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INTRODUCTION

Development in the field of control technology with application of computer control and measurement systems created demand for precise and reliable position measurement of positioning elements. This measurement is a feedback in any control system and the control quality rating depends directly on its precision. More and more often one can find systems provided with actuators controlled by analog or FIELDBUS type transmission signal. In such systems a position transducer becomes a critical device, as it also influences the reliability of limiter action which directly effects the safety of the controlled system operation.

With the new needs and expectations of industry regarding the position transducers, INTEC *Zakład Elektroniki i Automatyki Przemysłowej* (The Company for Industrial Electronics and Automatics) began research works on developing a contactless, small-size, high precision and reliability transducer. Among several available measuring methods, we have chosen the one using a resolver, that is a special, induction type, rotary detector. Precision, absolutely durable mechanical construction as well as the resistance to the extreme environmental conditions and disturbances, make the resolvers extensively utilised in armaments industry, avionics and in numerical control systems for machine tools. Detectors of any other kind, including the code photo-converters, cannot even compare with resolvers in respect of reliability. Our works on application of a resolver as a measuring element in two-conductor angular position transducers resulted in introducing to the market in 1995 a new line of induction type position transducers (PPI). This new type transducer has quickly become popular owing to its simple installation in various type actuators, precision and the outstanding resistance to any environmental hazard. Presently the new transducers are factory-mounted in electric actuators by their manufacturers: ZAP S.A. in Ostrów Wielkopolski, CHEMAR S.A. in Kielce and ZPUA P.P. in Wrocław. Quite often they are user-installed in old type actuators when running revamping projects.

In 1997 we implemented a series of types of miniature position transducers PPO, based on the newest attainments in potentiometer design. They are of simpler design, smaller and chipper than PPI transducers. Careful sealing and applied type of bearing made them near equally resistant to environmental stress.

Also in 1998 we developed the TRANSOLVER® - a smart resolver-type position transducer. Owing to application of an internal microprocessor, this type of transducer presents many functions that make its operation easier, for example automatic tuning to the actuators end positions. TRANSOLVER passed laboratory and field tests successfully and at the end of 1998 entered the market.

INTEC provides position transducers for manufacturers of actuators and for needs of revamping projects. We offer site installation of transducers in old-type actuators or deliver necessary documentation and mounting kits.

TRANSOLVER®

Application and performed functions: TRANSOLVER has been designed for operation in analog and digital automatic control and measuring systems working in harsh environmental conditions. Its basic application is interaction with the positioning actuators of automatic control systems, where it works as a feedback signal measuring transducer. Compact design and general-purpose software make possible using TRANSOLERS in many other metrological applications such as robotics, weather measurements, radar systems, air-conditioning and remote control systems.

Design: The transducer consists of an enclosure with a stem for mounting on a screw, rotary axle, waterproof membrane type keypad with two pushbuttons and a LED display that is resistant to low and high temperature, rear cover with a watch glass and undetachable screened cable 500 mm long. Inside, there is a resolver (contactless angular position converter) and a microprocessor type processing system. Different length of the cable and axle are available when ordered.

Mounting: The transducer should be mounted to a base plate, 1.5÷3 mm thick, in a hole Φ 10 mm dia., using a locknut and a crown washer. A gear coupling to be fixed on the axle. As there is no mechanical limiter, the gear wheel may be rigidly fixed on the axle. The cable should be cut to a proper size, the ends mended and fitted with terminals and the heat-shrinkable tubing provided in the set. The larger tubing and terminal are for the screen end. Should the gear eccentricity be found (in older actuators) a flexible type base plate to be applied or adequate tooth clearance to be allowed for.

Technical parameters	
Supply voltege and system	12÷36 VDC , two-conductor type
Measured range	0÷360° without limiter
Range adjustment	20÷100%
Output signal	4÷20 mA
Nonlinearity acc. with PN-88/M-42000-17	0.25%
Nonlinearity acc. with PN-88/M-42000-18	0.4% (referred to characteristics limits)
Temperature error	0.15% / 10°C
Working temperature	-25÷70°C
Protection class	IP-64
Mechanical life-period	practically unlimited
Attenuation	70 dB (50 Hz)
Vibration resistance	15 G
Data memory	EEPROM
Display	LCD, 4 digits and units symbols
Standard capacity of cycles counter	1000000 cycles every 100 or other

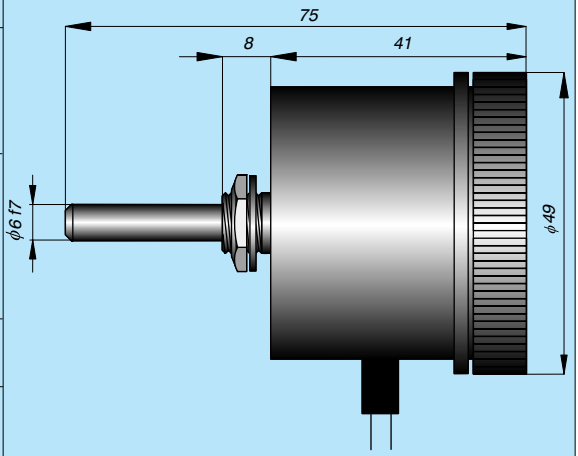
Fastening
On a M10x75 thread with a crown washer, fit on F 10 mm outlet.

Engaging
A shaft F6 mm, for fitting a gear wheel onto a friction clutch.

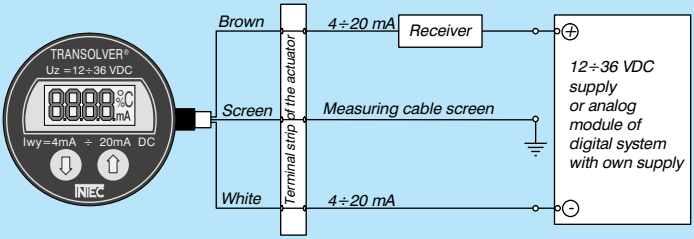
Sealing
The shaft - fluorovulcanizate, back cover - water-proof diaphragm, electronic components - silicone filling compound cured chemically.

Bearings
2 ball bearings.

Application
Servo-motors manufactured by ZAP S.A. and CHEMAR SA and those other ones that have been adapted for building in typical potentiometers.



