.
Interconnecting cables must be of size that can support currents at least of 0,8 A.
To reduce external electrical interference, the power supply must satisfy EC standards and thence be contained within a metal casing with also shielded and grounded supply cables.
Warm-up: after turning on the transducer, it is advisable to wait a few seconds before starting any measure or calibration. This gives the built-in electronics time to warm up and to reach the correct operational temperature. The warm-up time, common to all the electronic equipment, depends on the context of the transducer application.

9.2. ABSORBED CURRENT

The absorbed current is about 70 mA (typical), with two cursors, analog output of 0÷10 V and active serial connection.
With the two current analog outputs, the absorbed current is about 110 mA.
In the version used for level measuring “L”, the absorbed current is about 30 mA.

9.3. SAMPLING FREQUENCY

The maximum sampling frequency is 1 kHz for transducers with strokes of up to 350 mm.

The sampling frequency is strictly related to:

- Transducer stroke.
- Number of cursors used: if a cursor gives the availability of a sampling frequency equivalent to 1 kHz, when using two cursors, each cursor will be sampled at a frequency equivalent to 500 Hz.
- Analog output for cursor velocity.

Version for level measurements “L” have a 7Hz sampling frequency.

To calculate the possible sampling frequencies consult *Table 1.*

TRANSDUCER STROKES	SAMPLING FREQUENCY
Up to 350 mm	1 KHz
from 350 to 1500 mm	500 Hz
from 1500 to 3000 mm	250 Hz

Table 1*: maximum sampling frequency with respect to length.*

Whenever a ***remote computer*** should request, by means of RS 485 connection (57.600 baud), the Cursor 0 position measurement, will have:

Request from remote computer:

@ 0 R 0 <CR>, for a total of 5 characters transmitted

Transducer reply:

0 R 0 1 2 0 5 0 0 <CR>, for a total of 10 characters transmitted

A program that continually questions the transducer, will generate (between questions and replies) a traffic of 15 characters. To transmit one character we need: 1 *start* bit, 8 *data* bits and 1 stop bit, thus a total of 10 bits per character.
So, considering requests and replies the total required bits amount to 150.

At transmission velocity of 57.600 bit/second, we obtain:

$$\frac{57.600 \text{ bit/ second}}{150 \text{ bit}} = 384 \text{ measurements/second (maximum)}$$

The computer may request two cursors to be measured. In this case the maximum number of measurement obtainable per second will be halved. Remember that these performance rates strictly depend on the computer (operating system and hardware) and the program structure used to interrogate the transducer.
For additional informations about serial communications protocol refer to Chapter 13.

9.4. RESOLUTION

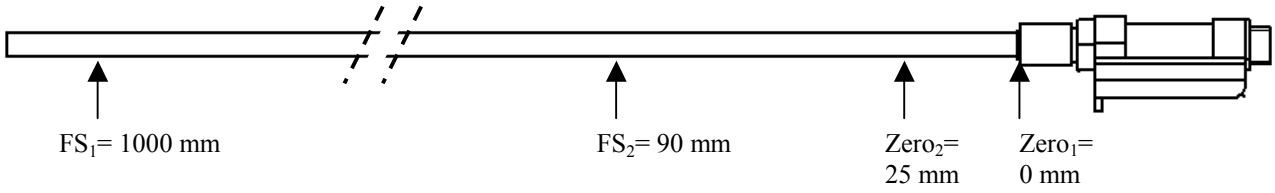
The transducer is digitally measuring the cursor position: It practically divides the measured lenght into many “steps”.

Every internal step correspond to a real lenght of 0,046mm: the transducer is practically measuring by doing a “step” counting.
For the internal measured “step” corresponds to 0.046 mm, it cannot measure displacement variations smaller than 0.046 mm and for this reason it is the measuring error that the transducer can commit when measuring the cursor position.

Dividing the measuring length, expressed in mm, by 0.046 and keeping only the whole part of the result we can get a good approximation of the length value expressed in the measuring unit inside the transducer.

The analog output has a 16 bit resolution. This means that theoretically it can divide its output interval (0-10V, 4-20mA) by 65535 points, corresponding, for example, to a ΔV minimum of 152 μV; effectively the real minimum variation (ΔV or ΔA) of the analog output is depending on the distance between the zero point (calibrated with TxZ control, for the cursor “x”) and the full scale point (calibrated with TxF control) expressed in the measuring unit inside the transducer, for this value is the number of distinct points that the transducer can resolve between two positions.

If the transducer was to have a measuring field equivalent to 1000 mm and voltage output of 0-10V, we would have:



Example 1: Suppose that we calibrate, with reference to the PCS hexagonal head, the zero position at 0 mm and the full scale at 1000 mm.

$\Delta V\text{min} = 10V/((1000-0)/0.046) = 0.00046\ V$

Example 2: Suppose that we calibrate, with reference to the PCS hexagonal head, the zero position at 25 mm and the full scale at 90 mm.

$\Delta V\text{min} = 10V/((90-25)/0.046) = 0.007077\ V$

It means that, the shorter the distance between the zero point and the full scale point, the greater the analog output $\Delta V\text{min}$ corresponding to a cursor displacement of 0.046 mm.
In the version for measuring level “L”, the measurement has a resolution of ± 0,15 mm.

9.5. NUMBER OF CURSORS

The transducers have a self-detecting function to detect the number of cursors applied to the measuring probe (*one or two*).
As soon as the transducer is turned on, it detects how many magnets are present on the probe and automatically sets the analog outputs enabled by the user during the personalisation procedure.

It is possible to program the transducer to work with both cursors and use one or the other as needs be.

In case where, during operating, one or two of the cursors are not present on the measuring probe wee see that:

- analog outputs: the output value goes up to a fixed value of 10 Vcc, until the cursor magnet is inserted.
- serial output: the absence of the cursors is signalled by the number 9999999 until the cursor is reinserted in the probe.

The minimum distance between the two cursors, in order not to interfere one with the other is 52 mm.
Smaller distances can generate interference between magnetic fields and there is even the possibility to have errors or even to lose the detection of one of the cursors.

9.6. ANALOG OUTPUTS

The analog outputs available in the series PC are maximum two as follows:

- From 0 to + 10 V.
- From 0 to + 5 V
- From 4 to 20 mA.
- From 0 to 20 mA.

It is possible to match to one analog output the cursor displacement (straight or reversed) or the velocity (OPTION) measures. For various possible configurations see Table 3.
For analog outputs a voltage of 0.00Vcc is not obtainable as the transducer is supplied with only positive voltage. The minimum voltage is about 50 mV (typical). These values can be reduced by using the mass dedicated to it as a reference for the analog signal (yellow wire or 5 pin, refer to chapter 10).

IMPORTANT NOTE: the outputs can only be positive and must be used paired: they can be *either* voltage *or* current, but not mixed; it is not possible to match a current output with a voltage one.

Number of cursors	Output: A/D1	Output: A/D 2
1	One displacement	-
1	One displacement	One velocity
2	One displacement	One displacement
2	One velocity	One velocity

Table 3: possible analog output configurations

The direction of the cursor displacement signal detected in voltage or in current can be modified by the User by means of RS485 throught external computer (recommended). In the case of a voltage output of 0÷10 V It is possible to match the 10 V signal at full scale. This setting of 0÷10 V can be inverted to 10÷0 V (It is possible also to do the personalisation for the current outputs).
For direction settings (if not specified in the order) see chapter 13.

9.7. RS-485 DIGITAL OUTPUT

RS-485 has a maximum resolution of 0,046 mm.
The transducer (*slave*) consents calibration and total management/configuration of its functions by remote unit (*master*).
The RS-485 serial connection allows the possibility to parallel connect up to 32 transducers at the same time. The cable can have a maximum length of 1000 metres (using 24 AWG twisted cable in accordance to EIA 485 Standard), if mounted with a good immunity against interference. In practice the defined standard reference limits are to be considered indicative and the results are depending on the application conditions. Whenever particularly long signal lines are used there may be signal dampening, which can be resolved by applying signal repeaters generally found on the commercial market.

Using this (RS 485) connection it is possible to program the outputs in the desired modality, even during transducer working.

The transmission velocity is fixed at 57600 baud and the serial communications port must be set in the following way:

- Data bit = 8
- Parity = None
- Stop bit stop = 1
- Flow control = None

Should transducers with RS 485 multi-drop output be connected to a computer not equipped with suitable interface, but RS 232 serial port (like a computer notebook), it is possible to interpose converters that pass from the RS232 to the RS485, remembering that they must support the conversion in transparent way with full RS485 protocol management.
On today's market we have *passive* and *intelligent* converters. The passive ones, however are ill-advised as they only provide relative signal level adaptation to two protocols, whereas the intelligent converters (recommended type) also provide the data flow direction recognition and self-adapting serial transmission velocity.
For any further details relative to RS485 connection, (specifications and requirement) not specifically dealt with here, refer to EIA 485 standard.

9.8. CURSOR VELOCITY (for displcement measurements)

In the chart, we correlate the transducer measuring field (=FS) with maximum cursor translation velocity in relationship to the resolution chosen for the measurement (Step)
In the figure, Y-axis refers to the maximum translation velocity while the measuring field of transducers (=FS) is represented on the X-axis. The graph scale is logarithmic and the reference point values reported (Y axis) on the table are expressed in metres per second (m/sec).
The resolution values refer to a measuring step, where a Step is considered to be the number of mm required to sample the translation velocity of the cursor having a significant measurement in relationship with the sampling frequency used for phenomena acquisition.

