Moisture measurement technology

Our portfolio with IMKO

IMKO MICROMODULTECHNIK GMBH

Endress+Hauser
People for Process Automation

Moisture measurement technology

High-quality moisture measurement technology is crucial for an optimum, cost-efficient process and the best end product in concrete plants, gravel plants, sewage treatment plants, the timber industry and when processing and storing agricultural products. To measure the moisture level of a material, at present the following technology is the best and most precise option in demanding industrial applications:
Time domain reflectometry, also called cable radar, and referred to as TDR for short.

Explanation of TDR

The sensor measures the average moisture content by measuring the propagation time of an electrical signal. During the propagation time of the electromagnetic 1GHz pulse, the sensor precisely determines the dielectric constant and therefore the moisture content – with an accuracy of ±1 picoseconds.

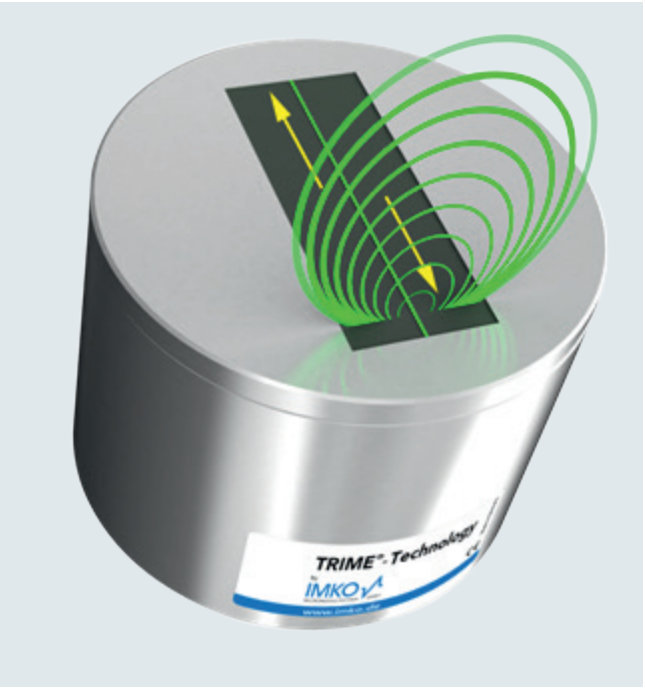
Patented technology from IMKO

IMKO, an Endress+Hauser company, offers a wide range of moisture measurement technology, such as TRIME and SONO measuring devices, which operate on the basis of the TDR measuring principle. These patented products offer advantages that are unparalleled on a global scale when it comes to customer applications:

- A very broad moisture measuring range of 0% to 100% over a temperature measuring range of -40°C to +150°C.
- Moisture measurement is accurate to within ±0.1%.
- Wide range of applications including being able to measure conductivity, mineral concentration and temperature. Measurements under extreme conditions are reliable. This is especially important when it comes to fresh concrete, foodstuff bulk goods and liquids such as acetone.
- Continuous measurement during processes without sample conditioning.

The SONO probe as a moisture tomograph

The guided radar wave propagates at the speed of light. Similar to a computer tomograph, it measures the material layer by layer in a disc shape. In contrast to conventional moisture probes, this measuring principle is not dependent on the height of the material overlap on the probe, the structure of the material, the fines content or many other disruptive factors. This enables the moisture measurement to be accurate to within ±0.1% in industrial applications.



Moisture measurement technology applications

IMKO's TDR products provide advantages across a diverse range of industrial applications. You can find an overview of the use of the products in the different sectors here.

