Strip guiding systems
Sensors

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ELEXIS Group

- **the right sensor for every application and environment**
- **precise and reliable**
- **compact design**

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EMG sensor technology – the basis for an optimum strip guiding system

Individual sensor solutions:

For metal strip production, treatment and processing, the material - which is supplied in the form of coils - is unwound and then fed to the production process. In most cases, it is rewound into coils thereafter to allow convenient transport. Due to its geometric shape, metal strip material tends to run unevenly from the deflector rolls in the treatment line.

The strip guiding system serves to keep a strip at the centre of the system or in any other defined position. The strip guiding system thereby prevents damage to the product or the production plant and ensures that the strip runs evenly through the production process.

Due to ever growing quality demands and high availability in combination with reduced operating and maintenance personnel, however, requirements are constantly increasing which has a great impact on the quality of strip guiding systems and their components.

As a rule, a strip guiding system consists of a selection of components, such as sensors, electronics and actuators.

Determining the strip centre position is the single most important goal for all strip control solutions.

Based on decades of experience and around 1,500 guiding systems sold every year, EMG has developed a wide range of sophisticated optical, inductive and radar-based sensors for achieving this goal.

We will put together the ideal package based on our customers' requirements and the respective installation situation.

Visit our website to find out more about our strip guiding solutions

Inductive sensors:

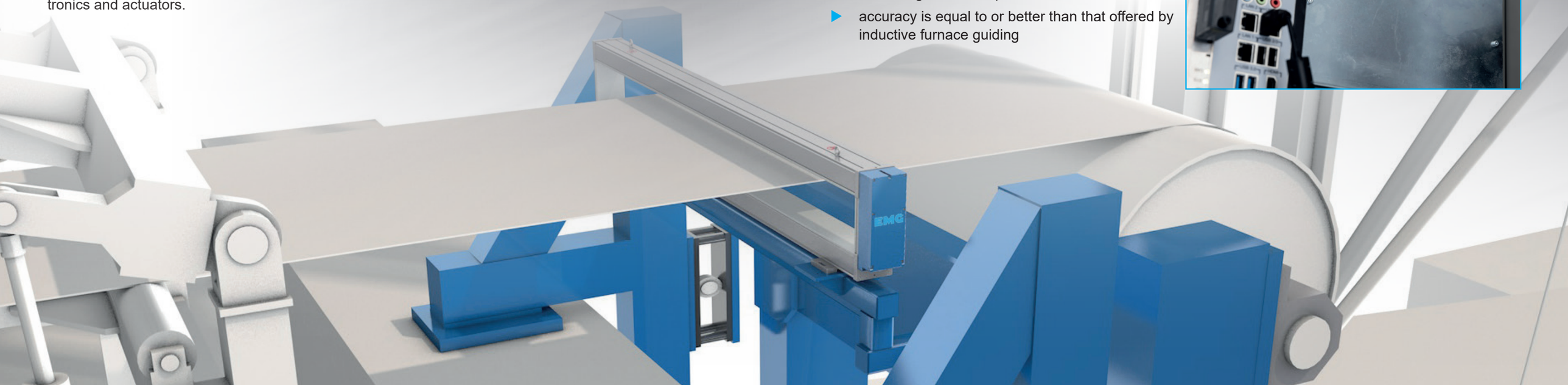
- maintenance-free and contact-free
- insensitive to external influences
- suitable for all electrically conductive materials
- also suitable for non-magnetic metals
- easy installation

Optical sensors:

- very large sensor gap and high degree of accuracy
- contact-free
- protected against ambient light (HF technology)
- extremely reliable
- independent of the pass line

Radar-based sensors:

- contact-free
- no sensor parts in the furnace
- no damage to the strip or the sensor
- accuracy is equal to or better than that offered by inductive furnace guiding

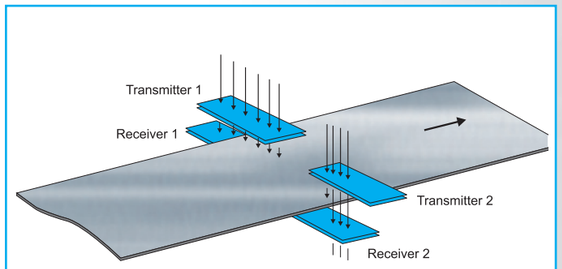


Inductive strip position measurement SMI

Operating method:

The measuring principle of the SMI sensor family (Strip Measurement Inductive) is based on electromagnetic induction.

In this setup, two centre sensors are arranged on each strip edge at right angles to the strip pass line level and they are configured in such a way that the strip passes between the sensors as centrally as possible:



The part of the sensor that is located above the strip functions as a transmitter and the opposite sensor functions as a receiver. The SMI2.11.x electronic unit supplies the transmitters with a regulated, sinusoidal alternating current voltage. At each transmitter coil, a distinctive electromagnetic alternating field is formed and directed towards the opposite receiver. The receivers detect a different intensity, depending on the position of the strip.

The alternating voltages induced in this manner provide analogue output signals for the strip edge position by evaluating the frequency-dependent amplitude level. The inductive measuring system contains complex self-monitoring facilities. The individual signals are combined into the collective messages "Measuring equipment OK" and "Strip detected".

In addition to the proven performance features 'freedom from maintenance' and 'stability', the modular sensor design, as well as the optimised symmetry properties of the SMI sensor family offer an improved centre measuring accuracy as well as various possibilities to achieve your individual requirements.

Since it is unsusceptible to disruptive external influences, even non-magnetic materials such as aluminium, copper, brass and austenitic chrome nickel steels (e.g. 1.4301) are also reliably detected with the SMI system.

Options:

- all SMI sensors are available with separate evaluation electronics for mounting outside the process line
- delivery of customer-specific constructions on request
- optional design, engineering or delivery of mechanical protective frames for all kinds of inductive sensors

Customer benefits:

- wide area of application ranging from 0.05 mm to 16 mm strip thickness (others available on request)
- maintenance-free
- SMI sensors are insensitive to
  - changing insulation resistance caused by dust deposits on the measurement setup
  - disturbance of the static field, e.g. in the case of inspection tours by system personnel
  - water and metal vapours produced during strip treatment processes
  - dust containing tinder and metal that is produced during machining procedures
  - ionising furnace atmospheres

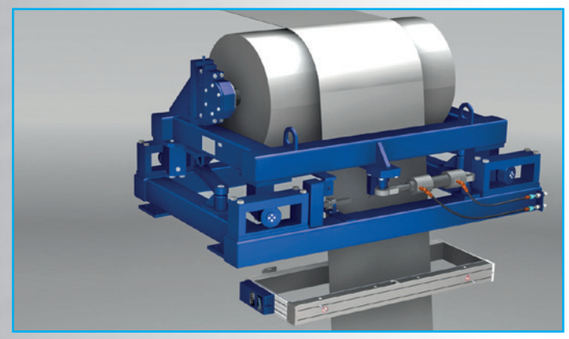
Available variants:

Design of all SMI variants:
Compact measuring frame with integrated evaluation electronics.
Optionally available with a 30 m connecting cable for remote mounting of the evaluation electronics.

