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User Manual
Version August 22, 2023

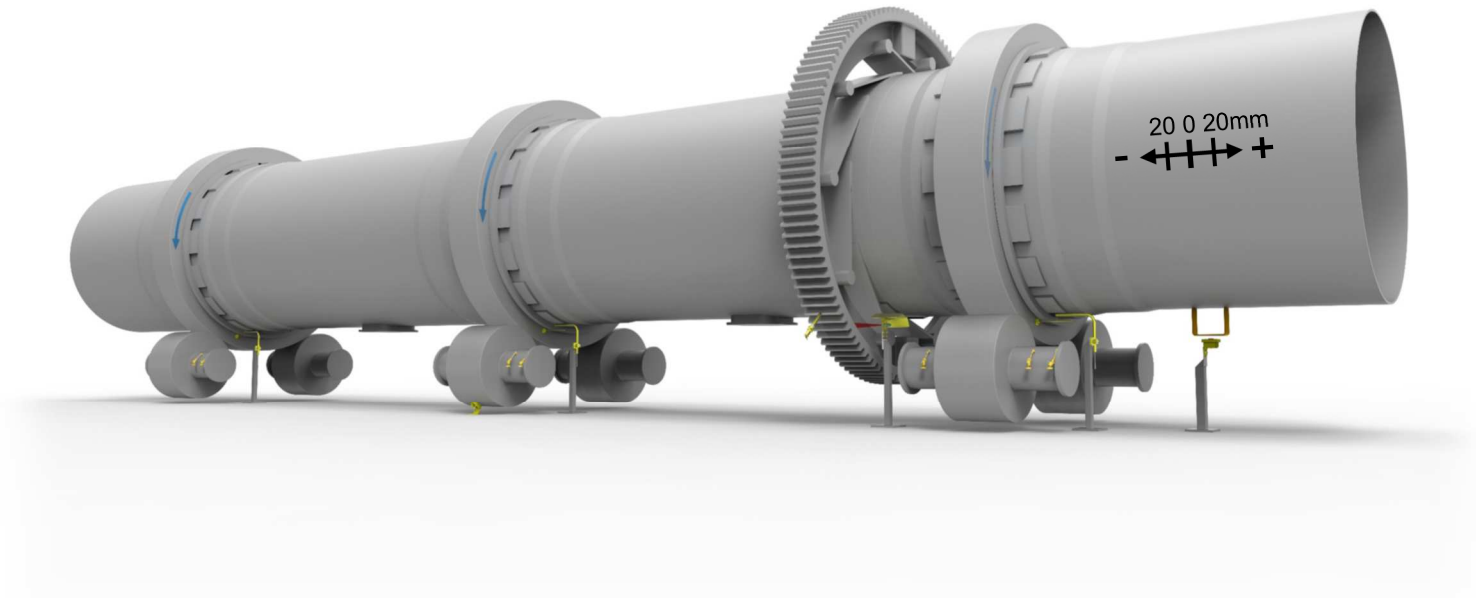
Travel Monitor

Part of Mechanical Kiln Monitoring System (MKM2)

1 INTRODUCTION

Fig. 1.0.1 Travel Controller

The Travel Monitor is part of the new **MKM2** and is used to measure the axial travel or position of a rotary kiln or dryer.
Rotary kilns are moved up and down typically with one or more hydraulic thrust roller to achieve a uniform wear pattern on the support rollers and the gear drive.
The Travel Monitor is measuring the kiln position with the help of an ultrasonic distance sensor. The main advantage of this system compared to others is that the measurement is not affected by deviations in the straightness of the measured surface. That allows to use any side surface on the kiln. A good place to locate the Travel Sensor is next to the girth gear.



2 SAFETY

Rotary kilns and dryers, where this system typically is used, are huge rotating equipment with many pinch points and hot surfaces 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. girth gear / pinion, kiln tires / support rollers, …)
Keep safe distance to avoid getting caught by moving parts
(e.g. switch flags on kiln shell and tires)
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 kiln might be very hot, especially the shell of the kiln.
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.

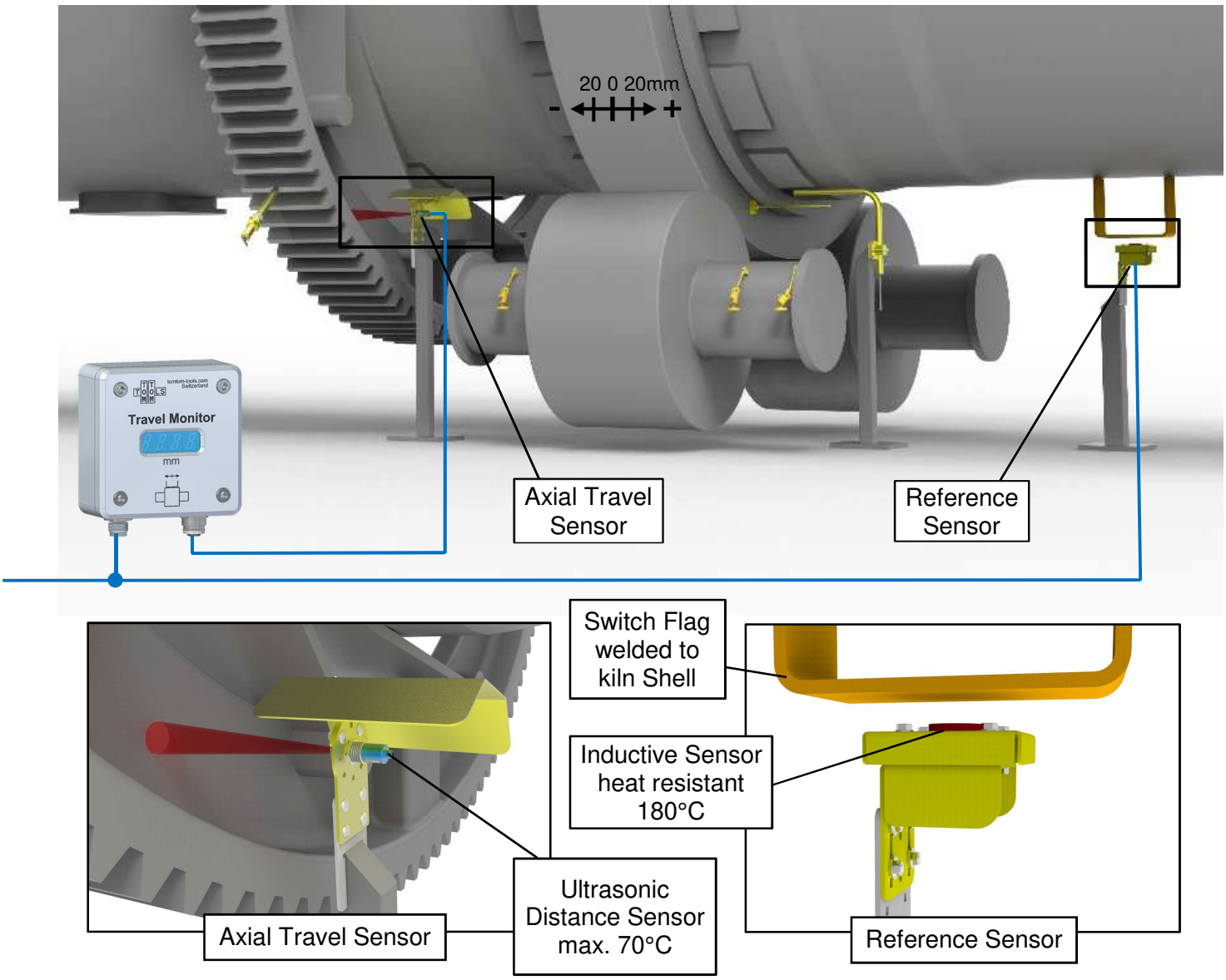
TABLE OF CONTENT

3 Features:

- Output: Axial kiln position value in mm
- Provides reliable results already with one continuous turn with the auxiliary drive of the kiln
- Very stable results which are not affected by wobbling or the shape of the reference surface
- High ranges of axial travel possible, up to +/-100mm
- Suitable for partially and full covered girth gears

4 TYPICAL SETUP

Fig. 4.0.1



Axial Travel Signal:
The axial kiln position is measured by an ultrasonic distance sensor, which is continuously scanning the side face of the girth gear. It has a measuring range from 65mm to 350mm. The distance values are sent to the Travel Controller as a 4…20mA analog signal.