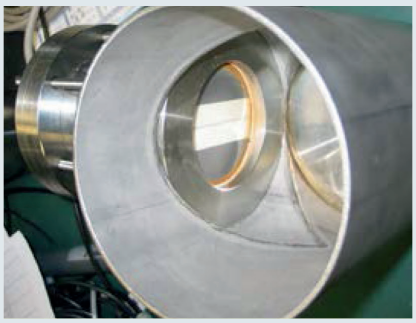
Bulk goods industry

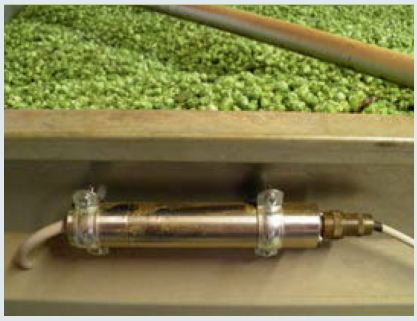
The modern TRIME radar technology in the SONO probes was specially developed for applications for producing foodstuffs, the construction industry and for the chemical and pharmaceutical industry. The moisture probes are available with different special geometries: Extremely light materials require very large measurement fields, while particularly dense or especially conductive materials necessitate special smaller measurement fields.

Concrete industry

If a moisture probe is installed directly in the silo, there is a risk that stationary material adheres to the probe and that this cannot be seen from the outside by the plant constructor. IMKO therefore recommends installing moisture probes underneath the silo flap, which ensures optimum self-cleaning of the probe surface. The SONO probes have such a robust design that even a load of large pebbles does not impact on the probes.

Unlimited possible applications in the process industry





Product overview

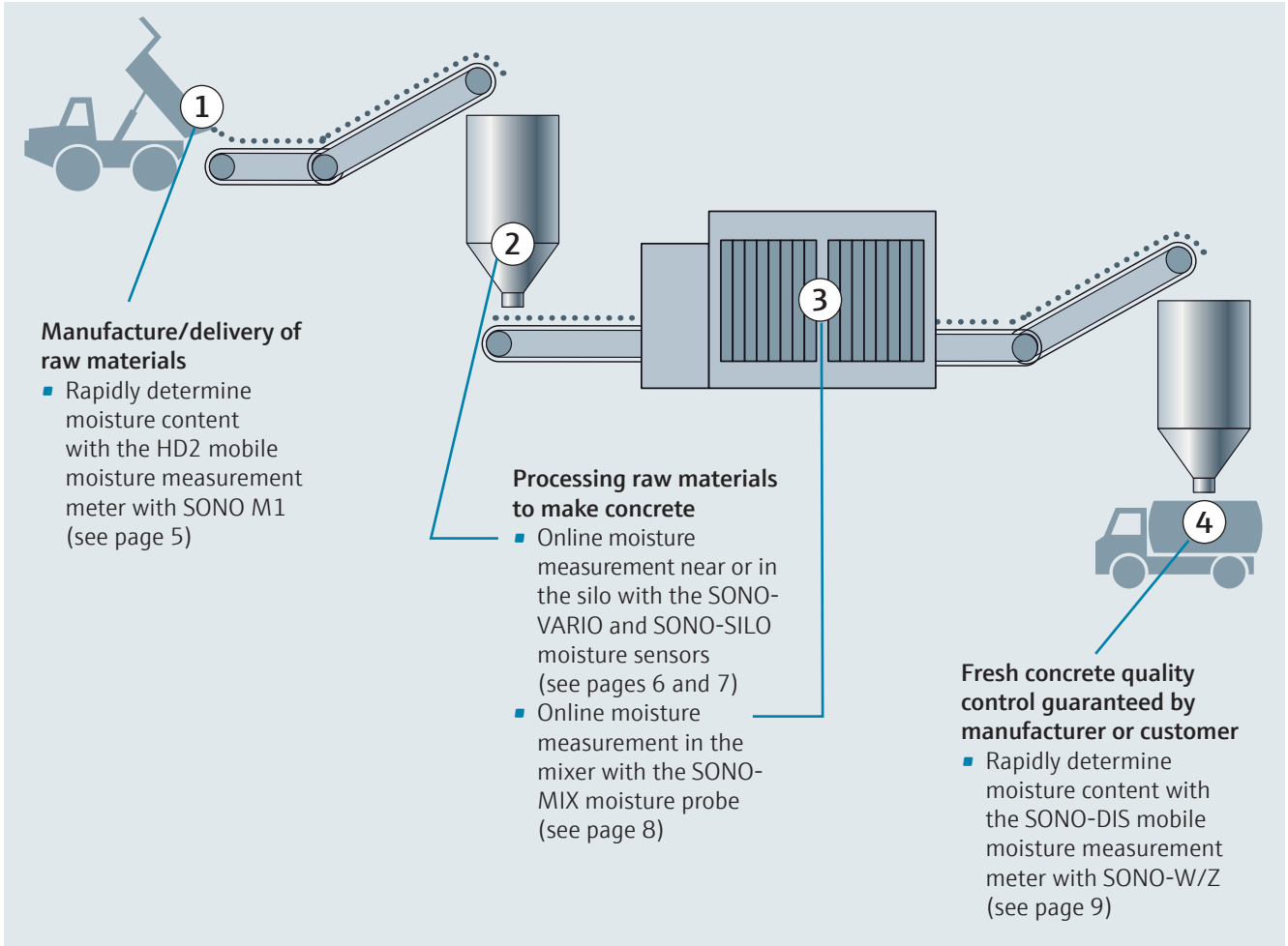
The following overview presents compatible products sorted by plant type for end customers and for relevant plant constructors.