SMI-SE (Standard Edition)

Strip centre measuring system for normal* ambient temperatures.

Sensor type	Accuracy	Max. change in width
SMI-SE / 150	+/- 2 mm	300 mm
SMI-SE / 300	+/- 2 mm	600 mm
SMI-SE / 500	+/- 3 mm	1000 mm
SMI-SE / 750	+/- 3 mm	1500 mm
SMI-SE / 900	+/- 5 mm	1800 mm

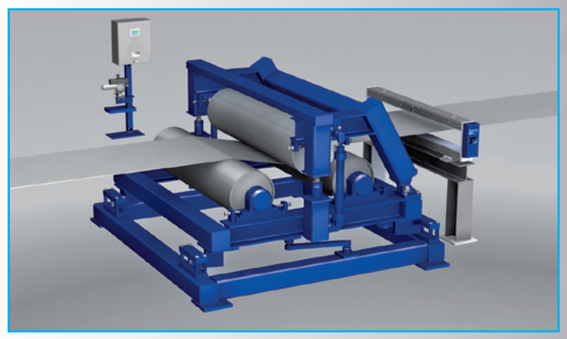


SMI-SE on a steering roll with proportional-integral steering guide

SMI-HE (High-precision Edition)

High-precision strip centre measuring system for normal* ambient temperatures.

Sensor type	Accuracy	Max. change in width
SMI-HE / 150	+/- 1 mm	300 mm
SMI-HE / 300	+/- 1 mm	600 mm
SMI-HE / 500	+/- 1 mm	1000 mm
SMI-HE / 750	+/- 1 mm	1500 mm
SMI-HE / 900	+/- 3 mm	1800 mm



High-precision SMI-HE strip centre measuring system on a SRHT steering frame

SMI-LE (Looper-Car Edition)

Strip centre measuring system for use at a normal* ambient temperature, with frame reinforcements for enhanced mechanical requirements, such as on a looper car.

Sensor type	Accuracy	Max. change in width
SMI-LE / 500	+/- 3 mm	1000 mm
SMI-LE / 750	+/- 3 mm	1500 mm
SMI-LE / 900	+/- 5 mm	1800 mm

*up to 50 °C

Visit our website to find out more about our SMI products!

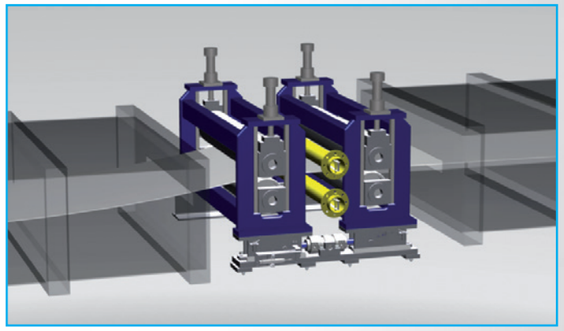
Additional inductive sensors

IMR:

Strip centre measuring system for use in aggressive and humid environments, such as in pickling or cleaning lines with medium temperatures of up to 80 °C.

Version:
Four encapsulated coils in a tube configuration for on-site insertion (by the customer) in medium-resistant, non-metallic protective pipes that run above and below the strip. Design and supply of non-metallic protective pipes for IMR sensors on request.

Sensor type	Accuracy	Max. change in width
IMR-SR / 300	+/- 5 mm	550 mm
IMR-SR / 500	+/- 5 mm	950 mm
IMR-SR / 800	+/- 5 mm	1550 mm



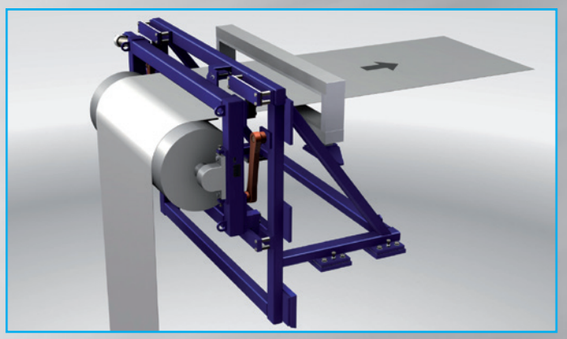
IMR: Strip centre measuring system in a damp environment

SMI3:

Strip centre measuring system for strip temperatures of up to 300 °C (max. ambient temperature at the sensors: 130 °C).

Version:
Compact measuring frame with thermal shielding and remote evaluation electronics.

Sensor type	Accuracy	Max. change in width
SMI3-SR / 400	+/- 5 mm	600 mm
SMI3-SR / 600	+/- 5 mm	1050 mm
SMI3-SR / 800	+/- 5 mm	1450 mm

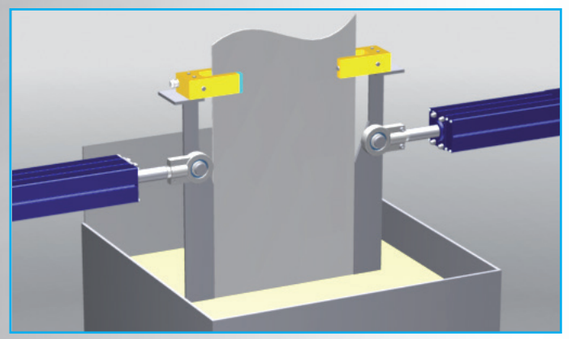


SMI3: Strip centre measuring system for ambient temperatures at the sensors of up to 130 °C

IGS:

Strip edge sensor for metal strip in areas where liquids with temperatures of up to 80 °C are sprayed or for metal strip with a overlaying protective film at a measuring accuracy of +/- 1 mm.

Version:
Encapsulated sensor (fork shaped) in a plastic housing, protection type IP 67, with a 50 mm sensor gap and 120 mm sensor depth. The evaluation electronics is separated from the IGS sensor.



IGS: Inductive fork sensor for strip edge measurement

EMI / EKI:

EMI: High-precision strip centre measuring system for operation at normal* ambient temperatures with a centre measuring accuracy of +/-1 mm. An optional output of the strip width is possible with an accuracy of +/- 1.5 mm**.

EKI: For strip edge measuring systems at a normal* ambient temperature with a measuring accuracy of +/- 1 mm**.

*up to 50 °C
**Generally speaking, this level of accuracy can only be achieved with a constant strip thickness, material type and pass line!

Version:
The compact measuring frame, which consists of anodised extruded aluminium profiles, contains inductive sensors that are moved by an electric motor on both edges of the strip.

The two sensors above and below the strip are mechanically coupled at the side via a synchronising shaft and they follow the strip edges in rigid position control loops.