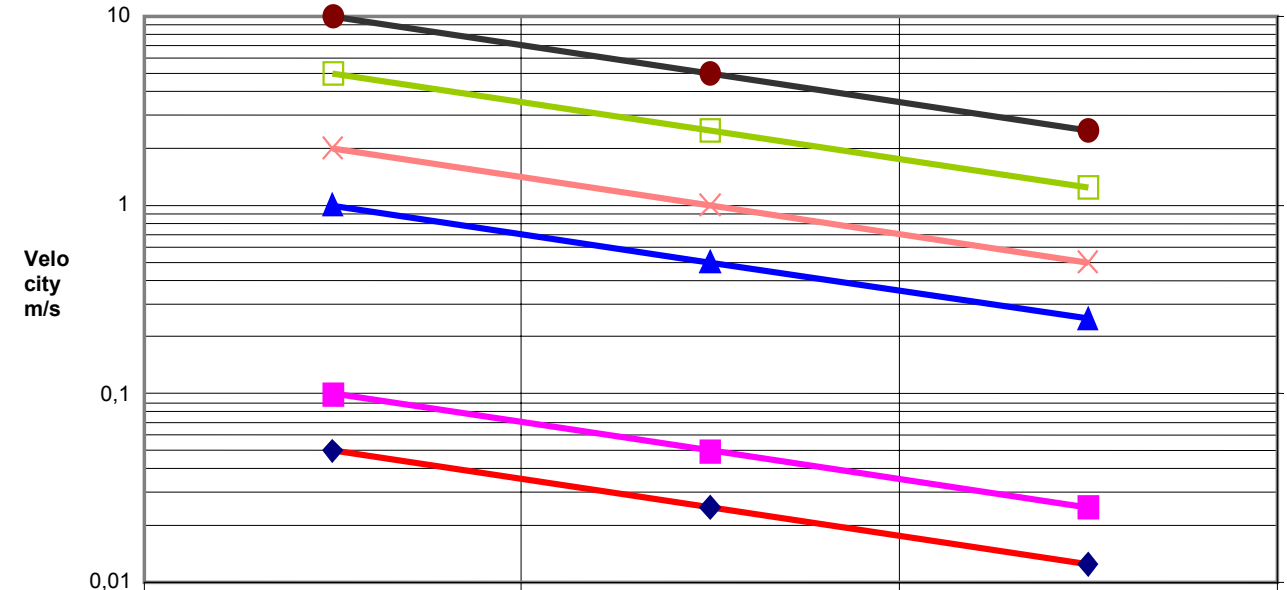
For example: a transducer with FS=350 mm in the case where cursor moves at a velocity of 1 m/sec, the significant measuring step is 1mm. If however the displacement value were 0,05 m/sec, we would have a corresponding significant measuring step of 0,05 mm.

When FS= 350 mm there is a corresponding *sampling frequency* = 1000 *samples* / sec.

If *cursor velocity is* = 50 mm / sec.

$$Step = \frac{50 \text{ mm / sec}}{1000 \text{ samples/ sec}} = 0{,}05 \text{ mm / samples}$$

Relationship between cursor translation velocity and FS, for significant measuring step



	Fs up to 350 mm	FS from 350 to 1500 mm	FS from 1500 to 3000 mm
0,05 mm	0,05	0,025	0,0125
0,1 mm	0,1	0,05	0,025
1 mm	1	0,5	0,25
2 mm	2	1	0,5
5 mm	5	2,5	1,25
10 mm	10	5	2,5

Step

The overmentioned resolutions depend also on the sampling rate and A/D converter capability of the electronics that is getting the transducer signal.

10. ELECTRICAL CONNECTIONS

In this chapter you are given information about electrical connections of series PC transducers.
It has been listed into: power supply, analog output and serial output.

Before feeding transducer check that the connections have been done according to following instructions:

In the case of interconnections longer than 5 meters, use conductors with diameters greater than 1 mm. In any case. It is to use only 100% shielded cables.
In the following text, the indications refer to the cable leads (option C, output with cable); in brackets (…) we have indications about connector pins (option P, connector output).
Example: WHITE (PIN3) means: WHITE output with cable, while (PIN3) refers to output with connector.

Incorrect connections can be easily found out by DS Europe and can cause serious damage to the transducer. The warranty does not cover this kind of damage.

10.1. CABLE OUTPUT

Table 1 indicate the color codes of conductors for the output cable.

CONDUCTOR COLOR	ELECTRICAL CONNECTION
RED	+ POWER SUPPLY
BLACK	- POWER SUPPLY
WHITE	+ ANALOG OUTPUT 1 (A/D1)
GREEN	+ ANALOG OUTPUT 2 (A/D2)
YELLOW	- ANALOG OUTPUT
BLUE	DATA – (RS-485)
BROWN	DATA + (RS-485)

Table 1: Connection to transducer cable output

10.2. CONNECTOR OUTPUT

Table 2 indicates the code for contacts (= PIN) of output connector.

CONTACT (= PIN) OF CONNECTOR	ELECTRIC CONNECTION
1	+ POWER SUPPLY
2	- POWER SUPPLY
3	+ ANALOG OUTPUT 1 (A/D1)
4	+ ANALOG OUTPUT 2 (A/D2)
5	- ANALOG OUTPUT
6	DATA– (RS-485)
7	DATA + (RS-485)

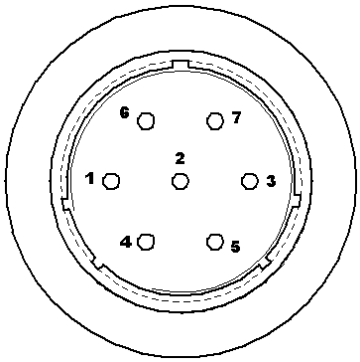
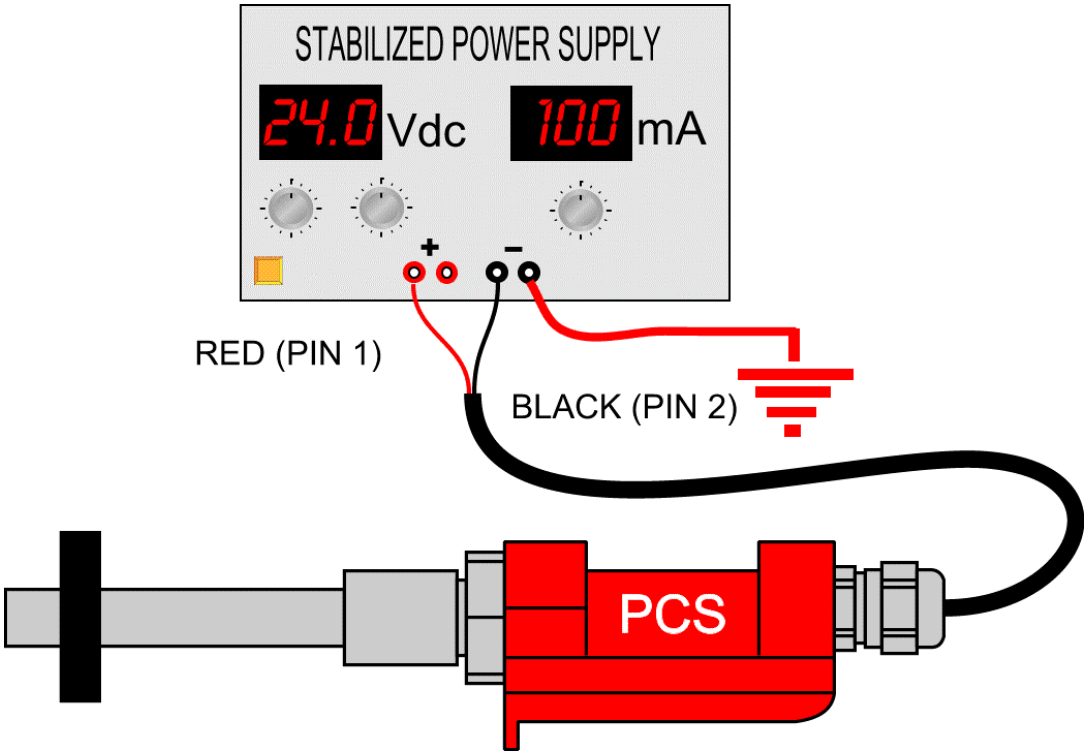


Table 2: Connection to transducer connector

10.3. POWER SUPPLY CONNECTION

Figure 6 shows how to connect the transducer to a stabilized and filtered power supply, which is to supply a voltage of 24 VDC and a current of at least 100 mA (better to choose power supply with 0,5 A min. current considering the operating pulse rate of the transducer).
When choosing power supply it is advisable to use *linear power supply* rather than switching type, which, if not of the best quality, has a great high frequency ripple which can noise the output or make It unstable.
Connect the RED wire (PIN1) to the positive terminal (+) of power supply and the BLACK wire (PIN2) to the negative terminal (-).
WARNING : The common of the power supply (" - " power supply) must be grounded in order to avoid damages due to mains fluctuations.

If several transducers are connected to the same power supply, make sure that the power



supply can distribute sufficient current.

figure 6:Connection to input for all PC series.

