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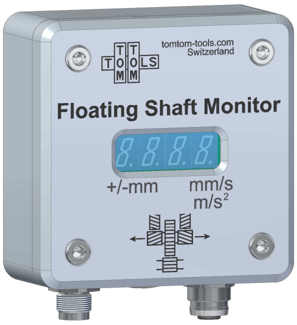
User Manual
Version January 1, 2022

Floating Shaft Monitor

For gearboxes with torque split

1 INTRODUCTION

Fig. 1.0.1 Controller

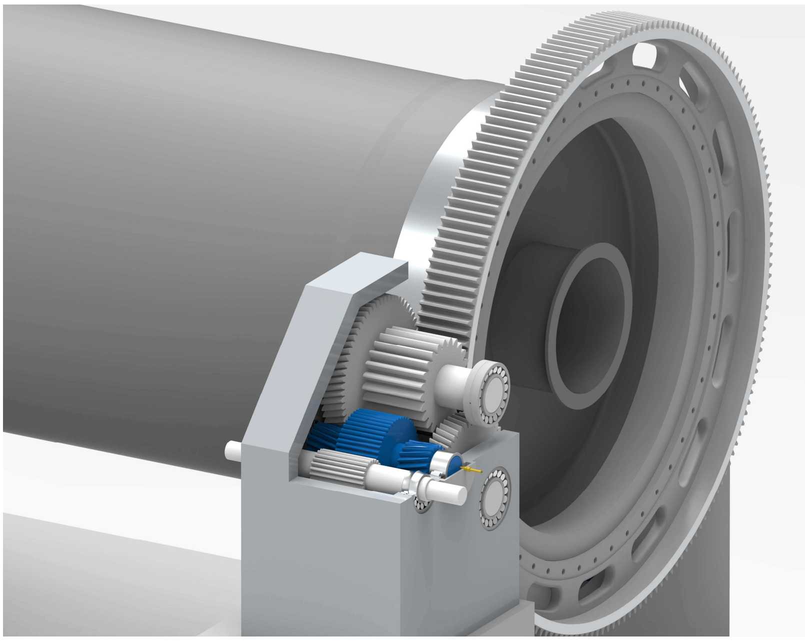


The Floating Shaft Monitor is used to measure and analyze the axial movement of the floating shaft in a gearbox with torque split function.

→It reveals dangerous shock peaks on the gears←.

For example: **Flender DMG2 (Combiflex), FLS Maag LGD, CMD Millrex and Wikov Side Drive** are designed to drive ball mills via a girth gear. These gearboxes are equipped with a floating shaft, which is dividing the torque evenly to the two output pinions, by its axial movement. Disturbances as radial runout on the girth gear or pitch errors at the splits of the girth gear can cause excessive axial movement which is harmful for the gears. Therefore, it is recommended to monitor the movement of the floating shaft.

Not only the value of the movement is important; but also, the axial speed or acceleration. A smooth slow sinusoidal movement by each turn of the mill is indicating eccentricity of the girth gear. Abrupt changes in axial position are indicating dangerous shock peaks caused by roundness or pitch problems in the girth gear.



Beside the traditional vibration analysis, the monitoring of the movement of the floating shaft brings a great visibility about the condition of the drive train. This simple method is also known by the manufacturer of these type of gearboxes, nevertheless usually the signals are not analyzed in a way to get the full benefit out of them.

The Floating Shaft Monitor analyzes the axial shaft movement and provides the amplitude, the speed or the acceleration as 4...20mA signals.

2 SAFETY

Ball Mills, where this system typically is used, are huge rotating equipment with many pinch points which can cause serious injuries. Therefore, only specialized and trained personnel shall work close to these machines. For installation, follow strictly the local safety rules given by the respective plant / factory / local authorities and discuss the application with the safety engineer in charge.
The tools provided by TomTom-Tools GmbH have proven their functionality in various applications; nevertheless TomTom-Tools GmbH does not take any responsibility for the application on site regarding safety or machine damage. The plant is responsible for the safety, according to the local law, in a way that nobody can be hurt or injured. The application and safety instructions below are guidelines and not exhausted which include the experience from previous installations. They might need to be adapted to the local circumstances and safety requirements.

Caution:

Pinch Points:
Do not put your hands nor any items close or into pinch points.
(e.g. tooth wheels, couplings …)
Keep safe distance to avoid getting caught by moving parts
(e.g. bolts on mill shell)
Install the sensors only when the equipment is stopped. Place the Reference Sensor out of reach, out of normal access

Magnetic Fields:
The magnets attached to some of the components are strong.
Be aware of the strong magnetic fields.
Keep the tool away from people with pace makers or any other sensitive item as credit cards or magnetic data carrier.

Hot Surfaces:
The mill and some components might be hot.
Do not touch it and keep safe distance.

Fire:
Take care about the risk of fire during the installation of the sensors.
Special precautionary measures are required while performing hot work close to inflammable materials e.g. lubricants

Gloves:
Wear proper gloves to protect your hands from hot and rough surfaces and sharp edges.