Reference Signal:
The kiln or dryer needs to be equipped with a sensor, which provides information about the speed of rotation. A switch flag is welded to the kiln shell and is passing the Reference Sensor at each turn. In case the kiln is also equipped with a Crank Monitor, only one Reference Sensor is needed for both systems. The signal can be shared.

5 INSTALLATION

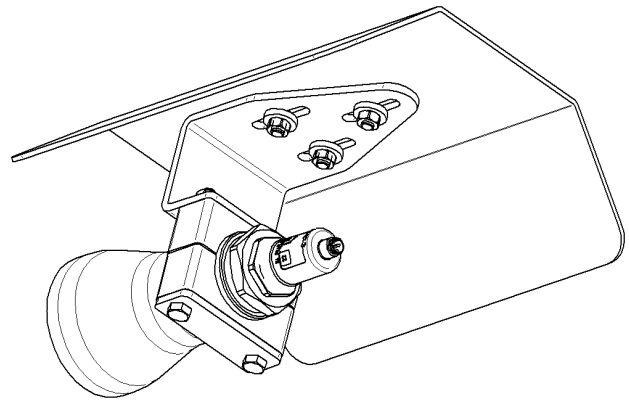
The installation and commissioning of the system is easy and quick. All sensors come with readymade brackets and are connected via pre-assembled connection cables.
To be able to calculate the axial kiln position, two sensor signals are required. One provides the rotation signal from the kiln shell, the other measures the distance to the side face of the girth gear.

5.1 Axial Travel Sensor

This sensor is measuring how much the girth gear is moving in axial direction, which is the same as the axial movement of the kiln. Kilns travel typically about 20…30mm up and down, but the system can measure much larger values, up to +/-100mm as well.

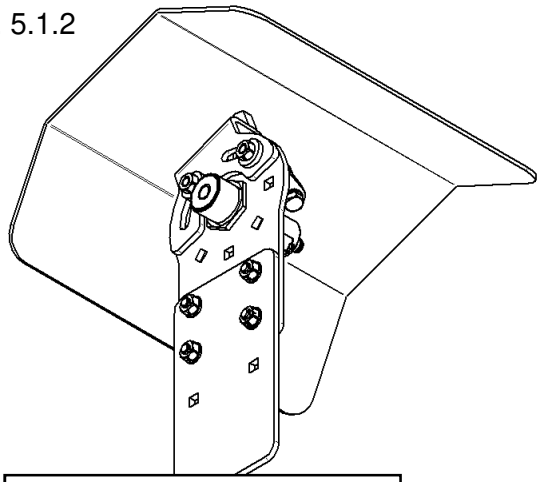
Two mounting options are available:

Fig. 5.1.1



For fully covered girth gears
to be welded onto the gear housing

Fig. 5.1.2



For partly visible girth gears
to be mounted on a pole

Installation guide lines:

a) Place the sensor next to the girth gear where it has a free view to the side face of the gear
b) On fully covered gears, a hole with a diameter of ~90mm needs to be cut in the cover
c) Look for a place where the temperatures are moderate and keep a good distance to the kiln shell
d) Make sure the heat shield is protecting the sensor from the heat radiation from the kiln and from direct sun light
e) The sensor has to be mounted stable and firm that it gets not moved accidently
f) Make sure that the distance between the sensor and the nearest point of the side face of the girth gear is within the measuring range of 65…350mm

5.2 Switch Flag on Kiln Shell

Place the switch flag at the same angular position or even use the same switch flag as for the temperature scanner is used. (It should be the “A” position if there is an “A, B, C” labeling on the kiln shell). For safety reason, place the Reference Sensor where it cannot be reached accidently

5.3 Reference Sensor

The Reference Sensor is a heat resistant inductive sensor (up to 180°C). It is used to measure the speed and rotation position of the kiln. When the switch flag is passing in front of the sensor, it provides an electrical pulse to the Crank Monitor at each turn of the kiln (the shell pace).

a) Look for a good location to place the sensor, before attaching the switch flag to the kiln shell. Make sure it is out of the way where regular access for maintenance is need.
b) Do not expose the Reference Sensor unnecessarily to high temperature. A good place for it might be between kiln inlet and the first tire.
c) Install a stable pole and attach the base plate by welding
d) Make sure the switch flag and the sensor are matching even when the kiln travels axially up or down and when the kiln changes its length due to thermal expansion.
e) Bolt the bracket to the base plate and install the sensor
f) Adjust the distance to the Switch Flag to be in the range of 10…25mm and make sure that the sensor will not touch the switch flag.
g) Connect the Reference Sensor with the heat resistant Teflon cable and the Lemo connector as shown in chapter 6.
Note: The cable can be extended with a standard M12 extension cord.

5.4 Pin Assignment

M12 Standard Pin	Standard Cables	Teflon Cable	Lemo Pin	Typical Usage
1	Brown	Brown	1	Power, +24VDC
2	White	White		Analog Signal
3	Blue	Green	3	GND
4	Black	Yellow	2	Signal
5 (optional)	Grey or Green / Yellow			various

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

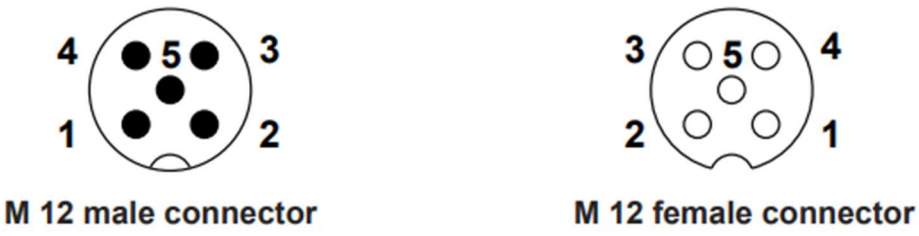
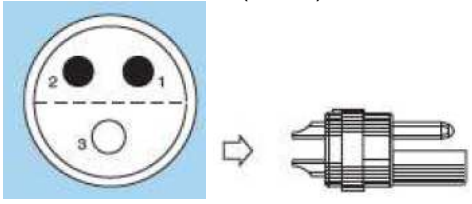