The transducer is protected against input polarity inversion and against the overvoltages within the limits fixed by the manufacturer of electronic components, in particular:

- If the RED wire and BLACK wire connections are inverted, there will be no current drawn because the protection diode will stop It.
- Series PC has an overvoltages protection system.
  For voltages above 30 Vcc this diode comes into action and short circuits the power supply, thus protecting the transducer from voltage pulses from drives (motors, remote controls etc). The maximum duration of overvoltage must never exceed 1 msec because after this period the component will be damaged in an irreversible manner and will need to be factory replaced.

10.4. CONNECTION OF 0÷10 V ANALOG VOLTAGE OUTPUT

To connect 0÷10 V analog voltage output, connect the YELLOW wire (PIN5) to the negative input of the multi-meter, or the data acquisition card (GND) and the WHITE wire (PIN3) to the positive.

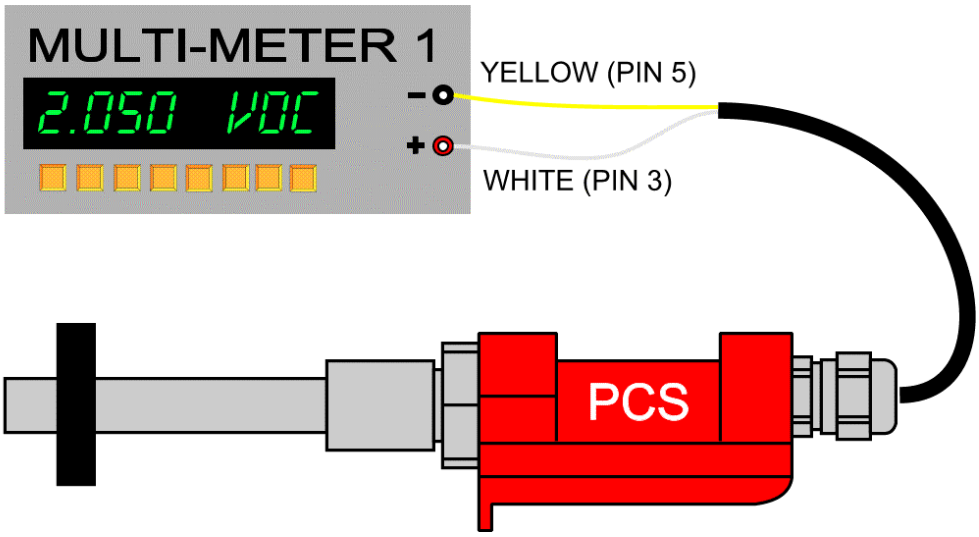


figure 7: Connection for analog voltage output

Note that for the analog signal negative, a separate YELLOW wire is used (PIN5) and not the BLACK input negative (PIN2); this provision allows us to separate feedback signal from the input and improve signal stability.

10.5. CONNECTION OF TWO VOLTAGE ANALOG OUTPUTS: 0÷10V

Connect the YELLOW wire (PIN5) to the negative of the multi-meteres or data acquisition card. Connect the WHITE wire (PIN3) to the positive of the first multi-meter and the GREEN wire (PIN4) to the positive of the second multi-meter.

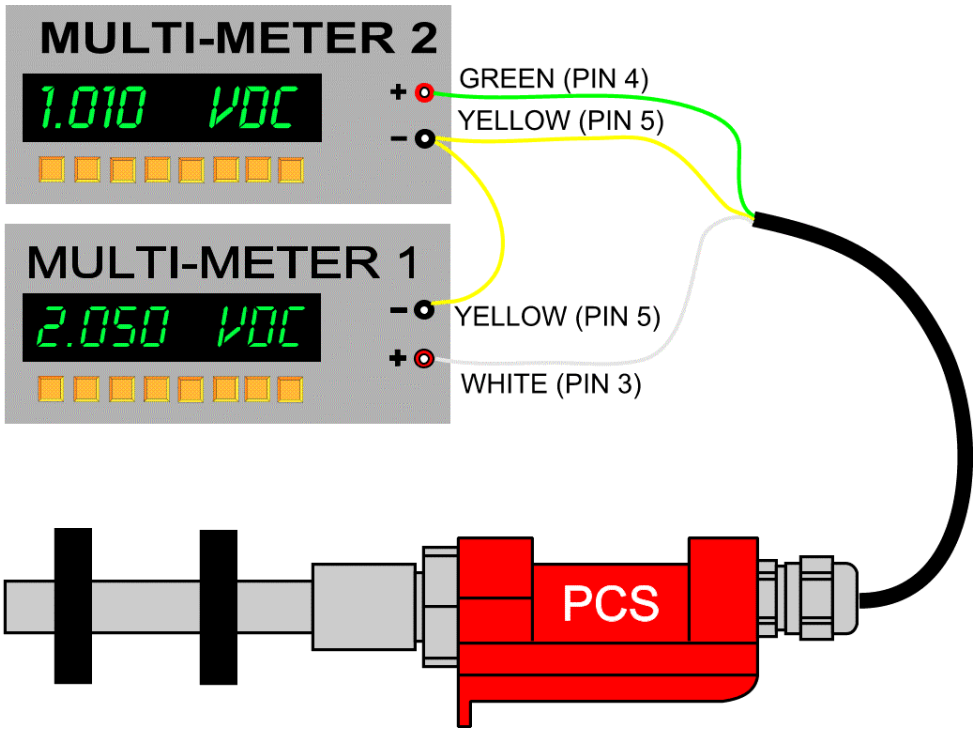


figure 8: Electrical connection for two analog voltage outputs.

The input impedance of data acquisition card, or multimeter, must be as high as possible in order to avoid a drop of voltage on the cable and on transducer output filter resistance. The input impedance must be in the proximity of 1 MOhm or greater; lower values in the proximity of 100 KOhm should be avoided.

10.6. CONNECTION OF 4-20mA CURRENT OUTPUT

For the current outputs (options supplied upon request) the connection can be carried out in the following two ways.
In *figure* 9 we have a representation of connection for two current outputs.

The maximum load resistance R_{Load} for the two current outputs is 600 Ohm.

10.6.1. CURRENT CONNECTION: 4÷20 mA WITH VOLTAGE READING: 1÷5 V

Figure 9 shows the electrical connection of the current output (4÷20 mA), but read as a voltage. This measurement is obtained by connecting a 250 ohm resistor to the output of the transducer. The resistor, covered by the 4-20 mA, consents us to visualise a drop of voltage of 1÷5 V.
The multimeter must be set to measure a DC voltage.

10.6.2. CURRENT CONNECTION

Like the previous paragraph, still referring to figure 9, but, in order to read the current, do not mount the 250 ohm resistor. Set the multimeter in order to read the 4÷20 mA current.

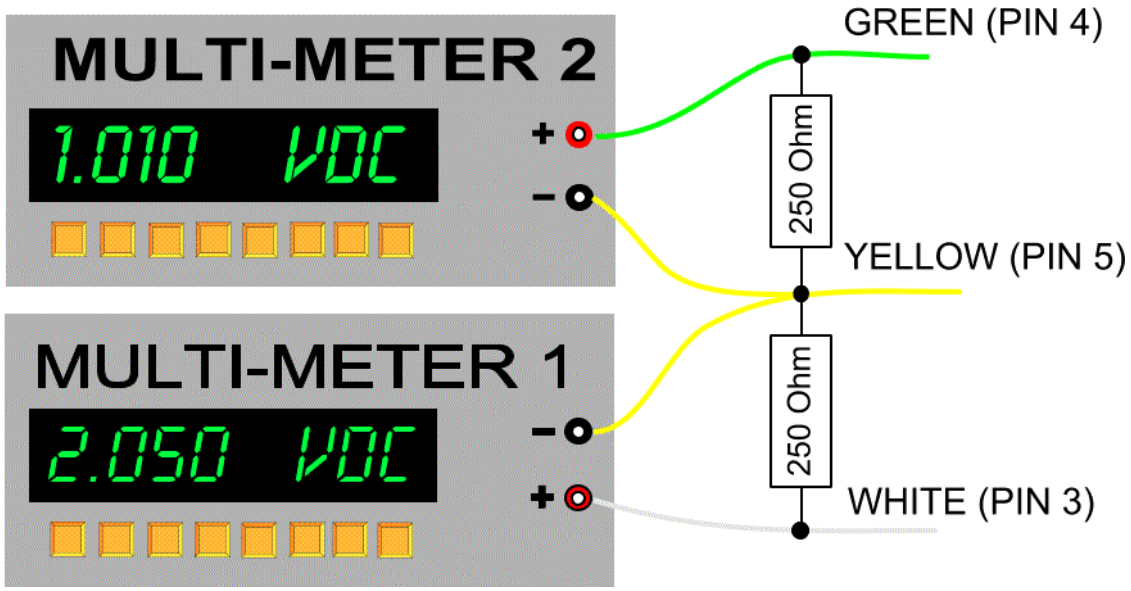


figure 9: Electrical connection of two 4÷20 mA outputs with a voltage reading of 1÷5 Vcc.

10.7. SERIAL PORT CONNECTION

To set up RS485 serial output connection to a remote unit, such as a computer or PLC, it is necessary to know specific connection layout of the chosen serial card interface (RS-485) because there is no standard connection.