The corresponding positions are continuously detected via integrated position sensors. The strip position is calculated from these positions and the extent of sensor coverage.

EMI / EKI for high-precision strip centre / strip edge guiding

Additional inductive sensors

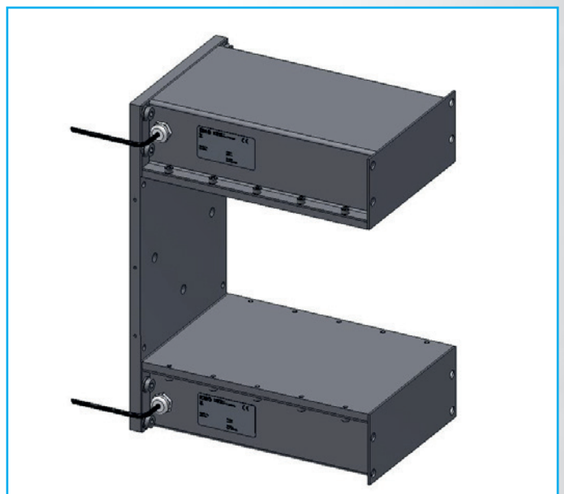
BMI4 and ESI1:

Inductive edge sensor (fork shaped) for contact-free detection of the edge position of metal strip material with a measuring accuracy at the operating point of +/- 1 mm.

Version:
Fork-shaped sensor with a transmitter and receiver coil, each in a protective housing. A maximum of 2 edge sensors can be simultaneously connected to the SMI evaluation electronics.

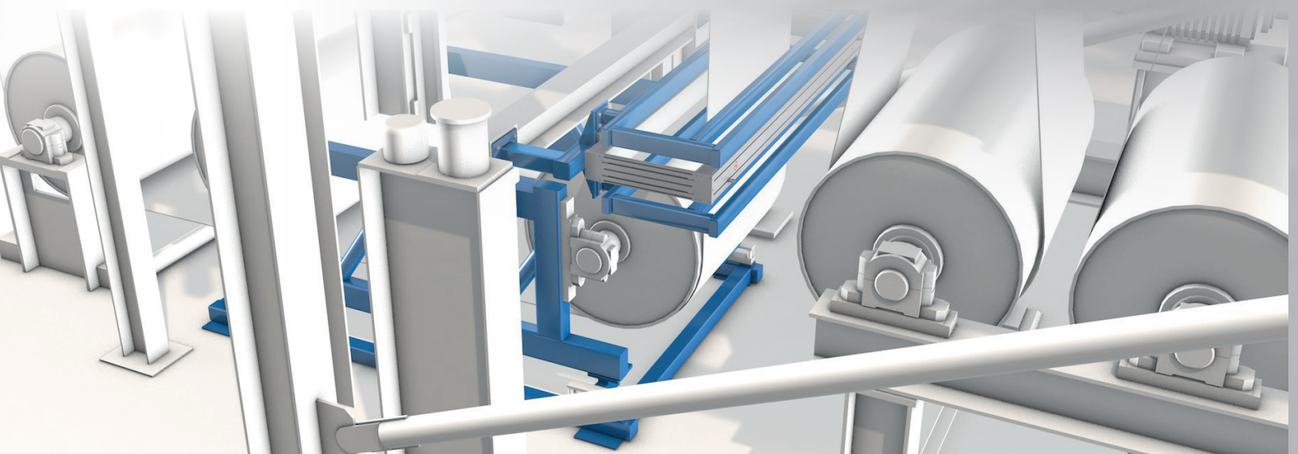
ESI1 for high temperature range:

- maximum effective temperature of 125 °C for strip edge measurement on hot-dip galvanizing up to 700 °C



BMI4: Inductive fork sensor for a normal temperature range

ESI1: Inductive edge sensor for a high-temperature range



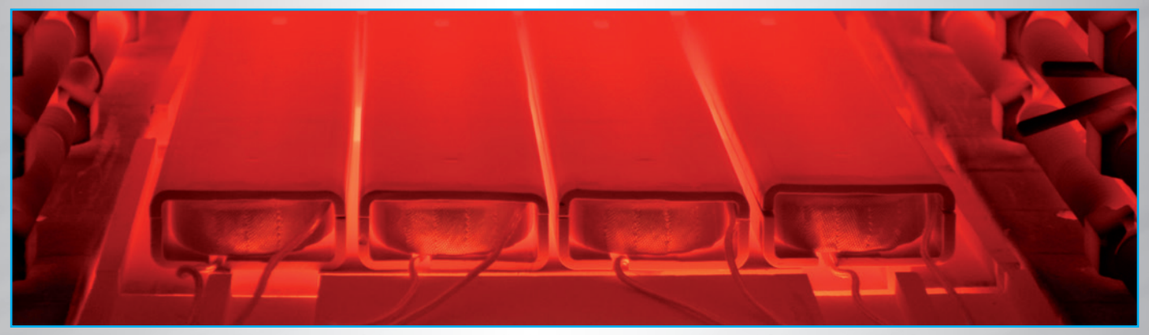
Inductive strip position measure-ment in a high-temperature range: IMH2

Performance features:

- stationary, maintenance-free measuring equipment
- self-supporting construction consisting of high-quality, temperature-resistant materials
- no cooling media necessary
- standardised electronics incl. CANopen interface
- ready-to-install construction adapted to the customer's situation

Customer benefits:

- simple project processing, including conversions and modifications
- high level of accuracy in the high-temperature range
- no impact from the furnace atmosphere
- reduction of strip breakage in the furnace
- easy assembly and commissioning
- no wear parts
- high service life

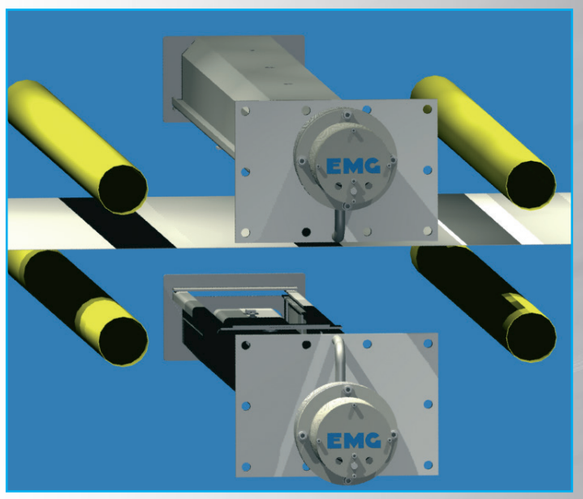


Burn-in test of the sensor coils in the purpose-designed furnace by EMG

Impact protection:

To protect the measuring equipment, particularly in the event of strip breakage, the use of mechanical deflectors (impact protection) is recommended.

We would be happy to advise our customers on how and where to install the mechanical deflectors on request.