TRANSOLVER® - outline drawing



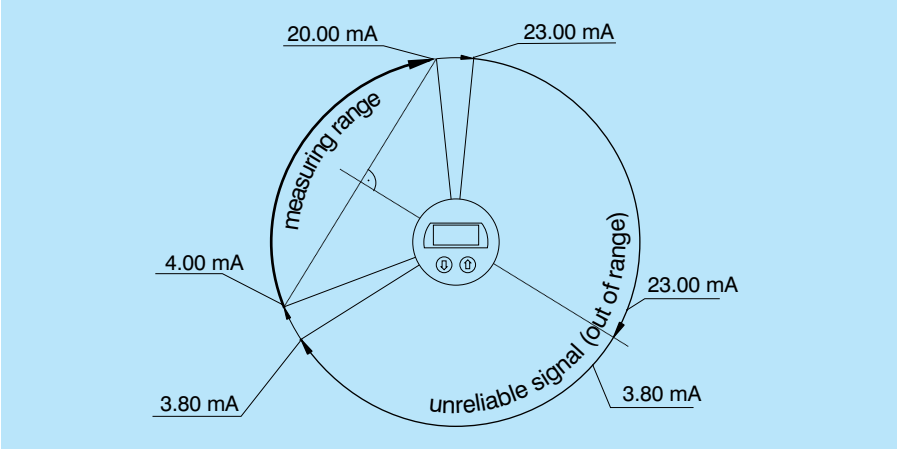
TRANSOLVER® - application diagram

Table of permissible receiver resistance versus supply voltage

Voltage [V]	*Resistance [Ω]*	*Voltage [V]*	*Resistance [Ω]*
36	*1100*	*24*	*500*
32	*900*	*20*	*300*
28	*700*	*16*	*100*

Date:	*Intelligent Resolwer Angular Position Transducer TRANSOLVER*	*ZEiAP INTEC*
5.01.99		
	Application diagram and outline drawing	
	Project made by	*Jerzy Kasprzak*

Functioning: TRANSOLVER is a two-conductor angular position transducer. The measuring element is a resolver. The measuring signal from the resolver is numerically scaled to 4÷20 mA current in a measuring line, in proportion to the axle deviation from a defined reference starting point. TRANSOLVER has an intelligent algorithm of selecting the starting and end point of the measuring range. Both parameters are controlled independently. The transducer has not been provided with any mechanical angle limiter. The measuring range can be defined from 0°÷ 70° (minimum), and up to 0°÷360° (round angle maximum), with the optional setting of the initial position, and the sense of rotation. Overrunning the measuring range results in such transducer response as it is read unreliable by the automatic control system, with additional specifying the side from which the range has been overrun.



Drawing 1. Measuring range and unreliable signal of TRANSOLVER.

Starting: having done connecting, engaging, and applying the supply voltage to the transducer, check the current flow in the measuring circuit. No current indication means the reverse direction of the applied voltage (the transducer is resistant to that). When started, the automatic display test follows, wherein consecutively all indicators are lit. Then the transducer starts operating and the current value in mA is displayed. Setting of the transducer is performed with 2 keys marked "⇑" and "⇓", which are placed below the membrane keypad.

- Output current;

- Initiation level;

- Deflection angle from the initial point, in degrees;

- Number of executed working cycles (number of returns divided by 2 and by the divisor setting);

- Current divisor of a cycle counter;

- Current temperature inside the transducer;

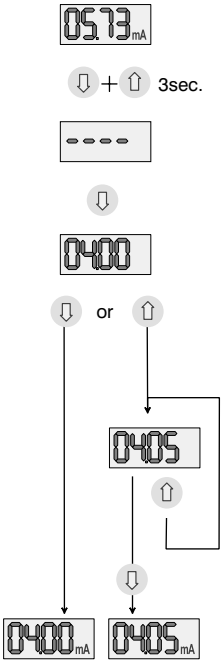
- Current setting of sense of rotation.

Programming: On pressing the "⇑" key, consecutive quantities are displayed and they are cyclically repeated. By using keys one can program the following quantities:

- start-point of the measuring range, optional;
- end-point of the measuring range, optional;
  NOTE! The transducer does not allow to set measuring range span less than 70°.
- sense of rotation;
- working cycle divisor value at the moment of resetting the cycle counter;
- setting equal value for the start and end point of the measuring range (option for special applications).

Note that from displaying a ready for programming symbol, time allowed for the user to finish programming is 90 seconds, and then the transducer shall return to normal operation mode and the altered values shall not be memorised.

Setting the start-point of the measuring range:



a) position the device to a starting point and while pressing the "⇑" key, set displaying current in mA;
b) press the "⇓" and then "⇑" and hold them pressed for 3 seconds;
c) on releasing the keys the display will show a ready to program symbol "----";
d) press in the "⇓" key;
e) the display shows 04.00 mA;
f) validate the value by pressing again the "⇓" key if no correction to the actuator run up is planned, or otherwise press "⇑" which shall increase the value by 00.05 mA;
g) each consecutive pressing in the "⇑" key shall bring a relevant increase of the initial current value. Maximum correction possible is 04.50 mA, and the next pressing the "⇑" key results in return to 04.00 mA value;
h) having finished the corrective action, validate the initial current value by pressing in "⇓";
i) mA symbol shall be displayed next to the set current value.

Having finished programming, two problem cases may eventually occur; the first 

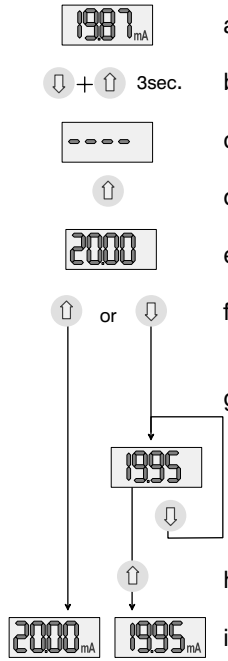
one consists in that having set the measuring range limit, the reading stays constant and equal to 3.80 mA, 23.00 mA or is step-changing between the two values. Such behaviour means (see drawing 1), that the transducer operates outside the measuring range. In such case the end point of the measuring range to be programmed (20.00 mA) and then the transducer should return to normal operation. If both measuring range limits have been already programmed, try to reverse the sense of rotation (see page 8).

In the other case the situation is signalled on the screen by "|––|" symbol. It 

means that too narrow measuring range has been set (Less than 70°). In such a situation the transducer initiates the line with a 3.80 mA current and performs only two functions: measuring range limits position change (which is accessible the same way as described above, but when displaying the "|––|" symbol and not a signal in [mA]), and rotation sense programming. If the end point of the measuring range has not been yet programmed that should be done. Upon setting the 20.00 mA point, the above symbol should not appear and the transducer shall return to normal operation.