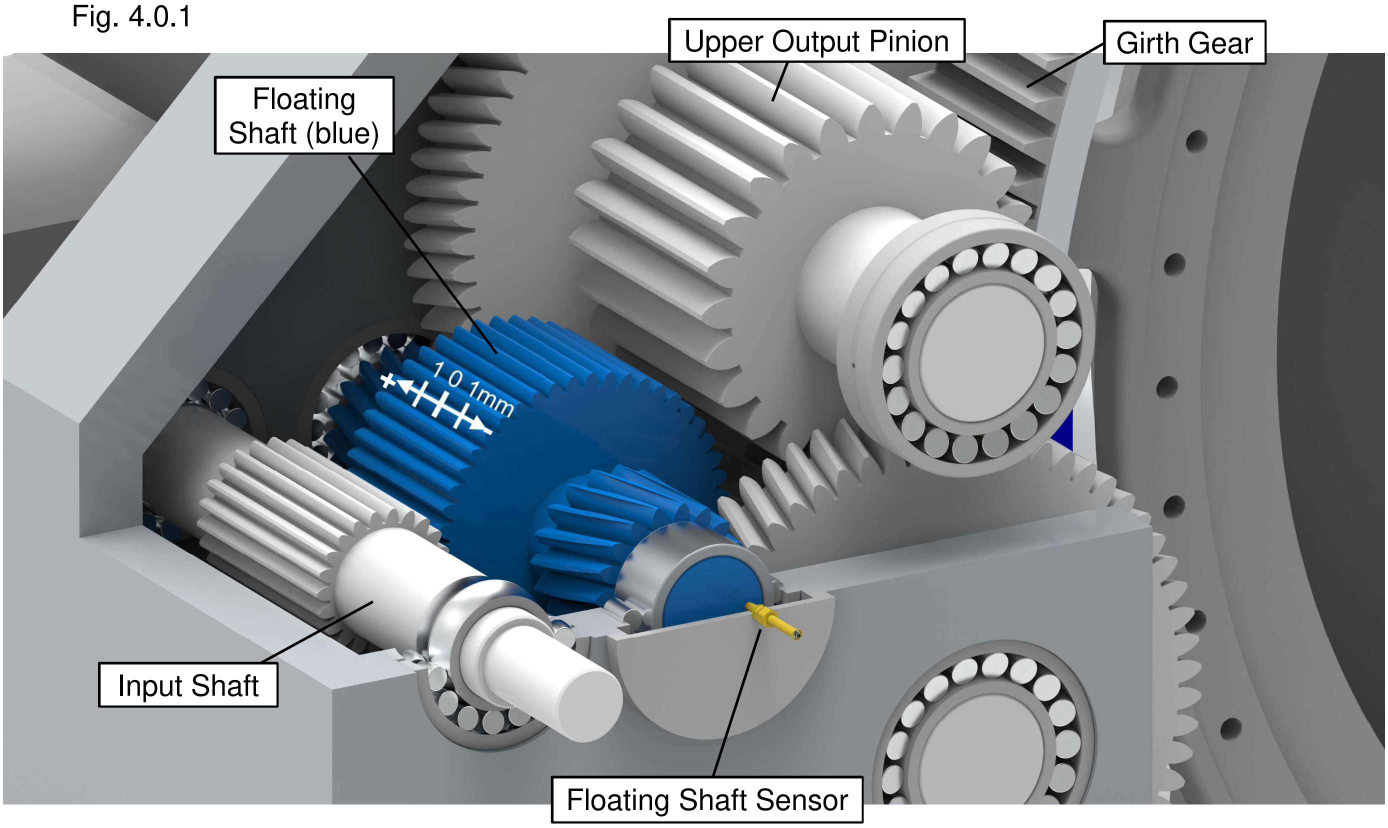
TABLE OF CONTENT

3 FEATURES:

- Output 1: Axial movement of floating shaft, Amplitude value in mm
- Output 2 (Option a): Maximal axial speed of floating shaft in mm/s
- Output 2 (Option b): Maximal axial acceleration of floating shaft in mm/s^2
- Indicates if the sensor is getting out of range
- Very stable results
- Does not require high sampling rate of the plant control system