Typical installation positions of EMG sensors in the process line with guiding sequence

Actuator components

- servo valve
- electro-servo-cylinder
- hydraulic power units

Digital control electronics EMG iCON®

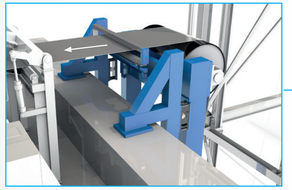
Software EMG_logiCAD/32

- programmes can be downloaded via PC
- the settings and parameter values pre-selected via the control panel are permanently stored
- troubleshooting for maintenance with "logiCAD / 32 Online-Test"

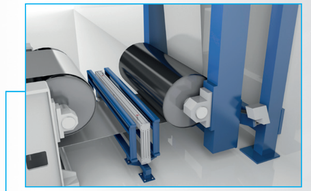
Communication for system control

- digital inputs / outputs
- analogue inputs / outputs
- Profibus-DP slave
- Ethernet OpenModbus / TCP server
- ProfiNet I / O device

Steering frame with integrated inductive SMI sensor

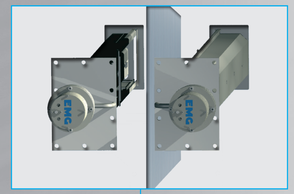


Steering frame with integrated inductive SMI sensor

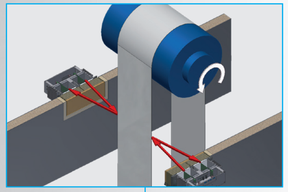


Visit our website to find out more about our sensor solutions

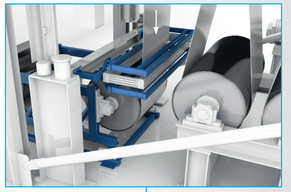
Inductive IMH2 sensors in the furnace



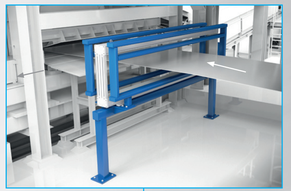
Radar-based EMG-Vivaldi® sensors in the furnace



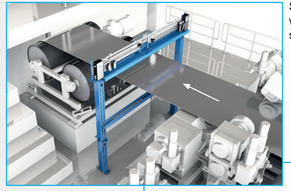
Steering frame with integrated inductive SMI sensor



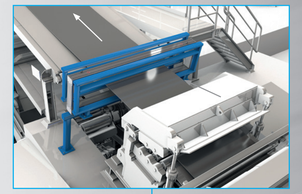
SMI inductive measuring system



Strip centre measuring system with two EVK optical sensor systems



SMI inductive measuring system



Strip running direction

Inductive strip edge position measurement VKI3

Operating method:

EMG's VKI3 measuring device uses an inductive measuring principle with a coil system, which is designed to reliably detect the precise position of the edge of metal strip and foil material in a contact-free manner, even when subjected to the harsh ambient conditions of a rolling mill where there is a high presence of rolling oil, atmospheric pollution and dirt.

On one side, the inductive EMG VKI3 measuring instrument detects the absolute strip edge position of all metallic materials as a result of the eddy currents generated. The measurement is largely independent of the material and flat strip running level, as material influences and changes in the strip running level can be compensated in part by means of the integrated reference coil. In terms of centre measuring accuracy, the material influences are compensated completely.

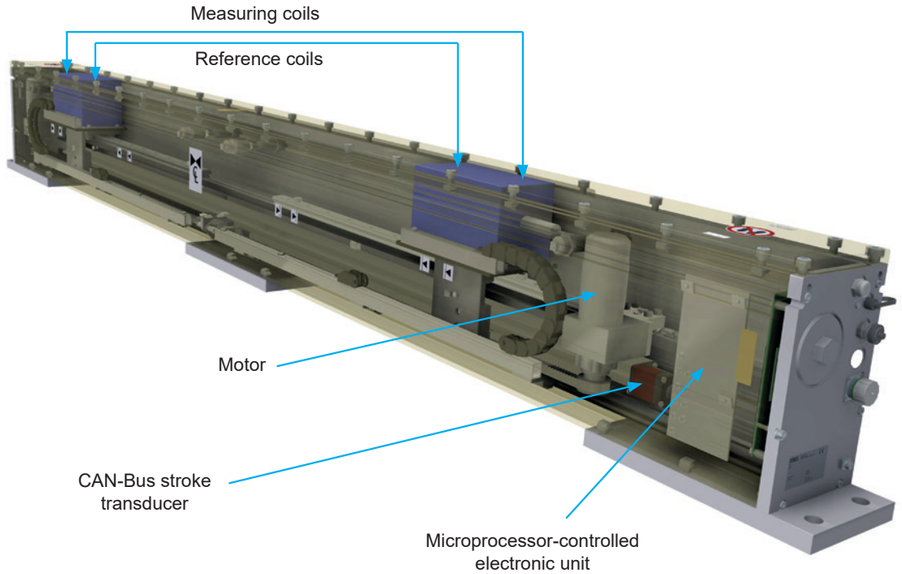
A sturdy aluminium housing protects the measuring electronics from hose water and temporary submersion in liquid.

The compact measuring beam has adjustable slides on both sides of the strip that are operated by electric motors, the position of which is constantly measured using a digital stroke sensor. The adjustable slides guide the inductive edge sensors at right angles to the strip running direction.

The sensors transmit current information on the pro-portion of the sensor covered by the strip to an integral electronic unit while following their assigned strip edge using a rigid position control loop. These position values and the sensor covering are used as basis for calculating the positions of both strip edges, the position of the strip and the strip width. A microprocessor-based electronic unit feeds, evaluates and monitors the entire measuring system and provides data output.

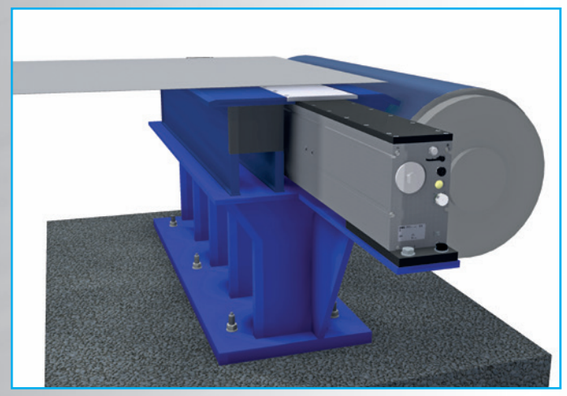
Different designs:

- Edge measurement (K)
- Centre measurement (M)
- Centre measurement for narrow strips (G)



Customer benefits:

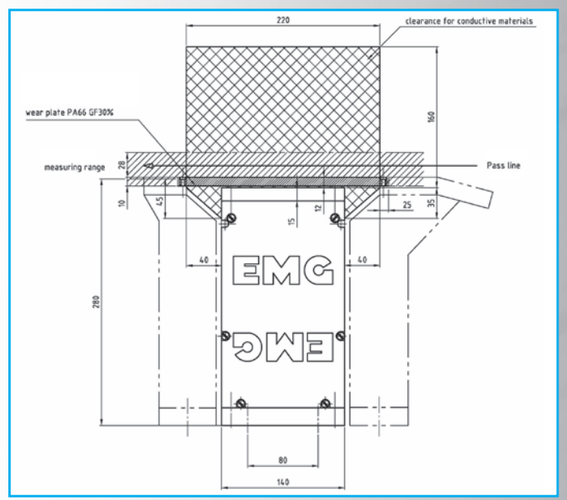
- maintenance-free
- high-precision strip edge, strip centre and strip width measurement
- compact design for limited installation space
- electronics integrated into the measuring device without any other external components
- various fieldbus interfaces for control and communication with the higher-level PLC
- integrated sensor system, factory-adjusted (measuring and reference coils)



VKI3 measuring instrument in a confined space

Technical features:

- complete integration of the electronics in the sensor
- high functional safety and operational reliability
- basic design to suit a large range of strip width variations
- compensation of faulty measurements due to crossbow effects in the strip possible
- optional ECU control unit, parallel to the interface for the automation device

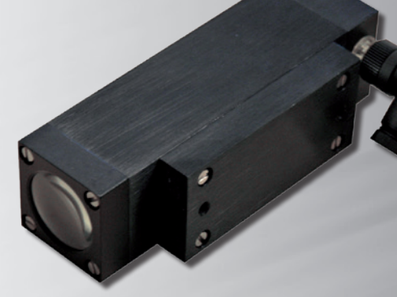


Separate wear plate to protect the VKI3

Performance features:

protection type:	IP 65 and IP 67 with separate wear plate
positioning speed of the sensor:	30 mm/s on each strip side
power supply:	unipolar DC voltage supply 24 V DC, 5 A
temperature range:	0 to +50 °C; 0 to +80 °C (with water cooling for the sensor system)
measuring accuracy of strip centre position:	+/- 1 mm (with flat strip shape, +/- 10 mm height alteration, constant material thickness, same material type in the pass line 20 mm)
measuring distance to the strip running level:	1-20-40 mm from sensor without sliding plate
dimensions:	140 x 270 x L mm (L is dependent on the measuring range and system width)
signal interface:	digital bus communication Profibus, Ethernet-Modbus TCP, Ethernet TCP socket
minimum strip width:	300 mm when detecting one strip edge 400 mm when detecting both strip edges (smaller strip widths on request)

Optical strip edge / strip centre measuring systems EVK / EVM



Operating method:

The EVK edge sensor positioning device and the EVM centre sensor positioning device are used for the non-contact strip edge and strip centre measuring of metal strip material. The device, which is highly reliable and unsusceptible to external interference, visually measures changes in the edge and/or centre position of the strip.

The strip edge is detected via a motorised, mobile sensor positioning device that is equipped with high-frequency (HF) alternating light measuring receivers LS 13/14, which are protected against ambient light. If the strip edge is displaced due to a change in strip width or a lateral strip deviation, this is detected by the photocells.

The superordinate control electronics then activates the DC motor to move the LS 13/14 light barriers or the actuator (servo valve or electric servo cylinder) of the control circuit in order to ensure that the strip edge always covers exactly half of the measuring range of the photocell.

Contamination of the light emitters is compensated by applying the reference measuring principle. This involves each measuring system using a measuring receiver and a reference receiver directed to the same light spot of the light emitter (e.g. LLS). While the measuring photocell detects the lateral position of the strip edge the reference photocell measures the background brightness of the light spot.

Customer benefits:

- precise and reliable measuring accuracy, as the system is insensitive to fluctuations in strip height
- high reliability and easy operation
- short commissioning time thanks to quick and simple installation (minimal installation space)
- active dirt compensation thanks to the reference measuring principle
- also suitable for use in harsh environments (e.g. pickling lines, cold-rolling mills, etc.)
- protected against ambient light through the use of HF alternating light
- distance between sensor and light source up to 4 m

Application examples of EVK / EVM:

EVM:
- strip centre guiding system typically on the uncoiler
- in case of limited installation space in the line
- can be used for strip offsets of up to +/- 8 mm

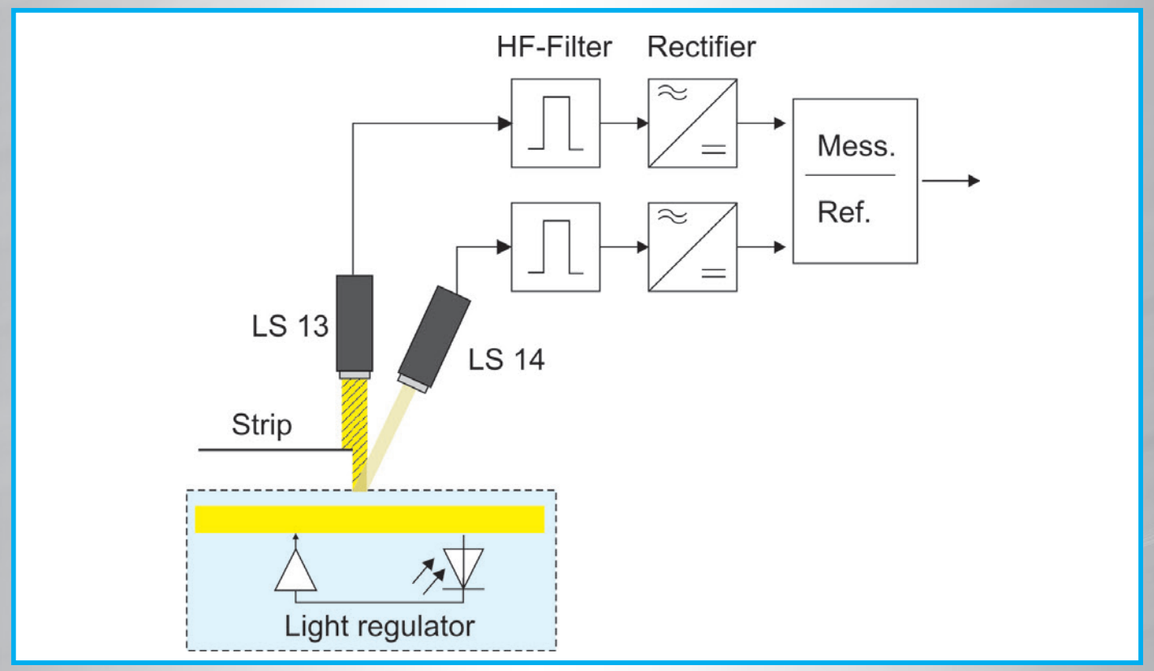
EVK:
- edge guiding system on the recoiler
- edge guiding system on the uncoiler (shearing line)
- can also be used for strip offsets larger than 8 mm

2 x EVK:
- strip centre guiding system on the uncoiler
- used on the side trimmer
- can also be used for deliberate strip offsets larger than 8 mm

Technical data EVK/EVM:

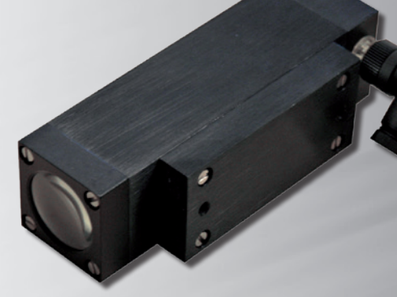
- output: < 50 VA per drive unit
- protection type: IP 54
- ambient temperature for operation: 0 to +50 °C
- measuring accuracy: < 1.0 mm
- supply voltage: 24 V DC / 0.5 A (starting current < 4 A)
- interface: CANopen

Visit our website to find out more about our EVK / EVM systems!