However, if the measuring range limits are programmed correctly, then the wrong rotation sense is the reason of showing up the symbol denoting too narrow measuring range, so reverse the sense of rotation.

Setting the end-point of the measuring range:



a) position the device to a starting point and while pressing the "⇑" key, set displaying current in mA;
b) press the "⇓" and then "⇑" and hold them pressed for 3 seconds;
c) on releasing the keys the display will show a ready to program symbol "----";
d) press in the "⇑" key;
e) the display shows 20.00 mA;
f) validate the value by pressing again the "⇑" key if no correction to the actuator run up is planned, or otherwise press "⇓" which shall decrease the value by 00.05 mA;
g) each consecutive pressing in the "⇓"key shall bring a relevant decrease of the initial current value. Minimum correction possible is 19.50 mA, and the next pressing the "⇓" key results in return to 20.00 mA value;
h) having finished the corrective action, validate the initial current value by pressing in "⇑";
i) mA symbol shall be displayed next to the set current value.

Having finished programming, two problem cases may eventually occur; the first 

one consists in that having set the measuring range limit, the reading stays constant and equal to 3.80 mA, 23.00 mA or is step-changing between the two values. Such behaviour means (see drawing 1), that the transducer operates outside the measuring range. In such case the initial point of the measuring range to be programmed (4.00 mA) and then the transducer should return to normal operation. If both measuring range limits have been already programmed, try to reverse the sense of rotation (see page 8).

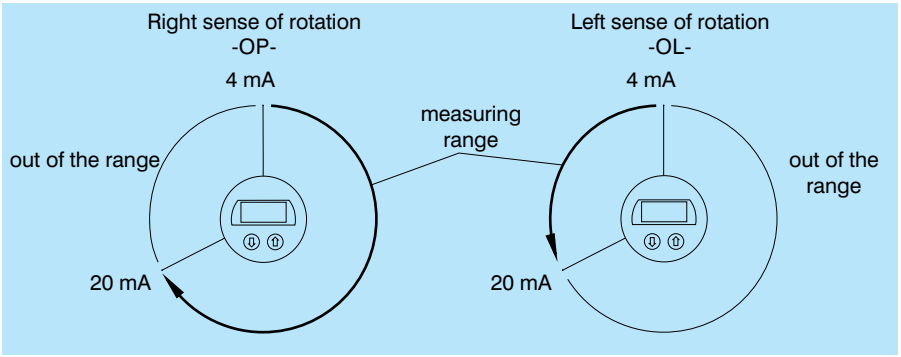
In the other case the situation is signalled on the screen by "| – – |" symbol. It 

means that too narrow measuring range has been set (Less than 70°). In such a situation the transducer initiates the line with a 3.80 mA current and performs only two functions: measuring range limits position change (which is accessible the same way as described above, but when displaying the "| – – |" symbol and not a signal in [mA]), and rotation sense programming. If the initial point of the measuring range has not been yet programmed that should be done. Upon setting the 4.00 mA point, the above symbol should not appear and the transducer shall return to normal operation.

However, if the measuring range limits are programmed correctly, then the wrong rotation sense is the reason of showing up the symbol denoting too narrow measuring range, so reverse the sense of rotation.

Sense of rotation and its modification:

Sense of rotation defines, at which side of the 4 mA point the measuring range is spread. Differentiation between left and right sense of rotation has been explained in the drawing below.



Drawing 2. Right and left sense of rotation (sight from the transducer's display).

As it can be seen, reversing of the sense of rotation shall not result in transposing between 4 and 20 mA, but the reading value increases in other direction from the 4 mA point.

If the right direction of rotation has been set, then looking at the transducer from the screen side, the reading shall increase, if the transducer axle rotates clockwise. If the left direction of rotation has been set, then the signal increases at the counter-clockwise axle rotation. The direction of rotation can be read on the screen, it is one of options available after "⇑" has been pressed several times. Sign -OP- stands for the right direction of rotation, and respectively -OL- for the left direction of rotation.

To reverse the sense of rotation:

⇩ + ⇧ 3sec.

⇩ or ⇧

a) while pressing "⇑" enter into a display mode of the selected sense of rotation;

b) first press "⇓" then "⇑" and hold them pressed for 3 seconds;

c) on releasing both keys a "----" sign shows up for ready to enter the direction of rotation;

d) use the "⇓" key to set leftward direction of rotation, use the "⇑" key to set rightward direction of rotation;

e) the transducer automatically exits from the programming mode and the selection shall be displayed on the screen.

Occasions when the sense of rotation needs reversing:

If after correct setting the required positions of the measuring range end-points the reading takes on a constant value equal to 3.80 or 23.00 mA which means that the system operates over the measuring range of the transducer (see Dwg. 1). The sense of rotation needs reversing.

After the reversal has been made a symbol of too narrow range "|– –|" may appear on the screen which means the measuring range needs extending by overrunning the device to a new start and end point of the measuring range or, the return to the previous direction of rotation is needed. Note, the transducer shall not work within the angle range smaller than 0÷70°.

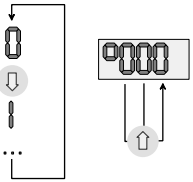
Entering a new divisor and resetting the working cycles counter.

a) display current divisor value (press "⇑" several times);

b) press in "⇓" and then "⇑" and hold them both pressed for 3 seconds;

c) on releasing the keys a ready to program sign shall be displayed "----";

d) press in "⇓";



e) enter a new divisor value, maximum 100. By pressing "⇓" a figure can be changed (cycling from 0÷9), by pressing "⇑" the figures position can be changed;

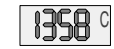
new divisor:

f) after setting the last figure, press "⇑";

g) the counter shall be reset and the reset cycle counter shall be displayed on the screen.

Note: to reset the counter without changing the divisor value, enter again its current value that has been used to the moment. The divisor value can be an integer from 1 to 100; should zero be entered, the value 1 shall be set, should a number bigger than 100 be entered, the value equal to 100 shall be set.