Fig. 5.4.2: Lemo Connector (3 Pin) View from cable side



5.5 Travel Monitor Controller

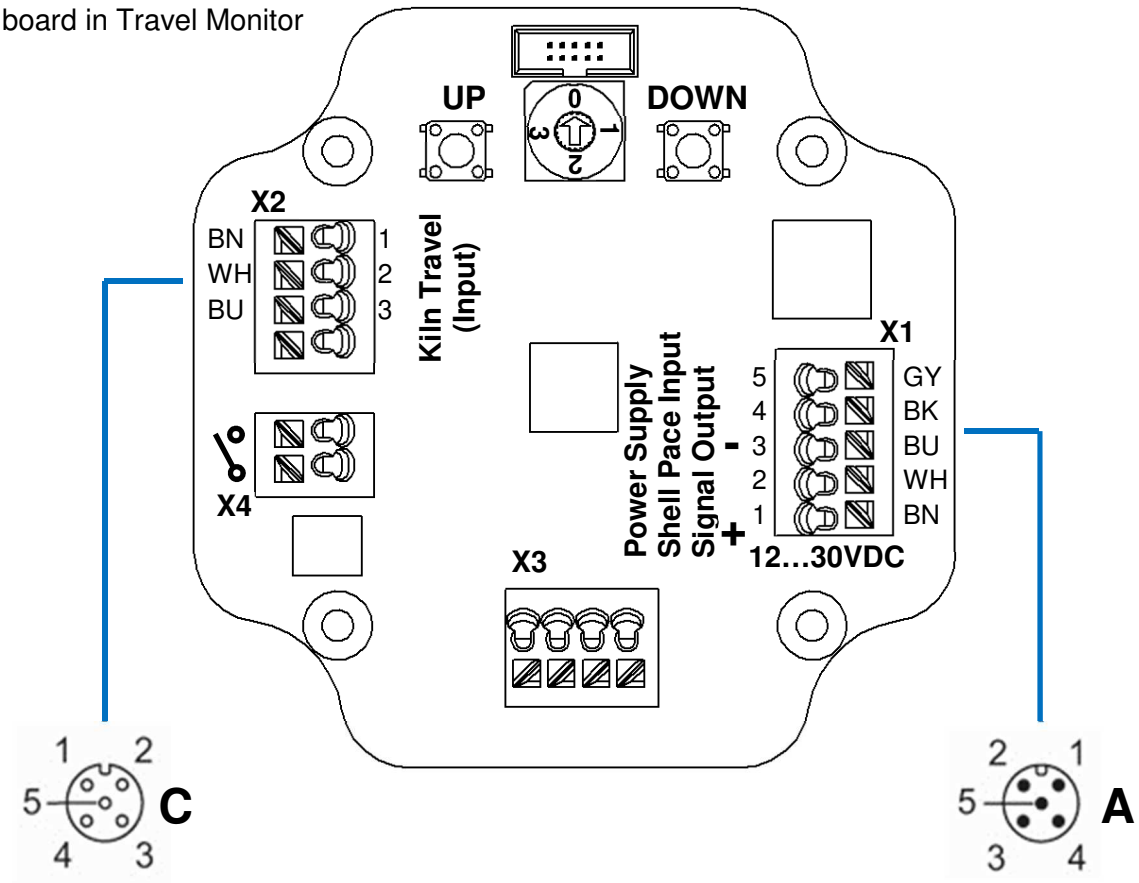
The controller is water and dust tight, and made to be placed close to the kiln drive.
Nevertheless, make sure it is not exposed directly to the radiation from the kiln.
Install the heat shield if needed.
For quick installation the controller can be attached by strong magnets e.g. to the steel structure near the girth gear, or to a pole.
For bolting, use four M5 Allen bolts, going through the housing.
As an option, it is also possible to mount all the Crank, Creep and Travel Monitor controllers in one electrical cabinet together with the power source and the I/Os from the plant control system. The pier with the kiln drive might be a good place because there are often connections to the control system already available.

6 WIRING

The Travel Monitor 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.

Connector	**1**	**2**	**3**	**4**	**5**
Color	Brown (BN)	White (WH)	Blue (BU)	Black (BK)	Grey (GY)
Usage	Power (+)	Analog Signal	GND	Signal	Signal

Fig. 6.0.1: Back side of circuit board in Travel Monitor



6.1 Wiring with Junction Box

This type of wiring is used, when more components of the MKM2 system are installed in combination with the Travel Monitor.
All the different parts of the MKM2 System (Crank Monitor, Creep Monitor and Travel Monitor) can be connected to the same junction box. Each controller is powered and supplied with the shell pace by an individual cable through which also the analog output signal is sent back to the junction box.

Fig. 6.1.1: Star Wiring (Option 1)

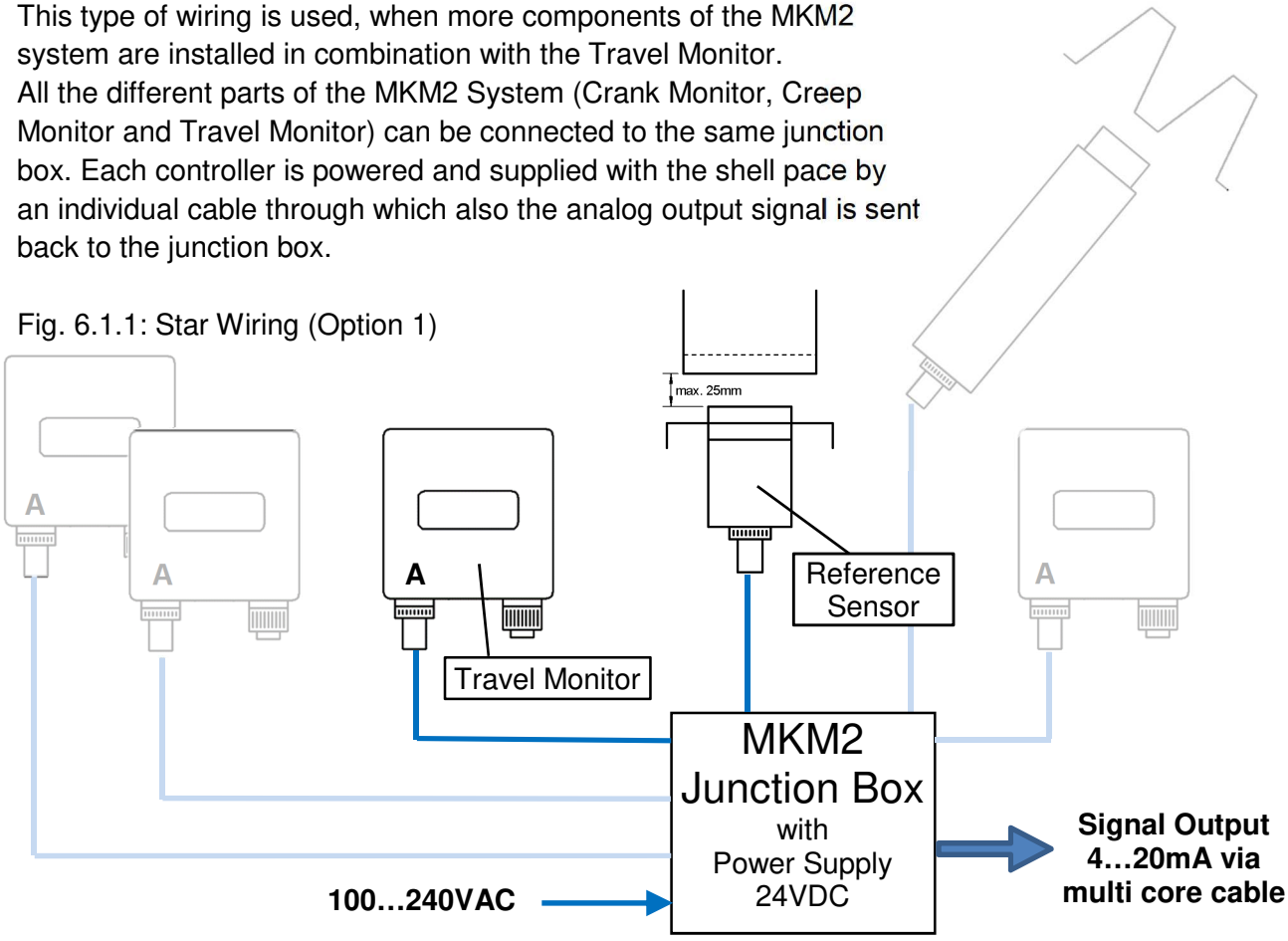
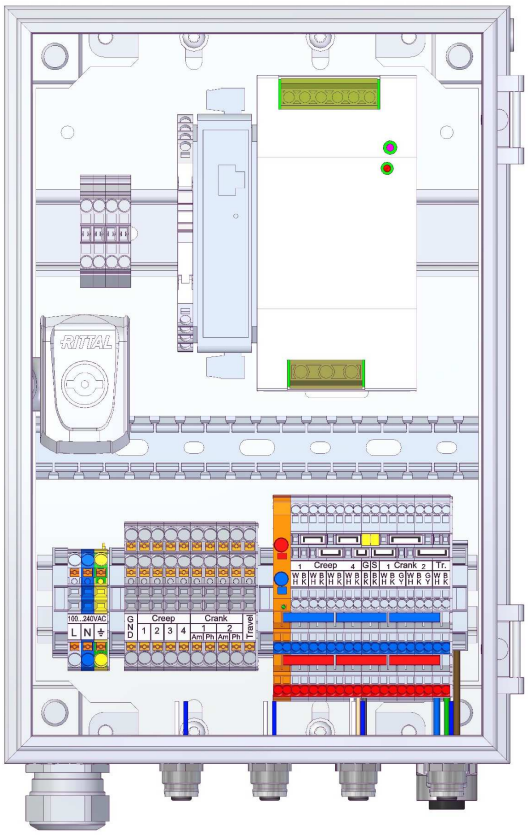