Basic representation of signal processing using the reference measuring principle

Optical strip edge / strip centre measuring systems EVK / EVM



Alternating light measuring receiver

The LS 13 and LS 14 alternating light measuring receivers are designed as photoelectric edge sensors with a large measuring distance between the light emitter and measuring receiver. The alternating light eliminates the influence of DC light and thereby ambient light. The LS 13 is used as a measuring receiver and the LS 14 is used as a reference receiver.

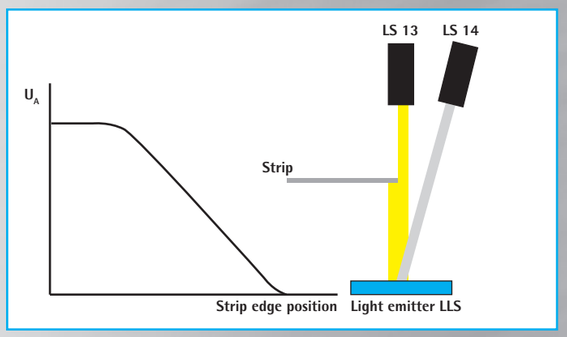
The high-frequency HF light (2 kHz) emitted by an external alternating light transmitter (e.g. LLS) is transmitted via the front lens to a photocell. The internal electronics generates an output voltage that is proportional to the incident light. Almost proportional to the ingression of one strip edge into the light beam, the potential-free output voltage U_A is changed.

Typical applications:

- EVK / EVM edge and strip centre guiding
- BREIMO and BREIMO-H strip width measuring

Technical data LS 13/14:

- supply of EVK- / EVM electronics
- ambient temperature for operation: 0 to +50 °C
- protection type: IP 65
- resolution: Infinite



Alteration of the output voltage U_A

Linear light emitter LLS:

When used in combination with the LS optical light receiver, the LLS linear light emitter forms a sensor system for contact-free strip edge position sensing (EVK) or centre position sensing (EVM) of non-transparent material.

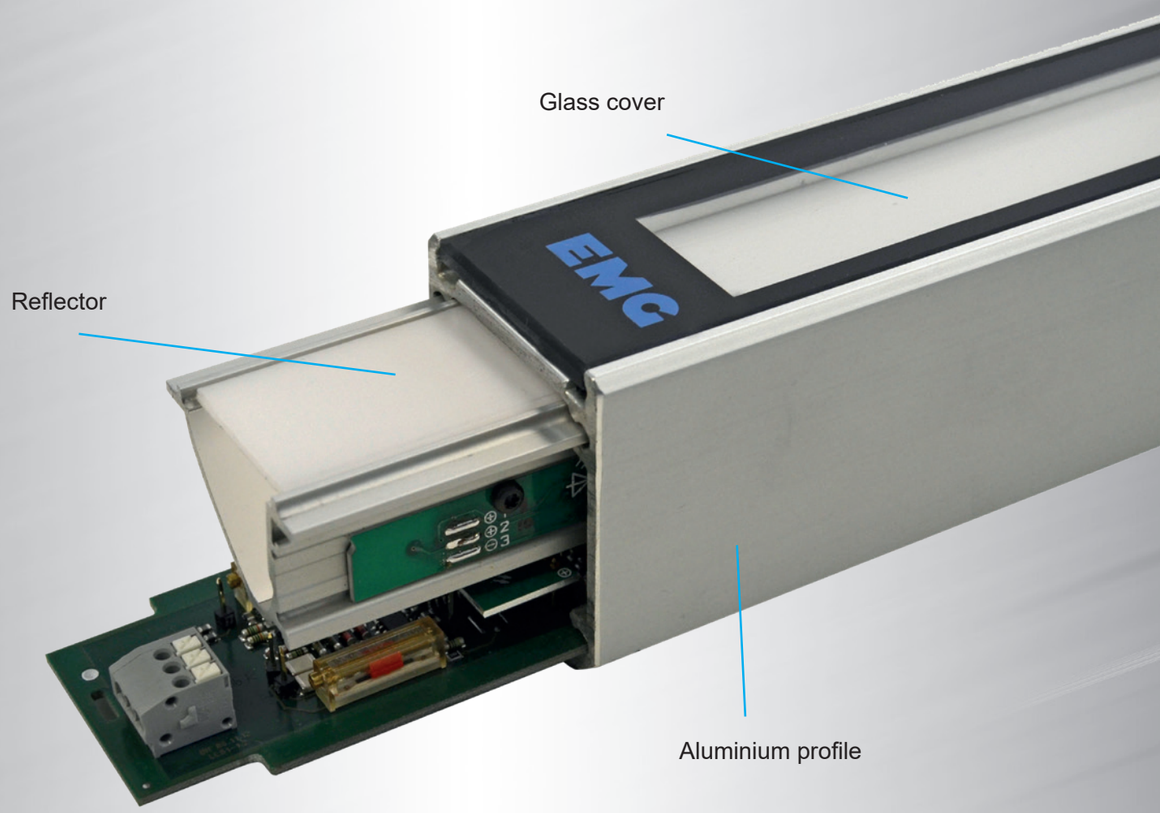
The LLS is characterised by its integrated LED technology which boasts a service life of 50,000 hours, its compact dimensions and its heavily reduced energy consumption thanks to an excellent level of efficiency. Precise control of the light intensity and fault monitoring are ensured via the integrated electronics.