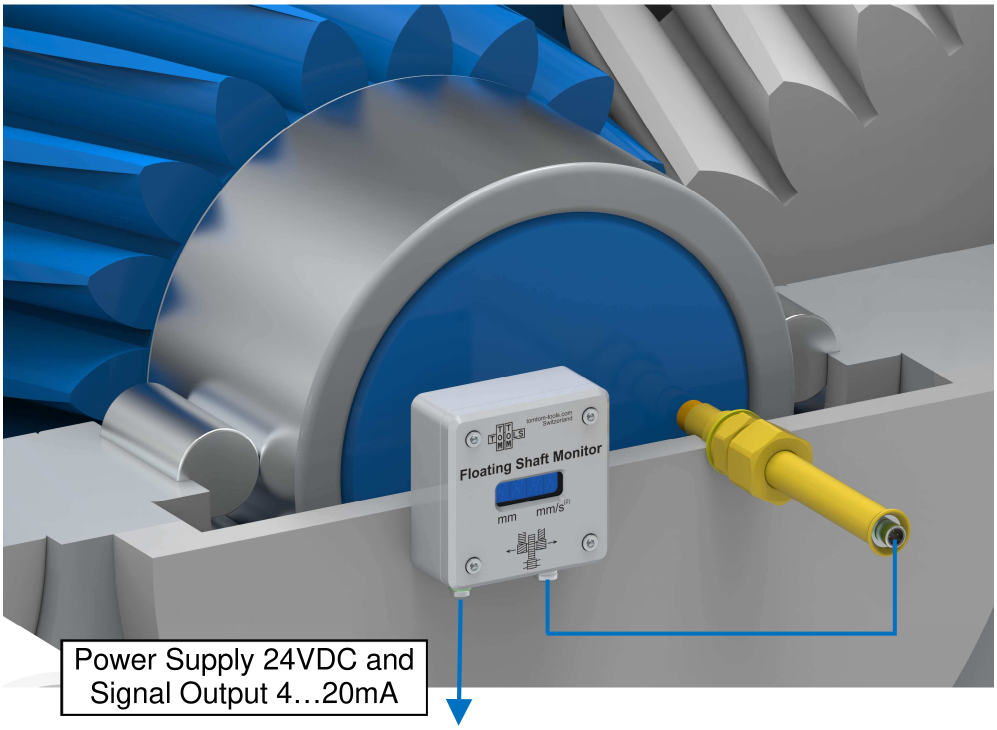
4 TYPICAL SETUP

Fig. 4.0.1



Floating Shaft Sensor:
The axial movement of the floating shaft (blue) is measured continuously by the Floating Shaft Sensor. It is an inductive distance sensor, installed in the side cover and measures the distance to the shaft end. It has a measuring range from 1mm to 8mm. The distance values are sent to the Floating Shaft Controller as a 4…20mA analog signal.

Fig. 4.0.2 Sensor connection to controller



5 INSTALLATION

The installation and commissioning of the system is easy and quick. The sensor comes with a special fitting to facilitate the installation and the cables are ready-made with water and dust tight M12 connectors.

5.1 Floating Shaft Sensor

Most gearboxes are already equipped with the threaded hole to accommodate the Floating Shaft Sensor. To install the sensor, follow the following steps:

a) **Remove the tap** on the cover of the floating shaft and mount the Sensor Fitting.
Use the tap which is slightly out of the center.
Do not use the center tap, because the floating shaft has usually a center bore which is not a good surface to measure.

b) **Place the seal ring** (USIT: UR 26.7X35X2.0) on the outer G3/4" tread of the Sensor Fitting

c) **Tighten the Sensor Fitting** is into the housing,
Use a G1¼" to G ¾" adapter if needed.

d) **Insert the sensor** carefully through the fitting and push it in until it touches the floating shaft

e) **Pull it back** by about 4…5mm to be approximately in the middle of the sensor range