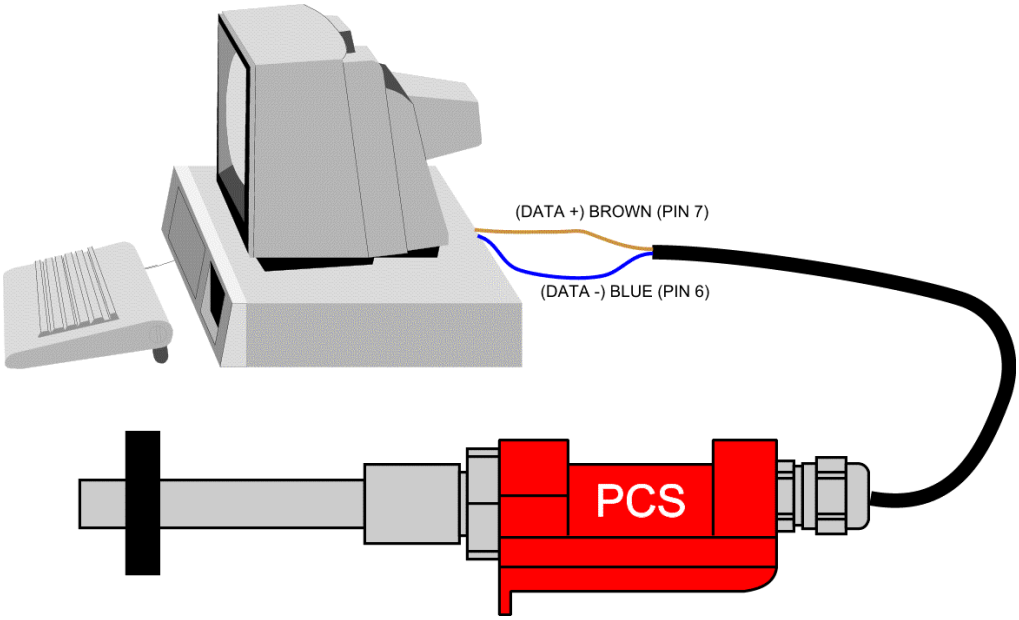


figure 10: Connection of the transducer to a remote unit (Computer)

In *figure 10* there is an example of connection to an RS485 serial port of a computer.
Connect the DATA + and DATA – wires to the terminal board.
Check carefully, referring to the RS485 card manuals (for the computer or for PLC), that DATA + of the transducer is connected to the DATA + of the remote unit, and likewise the DATA – of the transducer is connected to DATA – of the remote unit.
The best immunity to interference, for an RS485 serial connection, is obtained by using 100% shielded connection cables made by twisted pairs.
In addition, if necessary, use cables with double shielding.
In case of cables with double shielding, it is preferable to connect the shields to ground so that the internal shield is connected to ground at on end (towards the transducer, for example) and the external shield is connected to ground at the opposite end (towards the computer, for example). This procedure must also be done when the interconnection cable is passing through metal conducts in order to obtain more efficient shielding.
Whenever necessary it is also wise to consider the use of opto-insulators for serial lines.
The overmentioned considerations, however, are always to be assessed with respect to the specific application used and are only indicative.
Should you not succeed in stabilising the connection between the computer and transducer:

1. Try inverting the DATA + signals with the DATA – signals and vice versa;
2. Check all connections to the other units on the data line, if present;
3. Make sure the maximum interconnection length has not been exceeded;
4. Check that the parameters of the serial communications port (computer) correspond to those indicated in chapter 9.7;
5. Check computer serial port performance using another computer (also fitted with RS,485 MULTI-DROP interface)

10.7.1. TERMINATION RESISTANCE

In the MULTI-DROP connection you need to connect two terminating resistors, one (if not present) on the remote (card, computer, PLC, etc.) and one on the last transducer of the chain (the transducers are not supplied with built-in terminating resistors).
The termination resistance value must be in the proximity of 120 Ohm (¼ of a watt).
The terminating resistor must never be put onto another transducer other than the last one, so as not to lower the line impedance too much (*figure 11*).

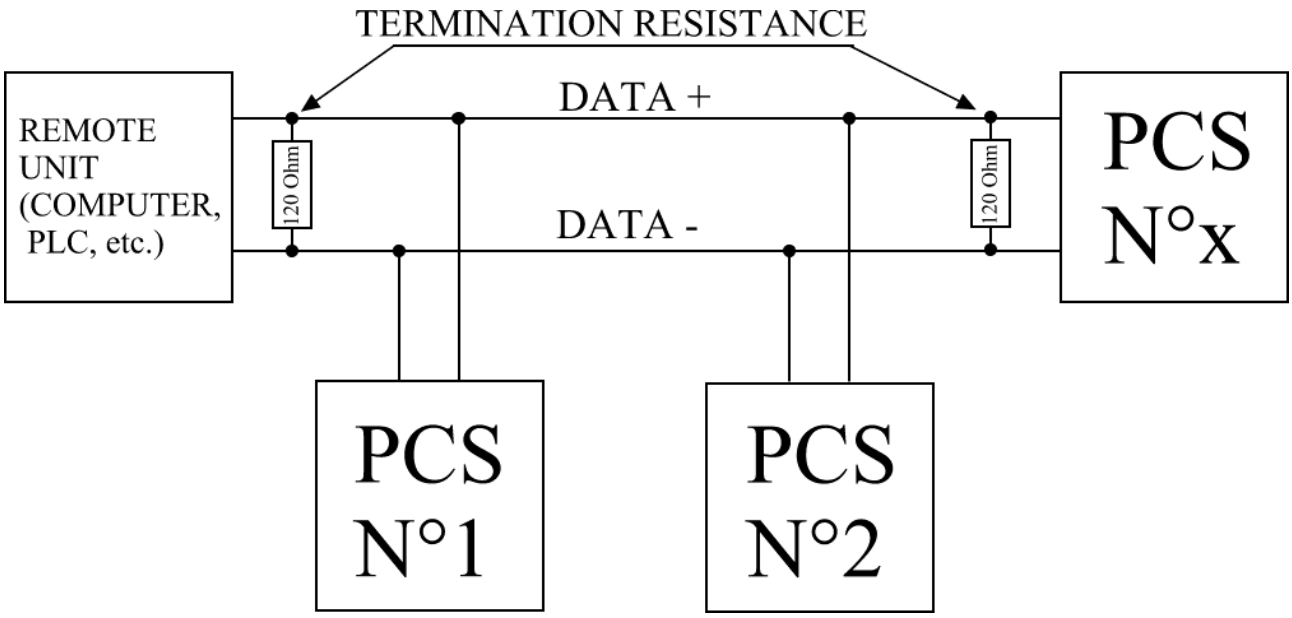


figure 1: Multi-drop connection

10.8. GROUNDING

Important: The transducer must be grounded accordingly to the Regulations in force in the country where it is used. These Regulations take priority to what is indicated in this manual.

The transducer is fitted with input filters for power supply, for the analog output signals and for digital signals. The use of such filters may be necessary depending on environmental conditions in which the unit is installed.
In order for these filters to operate correctly, the transducer needs to be connected to a ground free from interference produced by other equipments.
Figure 12 shows how to ground the transducer. This connection must be done with a conductor connected to a tag (2) of the shortest possible length and section (accordingly to Regulations).
As an alternative, It is possible to connect the shield (3) or the measuring rod (1); it is very important that it is only connected at one of these points to avoid ground looping.
WARNING : The common of the power supply (“ - “ power supply) must be grounded in order to avoid damages due to mains fluctuations.
For further details see chapter 11 on electromagnetic interference.

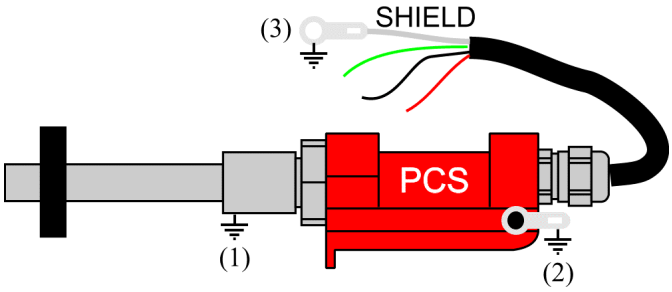


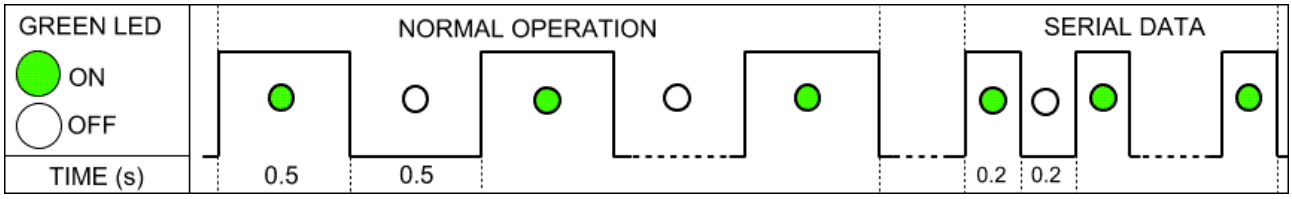
figure 12: grounding.

11. WARNING LEDs

A pair of LEDs are soldered onto the internal printed ciruitry: and they show the transducer inner working status. (*fig. 15*).