Setting a full range operation mode (points 4 mA and 20 mA in the same position)

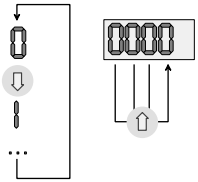


a) while pressing "⇑" enter into the working cycle display mode;

b) press "⇓" and then "⇑" and hold them both pressed for 3 seconds;

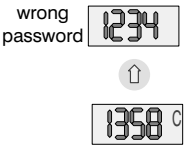
c) on releasing the keys, the symbol of readiness to enter the password "----" appears on the screen;

d) press in "⇓";



c) enter a password, typical 1151. By pressing "⇓" a figure can be changed (cycling from 0÷9), by pressing "⇑" the figures position can be changed;

f) the last figure changed, pressing "⇑" results in setting a 4 and 20 mA point in the same position that has been taken previously by the 4 mA point and the transducer automatically switches to display the current;



g) entering a wrong password followed by pressing in the "⇑" key wont bring any changes, with the transducer returning to displaying number of cycles.

Note: Having programmed the round angle operation, the position of the 4 mA point does not change, whereas shifted is the 20 mA point. Offset of the 4 mA point results in automatic shifting of the 20 mA point although the transducer still operates in the round angle; however programming a new 20 mA position automatically results in switching to the operation in incomplete angle (4 mA and 20 mA point at different positions).

Note:

1. Entering into programming mode is possible not until the current value (in mA) is displayed. In case of executing percentage measurement or temperature measurement the transducer shall not enter into the programming mode on pressing the both keys. At displaying the cycle counter the transducer shall enter into a mode of setting 4 mA and 20 mA points in the same position, at displaying the divisor into a mode of setting the divisor, at displaying the sense of rotation into selection of the sense of rotation.
2. While reversing the sense of rotation and while changing or transposing positions 4 and 20 mA the transducer may read a try of setting too small operating range. The transducer is protected against possible setting the measuring range under 70°. At a try of setting a smaller range the symbol "| – – |" is displayed and the transducer shall initiate the line on emergency basis by the current 3.80 mA. This symbol shall disappear on correct range setting or reversing the sense of rotation and then the transducer goes back to the normal operation.

   At setting too small measuring range, the only available options are the option of address change and the option of selection the sense of rotation.
3. Setting minimum and maximum range is totally independent. So executing corrections to any of the two settings (for instance to get the actuator closed) can be done on-line with no need for overrunning the system into the both positions. Before each programming procedure, concerning both the measuring range and the cycle counter as well, the actuator should be turned off the automatic mode and, the functions of protection and control that are related to the specific position transducer locked.
4. All data entered into the transducer are memorised in the EEPROM memory and stored until the next programming, regardless of the supply voltage on or off.
5. After 1.5 minutes from entering the programming mode (displaying the "----" symbol) the transducer returns to the normal operation mode and the entered changes shall not be saved.

Induction Type Angular Position Transducer PPI-01/B

Design: PPI-01/B transducer consists of an enclosure with a stem for mounting on a screw, a rotary axle with a mechanical limiter, a rear screw-on cover and undetachable screened cable 500 mm long. Underneath the cover there is a zero adjusting potentiometer, range adjusting potentiometer, and a jumper for reversing the sense of rotation. Inside the enclosure there is a resolver and an electronic type processing system. Different lengths of the cable and axle are available when ordered.

Mounting: The transducer should be mounted to a base plate, 1.5÷3 mm thick, in a hole (F) 10 mm dia., using a locknut and a crown washer. A gear coupling to be fixed on the axle. As there is no mechanical limiter, the gear wheel may be rigidly fixed on the axle. The cable should be cut to a proper size, the ends mended and fitted with terminals and the heat-shrinkable tubing provided in the set. The larger tubing and terminal are for the screen end. Should the gear eccentricity be found (in older actuators) a flexible type base plate to be applied or adequate tooth clearance to be allowed for.

Starting: Having connected, engaged, and applied the supply voltage to the transducer, check the current flow in the measuring circuit. No current indication means the reverse direction of the applied voltage (the transducer is resistant to that). Next step is overrunning the actuator into a position corresponding to the 20 mA current in the line and setting this value by using the jumper for reversing the sense of rotation and the potentiometer for the range adjustment. Then overrun the actuator into a position corresponding to the 4 mA current in the line and set this value by using the zero adjusting potentiometer. The last operation is returning to 20 mA position and correcting possible deviation that might result from the adjustment action interrelations, by using the range adjustment potentiometer. In practice, when setting the extreme values one should take into account the actuators run-up and possible inaccuracy of the extremes. It is then recommended to set a little bit greater value than 4 mA and a little bit lower value than 20 mA.

Application: PPI-01/B has been designed for operation in analog and digital automatic control and measuring systems working in harsh environmental conditions.

Technical parameters	
Supply voltage and system	12÷36 VDC , two-conductor type
Measured range	0÷300°
Range adjustment	50÷100%
Output signal	4÷20 mA
Nonlinearity acc. with PN-88/M-42000-18	0.4% (ref. to the extremes of the characteristic)
Temperature error	0.25% / 10°C
Working temperature	-25÷70°C
Protection class	IP-64
Mechanical life pariod	practically unlimited
Attenuation	70 dB (50 Hz)
Vibration resistance	15 G

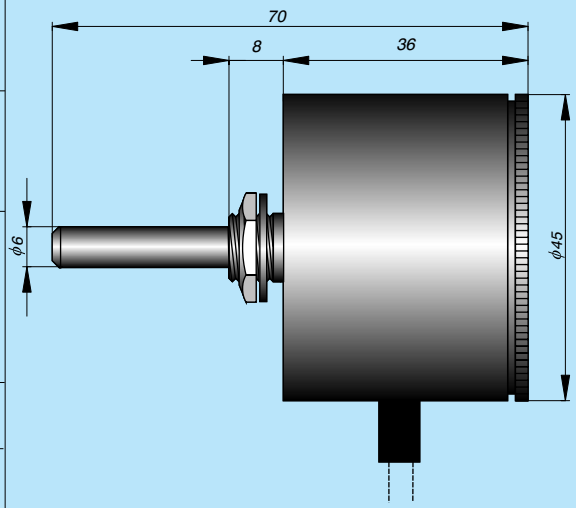
Fastening
On a M10x75 thread with a crown washer, fit on F 10 mm outlet.

Engaging
A shaft F6 mm, for fitting a gear wheel onto a friction clutch.