Fig. 6.1.2: MKM2 Junction Box (optional)
A pre-wired junction box with 24VDC power supply is available. It is compact, does not require much space and is equipped with M12 connectors, which make the installation very easy and quick.

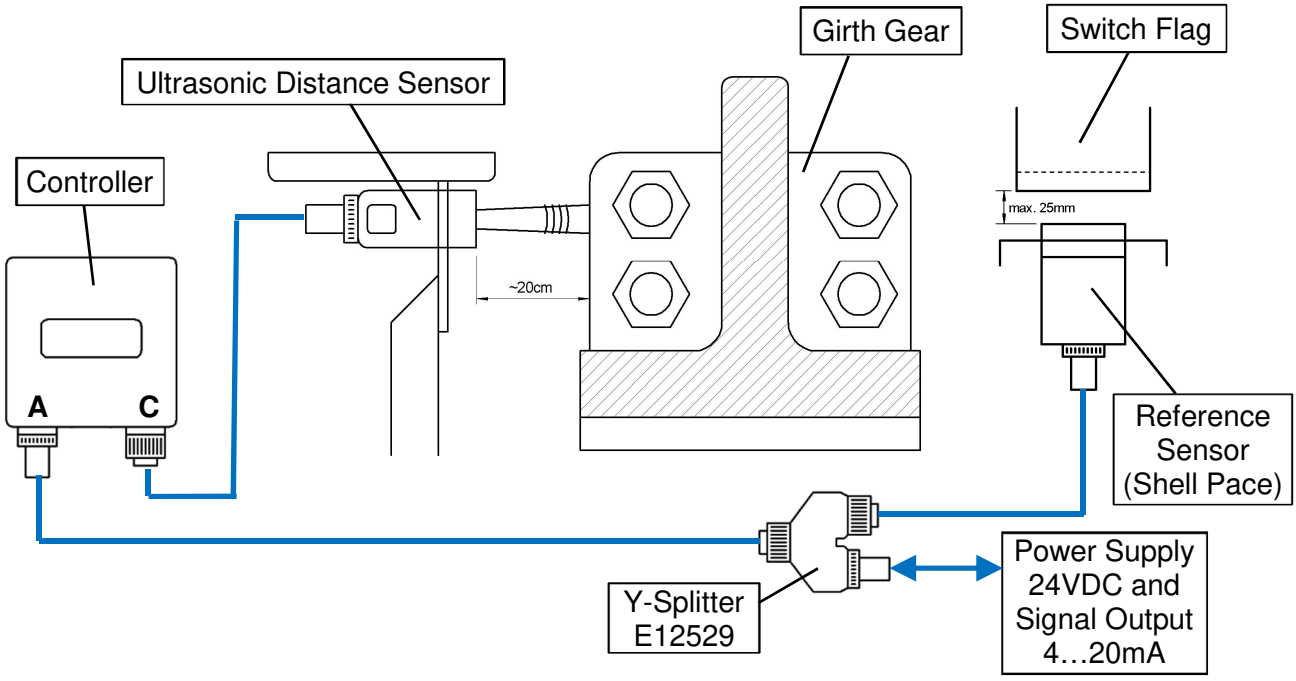
More details about the wiring can be found in the Chapter 7.



6.2 Single Application

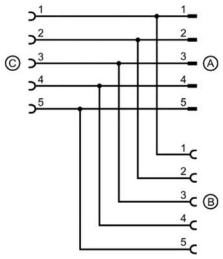
When only the Travel Monitor gets installed, it can be connected via a simple wiring without the need of a junction box. A cable with 4 pins is sufficient to supply the power, the reference signal and to feed the output signal back to the control system of the plant.

Fig. 6.2.1: Power and Reference Signal Distribution



To feed the signal of the Reference Sensor to the controller, use the following Y-Splitter M12-A (with 5 pins): IFM E12529

Fig. 6.2.2: Y-Splitter



6.3 Power Supply

Only one single 24VDC (1A) power source is required for the Travel Monitor and all other Crank and Creep Monitor units on a kiln. By using the MKM2 Junction box, the 24V power supply converter is already included, hence 100…240VAC is required.
The power supply and also the connection to the control system of the plant is usually done at the pier with the kiln drive, because there are already connections to the plant control system available.

6.4 Reference Signal (Shell Pace)

The rotation signal of the kiln, the Shell Pace, is provided by the Reference Sensor as shown in Fig. 6.1.1. or 6.2.1. The Shell Pace signal is fed to the Travel or the different Crank controllers via pin 4 (black wire). They all are using the same reference signal, except the controllers from the Creep Monitor Systems, which use multiple pulses per kiln turn.

6.5 Travel Measurement by Ultrasonic Distance Sensor

The side face of the girth gear is “scanned” continuously by the ultrasonic distance sensor. That means the measured distance readings represent the topology of the girth gear at the diameter where the sensor is placed.
The controller will compare the shortest distances at each turn and calculate the axial position of the kiln out of it.
It is recommended to place the ultrasonic sensor in a way that it catches the side face of the flanges from the gear connection, as shown in Fig. 6.2.1. These flanges are quite big and form a sufficient large area which is easy to measure by the sensor. It provides an analog signal (4…20mA) on pin 2 (white wire) according to the distance to the surface of the girth gear. The Sensor has to be connected to the controller via Connector C, as shown in Fig. 6.2.1.
The sensor mic+35/IU/TC has a default range of 65…350mm (4…20mA). Therefore, it should be installed with approximately 20cm distance to the nearest point on the girth gear to be in the middle area of its range. If the sensor distance reaches the end of the range, the message “dist” will be displayed.
Note: The actual measured distance of the sensor is displayed on the sensor itself and on the controller when the rotary switch is in position 3 (see chapter 7.3)

Fig. 6.5.1: Ultrasonic Distance Sensor mic+35/IU/TC (Microsonic)