11.1. GREEN LED

Green LED shows that the transducer is powered and that there is a serial data transmission with the external computer throught the RS485 output.
The LED is normally blinking with a 0,5Hz frequency and when there is a data transmisssion there is an overimposed frequency modulation that follows the data transmission

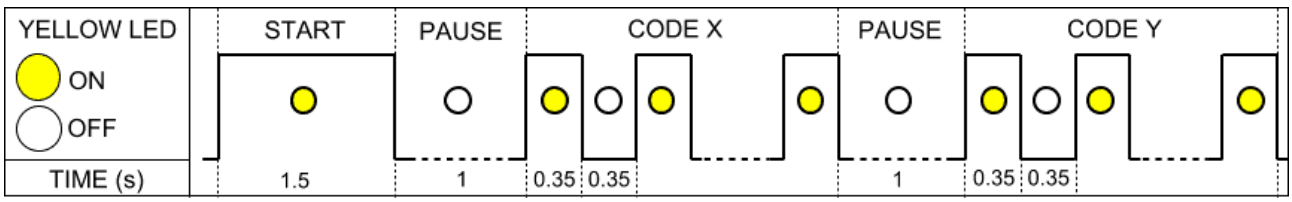


Green LED blinking description

11.2. YELLOW LED

Yellow LED shows information about the inner transducer way of working and also about errors (listed in the table) during the transducer working and when calibrating with push buttons.
"X" and "Y" blinking codes: "X" shows the kind of error and "Y" which cursor generates the error.

Blinking code	"X" Code	"Y" Code
Normal transducer condition	1	Number of set cursor (1 or 2).
No STOP signal on transducer	2	Number of cursor generating the error (1 or 2).
Not calibrated cursor	3	Number of cursor generating the error (1 or 2).
Unstringed cursor (lost cursor)	4	Number of cursor generating the error (1 or 2).



The blinking is like a "binary" code where the beginning of the status blinking is a long pulse and between X and Y codes there is a pause with LED off.

12. PROTECTION FROM ELECTROMAGNETIC EXTERNAL INTERFERENCE

NOTE: The measuring head, containing all the electronics, consists of a thick die-cast aluminium alloy box.
It is sealed (at least IP 65) with a rubber sealing and the cover is clamped with four screws on the box.
Under these conditions the series PC satisfies the EC Regulations, which are listed in the manual.
For industrial installation, where there is a great deal of electromagnetic interference, you are advised to take the following installation provisions for general use:

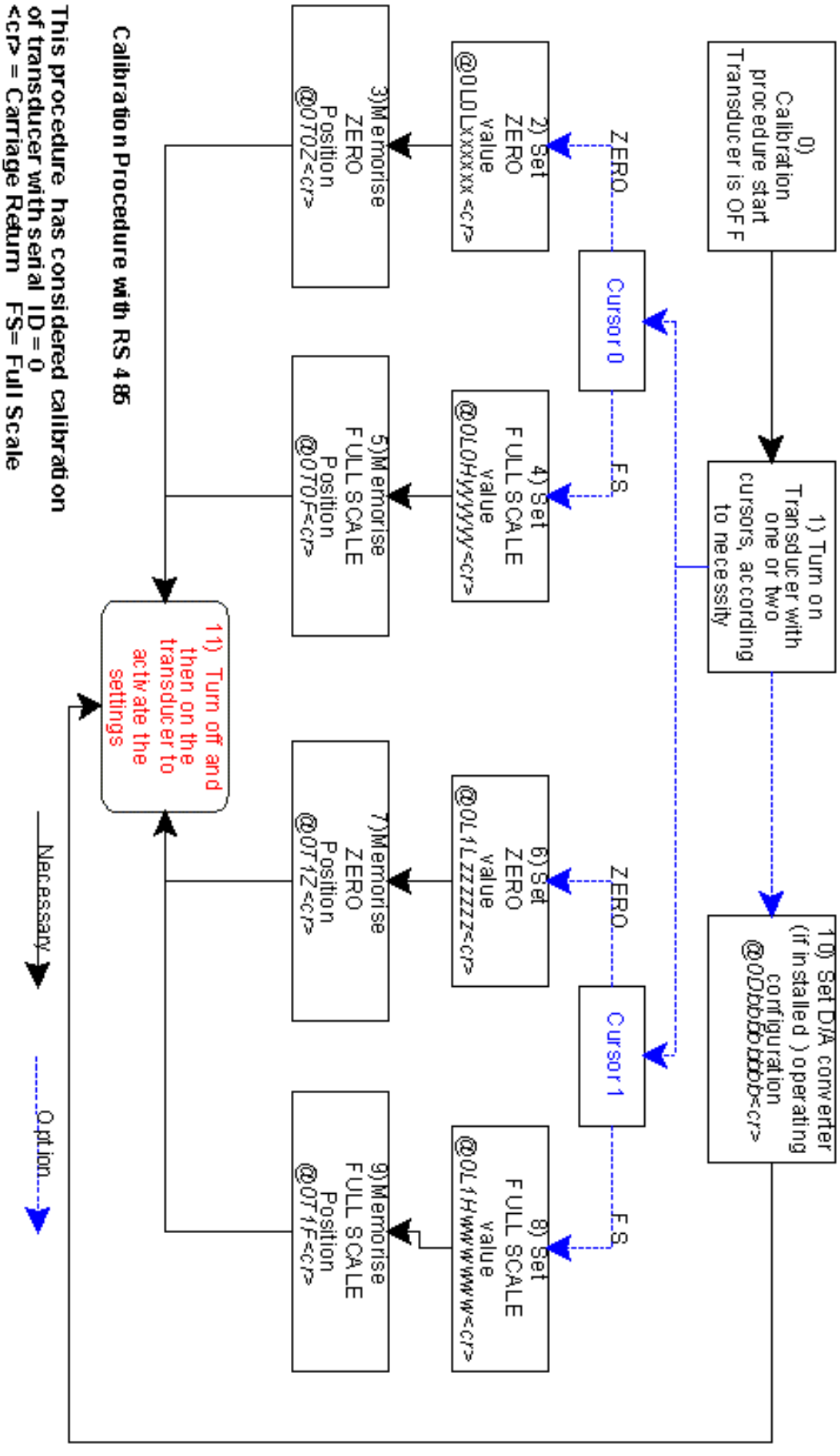
- Ground the metal frame to which the transducer is clamped. Better to have a grounding well separate from the main factory ground network, which is always full of electric interference.
- Ground the shield of the interconnection cable towards the conditioning electronics, to prevent ground looping.
- Should there be excessive interference, put the interconnection cable inside a steel tube (paramagnetic) with external insulation and connect it to ground near the transducer (from the opposite side of the cable shield).
- Apply all the ground and safety regulation.
- *Where there are long stretches of interconnecting cables*, solder cable joints inside the metal junction boxes.
  The shielding must not be locally grounded in the casing itself, but interconnected with one another.
- To obtain CE marking the measuring head and the interconnecting cables must be grounded (on a good ground).
  The measuring head is fitted with a ground terminal.

13. CALIBRATION METHODS

To calibrate the PC (PCS, PCR, etc.) the following procedure can be used:

- Using two push buttons inside the transducer and a tester connected to the analog output of the D/A 1 (*reduced calibration*, only usable if the transducer has D/A 1).
- Using remote unit (PC, PLC, etc.) and software.

Both permit you to calibrate transducer in a simple way. Using the serial connection makes everything easier as you have the added advantage of being able to personalise the analog output performance.


Calibration Procedure with RS 485
This procedure has considered calibration of transducer with serial ID = 0
<cr> = Carriage Return FS= Full Scale
0) Calibration procedure start Transducer is OFF
1) Turn on Transducer with one or two cursors, according to necessity
10) Set D/A converter (if installed) operating configuration @0Dbbbbbbbb<cr>
Cursor 0
ZERO
F.S.
2) Set ZERO value @0L0Lxxxxxx<cr>
3)Memorise ZERO Position @0T0Z<cr>
4) Set FULL SCALE value @0L0Hyyyyyy<cr>
5)Memorise FULL SCALE Position @0T0F<cr>
Cursor 1
ZERO
F.S.
6)Set ZERO value @0L1Lzzzzzz<cr>
7)Memorise ZERO Position @0T1Z<cr>
8) Set FULL SCALE value @0L1Hwwwwww<cr>
9)Memorise FULL SCALE Position @0T1F<cr>
11) Turn off and then on the transducer to activate the settings
Necessary
Option

13.1. MECHANICAL AND ELECTRICAL MEASURING FIELD COINCIDENCE:

The testing certificate is issued at the end of transducer manufacturing, following a complete operating performance check up (using computer testing procedure). Parameters and measurements reported are results of pre-calibration carried out to test transducer operating performance.
Any additional settings, by the User, are limited to match the electrical analog outputs (or digital) of the transducer (zero or full scale) with the limits of the mechanical stroke (initial and end of stroke) of the machine. Transducers having the same measuring field can have *zero* or *full scale* signals slightly different for the tolerance of components and tolerance during machining.
Important: The settings during installation should only be done if considered to be really necessary.