Concrete plants

There are 1700 transport plants, 1200 concrete finished parts plants and 600 concrete block plants in Germany alone.

Challenges

To produce concrete, cement is mixed with additives such as **sand, gravel** and **grit** and then mixed with water. The ratio of water to cement is precisely defined for each different kind of concrete. Moisture measurement technology is used to monitor the water content of the additives and the completed mixture throughout the manufacturing process. The more accurate the measurement, the better the quality of the concrete throughout its entire life cycle.



1 Quick check of raw materials at the point of manufacture and delivery

Mobile moisture measurement system for sand, gravel, grit and other materials

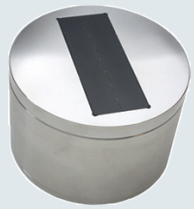
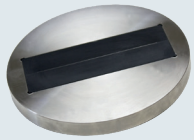
	Item no.	Description
	300107 308081	**Complete HD2 measurement carrying case set with SONO-M1** The set comprises: ▪ HD2 display unit ▪ SONO-M1 moisture probe ▪ AC adapter (12 V/2 A) ▪ Travel plug adapter for various countries

The accuracy of the measuring systems is 0.1-0.2%, while products from competitors only achieve 0.5%.

	300107	**HD2** Robust battery-powered mobile display unit for various probes: SONO-M1, SONO-M1C, SONO-M2.
	308081	**SONO-M1** Mobile moisture probe for sand, gravel, grit and balls of clay. Probe with integrated TDR electronics. The probe has a diameter of 64mm and uncoated rods with a rod length of 100mm.
	308098	**SONO-M1C** Mobile moisture probe for conductive materials such as coal, iron oxide, soils and sand containing clay, fly ash, sandstone, furnace slag and other materials. Probe with integrated TDR electronics, 64mm diameter and coated rods with a rod length of 100mm.
	308079	**SONO-M2** This particularly slim mobile moisture probe for sand, gravel and grit with integrated electronics enables deeper penetration of the aggregate.
	308080	**Telescopic extension for the SONO-M2** Pull-out telescopic extension of up to two meters.

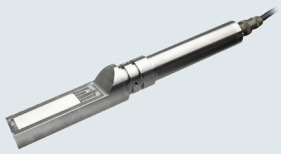
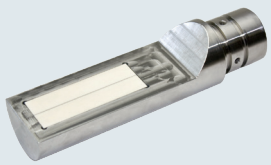
② Continuous measurement of additives during processing

SONO-VARIO range

	Item no.	Description
	308070	**SONO-VARIO Standard** Moisture probe for sand with a grain size of up to 4mm. With military connection on the rear.
	308074	**SONO-VARIO Xtrem** For abrasive applications using gravel (grain sizes: 8/16/32) and grit. With military connection on the rear.
	306063	**Exchangeable, especially wear-resistant sensor head** for SONO-Xtrem
	308031	**SONO-VARIO mounting flange**, 108mm and SONO-MIX Compact.
		Accessories for SONO-VARIO and MIX range:
	308029	**4m sensor cable** with military connector
	308032	**10m sensor cable** with military connector
	308033	**25m sensor cable** with military connector
	308078	**Baffle plate** with a probe slot for the SONO-VARIO.
	308036	**Universal bracket** with tilting mechanism and retaining head. For installing the SONO-VARIO under a silo flap or above a conveyor belt.
	308107	**Highly wear-resistant gliding carriage** For installing the **SONO-VARIO Xtrem Carbide** on conveyor belts. With highly wear-resistant WIDIA glide surface. Includes three threaded rods for attachment.