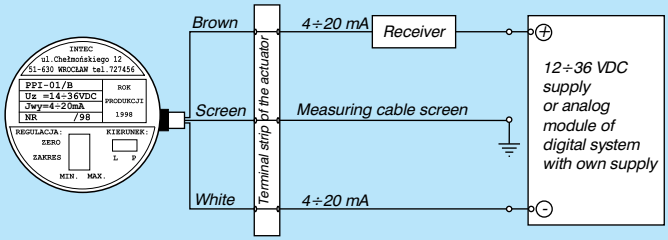
Sealing
The shaft - fluorovulcanizate, back cover - water-proof diaphragm, electronic components-silicone filling compound cured chemically.

Bearings
2 ball bearings.

Application
Servo-motors manufactured by ZAP S.A. and CHEMAR S.A. and those other ones that have been adapted for building in typical potentiometers.



PPI-01/B transducer - outline drawing



PPI-01/B transducer - application diagram

Table of permissible receiver resistance versus supply voltage	*Voltage [V]*	*Resistance [Ω]*	*Voltage [V]*	*Resistance [Ω]*
	36	*1100*	*24*	*500*
	32	*900*	*20*	*300*
	28	*700*	*16*	*100*

Date:	*Induction Type Angular Position Transducer PPI-01/B*		*ZEiAP INTEC*
9.01.99			
	Application diagram and outline drawing		
	Project made by	*Jerzy Kasprzak*	

Induction Type Angular Position Transducer PPI-01/A

Design: PPI-01/A transducer consists of an enclosure, inside of which there is a rotating sleeve fitted for mating with a counter-stud. There is a mechanical limitter for the sleeve. Inside the enclosure there is a resolver and an electronic type processing system. Adjusting potentiometers and a jumper for reversing the sense of rotation have been placed under the screwed-on cover. A screened cable 500 mm long is permanently attached to the enclosure.
Mounting: The transducer is mounted in SWA, SWB and SWC actuators in the place of a potentiometer, by screwing the enclosure with 2 studs provided, through the holes used previously by the potentiometer. If the gear wheel has been found rubbing at the transducer enclosure (in old type actuators), a spacer washer to be put under the enclosure (delivered with the order). The cable should be cut to a proper size, the ends mended and fitted with terminals and the heat-shrinkable tubing provided in the set. The larger size tubing and terminal are for the screen end.
Starting: The mechanical engaging to be performed by screwing the counter-stud cap in, while locking the transducer sleeve with the No.6 spanner. Having connected, engaged, and applied the supply voltage to the transducer, check the current flow in the measuring circuit. No current indication means the reverse direction of the applied voltage (the transducer is resistant to that). Next step is overrunning the actuator into a position corresponding to the 20 mA current in the line and setting this value by using the jumper for reversing the sense of rotation and the potentiometer for the range adjustment. Then overrun the actuator into a position corresponding to the 4 mA current in the line and set this value by using the zero adjusting potentiometer. The last operation is returning to 20 mA position and correcting possible deviation that might result from the adjustment action interrelations, by using the range adjustment potentiometer. In practice, when setting the extreme values one should take into account the actuators run-up and possible inaccuracy of the extremes. It is then recommended to set a little bit greater value than 4 mA and a little bit lower value than 20 mA.
Application: PPI-01/A has been designed for operation in analog and digital automatic control and measuring systems working in harsh environmental conditions.

Technical parameters	
Supply voltage and system	12÷36 VDC , two-conductor type
Measured range	0÷300°
Range adjustment	50÷100%
Output signal	4÷20 mA
Nonlinearity acc. with PN-88/M-42000-18	0.4% (ref. to the extremes of the characteristic)
Temperature error	0.25% / 10°C
Working temperature	-25÷70°C
Protection class	IP-54
Mechanical life pariod	practically unlimited
Attenuation	70 dB (50 Hz)
Vibration resistance	15 G

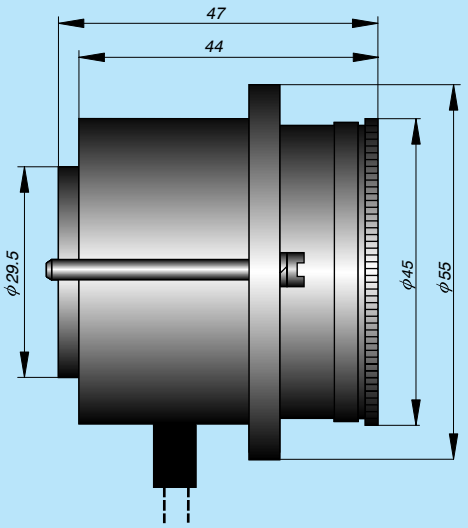
Fastening
Two screws M3, L33 mm spaced at 48.5 mm, fit: on F 29.5 mm.

Engaging
Inner rotary sleeve mating with a stretcher bar, hole diameter: F 5 mm, the sleeve length: 38 mm, the sleeve lock: hexagon S6.

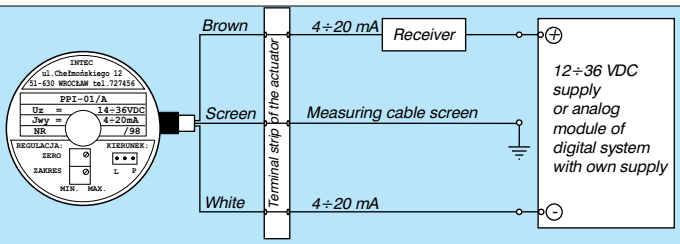
Sealing
The shaft - fluorovulcanizate, back cover - water-proof diaphragm, electronic components - silicone filling compound cured chemically.

Bearings
2 graphite bearings.

Application
Servo-motors manufactured by ZPUA S.A. and ZAP S.A. series: SWA, SWB, SWC.