13.2. CALIBRATION WITH PUSH BUTTONS:

The transducer is factory pre-calibrated. Using built-in A and B push buttons, it can be calibrated on the field (*reduced calibration,* only usable if transducer has D/A 1)
On the field, it is *only possible to calibrate the zero and full scale positions.*
The result of the operation will be read by a tester positioned at output of D/A converter 1(between **White** and Yellow wires).
Calibrating operation always use D/A converter 1.
For convenience reasons, the cursor or float nearest to the electronics (red casing with electrical output) is referred to as *cursor 0,* while the cursor or float positioned between the Cursor 0 and the probe point will be referred to as *Cursor 1.*
To get a better idea of the identification number and position of the cursors on the probe, consult *figure 13*.

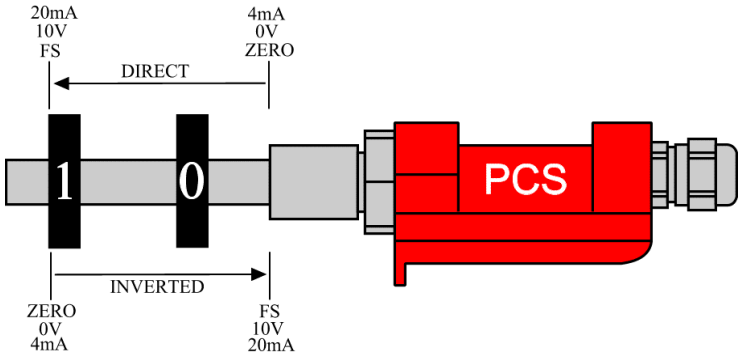


figure 13: View of PCS transducer with calibration and cursors numbers

To gain access to push buttons A and B you need to open the cover (*figure 14*) doing the following operations:

- Unscrew the four screws as shown in *figure 14*;
- Carefully remove the cover;
- Individualise the two push buttons on the printed circuit (*figure 15*);
- Calibrate as shown in sections.
- Once you have done the calibration, carefully put the cover back on and tightly screw it down making sure it is really well sealed.

Important: during calibration phase, avoid:

- Introducing or touching components with metal tools;
- Using or inserting liquid of any kind whatsoever;

- Move or put strain on internal wires;
- Carry out any kind of welding job on the card or near the circuit.;

Note: paragraphs 13.2.1 and 13.2.2 are referring to a D/A1 with voltage analog output but the fluctuating values can be current too (see following table).

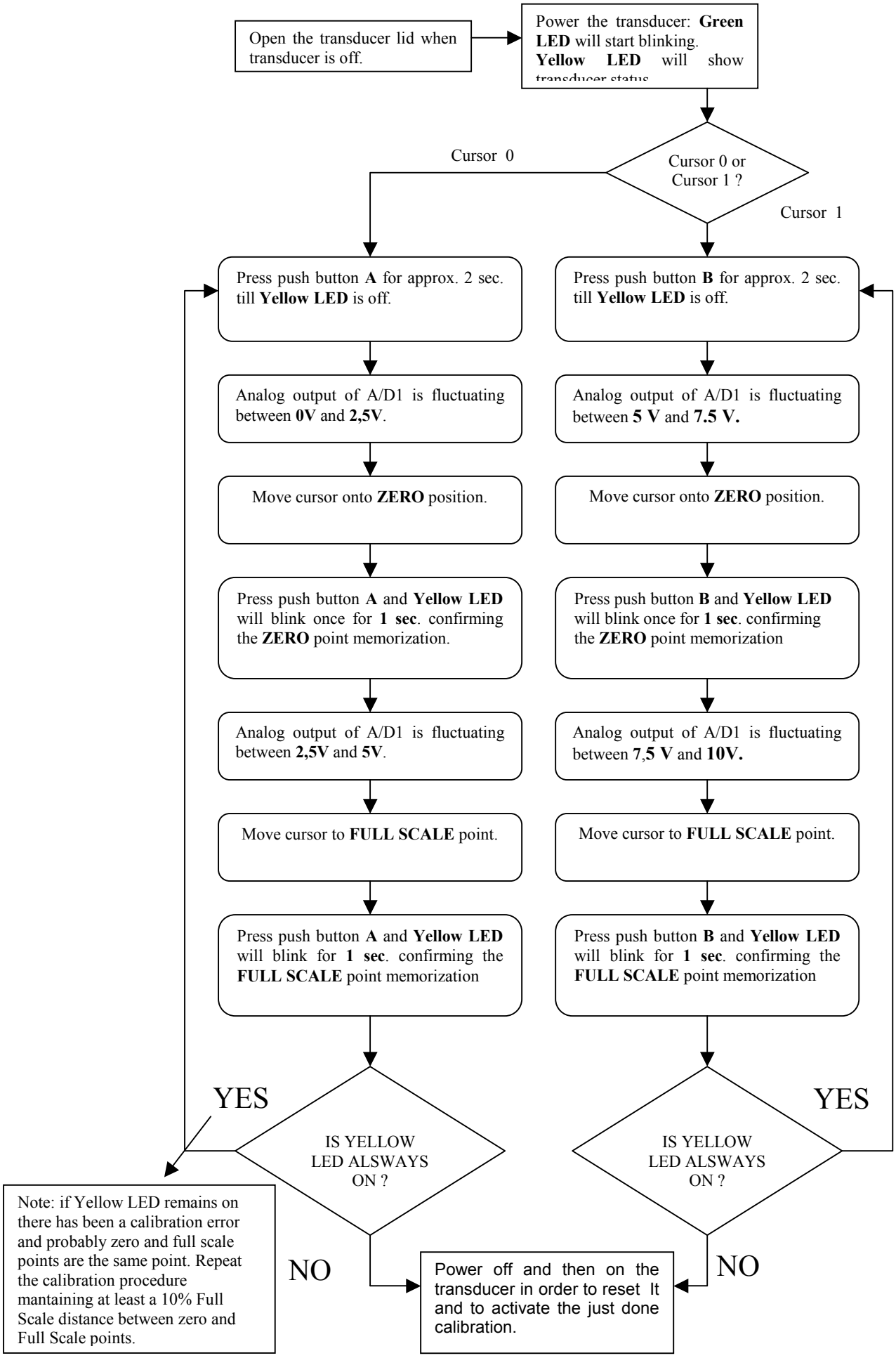
13.2.1. "0" cursor

1. Cursor "0" is beginning to be calibrated when *push button "A"* is pressed for approx. 2 sec. till YELLOW LED is off.
2. D/A converter 1 output is fluctuating from 0 to 2,5V (square wave with 0,25Hz frequency)
3. Cursor "0" is to be placed on *zero point*: when *push button "A"* is pressed the YELLOW LED will blink once for 1 sec. to show that zero position has been memorized.
4. D/A converter 1 output is fluctuating from 2,5V to 5V (square wave with 0,25Hz frequency)
5. Cursor "0" is to be placed on *Full Scale point*: when *push button "A"* is pressed the YELLOW LED will blink once for 1 sec. to show that zero position has been memorized. (there must be a 10% Full scale distence between zero and full scale points),
6. If YELLOW LED is OFF the calibration has been successfull and then It is to be powered off and then on in order to reset It and have the system operationg with the new calibration.
7. If YELLOW LED is ON there has been a calibration error and then restart calibration procedure by pressing push button A.

13.2.2. "1" cursor

8. Cursor "1" is beginning to be calibrated when *push button "B"* is pressed for approx. 2 sec. till YELLOW LED is off.
9. D/A converter 1 output is fluctuating from 5 to 7,5V (square wave with 0,25Hz frequency)
10. Cursor "1" is to be placed on *zero point*: when *push button "B"* is pressed the YELLOW LED will blink once for 1 sec. to show that zero position has been memorized.
11. D/A converter 1 output is fluctuating from 7,5V to 10V (square wave with 0,25Hz frequency)
12. Cursor "1" is to be placed on *Full Scale point*: when *push button "B"* is pressed the YELLOW LED will blink once for 1 sec. to show that zero position has been memorized. (there must be a 10% Full scale distence between zero and full scale points),
13. If YELLOW LED is OFF the calibration has been successfull and then It is to be powered off and then on in order to reset It and have the system operationg with the new calibration.
14. If YELLOW LED is ON there has been a calibration error and then restart calibration procedure by pressing push button B. .