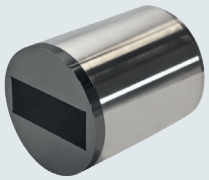
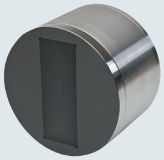
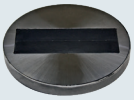
② Continuous measurement of additives during processing

SONO-SILO range

	Item no.	Description
	308050	**SONO-SILO Standard** For measuring the moisture in sand and other fine-grained materials. With military connection on the rear.
	306064	**Exchangeable, especially wear-resistant sensor head** for SONO-SILO Outer diameter: 55mm
		Accessories for SONO-SILO range:
	308034	**Mounting flange** for the SONO-SILO installation tube Internal diameter: 55mm
	308037	**1 m installation tube**/SILO extension Outer diameter: 55mm
	308038	**0.2 m installation tube**/SILO extension Outer diameter: 55mm
	308106	**Adapter set** for adapting the outer diameter of the SONO-SILO from 55mm to 76.2mm. Fits with the Hydronix bracket, comprises: ▪ 1 x installation tube/extension, D = 55mm, L = 0.2m ▪ 1 x adapter to make D = 76.2mm, L = 80mm
	308029	**4m sensor cable** with military connector
	308032	**10m sensor cable** with military connector
	308033	**25m sensor cable** with military connector
	300131	**SONO-VIEW** Stand-alone display and configuration unit to reliably control processes involving the TRIME or SONO moisture probes. Up to four probes can be connected online via a serial interface. For displaying measuring data, selecting the mode of operation and other functions.

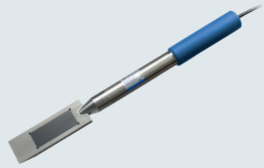
③ Continuous measurement of fresh concrete during processing

SONO-MIX and MIX-MINI

	Item no.	Description
	308027	**SONO-MIX Standard** Mixer probe with solid carbide head and highly abrasion-resistant ceramic, for high stability and a long operating life. Dimensions: 108 x 132mm (diameter x length) With military connection on the rear.
	308089	**SONO-MIX Compact** Mixer probe with solid carbide head and highly abrasive-resistant ceramic, for high stability and a long operating life. Dimensions: 108 x 71mm (diameter x length) With military connection on the rear.
	308028	**Mounting frame** for the SONO-MIX, 108mm
	306062	**Exchangeable, especially wear-resistant sensor head** for SONO-MIX with solid carbide plate.
	308094	**SONO-MIX MINI** Small mixer probe to be installed in a container, scraper or other narrow mounting slot. Probe head made of abrasion-resistant ceramic, for high stability and a long operating life. Incl. 5m connecting cable.
	308029	**4m sensor cable** with military connector
	308032	**10m sensor cable** with military connector
	308033	**25m sensor cable** with military connector
	300131	**SONO-VIEW** Stand-alone display and configuration unit to reliably control processes involving the TRIME or SONO moisture probes. Up to four probes can be connected online via a serial interface. For displaying measuring data, selecting the mode of operation and other functions.

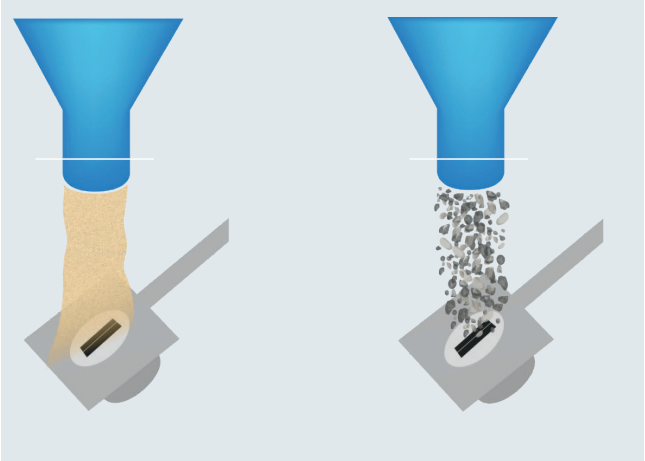
④ Fast quality control of fresh concrete – directly on site