Technical data LLS:

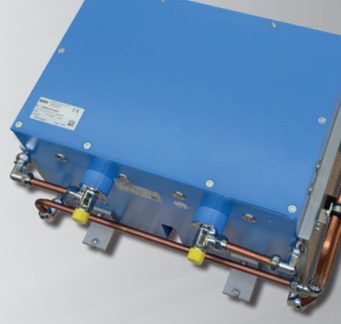
- controlled supply voltage: 24 V DC (22 V DC to 28 V DC at the LLS connection)
- ambient temperature for operation: 0 to +50 °C
- protection type: IP65 (water influences the optical characteristics of the light emitter), (optional: IP65 + IP67)
- connection via supplied plug (0.75 mm^2)
- available in five different lengths: LLS 475* / 675* / 875* / 1075* / 1275* (*designation corresponds to the usable range in mm)

BREIMO:

BREIMO is the contact-free, optical strip width measuring system for steel strip material in continuously running processes. Consisting of a measuring frame (BMS) with two sensor positioning devices (EVK), the corresponding light emitters (LLS) and a common linear stroke transducer, BREIMO is an extremely reliable strip width measuring system.



Radar-based strip centre measurement in the furnace EMG-Vivaldi®



Operating method:

A particular challenge is to measure the strip position in extreme environments, such as in annealing fur-naces. EMG has many years of experience with its IMH inductive strip centre measuring systems in furnaces with temperatures of up to 1100 °C. Despite IMH, there is often a desire to determine the strip centre position in furnaces without having any active or interfering sensor elements in the furnace itself.

The EMG-Vivaldi® sensor is located outside the furnace and conducts its measurements through the pressure-tight enclosed furnace wall. The sensor system, which is mounted externally on the furnace wall, focuses electromagnetic waves onto the edge of thin metal strip through the non-conductive insulation of the furnace. As the furnace wall is completely enclosed, the strip is not able to damage the sensor itself.

The system is commissioned by means of a simple reference measurement and calibration process. The EMG-Vivaldi® technology can replace other systems. EMG offers special conversion kits for the IMH sensors.

Customer benefits:

- no sensor parts in the furnace
- measurement from outside through the furnace wall, consisting of furnace insulation and enclosed pressure-tight plate
- no direct contact between the antenna housing and the interior of the furnace
- no installation in the furnace necessary
- no possible deformation of the antennas
- no possible damage to the sensor caused by the strip
- no cleaning of the antennas necessary
- the antennas or sensor electronics can be replaced without stopping the line
- low total cost of ownership (TCO)
- only one type of sensor for all strip materials (sensor is independent of the furnace dimensions, as well as the strip width, strip temperature and material grade)
- particularly high quality thermal furnace wall insulation on the sensor
- low space requirement outside the furnace during assembly

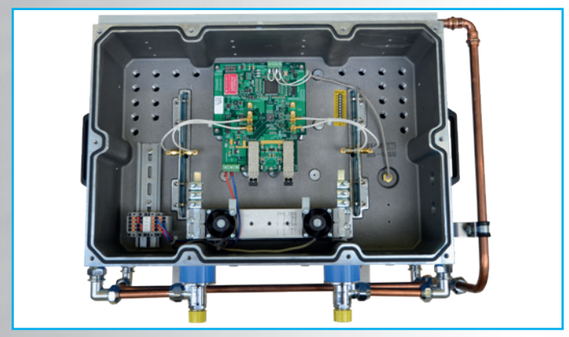
The Vivaldi technology:

EMG-Vivaldi® is based on the principle of so-called Vivaldi antennas. The EMG-Vivaldi® system consists of two pairs of antennas, each of which is positioned on a side wall of the furnace. One antenna is used as a transmitter and the other one as a receiver. The antennas transmit and receive linearly polarised electromagnetic waves (EMW). These waves are reflected by the strip edge and they transmit the edge position by means of an optimised digital runtime measurement.

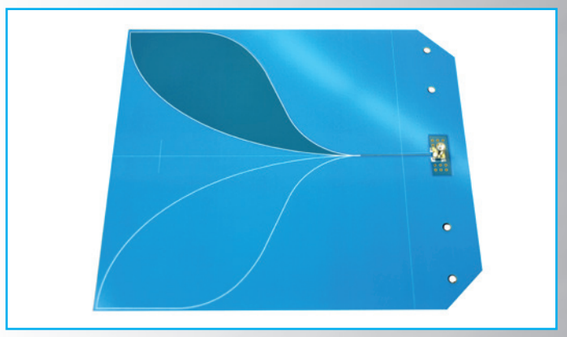
Evaluation of the data, and thus the determination of the strip centre position, is conducted within the control cabinet via an RPU (Radar Processing Unit) and a DPU (Data Processing Unit). The furnace wall is covered in a non-metallic insulating material, which exhibits a low absorption rate for electromagnetic waves in the Vivaldi frequency range of 0.8 to 4 GHz.

No sensor element projects into the interior of the furnace and both the electronics and the antennas on the furnace outside wall can be cooled with water if required. The radar windows (metal flanges with a special cover that are penetrated by the electroma-gnetic wave) are installed in the furnace wall in a pressure-tight construction with particularly high quality, thermal heat insulating properties.

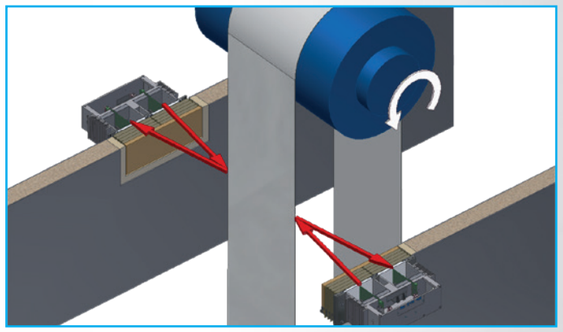
An additional advantage is that the actual sensor can be removed from the furnace without having to open the furnace itself, which enables the furnace wall to retain its pressure-tight seal. This feature significantly simplifies the process of replacing an antenna or the electronics, as the furnace does not have to be cooled down beforehand. An unforeseen strip crack cannot damage the sensor – therefore additional strip deflectors in the furnace are not necessary.



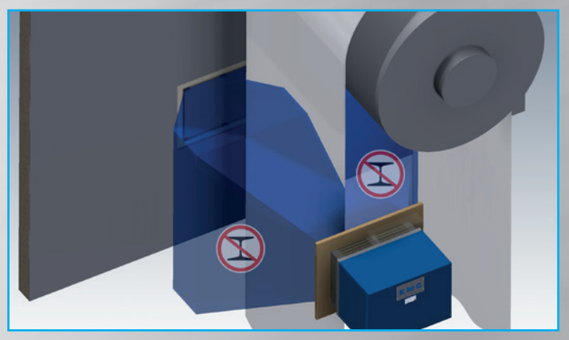
EMG-Vivaldi® sensor, interior view



Vivaldi antenna



Functional principle of EMG-Vivaldi®

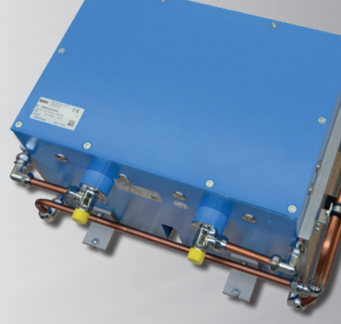


Schematic representation of the free space required to metallic parts in the furnace