f) **Tighten the Gland Nut** on the Sensor Fitting

Fig. 5.1.1. Adapter Fitting

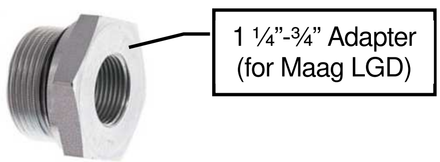


Fig. 5.1.2. Location for sensor installation

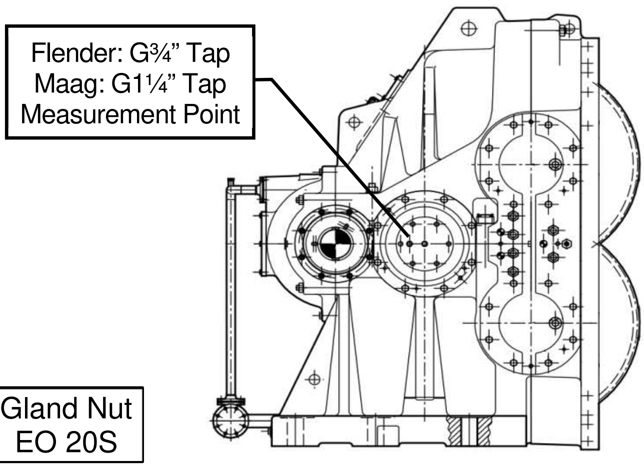


Fig. 5.1.3 Floating Shaft Sensor

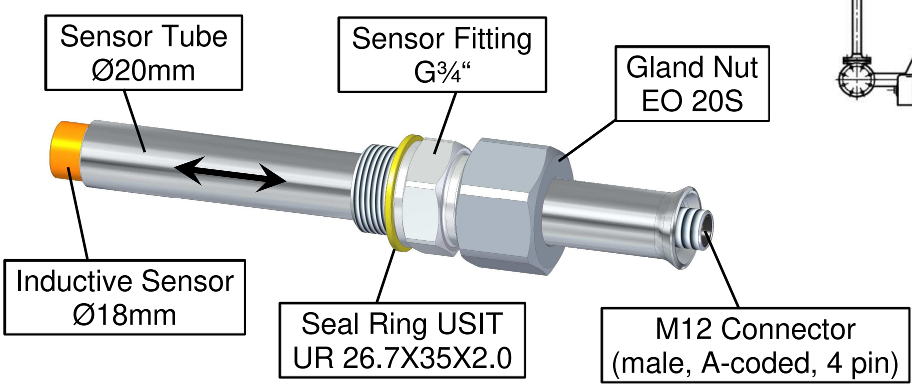
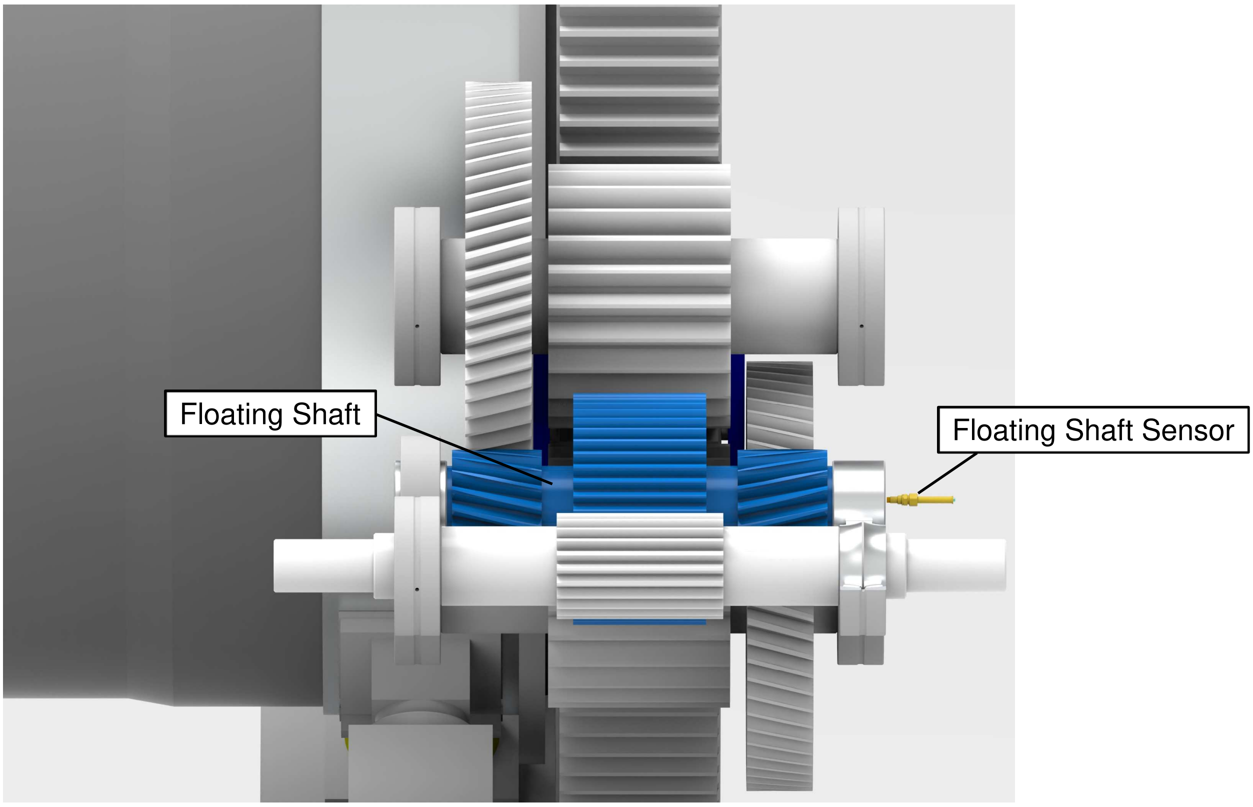
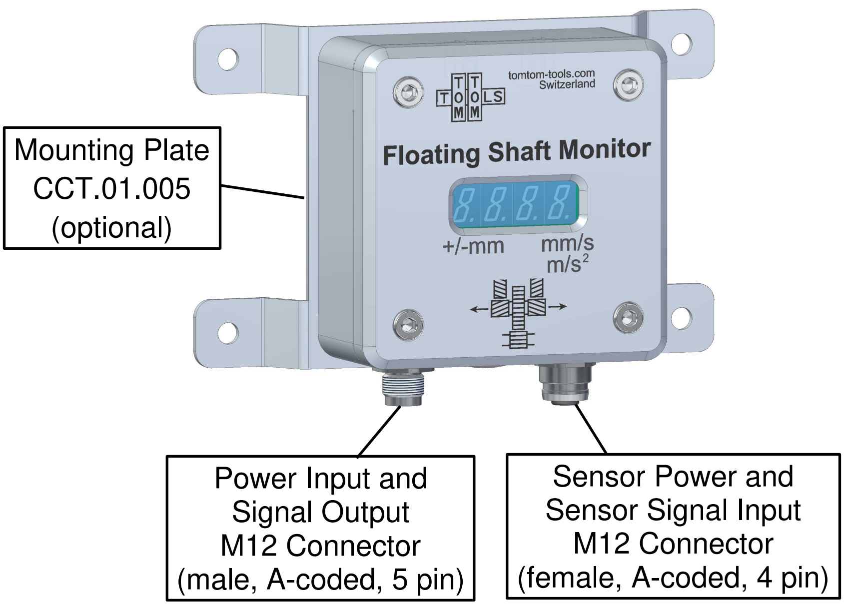