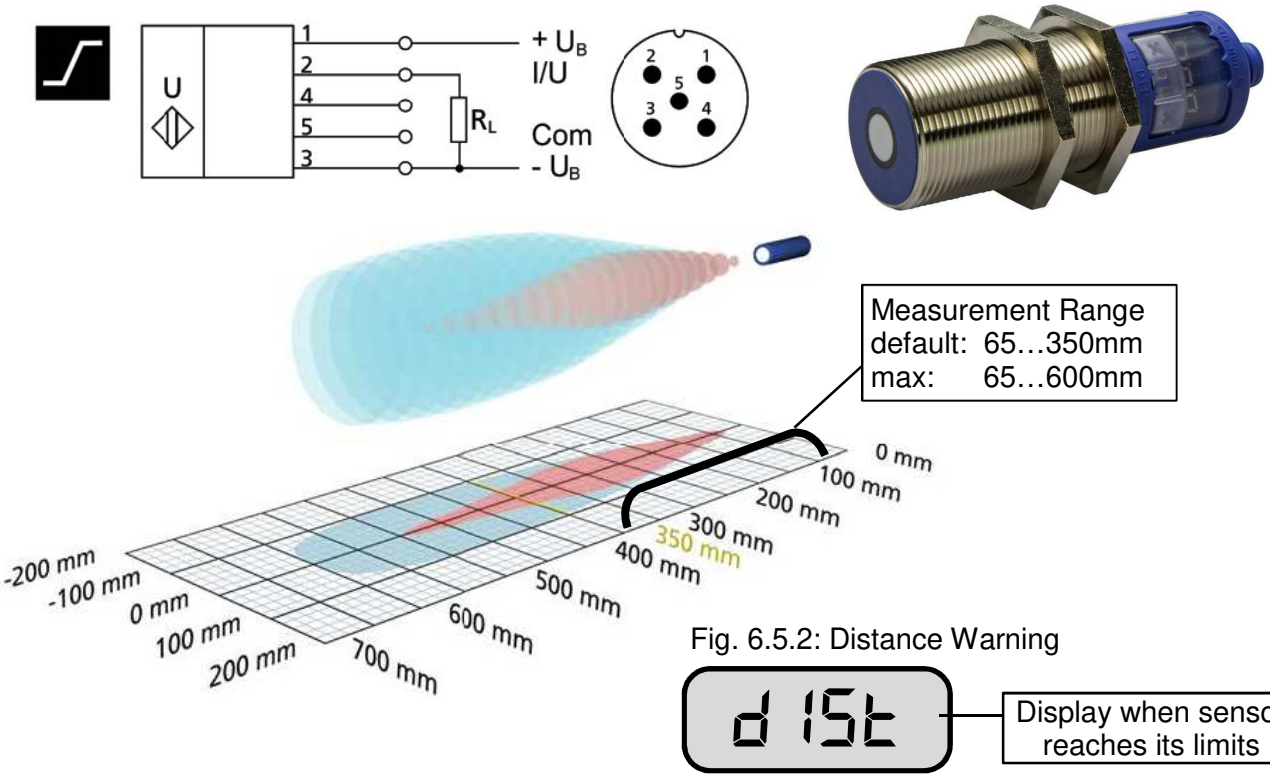


Fig. 6.5.2: Distance Warning

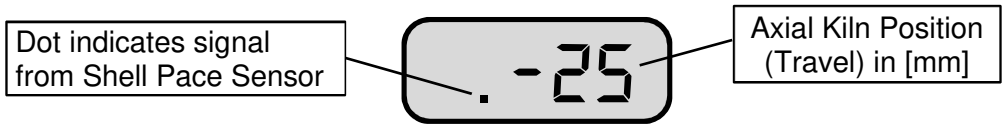
Display when sensor reaches its limits

6.6 Signal Output

The controller is recording the shortest distance readings during each turn and calculates the current axial position of the kiln. The zero point, where the girth gear is located in the middle of the pinion width, has to be defined when the Travel Monitor gets commissioned.

The display of the controller shows the position value. It is the deviation from the zero point in mm. Here the example shows -25 that means the kiln is 25mm below the zero point.

Fig. 6.6.1: Display



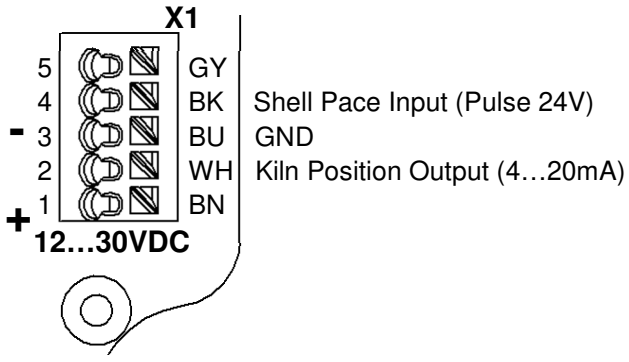
The output of the Travel Monitor controller is an analog signal of 4…20mA provided on the terminal block X1, Pin 2.

Axial Kiln Position (Travel): Pin 2 (white)

4mA → -48mm **12mA → 0mm** **20mA → +48mm**

In case of standard wiring, the output signals are connected to Pin 2 (white wire) which represents the axial kiln position (Travel) on plug A.

Fig. 6.6.2: Terminal Block X1



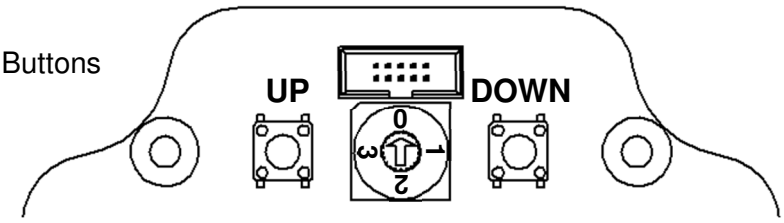
The current loops are based on the common ground (GND) on Pin 3 (blue wire)

Note:
In case the travel cannot be calculated or if there is an issue with one of the sensors, the display will show - - - - and the analog output signals will be at the maximum of 20mA.

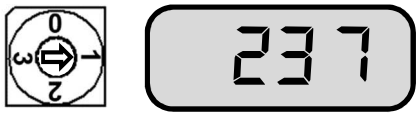
7 CONFIGURATION

The Travel Monitor works already with the default settings and shows the distance values as soon as the kiln is rotating. To bring the analog output signal into the proper working range and to set some smoothening filter, 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 Offset Adjustment

As the ultrasonic distance sensor is placed with about 0.2m distance to the side face of the girth gear, this offset needs to be compensated. On a new device the offset value is zero. That means the display will show the minimum value which is measured during one kiln turn, but this is not the real position of the kiln yet. Here in the example the display shows 237mm. To bring the display to zero when the kiln is in its middle position, 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 simultaneously the UP and DOWN button. The controller will save automatically the offset (here in the Example 237)
4. If the kiln was not precisely in its middle position, the offset value can be adjusted by pushing the UP or DOWN button (0…999mm)

7.2 Sensor position and counting direction

When the ultrasonic sensor is placed at the uphill side of the girth gear, the sensor distance increases when the kiln travels downwards, which is displayed as a positive value. On the other hand, when kiln is moving upwards, the distance will be less and the display shows it as a negative value.
This sense of counting might look a bit confusing. It can be changed by relocating the ultrasonic sensor to the downhill side of the girth gear, which is not very convenient. Therefore, the counting direction can also be inverted in the software by entering the same offset but as a negative value.

Fig. 7.2.1:
Example: Sensor offset 237mm
and sense of counting is inverted (indicated by the -)

7.3 Sensor Linearization

The ultrasonic sensor covers by default a range from 65…350mm which correspond to the 4…20mA output signal. Hence the sensor linearization is 17.8mm/mA. This value is already set by default in the controller settings. It needs only be changed if a different sensor is used or if the range of the sensor was changed.
The linearization can be adjusted by using the UP and DOWN button while the rotary switch is at position 2.
Range: 00.0…99.9mm/mA Default: 17.8mm/mA