Performance features - Vivaldi antenna:

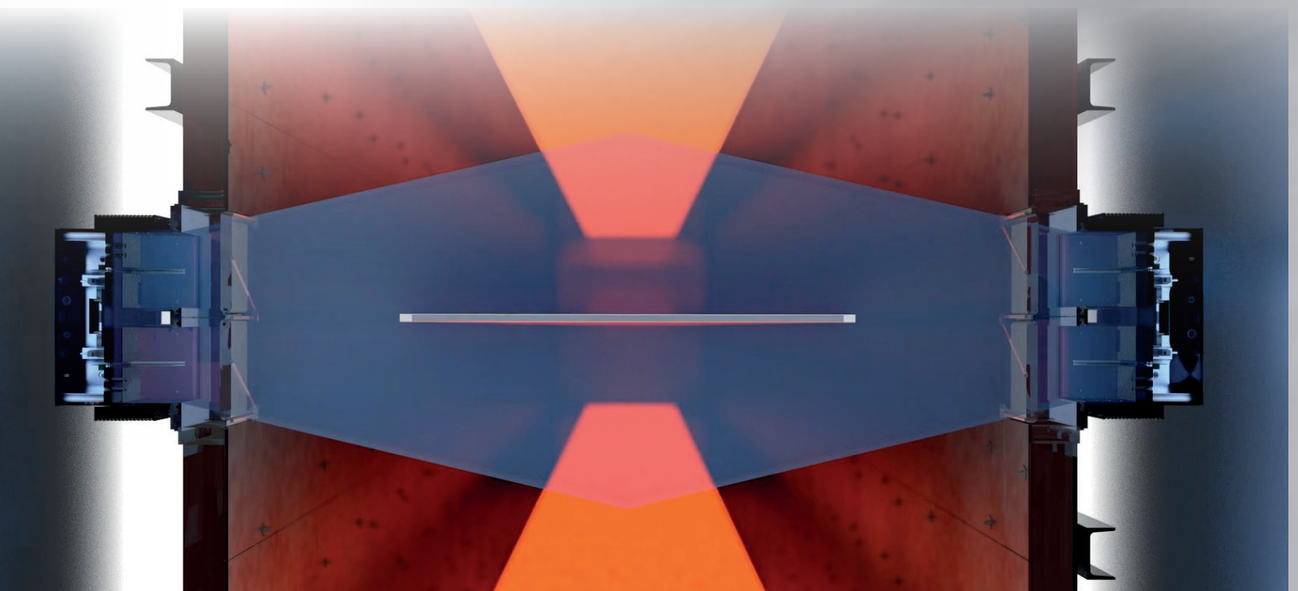
- transmits and receives a linearly polarised electromagnetic wave
- plane parallel structure on a dielectric carrier metallised on both sides
- an operating frequency of 0.8 to 4 GHz enables measurement through the insulation material
- large electromagnetic strip width and stable measuring signals, as well as a higher measuring resolution
- simple electrical connection
- simple replacement of the antennas in the housing

Radar-based strip centre measurement in the furnace EMG-Vivaldi®



Technical data:

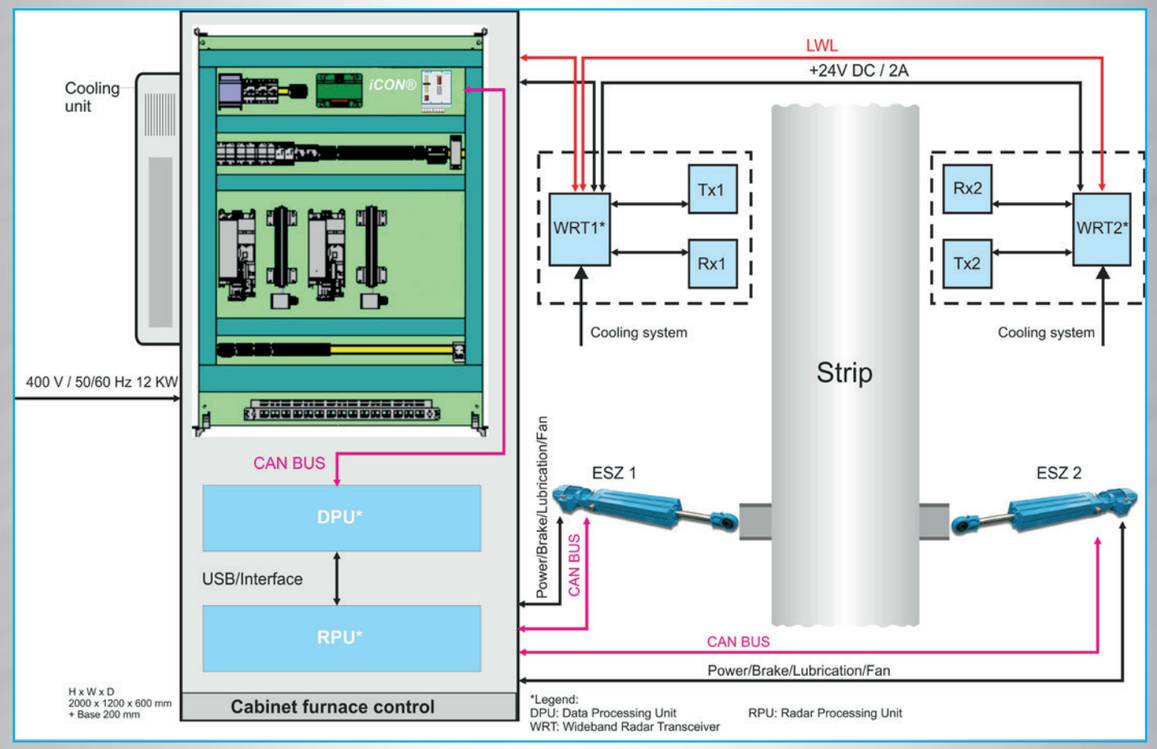
Strip thickness	min. 0.1 mm
Strip temperature	independent
Strip position sample rate	50 Hz / 20 ms
Centre position accuracy	up to +/- 1 mm
Cooling	no cooling is required for temperatures up to +70 °C on the furnace outside wall and an ambient temperature of up to +50 °C (optional water cooling)
Installation position	observe the required clearances to metallic parts in the furnace; the exact dimensions are dependent on the individual conditions of the line (in particular, the width of the furnace and the minimum strip width)
Sensor cable	optical cable assembly between the antenna boxes and control cabinet



System architecture:

The sensor electronics and the antennas on the outside of the furnace wall can be cooled with water if required. They are connected to the control cabinet via prefabricated optical waveguides.

The other electronics, which provide the control signals for the electric servo cylinders (ESZ) to control the steering frame, are accommodated in the temperature-con-trolled control cabinet.



Visit our website to find out more about EMG-Vivaldi®!