Fig. 5.1.3 Visualization of gear set with floating shaft and sensor



5.2 Floating Shaft Controller

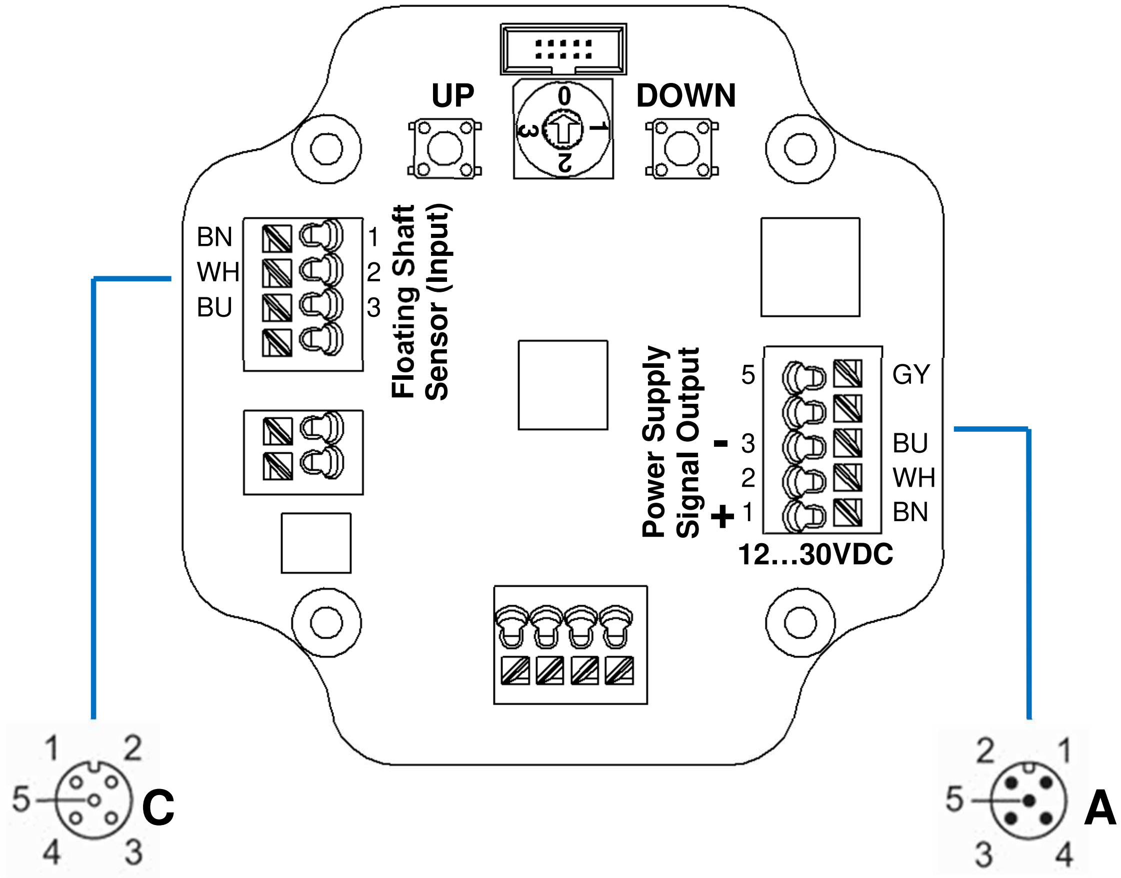
The controller is water and dust tight, and made to be placed close to the mill drive.
Nevertheless, make sure it is not exposed to high vibration, heat and sunlight.
Install the heat shield cover if needed.
For quick installation the controller can be attached by strong magnets e.g. to the gearbox, to a steel structure or to a pole near the mill.
For bolting, use four M5 Allen bolts, going through the housing.
As an option, it is also possible to mount the controller into the electrical cabinet of the mill, together with the power source and the I/Os from the plant control system.



6 WIRING

The controller is pre-wired from the terminal blocks on the circuit board to the M12 connectors in the housing.
The numbering and color coding are in accordance with IEC 61076-2-101.
All M12 connectors and cables in use are A-coded.

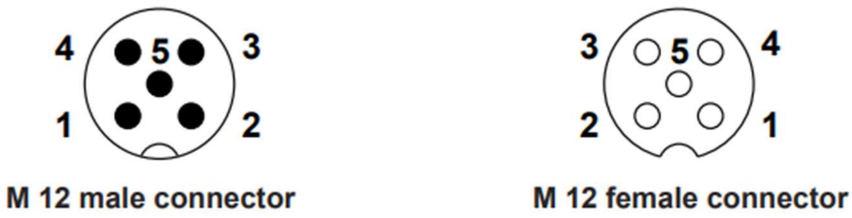
Fig. 6.0.1: Back side of the circuit board in the Floating Shaft Monitor



6.1 Pin Assignment

Pin	Cable Colors	Connector A	Connector C
1	Brown	Power input +24VDC	Sensor Power +24VDC
2	White	Output Signal 1 “Axial Movement” 4…20mA	Sensor Signal Input 4…20mA
3	Blue	GND	GND
4	Black	n.c.	n.c.
5	Grey	Output Signal 2 “Velocity or Acceleration” 4…20mA	n.c.

Fig. 5.4.1: M12 Connector (A-Coded) View from Front Side



6.2 Power Supply

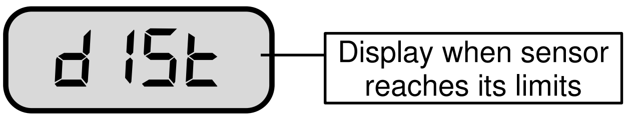
Only one single 24VDC (0.2A) power source is required for the Floating Shaft Monitor.
It is usually accommodated in the cabinet with the analog input connections to the control system of the plant.

