# Precision Angle Displacement Sensor 

Capacitive, without contact rings
Series 88600

| Code: | 88600 EN |
| :--- | :--- |
| Delivery: | ex stock / 5 weeks |
| Warranty: | 24 months |



- Measurement ranges up to $160^{\circ}$
- High linearity up to 0.05\% F.S.
- Contact-free transmission
- Integrated amplifier
- Robust, maintenance-free
- Very low inertia moment
- Special versions by request


## Application

The 88600 series combines the precision of expensive optical angle encoders with high resolution and an analog output, without being subject to the restricted applications of potentiometric angle sensors.
Typical applications

- Position feedback in servo-systems
- Zero detectors
- Pendulum weighing machines
- Cam and butterfly flap positions
- Twist angles
- Angular actuators
- Optical angle measurements
- Jockey roller controllers


## Description

This capacitive DC/DC angle displacement sensor with integrated amplifier only requires a DC voltage for a power supply and delivers an output voltage that is proportional to the angular position of the shaft. The shaft can be turned clockwise or counterclockwise with a permissible angular speed of up to $18,000 \%$ (option).
A highly accurate differential rotary capacitor is used to convert the angle into an electrical voltage. The integrated electronics consists of an oscillator, demodulator and amplifier. It can display the measurement signal directly or can, for instance, pass it to process monitoring equipment.
Power supply and transmission of measured signals is without contact within the sensor. Operation is therefore maintenance-free. The precision roller bearings used give the sensor a long service life.
Parts that are important for the function are made from material with no internal stresses and protected against corrosion.

## Mounting instructions

The three threaded holes on the front plate (shaft side) allow the sensor to be mounted in any position. To determine the angular position of the measuring range, the shaft has a reference groove and the front face a reference hole (see rear).

Technical Data

| Model | Operating <br> Measurement <br> Range 1． | Non－ <br> Linearity <br> （\％F．S．） | Possible <br> Measurement <br> Range 1． | Non－Linearity in <br> Possible Measurement <br> Range | Position of <br> Measurement <br> Range $1 .+2$. | Output <br> Voltage mV／ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $88600-000$ | $\pm 30^{\circ}$ | $\leq \pm 0.05 \%$ | $\pm 40^{\circ}$ | $\leq \pm 0.10 \%$ | $0^{\circ} \pm 3^{\circ}$ | 100 |
| $88601-000$ | $+10^{\circ} \ldots+70^{\circ}$ | $\leq \pm 0.05 \%$ | $0 \ldots+80^{\circ}$ | $\leq \pm 0.10 \%$ | $+40^{\circ} \pm 3^{\circ}$ | 100 |
| $88602-000$ | $-10^{\circ} \ldots-70^{\circ}$ | $\leq \pm 0.05 \%$ | $0 \ldots-80^{\circ}$ | $\leq \pm 0.10 \%$ | $-40^{\circ} \pm 3^{\circ}$ | 100 |
| $88603-000$ | $\pm 60^{\circ}$ | $\leq \pm 0.10 \%$ | $\pm 80^{\circ}$ | $\leq \pm 0.15 \%$ | $0^{\circ} \pm 3^{\circ}$ | 100 |
| $88603-001$ | m | $\pm 60^{\circ}$ | $\leq \pm 0.05 \%$ | $\pm 80^{\circ}$ | $\leq \pm 0.10 \%$ | $0^{\circ} \pm 3^{\circ}$ |
| $88603-002$ | $+20^{\circ} \ldots+140^{\circ}$ | $\leq \pm 0.10 \%$ | $0 \ldots+160^{\circ}$ | $\leq \pm 0.15 \%$ | $+80^{\circ} \pm 3^{\circ}$ | 100 |
| $88603-003$ | $+20^{\circ} \ldots+140^{\circ}$ | $\leq \pm 0.05 \%$ | $0 \ldots+160^{\circ}$ | $\leq \pm 0.10 \%$ | $+80^{\circ} \pm 3^{\circ}$ | 50 |
| $88603-004$ | $-20^{\circ} \ldots-140^{\circ}$ | $\leq \pm 0.10 \%$ | $0 \ldots-160^{\circ}$ | $\leq \pm 0.15 \%$ | $-80^{\circ} \pm 3^{\circ}$ | 50 |
| $88603-005$ | $-20^{\circ} \ldots-140^{\circ}$ | $\leq \pm 0.05 \%$ | $0 \ldots-160^{\circ}$ | $\leq \pm 0.15 \%$ | $-80^{\circ} \pm 3^{\circ}$ | 50 |