PPI-01/A transducer - outline drawing



PPI-01/A transducer - application diagram

Table of permissible receiver resistance versus supply voltage	*Voltage [V]*	*Resistance [Ω]*	*Voltage [V]*	*Resistance [Ω]*
	36	*1100*	*24*	*500*
	32	*900*	*20*	*300*
	28	*700*	*16*	*100*

Date:	*Induction Type Angular Position Transducer PPI-01/A*		*ZEiAP INTEC*
9.01.99			
	Application diagram and outline drawing		
	Project made by	*Jerzy Kasprzak*	

Induction Type Angular Position Transducer PPI-01/C

Design: PPI-01/C transducer consists of a resolver placed in an enclosure that is fitted for mounting on a screw, and of a rotary axle with a mechanical limiter. All that is connected with a permanent cable to the transducer. Adjusting potentiometers and a jumper for reversing the sense of rotation have been placed under the screwed-on cover. The transducer has been provided with a 500 mm long permanently attached cable.
Mounting: A detailed description of the transducer mounting in the NWA-78 drives, in the older model and in the new model of NWA-100 drives has been presented in the drawings on the next page. The only work necessary before mounting, which has to be done at the workbench, is drilling a hole F 45 mm in a plastic scale of the power transmission systems mechanical indicator. The mounting procedure has been prepared with regard to provide convenient access when servicing the adjusting potentiometers and the jumper for reversing the sense of rotation. The PPI-01/C transducer can be used also with other actuators, when there is not sufficient space for placing there the PPI-01/B transducer.
Starting: The mechanical engaging to be performed by forcing the gear wheel, that has been left after taking out a potentiometer, on the axle of the transducers detector. Having connected, engaged, and applied the supply voltage to the transducer, check the current flow in the measuring circuit. No current indication means the reverse direction of the applied voltage (the transducer is resistant to that). Next step is overrunning the actuator into a position corresponding to the 20 mA current in the line and setting this value by using the jumper for reversing the sense of rotation and the potentiometer for the range adjustment. Then overrun the actuator into a position corresponding to the 4 mA current in the line and set this value by using the zero adjusting potentiometer. The last operation is returning to 20 mA position and correcting possible deviation that might result from the adjustment action interrelations, by using the range adjustment potentiometer. In practice, when setting the extreme values one should take into account the actuators run-up and possible inaccuracy of the extremes. It is then recommended to set a little bit greater value than 4 mA and a little bit lower value than 20 mA.
Application: PPI-01/C has been designed for operation in analog and digital automatic control and measuring systems working in harsh environmental conditions.

Technical parameters	
Supply voltage and system	12÷36 VDC , two-conductor type
Measured range	0÷300°
Range adjustment	50÷100%
Output signal	4÷20 mA
Nonlinearity acc. with PN-88/M-42000-18	0.4% (ref. to the extremes of the characteristic)
Temperature error	0.25% / 10°C
Working temperature	-25÷70°C
Protection class	IP-54
Mechanical life pariod	practically unlimited
Attenuation	70 dB (50 Hz)
Vibration resistance	15 G

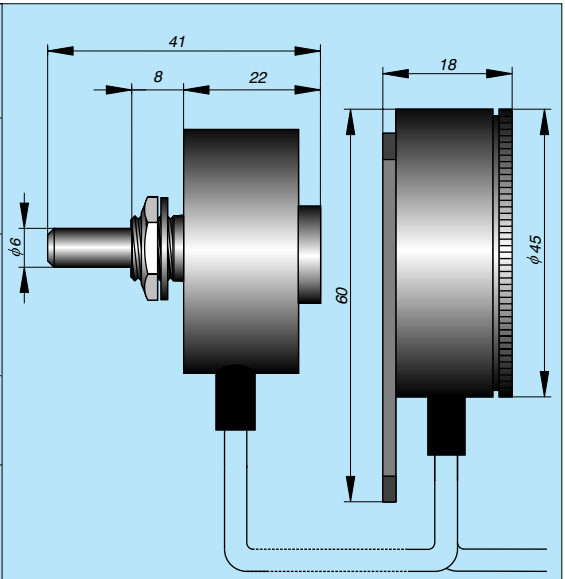
Fastening
On a M10x75 thread with a crown washer, fit on F 10 mm outlet.

Engaging
A shaft F6 mm, for fitting a gear wheel onto a friction clutch.

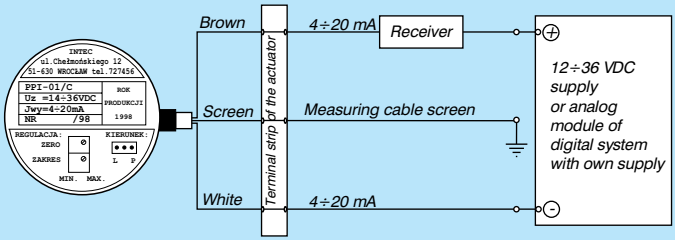
Sealing
The shaft - fluorovulcanizate, back cover - water-proof diaphragm, electronic components - silicone filling compound cured chemically.

Bearings
1 ball bearing, 1 graphite bearing.

Application
Servo-motors series NWA 78 and 100 manufactured by CHEMAR S.A. and those other ones that have been adapted for building in typical potentiometers.



PPI-01/C transducer - outline drawing



PPI-01/C transducer - application diagram

Table of permissible receiver resistance versus supply voltage	*Voltage [V]*	*Resistance [Ω]*	*Voltage [V]*	*Resistance [Ω]*
	36	*1100*	*24*	*500*
	32	*900*	*20*	*300*
	28	*700*	*16*	*100*

Date:	*Induction Type Angular Position Transducer PPI-01/C*		*ZEiAP INTEC*
9.01.99			
	Application diagram and outline drawing		
	Project made by	*Jerzy Kasprzak*	

Miniature Angular Position Transducer PPO-01/A

Design: PPO-01/A transducer consists of an enclosure with a stem for mounting on a screw, a rotary axle with a mechanical limiter, a rear screw-on cover and undetachable screened cable 500 mm long. Underneath the cover there is a zero adjusting potentiometer, range adjusting potentiometer, and a jumper for reversing the sense of rotation. Inside there is a servo potentiometer made of conducting glass type material and provided with bearings, and an electronic processing system. Different lengths of the cable and axle are available when ordered.

Mounting: The transducer should be mounted to a base plate, 1.5÷3 mm thick, in a hole (F) 10 mm dia., using a locknut and a crown washer. A gear coupling to be fixed on the axle. As there is no mechanical limiter, the gear wheel may be rigidly fixed on the axle. The cable should be cut to a proper size, the ends mended and fitted with terminals and the heat-shrinkable tubing provided in the set. The larger tubing and terminal are for the screen end. Should the gear eccentricity be found (in older actuators) a flexible type base plate to be applied or adequate tooth clearance to be allowed for.