6.3 Floating Shaft Measurement

The axial shaft position is measured by an inductive distance sensor. It provides an analog signal (4…20mA) on pin 2 (white wire) which represents the distance to the shaft end. The sensor has to be connected to the controller via Connector C, as shown in Fig. 4.0.2.
The sensor IG6083 has a range of 1…8mm (4…20mA). Therefore, it should be installed with approximately 4…5mm distance from the roller surface to be in the middle of its range. If the sensor distance reaches the end of the range, the message "dist" will be displayed.

Fig. 6.5.1: IG6083 Inductive analog sensor (M18x1) from IFM

Fig. 6.5.2: Distance Warning

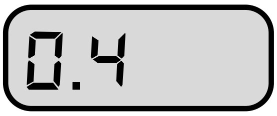


6.4 Signal Output

a) Axial Movement "Floating"

The controller is measuring the axial movement in mm. It is the deviation from the middle position towards both sides.
Here the example shows +/-0.4mm shaft movement; it is the same as 0.8mm in total from one to the other side.

Fig. 6.4.1: Display of Axial Movement in +/-0.4mm



The axial movement is provided by the controller as an analog output signal of 4…20mA on the terminal block and connector A, Pin 2, white wire.

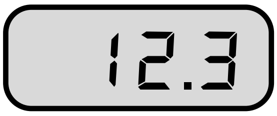
Axial movement of floating shaft: Pin 2 (white)

4mA → 0mm 20mA → +/-2mm

b) Axial Velocity of Floating Shaft (default)

Additionally, to the axial movement it is important to know in what time the shaft is floating from one side to the other or if shock peaks are present. The controller is calculating the highest axial shaft velocity and displays it in mm/s.
The velocity values are displayed at the right side of the display.

Fig. 6.4.2: Display of Axial Shaft Velocity in mm/s
(Example: 12.3mm/s)



The axial velocity is provided by the controller as an analog output signal of 4…20mA on the terminal block and connector A, Pin 5, grey wire. The ratio depends on the value which is configured. The different options are explained later in the chapter 7.2.

Axial velocity of floating shaft: Pin 5 (grey)

Parameter [mm/s/mA]	**0.25**	**0.5**	**1**	**2**
Output 4…20mA →	0…4mm/s	0…8mm/s	0…16mm/s	0…32mm/s

c) Axial Acceleration of Floating Shaft (optional)

It is possible to change the monitoring from velocity to acceleration. In this mode the controller is identifying the highest axial shaft acceleration and displays it in m/s^2 instead of the velocity. The letter "A" indicates that the value represents the shaft acceleration.

Fig. 6.4.3: Display of Axial Shaft Acceleration in m/s^2
(Example: $1.56 m/s^2$)

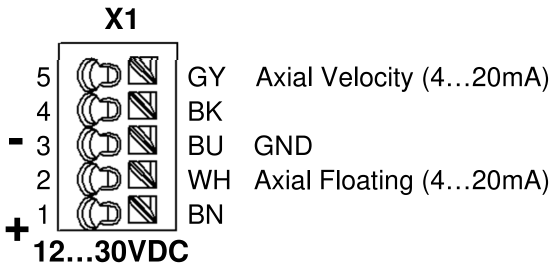
The axial acceleration is now provided by the controller in the same way as the velocity explained before. The analog output signal of 4…20mA goes to the connector A, Pin 5, grey wire. The ratio depends also on the value which is configured. The different options are explained later in the chapter 7.2.

Axial acceleration of floating shaft: Pin 5 (grey)

Parameter [mm/s^2/mA]	**0.25**	**0.5**	**1**	**2**
Output 4…20mA →	0…4m/s^2	0…8m/s^2	0…16m/s^2	0…32m/s^2

Fig. 6.4.4: Terminal Block X1

The current loops on Pin 2 and Pin 5 are based on the common ground (GND) on Pin 3 (blue wire)

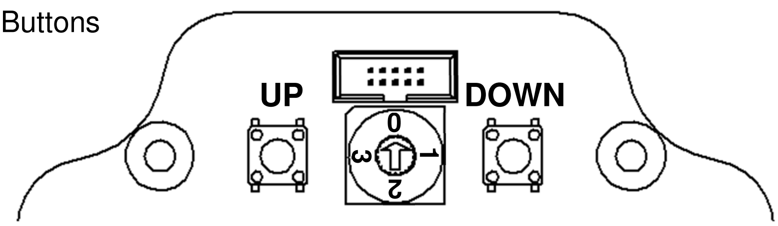


Note:
The axial travel and the velocity or acceleration values are alternately displayed on the controller and provided as two separate 4…20mA signals.

7 CONFIGURATION

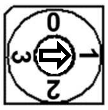
The Floating Shaft Monitor works already with the default settings and shows the values of the axial as soon as the mill is rotating. To bring the analog output signal into the proper working range and to adapt the system to an existing sensor, the controller can easily be configured. It is done by using the rotary switch to select the parameter and the UP and DOWN button to change the values.