## Electrical values

Excitation voltage：$\quad 15.00 \mathrm{~V}$ DC（other voltages，refer to options）， with protection against polarity reversal

## Excitation current：

Output：

$$
\begin{aligned}
& \text { ripple } \\
& \text { impedance }
\end{aligned}
$$

Repeatability：
$\leq 30 \mathrm{~mA}$
short－circuit proof，best linearity at $1 \mathrm{k} \Omega$ load $\leq 20 \mathrm{mV}_{\mathrm{pp}} / 400 \mathrm{kHz}$
$<2 \Omega$

Resolution：
Electrical zero adjustment： $\leq 0.01 \%$

Internal carrier frequency：
$<0.01^{\circ}$
$\pm 3$ \％
400 kHz
Environmental conditions
Range of operation temperature：

$$
\begin{array}{r}
0^{\circ} \mathrm{C} \ldots+75^{\circ} \mathrm{C} \\
-55^{\circ} \mathrm{C} \ldots+125^{\circ} \mathrm{C} \\
\leq \pm 0.027 \% \text { F.S./K }
\end{array}
$$

Mechanical values
Area of rotating：continuous rotation is possible，no mech．stoppers Torque：

$$
\begin{aligned}
& \text { breakaway torque } \\
& \text { slip torque }
\end{aligned}
$$

$49 \times 10^{-3} \mathrm{Ncm}$ $34 \times 10^{-3} \mathrm{Ncm}$
Moment of inertia： $0.76 \mathrm{gcm}^{2}$
Max．shaft load：

## radial

axial： 44 N 31 N

Durability of the ball bearing：$\approx 17000 \mathrm{~h}$ at 10 RPM and 44 N axle load Mounting position： irrespective of its position
Maximum angular speed： $1440 \%$ ，with $\leq 2 \%$ output voltage drop optionally： $18.000 \%$
Weight： approx． 400 g

## Order Information

Angle sensor
Measuring range $\pm 30^{\circ} \mathrm{C}$ ，with option V005 Model 88600－000－V005

## Accessories

Mating connector（cable coupling）， 5 pin
Mating connector 5 pin， $90^{\circ}$ outlet Model 9900－V647
Connecting cable，length 3 m ， one end open

## Model 99547－000A－0160030

Connection cable，length 3 m ，with connector 9941，
12 pin，for burster desktop devices
Model 9916

## Options

V001：Excitation voltage
The sensor may be adjusted to a fix excitation voltage in range between 12 V DC and 16 V DC（standard is 15 V DC）．Please mention the desired voltage when ordering．
V005：Maximum angular speed $18000 \%$ with output voltage drop of maximum 2 \％．

## Explanations

1．Arithmetic sign：when quoting angles，＂+ ＂indicates clockwise rotation，while＂－＂indicates counterclockwise（looking at the shaft）．
2．The shaft of the sensor is located at the center of the measur－ ing range when the angle between the reference groove（in the shaft）and the reference hole（in the housing）correspond to the value given in the table（see drawing）．
3．In addition to the zeroing potentiometer，external zeroing by approx．$\pm 4.5^{\circ}$ or $\pm 9^{\circ}$（depending on type）is possible－see connection diagram．

Dimensional drawing

Wiring diagram
for remote zero


## Wiring code

| iring code |  |
| :---: | :---: |
| A： | + Excitation |
| B： | Excitation ground |
| C： | Remote Zero |
| D： | + Signal output |
| E： | Signal ground |

Block diagram