Starting: Having connected, engaged, and applied the supply voltage to the transducer, check the current flow in the measuring circuit. No current indication means the reverse direction of the applied voltage (the transducer is resistant to that). Next step is overrunning the actuator into a position corresponding to the 20 mA current in the line and setting this value by using the jumper for reversing the sense of rotation and the potentiometer for the range adjustment. Then overrun the actuator into a position corresponding to the 4 mA current in the line and set this value by using the zero adjusting potentiometer. The last operation is returning to 20 mA position and correcting possible deviation that might result from the adjustment action interrelations, by using the range adjustment potentiometer. In practice, when setting the extreme values one should take into account the actuators run-up and possible inaccuracy of the extremes. It is then recommended to set a little bit greater value than 4 mA and a little bit lower value than 20 mA.

Application: PPO-01/A has been designed for operation in analog and digital automatic control and measuring systems working in not rugged conditions of operation.

Technical parameters	
Supply voltage and system	12÷36 VDC , two-conductor type
Measured range	0÷300°
Range adjustment	50÷100%
Output signal	4÷20 mA
Nonlinearity acc. with PN-88/M-42000-18	0.6% (ref. to the extremes of the characteristic)
Temperature error	0.25% / 10°C
Working temperature	-25÷70°C
Protection class	IP-54
Mechanical life pariod	10 000 000 cycles
Attenuation	50 dB (50 Hz)
Vibration resistance	10 G

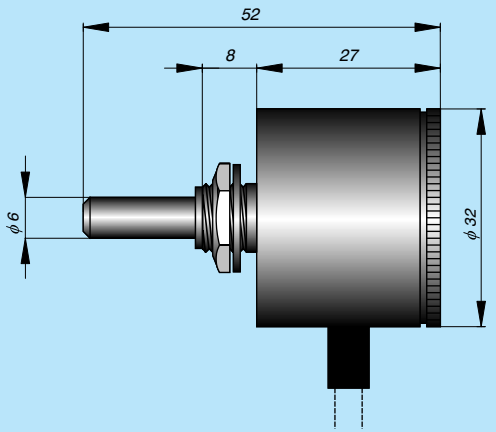
Fastening
On a M10x75 thread with a crown washer, fit on F 10 mm outlet.

Engaging
A shaft F6 mm, for fitting a gear wheel onto a friction clutch.

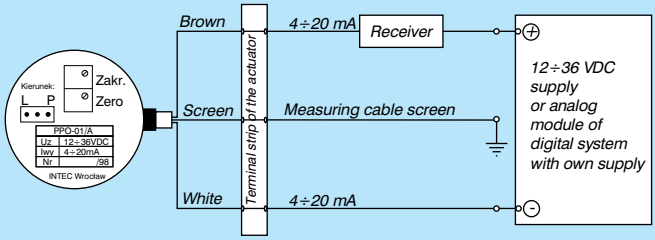
Sealing
The shaft - fluorovulcanizate, back cover - water-proof diaphragm, electronic components-silicone filling compound cured chemically.

Bearings
2 ball bearings, 1 graphite bearing.

Application
Servo-motors manufactured by ZAP S.A. and CHEMAR S.A. and those other ones that have been adapted for building in typical potentiometers.



PPO-01/A transducer - outline drawing



PPO-01/A transducer - application diagram

Table of permissible receiver resistance versus supply voltage

Voltage [V]	*Resistance [Ω]*	*Voltage [V]*	*Resistance [Ω]*
36	*1100*	*24*	*500*
32	*900*	*20*	*300*
28	*700*	*16*	*100*

Date:	*Miniature Angular Position Transducer PPO-01/A*		*ZEiAP INTEC*
9.01.99			
	Application diagram and outline drawing		
	Project made by	*Jerzy Kasprzak*	

Miniature Angular Position Transducer PPO-01/B

Design: PPO-01/B transducer consists of an enclosure with a stem for mounting on a screw, a rotary axle with a mechanical limiter, a rear screw-on cover and undetachable screened cable 500 mm long. Underneath the cover there is a zero adjusting potentiometer, range adjusting potentiometer, and a jumper for reversing the sense of rotation. Inside there is a high durability precision potentiometer, and an electronic processing system. Different lengths of the cable and axle are available when ordered.

Mounting: The transducer should be mounted to a base plate, 1.5÷3 mm thick, in a hole (F) 10 mm dia., using a locknut and a crown washer. A gear coupling to be fixed on the axle. As there is no mechanical limiter, the gear wheel may be rigidly fixed on the axle. The cable should be cut to a proper size, the ends mended and fitted with terminals and the heat-shrinkable tubing provided in the set. The larger tubing and terminal are for the screen end. Should the gear eccentricity be found (in older actuators) a flexible type base plate to be applied or adequate tooth clearance to be allowed for.

Starting: Having connected, engaged, and applied the supply voltage to the transducer, check the current flow in the measuring circuit. No current indication means the reverse direction of the applied voltage (the transducer is resistant to that). Next step is overrunning the actuator into a position corresponding to the 20 mA current in the line and setting this value by using the jumper for reversing the sense of rotation and the potentiometer for the range adjustment. Then overrun the actuator into a position corresponding to the 4 mA current in the line and set this value by using the zero adjusting potentiometer. The last operation is returning to 20 mA position and correcting possible deviation that might result from the adjustment action interrelations, by using the range adjustment potentiometer. In practice, when setting the extreme values one should take into account the actuators run-up and possible inaccuracy of the extremes. It is then recommended to set a little bit greater value than 4 mA and a little bit lower value than 20 mA.

Application: PPO-01/B has been designed for operation in analog and digital automatic control and measuring systems working in not rugged conditions of operation.

Technical parameters	
Supply voltage and system	12÷36 VDC , two-conductor type
Measured range	0÷300°
Range adjustment	50÷100%
Output signal	4÷20 mA
Nonlinearity acc. with PN-88/M-42000-18	0.6% (ref. to the extremes of the characteristic)
Temperature error	0.25% / 10°C
Working temperature	-25÷70°C
Protection class	IP-53
Mechanical life pariod	1 000 000 cycles
Attenuation	50 dB (50 Hz)
Vibration resistance	10 G

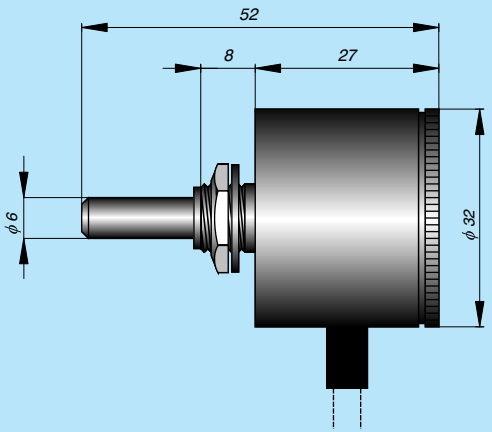
Fastening
On a M10x75 thread with a crown washer, fit on F 10 mm outlet.