D/A1 Output fluctuation during calibration	**0-10 V**	**0-20 mA**	**4-20 mA**
Cursor "0": D/A1 fluctuation for ZERO	0 V	0 mA	4 mA
	2,5 V	5 mA	8 mA
Cursor "0": D/A1 fluctuation for FULL SCALE	2,5 V	5 mA	8 mA
	5 V	10 mA	12 mA
Cursor "1: D/A1 fluctuation for ZERO	5 V	10 mA	12 mA
	7,5 V	15 mA	16 mA
Cursor "1": D/A1 fluctuation for FULL SCALE	7,5 V	15 mA	16 mA
	10 V	20 mA	20 mA


Open the transducer lid when transducer is off.
Power the transducer: **Green LED** will start blinking. **Yellow LED** will show transducer status
Cursor 0 or Cursor 1 ?
Cursor 0
Cursor 1
Press push button **A** for approx. 2 sec. till **Yellow LED** is off.
Press push button **B** for approx. 2 sec. till **Yellow LED** is off.
Analog output of A/D1 is fluctuating between **0V** and **2,5V**.
Analog output of A/D1 is fluctuating between **5 V** and **7.5 V.**
Move cursor onto **ZERO** position.
Move cursor onto **ZERO** position.
Press push button **A** and **Yellow LED** will blink once for **1 sec**. confirming the **ZERO** point memorization.
Press push button **B** and **Yellow LED** will blink once for **1 sec**. confirming the **ZERO** point memorization
Analog output of A/D1 is fluctuating between **2,5V** and **5V**.
Analog output of A/D1 is fluctuating between **7,5 V** and **10V.**
Move cursor to **FULL SCALE** point.
Move cursor to **FULL SCALE** point.
Press push button **A** and **Yellow LED** will blink for **1 sec**. confirming the **FULL SCALE** point memorization
Press push button **B** and **Yellow LED** will blink for **1 sec**. confirming the **FULL SCALE** point memorization
YES
IS YELLOW LED ALSWAYS ON ?
YES
IS YELLOW LED ALSWAYS ON ?
Note: if Yellow LED remains on there has been a calibration error and probably zero and full scale points are the same point. Repeat the calibration procedure mantaining at least a 10% Full Scale distance between zero and Full Scale points.
NO
Power off and then on the transducer in order to reset It and to activate the just done calibration.
NO

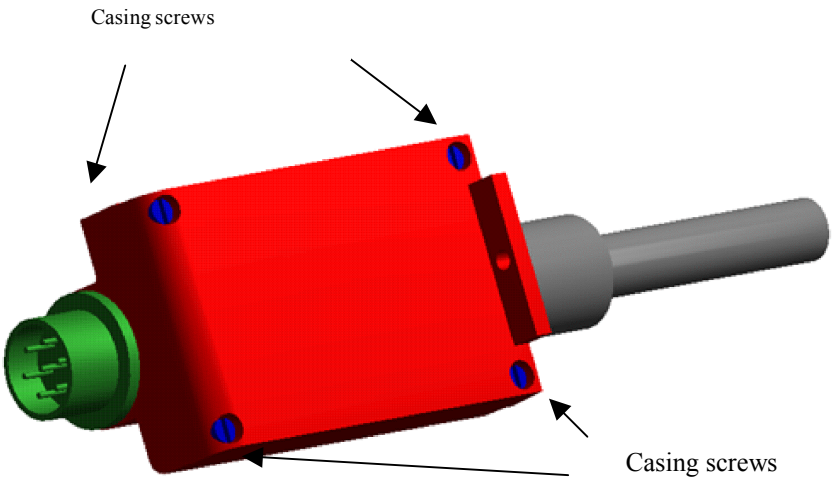


figure 14: Lower view of container for housing PC Series electronics

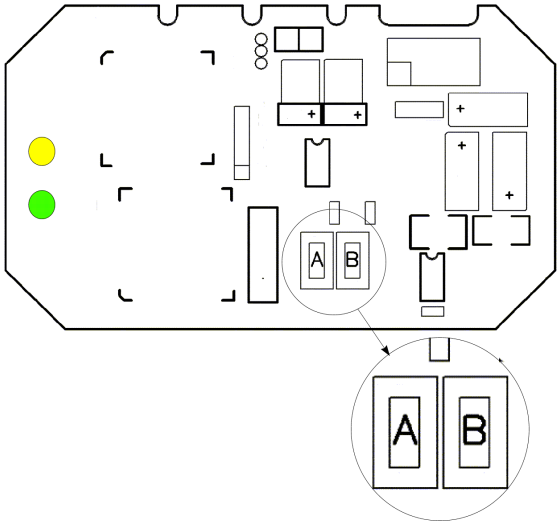


figure 15: Detailed view of push buttons and LEDs used for calibration.

One of the advantages of using the series PC is the possibility to be able to use only one part of the nominal stroke of the transducer without having to alter the stability and resolution of the transducer.

12.3 REMOTE CALIBRATION

All the settings relative to series PC calibration are memorised in an built-in EEPROM memory.
With this kind of memory the data storage is mantained even when there is no transducer power supply nor a built-in battery.

One of the features of EEPROM memories, that must always be considered while using the transducer, is that despite the fact the maximum number of storage cycles on these memories is very high, it is finite (a maximum of 10.000 typical storage cycles, according to statement made by Manufacturer of memories in question).

However, for typical transducer use, the specifications of these memories are more than sufficient.

The calibrating procedure by means of remote computer is described in the chapter 13 with the digital protocol.

14. SERIAL COMMUNICATIONS PROTOCOL

The series PC can also be used by means of remote connection to a computer or PLC.

You can:

- use the transducer measuring functions in “remote” mode;
- do transducer personalisation;
- configure analog outputs;

The simple communications protocol allows the transducer to be part of an RS485 multi-drop serial transmission line where there is a computer (operating as *master*) and one or more sensors which operate as *slaves*. During the serial transmission, the protocol function is to guarantee integrity of transmitted data, whether they be commands, measurements or transducer replies.
All the operations listed above are carried out by establishing communication between computer and transducer by means of a series of commands.
These commands must be an ASCII command string with a certain format.

14.1. PROTOCOL FORMAT

The protocol considers two types of message formats to be sent to the series PC transducer: one for *general commands* and the other for *transducer configuration* type commands.

14.2. COMMAND MESSAGE STRUCTURE

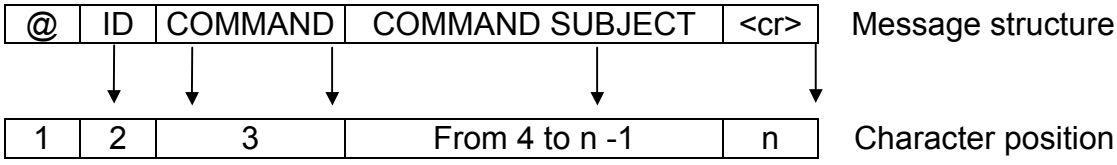
Structure of command messages to be sent from the computer to the PCS/PCR is as follows:

Each *command* must begin with an ASCII message initial character, @ (0x40).
This character “@” always takes first place in the message construction.
Afterwards we need to insert the identification (ID) of the transducer to which the command is being addressed. The ID must always be expressed as a number between “0” and “9”, or a letter between “A” and “Z” (capital), or simply by a question mark “?” when you wish to send a message to a transducer for which you have no identity.
The question mark, with the RS485 multi-drop serial connections (plus PCS/PCR on the same serial line), must be used with only one transducer connected to the line at a time. This is to avoid that all the connected transducers reply at the same time and thence creating a totally unmanageable situation. The “?” application is the way to establish connection with a transducer that has no ID and then afterwards designate it with one.

After identification (still in the second position of message construction) It is needed a character equivalent to the command you wish to send to the PCS/PCR.
The ASCII character always is in the third position in the message construction.
There is a description of the commands, further on, in section 14.3.

The command sent to the transducer must be followed by, if present, its subject matter, which can be formed by one or a number of ASCII characters starting from the fourth position in the message.
The end of message must always end with “<cr>” (Carriage Return, 0x0D).

COMMAND MESSAGE STRUCTURE



14.3. ACCEPTED COMMANDS

NOTE: The transducer recognises the command character sent, regardless of whether the equivalent letter is capital or small.

Suppose there is to connect a transducer with ID “0”, the following commands could be utilised:

14.3.1. COMMAND “A”

Command “A” allows to modify, or designate, the *transducer identity* (ID).
Accepted values are from “0” to “9” or “A” to “Z” (capital).

Example:

@	0	A	1	<cr>

To confirm command execution, i.e. substitution of ID from 0 to 1, the transducer responds with an exclamation mark “!”.
If you cannot remember the transducer ID, it is possible to connect up to it using the ?.

Example:

@	?	A	1	<cr>

14.3.2. COMMAND “D”

The command “D” allows to program the *configuration byte of the D\A converters*, thus setting their way to operate.
The command can be summarised by the format “Dbbbbbbbb”, where “D” is the real true command and “bbbbbbbb” are the 8 bits which make up the byte (each “b” can only be a value “0” or the value “1”). The bits are numbered from right to left.
The first on the right is the number 0 (sequence 7-6-5-4-3-2-1-0).

BIT	D/A	Bit VALUE = 0	Bit Value = 1
0	1	CURSOR 0	CURSOR 1
1	1	DISPLACEMENT	VELOCITY
2	1	DIRECT	INVERTED
3	1	OFF	ON
4	2	CURSOR 0	CURSOR 1
5	2	DISPLACEMENT	VELOCITY
6	2	DIRECT	INVERTED
7	2	OFF	ON

Table 3: D/A byte configuration

Example:

@	0	D	10011000	<cr>

In the example, the D/A 2 (1001) converter is configured as on, direct, representing the displacement measure for cursor 1 while the D/A 1 (1000) is configured as on, direct, representing the displacement measurement for cursor 0.

The settings of the analog outputs only come into effect if, following the Customer's orders, the relative D/A converters have been installed. In the absence of such converters, command "D" has no effect on the transducer functionality.

14.3.3. COMMAND "L"

The command "L" allows to *set a numerical value* of the ZERO and FULL SCALE references of the two cursors, expressing them in millimetres (*or other mechanical units*) in order to obtain a displacement or level measurement for the digital data (RS485), expressed in mechanical units.
The command format must be like the one described in the examples, where "L" is followed by the cursor number (0 or 1) to which the intended setting refers. This is then followed by "L" if you wish to set the ZERO value or "H" if you wish to set the FULL SCALE value.
The command subject must be a number composed of 6 positive figures (without signs).
Should two cursors be used on the same measuring probe, cursor "0" refers to the one nearest the electronics (connector or cable output) while the cursor "1" refers to the furthest one (see figure 13).