Mobile moisture measurement system for fresh concrete

	Item no.	Description
	300124	**SONO-DIS** Robust battery-powered mobile display unit for the SONO-W/Z and SONO-M1 moisture probes. Strong, weather-resistant IP67 aluminum housing. Dimensions: 150 x 64 x 36mm
	308085	**SONO-W/Z** Robust mobile moisture probe for measuring water content and cement in fresh concrete. Sensor: 154 x 60mm (length x width)
	308081	**SONO-M1** Mobile moisture probe for sand, gravel, grit and balls of clay. Probe with integrated TDR electronics. The probe has a diameter of 64mm and uncoated rods with a rod length of 100mm.
	300124 308085	**Complete SONO-DIS measurement carrying case set with SONO-W/Z** The set comprises: ▪ SONO-DIS display unit ▪ SONO-W/Z moisture probe ▪ AC adapter (12 V/2 A) ▪ Travel plug adapter for various countries
	300124 308085 308081	**Complete SONO-DIS measurement carrying case set with SONO-W/ZM1 and SONO-M1** The set comprises: ▪ SONO-DIS display unit ▪ SONO-W/Z moisture probe ▪ SONO-M1 moisture probe ▪ AC adapter (12 V/2 A) ▪ Travel plug adapter for various countries

Installation of the SONO-VARIO probe

To measure bulk solids, the SONO-VARIO is ideally installed under a silo flap or on a conveyor belt.
It is important to find the **appropriate bracket angle** depending on the material. It must not be too steep or too flat. **The probe surface should be completely covered** during material flow.

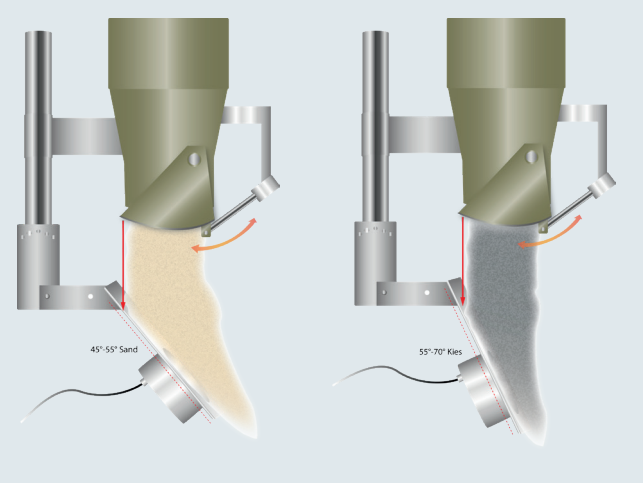


Important installation instructions

We recommend paying close attention to the appropriate bracket angle: It must not be too steep or too shallow. It should be between 45°–55° for sand and a little steeper, around 55°–70°, for gravel and grit so that no backed-up water can accumulate on the surface of the probe.

When it comes to material flow, the following points should be implemented:

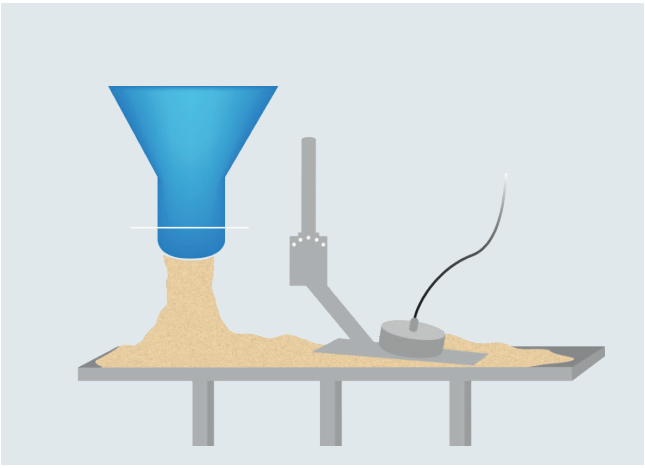
- The probe surface is to be completely covered with material to a height of at least 30mm.
- The material flow must pool on or against the sensor surface.
- The probe should be attached under the flap in such a way that the first material to fall out of the flap will first flow over the baffle plate and then the probe; even before the flap has been fully opened.