Fig. 7.0.1:
Configuration Switch and Buttons



Normal operation: rotary switch position "0"

7.1 Adjustment of Output Range



As mentioned in the chapter 6.4, the analog output can be adjusted to the expected velocity or acceleration of the floating shaft. These values can be quite different, depending on the gearbox design. Different manufacturer chose different helix angles on the gears which result in a different behavior of the floating shaft. To adjust the output to the range of velocity or acceleration, perform the following steps:

1. Open the controller to get access to the circuit board
2. Turn the rotary switch to position 1
3. Push the UP or DOWN button to select the required range.
   The following parameters are available: 0.25, 0.50, **1.00***, 2.00
   they represent: [mm/s/mA] in the velocity mode
   [m/s²/mA] in the acceleration mode

At the right side of the display indicates a letter in what mode the controller is measuring.

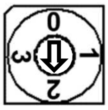
- "V" stands for the velocity mode* (the output signal will be in mm/s)
- "A" stands for the acceleration mode (the output signal will be in m/s^2)

Note:
The mode is changed by pushing the UP or DOWN button when the end of the possible parameter is reached.

Fig. 7.1.1: Velocity Mode
1mA represents 1mm/s (*default)

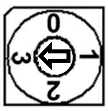
Fig. 7.1.1: Acceleration Mode
1mA represents $0.5mm/s^2$

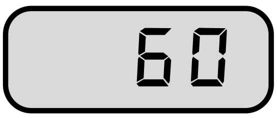
7.2 Sensor Linearization



The Floating Shaft Sensor covers a range from 1…8mm which correspond to the 4…20mA output signal. Hence the sensor linearization is 0.450mm/mA. This value is already set by default in the controller settings. It needs only be changed if a different sensor is used.
The linearization can be adjusted by using the UP and DOWN button while the rotary switch is at position 2.
Range: 0.100…1.000mm/mA Default: 0.450mm/mA

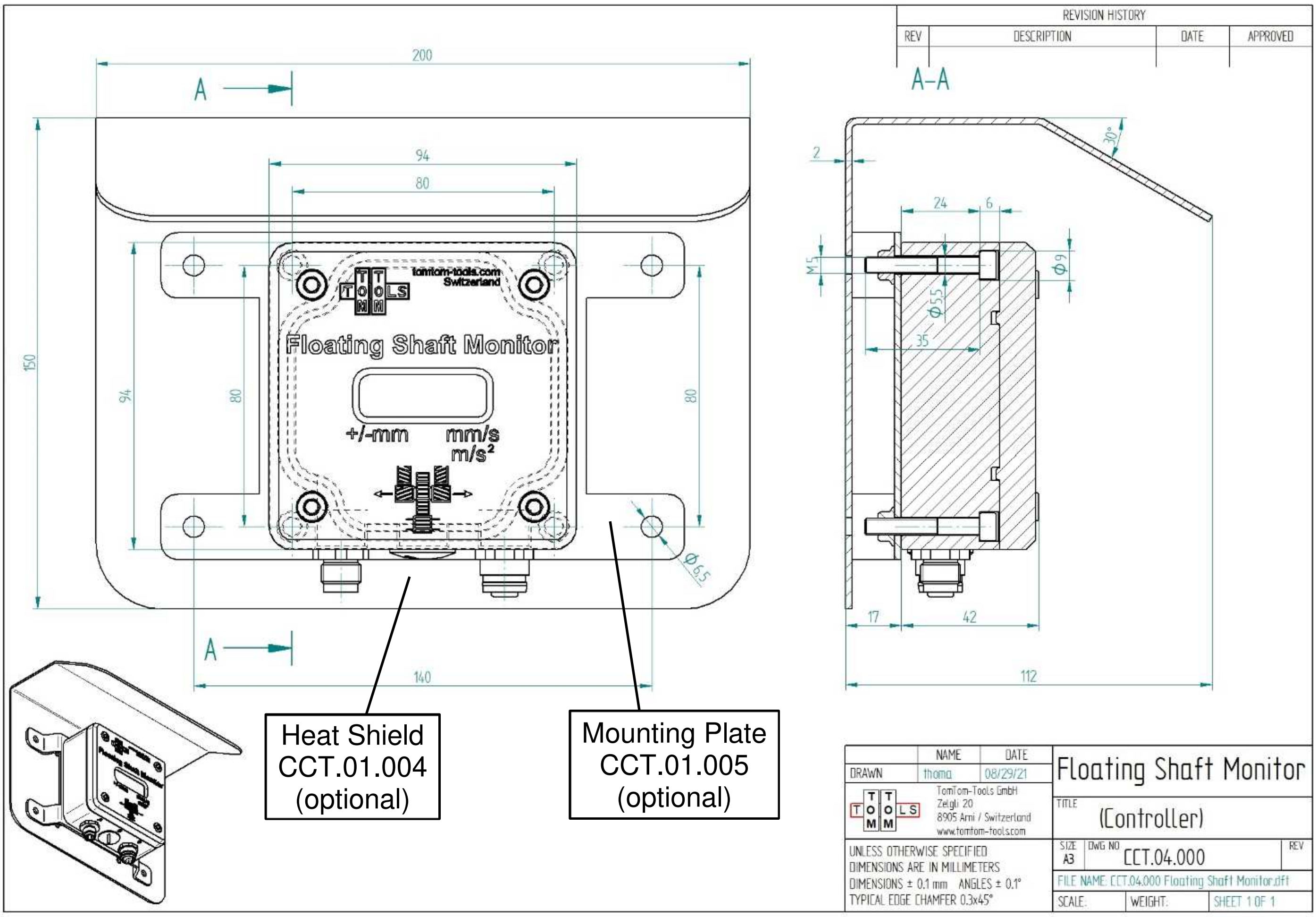
7.3 Time Window





The movement values of the floating shaft are calculated base on the sensor values within the last 60s (default). To change the value, push the UP or DOWN button as required. (possible range: 10 to 120s)