Engaging
A shaft F6 mm, for fitting a gear wheel onto a friction clutch.

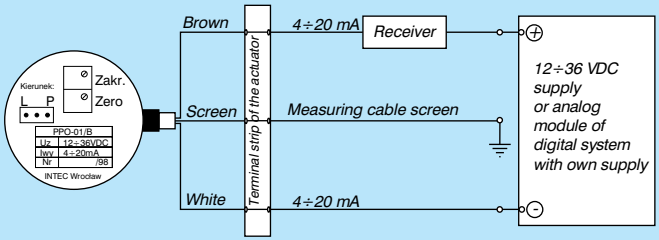
Sealing
The shaft - fluorovulcanizate, back cover - water-proof diaphragm, electronic components - silicone filling compound cured chemically.

Bearings
1 slide bearing (bronze sleeve).

Application
Servo-motors manufactured by ZAP S.A. and those other ones that have been adapted for building in typical potentiometers.



PPO-01/B transducer - outline drawing



PPO-01/B transducer - application diagram

Table of permissible receiver resistance versus supply voltage	*Voltage [V]*	*Resistance [Ω]*	*Voltage [V]*	*Resistance [Ω]*
	36	*1100*	*24*	*500*
	32	*900*	*20*	*300*
	28	*700*	*16*	*100*

Date:	*Miniature Angular Position Transducer PPO-01/B*		*ZEiAP INTEC*
9.01.99			
	Application diagram and outline drawing		
	Project made by	*Jerzy Kasprzak*	

Miniature Angular Position Transducer PPO-02/A

Design: PPO-02/A transducer consists of an enclosure with a stem for mounting on a screw, a rotary axle with a mechanical limiter, a rear screw-on cover and undetachable screened cable 500 mm long. Underneath the cover there is a zero adjusting potentiometer, range adjusting potentiometer, and a jumper for reversing the sense of rotation. Inside there is a precision potentiometer, which durability is matching the electrical actuators life (with 100% margin), and an electronic processing system. Different lengths of the cable and axle are available when ordered.

Mounting: The transducer should be mounted to a base plate, 1.5÷3 mm thick, in a hole (F) 10 mm dia., using a locknut and a crown washer. A gear coupling to be fixed on the axle. As there is no mechanical limiter, the gear wheel may be rigidly fixed on the axle. The cable should be cut to a proper size, the ends mended and fitted with terminals and the heat-shrinkable tubing provided in the set. The larger tubing and terminal are for the screen end. Should the gear eccentricity be found (in older actuators) a flexible type base plate to be applied or adequate tooth clearance to be allowed for.

Starting: Having connected, engaged, and applied the supply voltage to the transducer, check the current flow in the measuring circuit. No current indication means the reverse direction of the applied voltage (the transducer is resistant to that). Next step is overrunning the actuator into a position corresponding to the 20 mA current in the line and setting this value by using the jumper for reversing the sense of rotation and the potentiometer for the range adjustment. Then overrun the actuator into a position corresponding to the 4 mA current in the line and set this value by using the zero adjusting potentiometer. The last operation is returning to 20 mA position and correcting possible deviation that might result from the adjustment action interrelations, by using the range adjustment potentiometer. In practice, when setting the extreme values one should take into account the actuators run-up and possible inaccuracy of the extremes. It is then recommended to set a little bit greater value than 4 mA and a little bit lower value than 20 mA.

Application: PPO-02/A has been designed for operation in analog and digital automatic control and measuring systems working in not rugged conditions of operation.

Technical parameters	
Supply voltage and system	12÷36 VDC , two-conductor type
Measured range	0÷270°
Range adjustment	50÷100%
Output signal	4÷20 mA
Nonlinearity acc. with PN-88/M-42000-18	1.6% (ref. to the extremes of the characteristic)
Temperature error	0.25% / 10°C
Working temperature	-25÷70°C
Protection class	IP-42
Mechanical life pariod	200 000 cycles
Attenuation	50 dB (50 Hz)
Vibration resistance	10 G

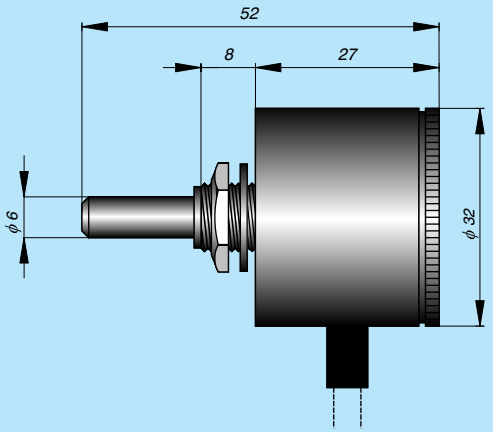
Fastening
On a M10x75 thread with a crown washer, fit on F 10 mm outlet.

Engaging
A shaft F6 mm, for fitting a gear wheel onto a friction clutch.

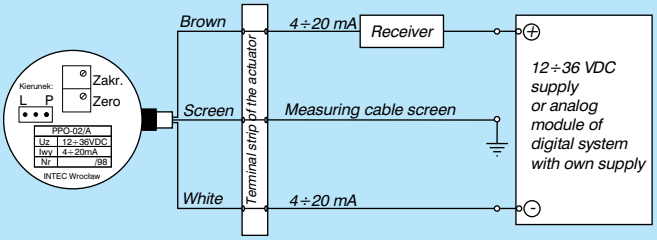
Sealing
The shaft - not sealed, back cover - water-proof diaphragm, electronic components - silicone filling compound cured chemically.

Bearings
1 slide bearing (bronze sleeve).

Application
Servo-motors manufactured by ZAP S.A. and those other ones that have been adapted for building in miniature potentiometers.



PPO-02/A transducer - outline drawing



PPO-02/A Transducer - application diagram

Table of permissible receiver resistance versus supply voltage	Voltage [V]	Resistance [Ω]	Voltage [V]	Resistance [Ω]
	36	1100	24	500
	32	900	20	300
	28	700	16	100

Date: 9.01.99	Miniature Angular Position Transducer PPO-02/A		ZEiAP INTEC
	Application diagram and outline drawing		
	Project made by	Jerzy Kasprzak	