The red arrow indicates how the opening flap of the silo should be located under the upper edge of the baffle plate so that the probe is not just partially but completely covered by material.

To measure the moisture of gravel and grit:

- When the ground or surfaces are uneven, we recommend mounting the probe at the highest point on the ground. Water must not be allowed to collect at the probe head since this could distort the measurement.
- The SONO-VARIO can be attached above a conveyor belt with the IMKO universal bracket. Especially if the materials are not homogeneous or flow very loosely, this can lead to a constant compaction of materials and therefore more precise measurements. Pressing the probe onto the material to be measured can prevent it from getting stuck.



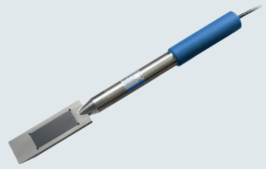
Concrete laboratories

There are around 700 of these types of laboratories in Germany.

Challenges

Torrefaction is considered to be an extremely lengthy method in laboratories; the alternative to this is mobile measurement of moisture in fresh concrete.

The ideal products

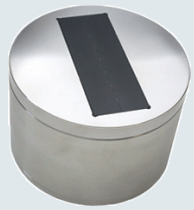
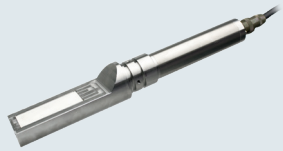
	Item no.	Description
	300124	**SONO-DIS** Robust battery-powered mobile display unit for the SONO-W/Z and SONO-M1 moisture probes. Strong, weather-resistant IP67 aluminum housing. Dimensions: 150 x 64 x 36mm
	308085	**SONO-W/Z** Robust mobile moisture probe for measuring water content and cement in fresh concrete. Sensor: 154 x 60mm (length x width)
	308081	**SONO-M1** Mobile moisture probe for sand, gravel, grit and balls of clay. Probe with integrated TDR electronics. The probe has a diameter of 64mm and uncoated rods with a rod length of 100mm.
	300124 308085	**Complete SONO-DIS measurement carrying case set with SONO-W/Z** The set comprises: ▪ SONO-DIS display unit ▪ SONO-W/Z moisture probe ▪ AC adapter (12 V/2 A) ▪ Travel plug adapter for various countries
	300124 308085 308081	**Complete SONO-DIS measurement carrying case set with SONO-W/ZM1 and SONO-M1** The set comprises: ▪ SONO-DIS display unit ▪ SONO-W/Z moisture probe ▪ SONO-M1 moisture probe ▪ AC adapter (12 V/2 A) ▪ Travel plug adapter for various countries

Gravel plants

Challenges

Before the sale and loading of gravel and sand, the moisture is measured and it should generally not exceed 6-8%.

The ideal products

	Item no.	Description
	308070	**SONO-VARIO Standard** Moisture probe for sand with a grain size of up to 4mm. With military connection on the rear.
	308074	**SONO-VARIO Xtrem** For abrasive applications using gravel (grain sizes: 8/16/32) and grit. With military connection on the rear.
	308050	**SONO-SILO Standard** For measuring the moisture in sand and other fine-grained materials. With military connection on the rear.
	308029	**4m sensor cable** with military connector
	308032	**10m sensor cable** with military connector
	308033	**25m sensor cable** with military connector
	300131	**SONO-VIEW** Stand-alone display and configuration unit to reliably control processes involving the TRIME or SONO moisture probes. Up to four probes can be connected online via a serial interface. For displaying measuring data, selecting the mode of operation and other functions.
	300107 308081	**Complete HD2 measurement carrying case set with SONO-M1** The set comprises: ▪ HD2 display unit ▪ SONO-M1 moisture probe ▪ AC adapter (12 V/2 A) ▪ Travel plug adapter for various countries