7.4 Filter

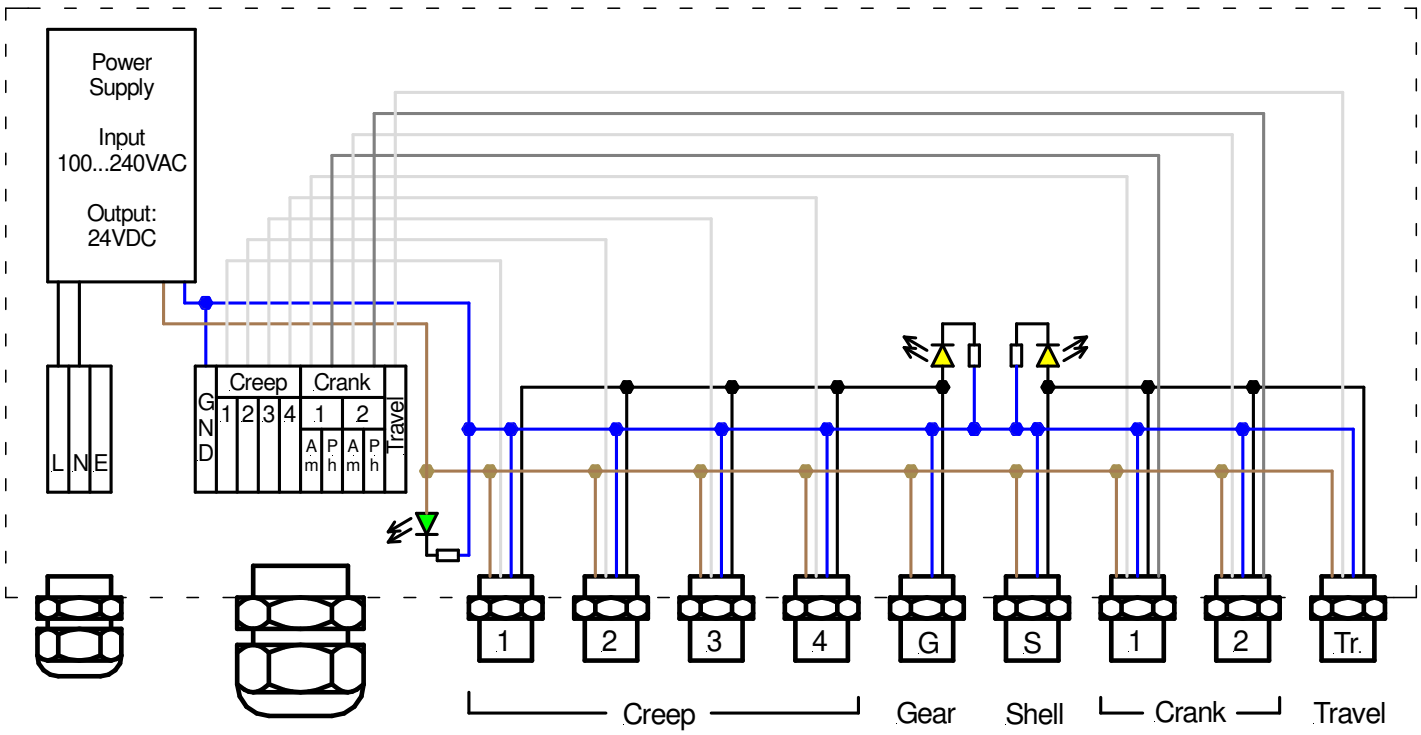
The Travel Monitor is equipped with a filter function to smoothen the output signal.
Normally filtering should not be required and the setting can remain on 1.
A value of 2, as in the example, means that the output signal is the average of the last two turns. A value of 5 will provide an average of the last five kiln turns; and so on.
To adjust the filter, turn the rotary switch to the position 3.
To change the value, push the UP or DOWN button as required. (possible range: 1 to 9)

Note: When the rotary switch is in position 3, the analog output (4…20mA) of the ultrasonic sensor is displayed as well (here 13mA).

8 JUNCTION BOX

8.1 Schematic (typical configuration)

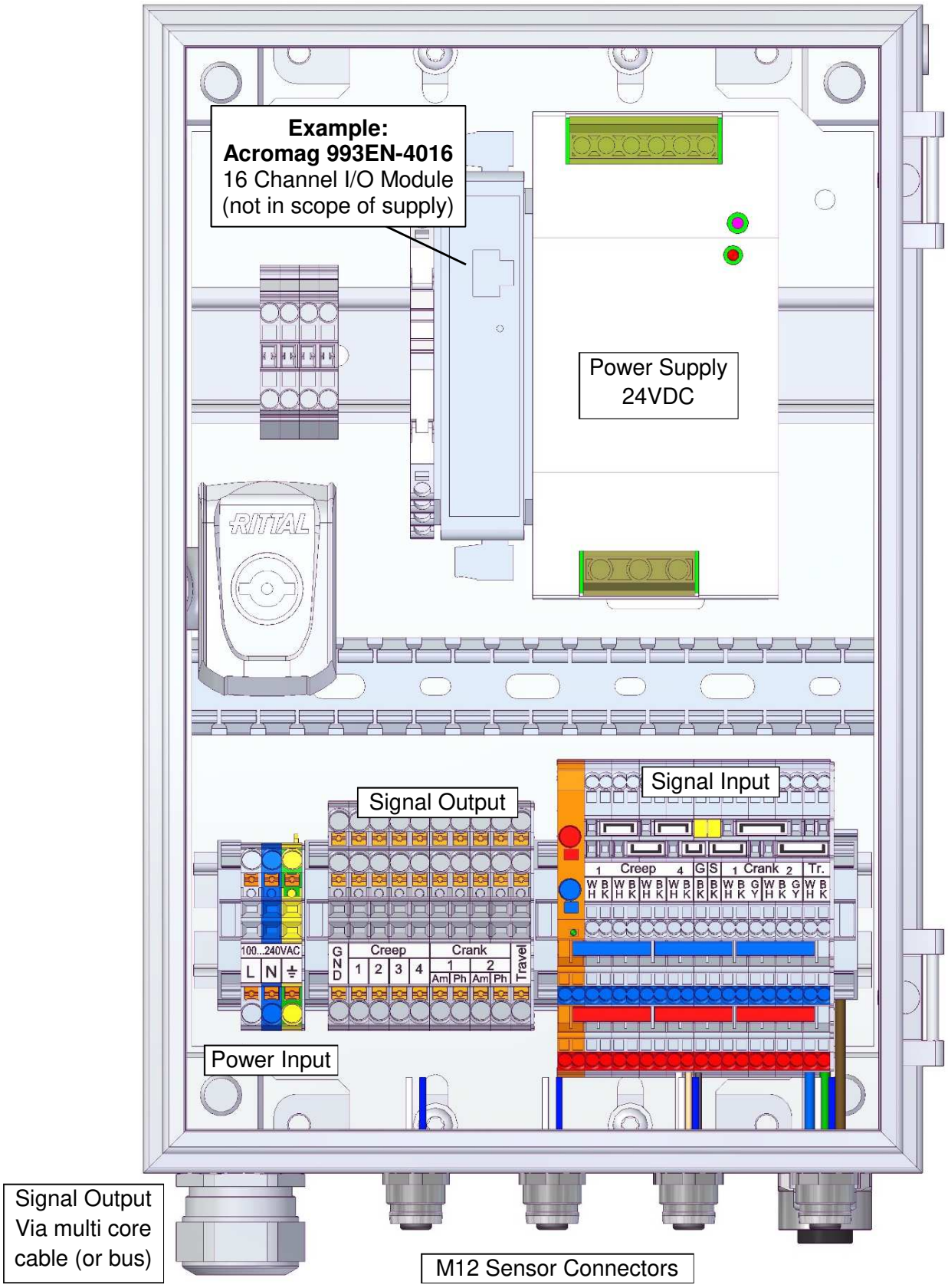
This configuration of the MKM2 Junction Box suits for Creep Monitor (4 Tires), Crank Monitor (2 Tires) and Travel Monitor



8.2 Layout

Dimensions:
200x300x155mm

The following picture shows a fully equipped MKM2 Junction Box which is suitable to combine Crank Monitor, Creep Monitor and Travel Monitor system. The box also offers space to add a serial protocol interface, e.g. Acromag 993EN-4016 or another I/O module.