IMPORTANT NOTE: after entering the new parameters, in order for them to have effect, it is necessary to switch the transducer off and then switch it on again. In this way the internal coefficients can be recalculated.

Example 1:

@	0	L0L	000000	<cr>

The lower reference (ZERO) of *cursor 0* is set at a value of 0 (mm).

Example 2:

@	0	L0H	001300	<cr>

The higher reference (FULL SCALE) of *cursor 0* is set at a value of 1300 (mm).

Example 3:

@	0	L1L	000100	<cr>

The lower reference (ZERO) of *cursor 1* is set at a value of 100 (mm).

Example 4:

@	0	L1H	001500	<cr>

The higher reference (FULL SCALE) of *cursor 1* is set at a value of 1500 (mm).

14.3.4. COMMAND "R"

Command "R" requests, from remote computer or PLC, the *measured value* for cursors 0 and 1.
The subject command "R" is an ASCII character which can take on the following values:

"R0" when you request the transducer for the first cursor value (cursor 0, near electronics).
Example 1:

@	0	R	0	<cr>

"R1" when you request the transducer for the second cursor value (cursor 1).
Example 2:

@	0	R	1	<cr>

14.3.5. COMMAND "V"

Command "V" requests revision of *firmware* installed into transducer.

Example:

@	0	V	<cr>

Example of a reply: PC V.01.00 S/N xxxxxx

On receiving command the transducer replies by sending an ASCII string containing the firmware version, the reference date and the serial number.

14.3.6. COMMAND "T"

Command "T" allows transducer *calibration*: it memorises what the transducer has measured, when the cursor is positioned in correspondence to the ZERO or FULL SCALE references, matching the measurement to the numerical references set with the "L" commands.

Example 1:

@	0	T0Z	<cr>

Measures and memorises the position of *cursor 0* at the ZERO point.

Example 2:

@	0	T0F	<cr>

Measures and memorises the position of *cursor 0* at the FULL SCALE point.

Example 3:

@	0	T1Z	<cr>

Measures and memorises the position of *cursor 1* at the ZERO point.

Example 4:

@	0	T1F	<cr>

Measures and memorises the position of *cursor 1* at the FULL SCALE point

IMPORTANT NOTE : after memorising the new positions, in order for them to have effect, it is necessary to switch the transducer off and then switch it on again. In this way the internal coefficients can be recalculated.

To ensure correct transducer operation it is necessary to calibrate the transducer so that the correlation summarised here can be observed:

	ZERO		FULL SCALE	
	Set reference	Memorise measurement	Set reference	Memorise measurement
Cursor 0	@0L0Lxxxxxx	@0T0Z	@0L0Hxxxxxx	@0T0F
Cursor 1	@0L1Lxxxxxx	@0T1Z	@0L1Hxxxxxx	@0T1F

Note 1: "xxxxxx" refers to the 5-figure subject to be sent to the transducer with relative command.
Note 2: Each command sent to the transducer must end with <cr> (Carriage Return, 0x0D)

14.3.7. COMMAND "X"

Command "X" allows to *read the memory contents* of the EEPROM programming.
In this memory the parameters for transducer configuration are permanently stored. These are modified and memorised with the aforementioned commands. Table 4 indicates the significance and location of the parameters.

INDEX	PARAMETER	NOTE	PROGRAMMING COMMAND
0	Low Limit 0	Cursor 0 ZERO reference	*@0L0Lxxxxxx*
1	High Limit 0	Cursor 0 FULL SCALE reference	*@0L0Hyyyyyy*
2	Minimum Calibration 0	Internal count value minimum 0	*@0T0Z*
3	Maximum Calibration 0	internal count value maximum 0	*@0T0F*

4	Low Limit1	Cursor 1 ZERO reference	*@0L1Lzzzzzz*
5	High Limit 1	Cursor 1 FULL SCALE reference	*@0L1Hwwwwww*
6	Minimum Calibration 1	Internal count value minimum 1	*@0T1Z*
7	Maximum Calibration 1	Internal count value maximum 1	*@0T1F*
8	A/D Configuration	A/D converters bit configuration	*@0Dbbbbbbbb*
9	Serial address	Transducer serial ID	*@0Ax*

Table 4: table of parameters in memory

Example:

@	0	X	0	<cr>

In the example the contents of the 0 parameter are read (cursor 0 ZERO refernence)

Note: “xxxxxx”, “yyyyyy”, “zzzzzz”, “wwwwww” are 6- figure subjects of commands used to program the transducer configuration.

14.4. TRANSDUCER REPLIES

The transducer always replies to a command which has been sent with the following reply strings, according to the command sent and the relative context.

Reply from 'PCS/PCR	Significance
! <cr>	They transducer replies with an exclamation mark when the command is accepted and then executed.
? <cr>	The question mark is the transducer reply to an unknown command or when an incorrect format is used. The command which has generated a question-mark type reply is not executed.
yRxxxxxxx<cr> E.g. 1: 0R0120500 E.g. 2: 1R-203450	This is the reply to the command requesting the measuring value (Ry, see 13.3.4), where "y" indicates the cursor number (0 or 1) and "xxxxxxx" corresponds to the requested measure value, signal included. The measurement executed is expressed in the mechanical units used to define the configuration parameters (command L). The measurement is given without decimal points. If, for example, the configuration parameters have been defined in tenths of a millimeter, the value of the position measurement will be given in tenths of a millimeter. The program which questions the transducer, to know the position of the cursors, will have to get It accordingly to the configuration setup.
yR9999999<cr>	This is the reply to the "Ry" command, requesting cursor y position measurement, whenever the cursor in question is not detected by the transducer (the cursor has been withdrawn from the measuring rod. When two cursors are used on the same measuring rod, this reply can also indicate a distance between the cursors lower than the accepted minimum.
xXzzzzzzz<cr> Eg.: 1X0001000	This is the command reply "X", requesting the letter of a configuration parameter, where "x" indicates the parameter requested and "zzzzzzz" corresponds to the parameter value (7 characters). The parameter value has no empty spaces. Whenever it has fewer characters than those established in the defined format, zeros are used to fill the spaces.

15. Declaration of conformity

Council Directive applied: 89/336/CEE modified with directives 92/31/CEE, 93/68/CEE

Standards for which conformity has been declared:

EMC:	EN 50081-2: 1994 – General standards on emission EN 55011 EN 50082-2: 1995 - General standards on immunity ENV 50140 ENV 50141 EN 61000-4-4 EN 61000-4-5 EN 61000-4-2 EN 61000-4-8 ENV 50204
Manufacturer:	DS Europe srl
Address:	via F. Russoli, 6 Milan (Italy)
Type of equipment:	Position and magnetostrictive level transducers
Models:	PC series (Mod. PCS – Mod. PCP – Mod. PCR – Mod. PCM) With analog and digital outputs.
Year of marking 1999	

Th equipment has been tested with the typical installation configuration, as prescribed by the product instruction manual.

DS Europe srl declares that the aforementioned equipment satisfies the requirements of the EMC Directive specified above.

Milan, 21/09/99

DS Europe srl
Technical Management

16. TESTS FOR APPLICATION OF CE MARK

16.1. TEST CENTRE AND LIST OF TESTS

The tests are carried out at the internationally recognised “Competent Body” Test Centre.

For compatibility tests the strictest legislation for industrial applications have been applied: EN 50081-2 (for emission phenomena) and EN 50082-2 (for immunity phenomena).
They include the following principle regulations: EN 55011; ENV 50140; ENV 50141 (DC I/O); ENV 50141 (signal: lines); EN 61000-4-4 (DC I/O); EN 61000-4-4 (signal: lines); EN 61000-4-2; EN 61000-4-8; EN 61000-4-5; ENV 50204.

16.2. TEST RESULTS AND LAW ON CONFIDENTIALITY

All the tests gave positive results.

The Test Centre and EC Regulations impose that all documents and test data therein remain confidential and that they can neither be published nor photocopied, and are only available for consulting purposes in our factory for approved Authorities.

G U A R A N T E E

The numerous mechanical and electrical controls carried out during manufacturing and final testing ensure that the units delivered are free of defective material, machining and operational defects.
Any units which prove to be defective, despite the above mentioned controls, shall be repaired or replaced free of charge by DS Europe, on the conditions that the units have been subject to normal or correct use and in any accordingly with the use described in the herein manual, and that such units shall be delivered to the DS Europe office, by the Customer, (who will have to forfeit the costs for the relative transport, insurance, customs etc.), within 6 months from the sales shipment from DS Europe to the Customer.
The Customer is to be fully aware, exonerating DS Europe from any responsibility with regard to such, that the returned units in as much as seemingly defective might be tampered with in order to carry out necessary controls; so, where we are dealing with units such as these and hence not covered by above guarantee, DS Europe will return the units, at the Customer’s expense, the units which, following the execution of the above mentioned controls, may no longer be intact.

Manual of instructions N°280200-I. All the information in this manual the information, or any part thereof, is confidential and cannot be made widespread without express written authorisation from DS Europe srl.
This manual, even after sales of transducer, is only handed over for viewing purposes and remains the property of DS Europe.

NOTE