Timber industry for OEMs and plant manufacturers

Measuring application

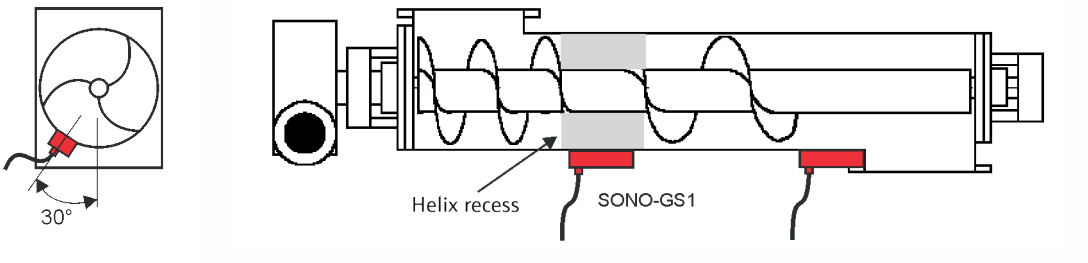
Moisture is measured continuously when drying sawdust, wood shavings, wood chips and bark for producing pellets or wood briquettes.

The ideal products

	Item no.	Description
	308073	**SONO-GS1** Surface probe, based on the TRIME measurement method, with a measuring field volume of five liters. To be installed in a container, material hopper or screw conveyor. Ideal for wood chips and other materials that are not homogeneous and have a very low density. Temperature range of up to 70°C. With military connection on the side.
	308029	**4m sensor cable** with military connector or, alternatively, without connector but with a waterproof armored thread coupling for IP67 and IP68 environments.
	308032	**10m sensor cable** with military connector or, alternatively, without connector but with a waterproof armored thread coupling for IP67 and IP68 environments.
	308033	**25m sensor cable** with military connector or, alternatively, without connector but with a waterproof armored thread coupling for IP67 and IP68 environments.
	300131	**SONO-VIEW** Stand-alone display and configuration unit to reliably control processes involving the TRIME or SONO moisture probes. Up to four probes can be connected online via a serial interface. For displaying measuring data, selecting the mode of operation and other functions.

Installation of the SONO-GS1 in a screw conveyor

The SONO-GS1 probe can be installed along the screw conveyor. It is recommended that you maintain an installation angle of 30°, as shown in the diagram, in order to ensure sufficient material contact with the probe. Installing the SONO-GS1 in a screw conveyor ensures ideal conditions with regard to material flow and material density, as the material is not measured when it is loose but rather after it has been compacted by the screw.



Feed/grain industry for OEM and plant manufacturers

Challenges

Mold and rot destroy **freshly harvested grains**. The continuous measurement of moisture therefore preserves the quality of the final product. Moisture measurement also helps to conserve energy during the drying process. The grain types in question primarily include corn, wheat, barley, rye, rapeseed, sunflower seeds, soya and rice.