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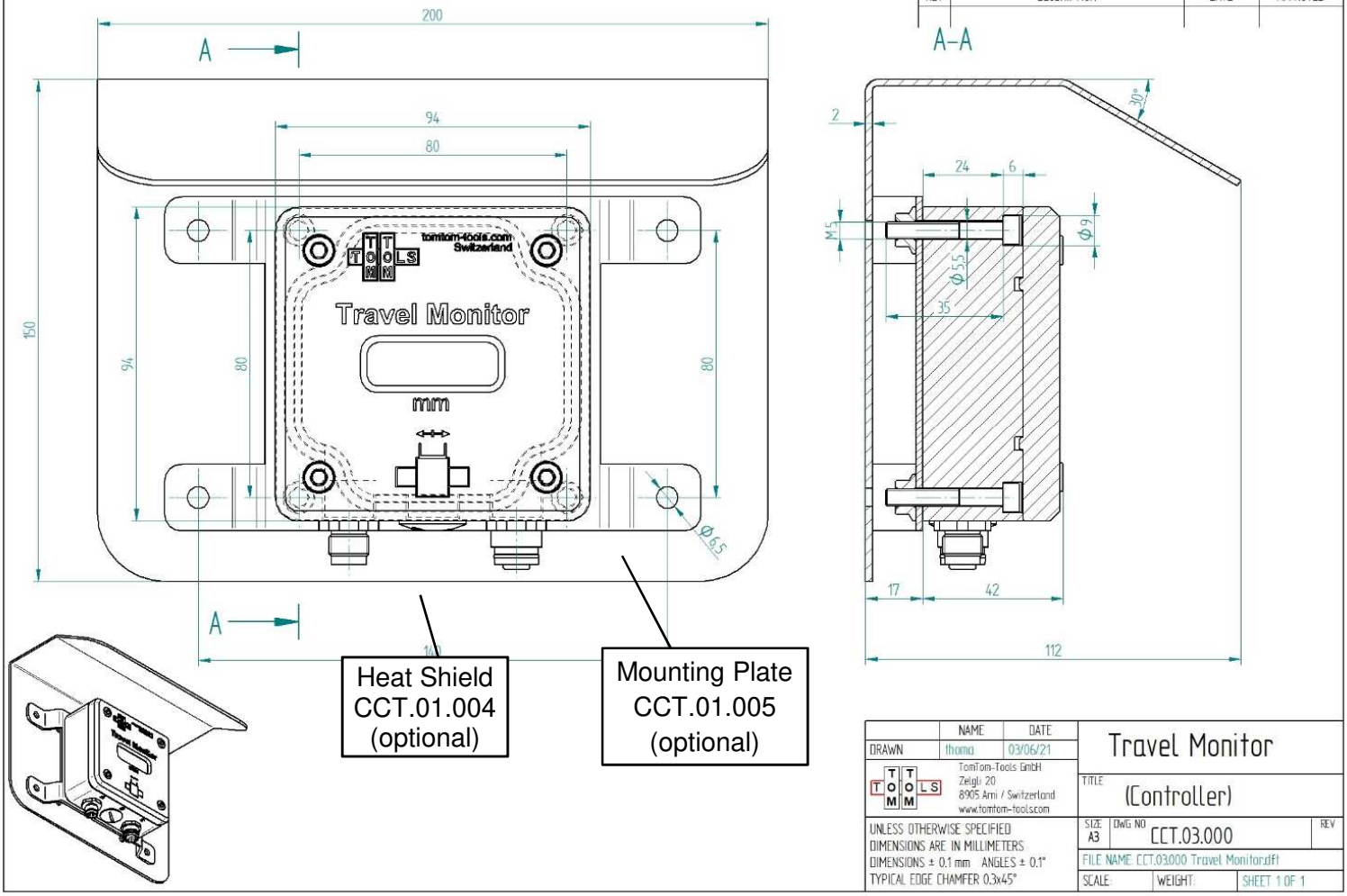

	NAME	DATE
DRAWN	thoma	03/06/21

TomTom-Tools GmbH
Zelgli 20
8905 Arni / Switzerland
www.tomtom-tools.com

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS ± 0.1 mm ANGLES ± 0.1°
TYPICAL EDGE CHAMFER 0.3x45°

TITLE: Travel Monitor (Controller)

SIZE A3 | DWG NO CCT.03.000 | REV

FILE NAME: CCT.03.000 Travel Monitor.dft

SCALE: | WEIGHT: | SHEET 1 OF 1

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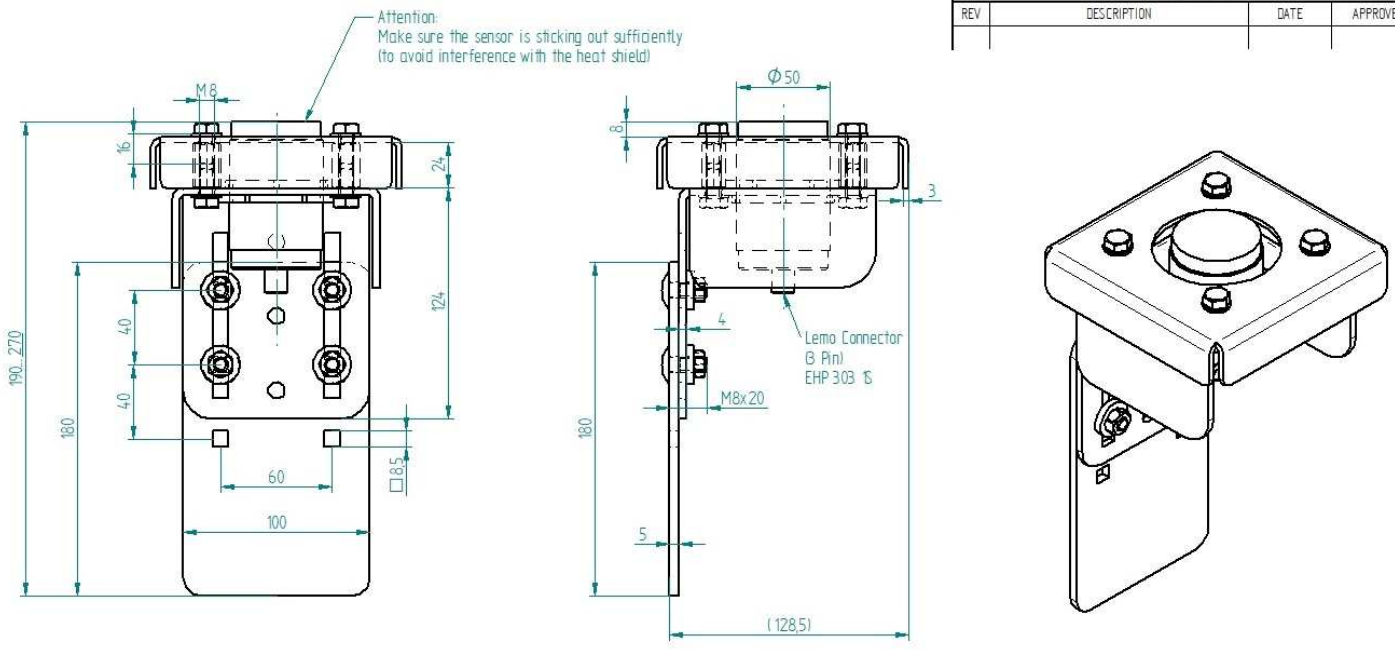

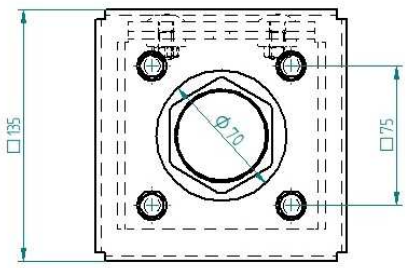

	NAME	DATE
DRAWN	XYZ	05/22/20

TomTom Tools GmbH
Zelgli 20
8905 Arni / Switzerland
www.tomtom-tools.com

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS ± 0.1 mm ANGLES ± 0.1°
TYPICAL EDGE CHAMFER 0.3x45°