8 DRAWINGS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tomtom-tools.com
Switzerland
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m/s²
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ϕ9
ϕ5,5
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(optional)
Mounting Plate
CCT.01.005
(optional)
NAME
DATE
DRAWN
thoma
08/29/21
TomTom-Tools GmbH
Zelgli 20
8905 Arni / Switzerland
www.tomtom-tools.com
Floating Shaft Monitor
TITLE
(Controller)
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS ± 0.1 mm ANGLES ± 0.1°
TYPICAL EDGE CHAMFER 0.3x45°
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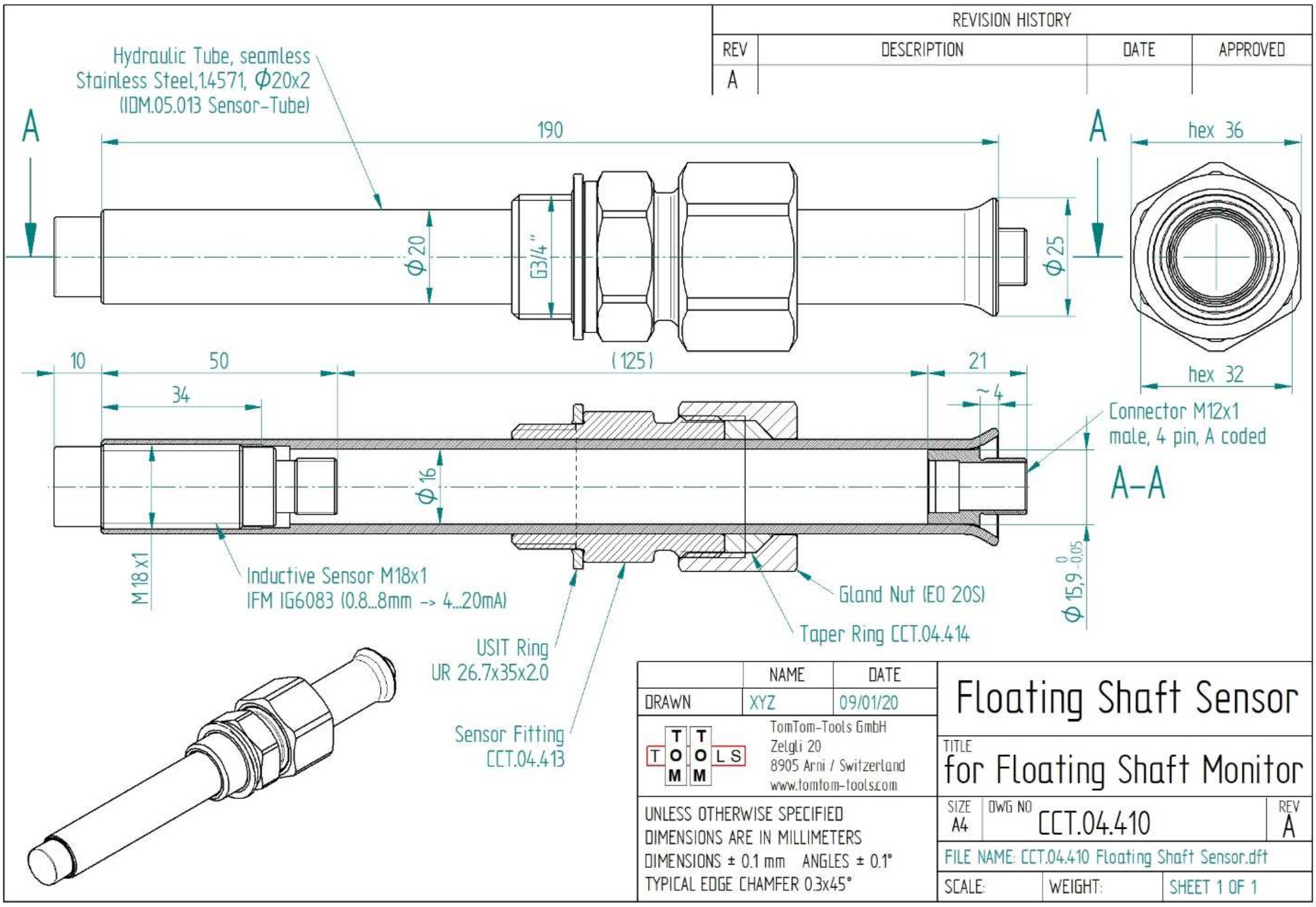
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10
50
(125)
21
34
~4
hex 32
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ϕ16
A-A
M18x1
Inductive Sensor M18x1
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09/01/20
TomTom-Tools GmbH
Zelgli 20
8905 Arni / Switzerland
www.tomtom-tools.com
Floating Shaft Sensor
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for Floating Shaft Monitor
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