The ideal products

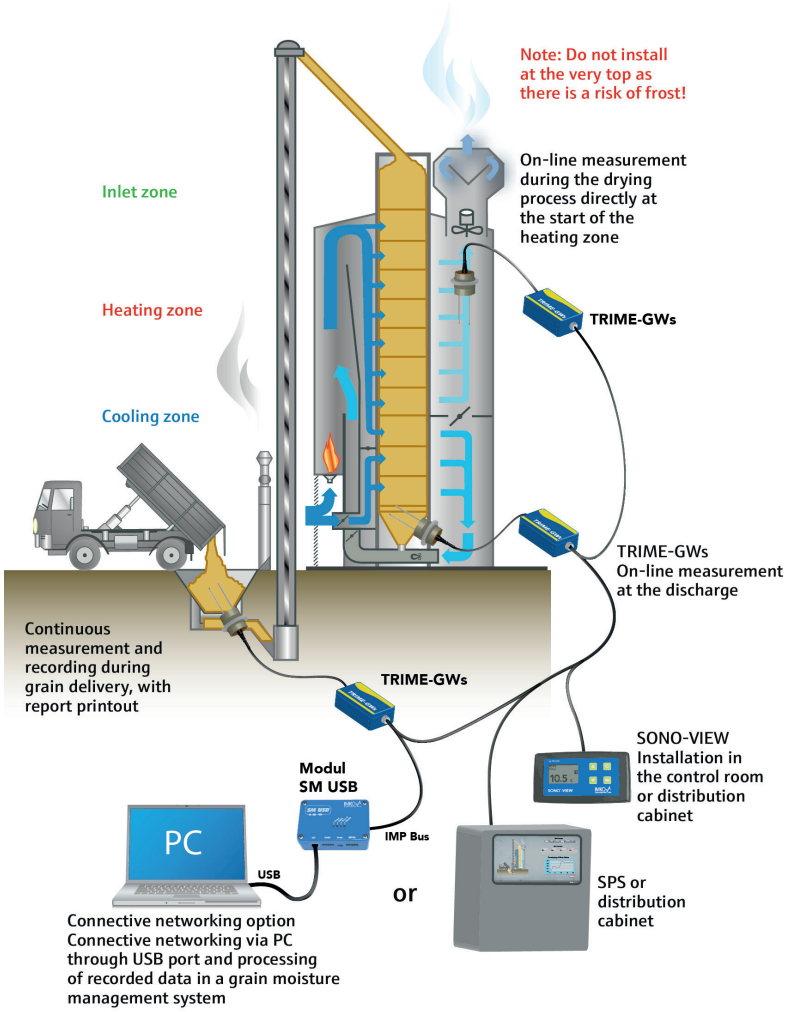
	Item no.	Description
	306010 307012	**TRIME-GW transmitter with GR probe** With integrated SONO TDR transmitter, based on the revolutionary TRIME measurement method. To be installed on the outside of the drying chamber. The transmitter can be used at temperatures ranging up to 70°C. With military connection on the side. GR probe incl. 2.5m cable With an integrated temperature sensor, it can be used directly in the grain dryer at temperatures up to 110°C. For materials with good pourability such as maize, wheat, rye, oleaginous fruits and others.
	306010 307002	**TRIME-GW transmitter with WS2 probe** With integrated SONO TDR transmitter, based on the revolutionary TRIME measurement method. To be installed on the outside of the drying chamber. The transmitter can be used at temperatures ranging up to 70°C. With military connection on the side. WS2 probe incl. 2.5m cable Wedge-shaped moisture probe made of PEEK with integrated temperature sensor can be used directly in the grain dryer at temperatures ranging up to 110°C. For materials with good pourability such as maize, wheat, rye, oleaginous fruits and others. Especially suitable for: Applications with a lot of surface water (steam dryer)
	308073	**SONO-GS1** For measuring the moisture in animal feed during the drying process Surface probe, based on the TRIME measurement method, with a measuring field volume of five liters. To be installed in a container, material hopper or screw conveyor. Ideal for wood chips and other materials that are not homogeneous and have a very low density. Temperature range up to 70°C. With military connection on the side.
	308088	**SONO-VARIO LD** Surface probe with integrated TDR electronics. To be installed in containers, conveyor belts, material hoppers, fluid bed dryers or screw conveyors. Ideal for measuring the moisture of seeds. Measuring field height: 50mm Temperature range up to 70°C. With military connection on the rear.

	Item no.	Description
	308031	SONO-VARIO mounting flange, 108mm
	308029	**4 m sensor cable** with military connector or, alternatively, without connector but with a waterproof armored thread coupling for IP67 and IP68 environments.
	308032	**10 m sensor cable** with military connector or, alternatively, without connector but with a waterproof armored thread coupling for IP67 and IP68 environments.
	308033	**25 m sensor cable** with military connector or, alternatively, without connector but with a waterproof armored thread coupling for IP67 and IP68 environments.
	300131	**SONO-VIEW** Stand-alone display and configuration unit to reliably control processes involving the TRIME or SONO moisture probes. Up to four probes can be connected online via a serial interface. For displaying measuring data, selecting the mode of operation and other functions.

Example of a measurement setup for a dryer

Using TRIME-GWs

Schematic diagram of the possible applications of TRIME-GWs in a dryer



TRIME-GWs can be used in various fields of application. They can, for example, be used to monitor the moisture of the delivered grain or to support or automate grain drying. Depending on the type and density of the grain to be measured, the appropriate calibration curve must be selected.

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