TITLE: Reference Sensor for Crank + Travel Monitor

SIZE A3 | DWG NO CCT.02.300 | REV

FILE NAME: CCT.02.300 Reference Sensor.dft

SCALE: | WEIGHT: | SHEET 1 OF 1

REVISION HISTORY			
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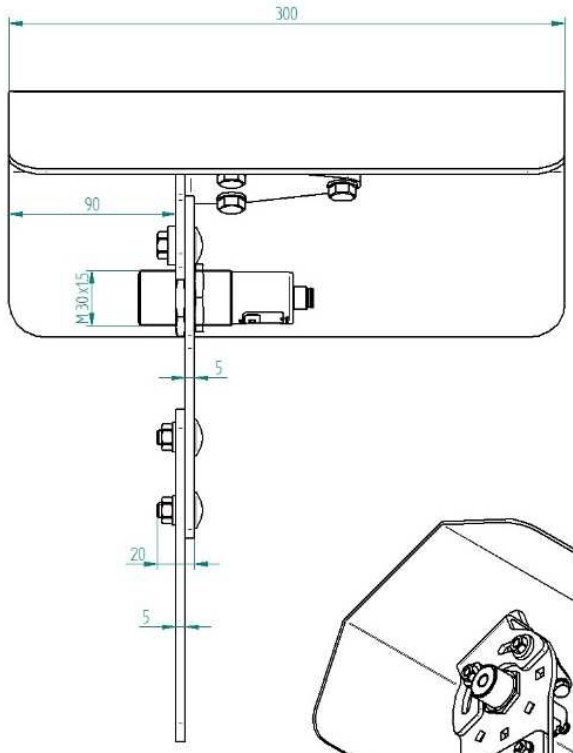
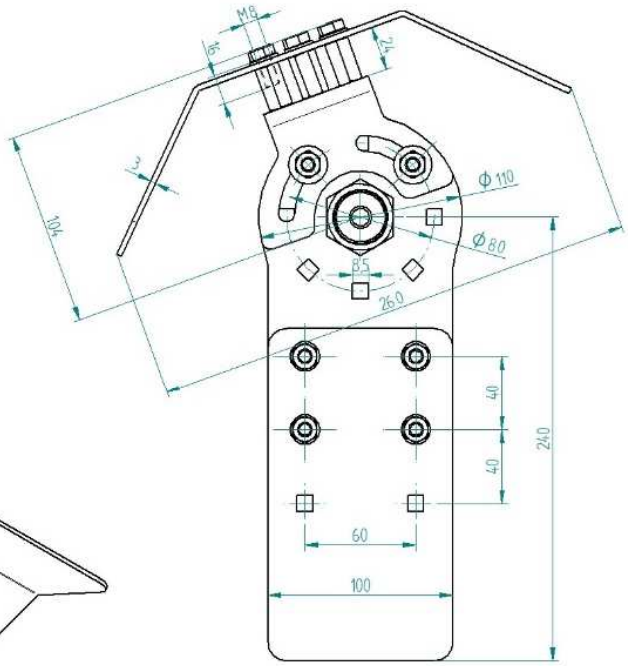
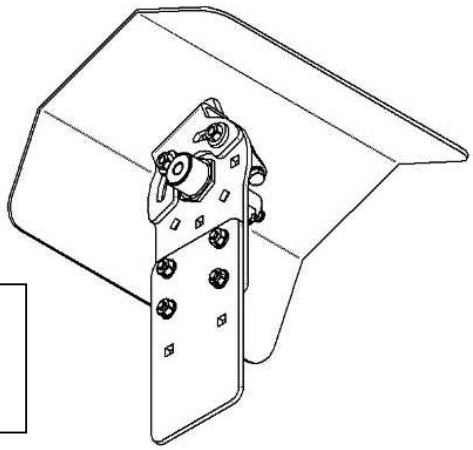






For partially open girth gear housing

	NAME	DATE
DRAWN	XYZ	05/14/20

TomTom-Tools GmbH
Zelgli 20
8905 Arni / Switzerland
www.tomtom-tools.com

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS ± 0.1 mm ANGLES ± 0.1°
TYPICAL EDGE CHAMFER 0.3x45°

Kiln Travel Sensor

TITLE: for Travel Monitor

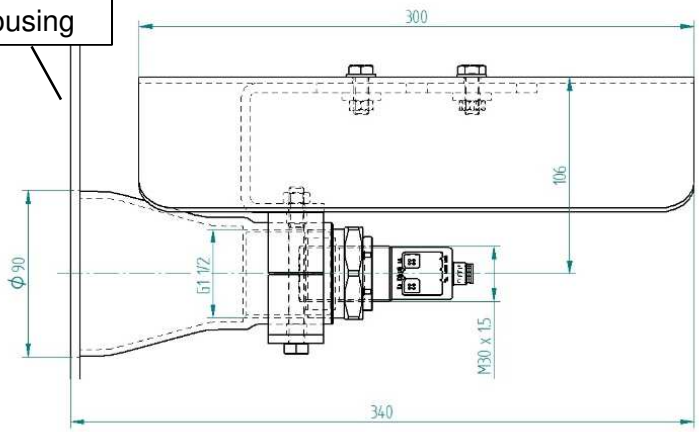
SIZE	DWG NO	REV
A3	CCT.03.400	

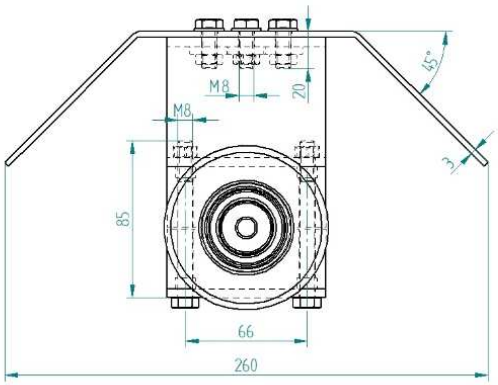
FILE NAME: CCT.03400 Kiln Travel Sensor.dft

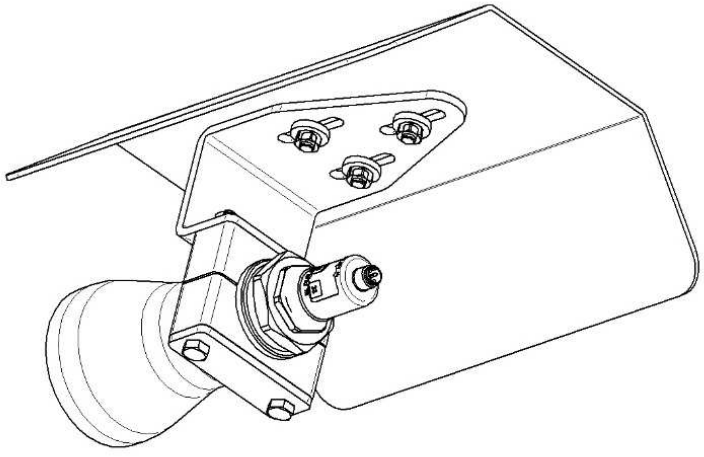
SCALE:	WEIGHT:	SHEET 1 OF 1

Girth Gear Housing

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED







For completely closed girth gear housing

	NAME	DATE
DRAWN	XYZ	08/28/20

TomTom-Tools GmbH
Zelgli 20
8905 Arni / Switzerland
www.tomtom-tools.com

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS ± 0.1 mm ANGLES ± 0.1°
TYPICAL EDGE CHAMFER 0.3x45°

Travel Sensor

TITLE: for Travel Monitor

SIZE	DWG NO	REV
A3	CCT.03.420	

FILE NAME: CCT.03420 Travel Sensor.dft

SCALE:	WEIGHT:	SHEET 1 OF 1