Thermo Scientific Terahertz Sensor

Online thickness, basis weight and density measurement for single and multilayer gauging applications
Thermo Scientific Terahertz Sensor

Multilayer, thickness, basis weight and density sensor

Terahertz sensor history
The Thermo Scientific™ Terahertz Thickness, Basis Weight and Density sensor is a unique technology, developed by TeraMetrix® (a division of LUNA) and incorporated into our web gauging measurement and control platforms. It represents the latest in a long line of Thermo Scientific web gauging solutions. Building off a legacy that started in the 1940’s as Tracer Labs to products brought to the market under the LFE, Aeonic, Eberline, Radiometrie, Eurotherm and EGS brands, we have shipped over 10,000 measurement and control solutions throughout the world and continue to bring more innovation to the market.

Each solution provides improved quality, material savings and increased line utilization over a vast array of applications. Headquartered in Erlangen, Germany with sales and service resources regionally located throughout the world, we have a complete suite of products and services to support customers’ gauging measurement and control requirements. Whether it is extending the life of a legacy platform to meet today’s gauging needs or adapting our building blocks to address a new application, we are your gauging partner.

This sensor provides several new and unique measurement capabilities that are not feasible in any other single sensor solution.
Unique capabilities and value
The Terahertz sensor is a safe, non-nuclear online measurement solution for use in a wide variety of applications, such as multilayer plastic sheet extrusion, multilayer foam extrusion, rubber tire calendaring, multilayer conveyor belt, roofing shingles, single-ply roofing (e.g. TPO or EPDM) and many other applications. The Terahertz sensor provides several new and unique measurement capabilities that are not feasible in any other single sensor solution.

It has the capability to provide simultaneous measurement of thickness, basis weight and density, whereas other solutions require the combination of a true thickness sensor and another true basis weight sensor to provide a density measurement. The Terahertz sensor is also capable of making individual layer measurements within a multilayer product and provides direct thickness measurement while being insensitive to color or additives.

The Terahertz sensor is available as a single sided, reflection type sensor for highly accurate thickness measurement of a multilayer web structure and can be used to measure all type of materials excluding metal and other conductive materials.

Features and benefits

Features
- Industrialized terahertz technology
- Non-contact single layer or multilayer thickness measurement of calendared, laminated or coextruded material
- Simultaneous measurement of total thickness, basis weight, density, moisture and delamination detection with one sensor
- State-of-the-art design
- Temperature stable sensor compatible with ambient temp of up to 50°C without external cooling
- Higher temperatures are possible with an environmental enclosure option. Consult your local representative for details

Benefits
- Accurate online measurement of single or multilayer product structure
- Better control and improved product quality
- Safe and non-radioactive
- No regulatory license required (unlike isotope or x-ray)
- Raw material savings
- Higher yield and reduced scrap
The Terahertz sensor makes its measurement by detecting the time it takes for the terahertz energy to travel through the material being measured and reflect off the surfaces of each layer. This is accomplished by using a laser to generate pulses of terahertz waves at ultra high frequency and a collinear receiver to measure the waves as they come back from each surface. See the diagram below for more details.

Using a proprietary data analysis technique, the Terahertz sensor determines the thickness of each layer by calibrating it by the speed of light in the material and measuring the time difference between $t_1$, $t_2$, $t_3$ and $t_4$ and the index of refraction of the material. As material thicknesses increase, the time for the terahertz energy to travel through it will also increase.

For simultaneous measurement of thickness, basis weight and density, an external reference structure must be used.

Layer 1 thickness = $t_2 - t_1$
Layer 2 thickness = $t_3 - t_2$
Layer 3 thickness = $t_4 - t_3$

1. $t_1$ to $t_4$ are the time at which the terahertz wave is detected by the sensor as it reflects off each surface.
2. Despite the diagram’s depiction, the transmitter and receiver are collinear.
Typical applications

Rubber tires

Typical textile calender line

Fabric calender
Simultaneous measurement of top gum thickness, fabric thickness, bottom gum thickness and total thickness using only one Terahertz sensor.

Wire cord calender
Simultaneous measurement of bottom gum thickness and total thickness using one Terahertz sensor. A second Terahertz sensor head can be added to measure top gum thickness.

Conveyor belt

Layer materials

Conveyor belt
Simultaneous thickness measurement of top cover rubber, nylon, polyester, bottom cover rubber and total thickness using only one Terahertz sensor.
Simultaneous thickness measurement of top PP layer, EVOH barrier layer, bottom PP layer and total thickness using only one Terahertz sensor.

### Typical performance specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness range</td>
<td>50 μm to over 150,000 μm (150mm) depending on material</td>
</tr>
<tr>
<td>Precision 2σ, 250 mS</td>
<td>± 0.1 μm to ± 0.5 μm</td>
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<tr>
<td>Spot size</td>
<td>2 mm diameter</td>
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<tr>
<td>Standoff distance from material</td>
<td>25, 75, or 150 mm</td>
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<tr>
<td>Data acquisition rate</td>
<td>100 Hz/1000 Hz</td>
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<tr>
<td>Operating temperature</td>
<td>0 to 50°C</td>
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<tr>
<td>Operation relative humidity</td>
<td>20% to 90% (non-condensing)</td>
</tr>
</tbody>
</table>

**Typical applications**

Coextrusion, lamination, foam products, shingles and other single ply roofing
Support you can depend on

Thermo Scientific products are supported by our extensive network of qualified application engineers who will work closely with you to understand and evaluate your specific production parameters. Our experts will help you choose the right instruments for your application, then keep them performing to spec. Their goal is to optimize your process today, and also lay the foundation for easy upgrades in the future.

**Product maintenance**
Our comprehensive service offering is based on corrective and preventative maintenance that not only reduces downtime, but also helps you improve your process. We offer multiple levels of support agreements, with varying degrees of access and response, including:

- System commissioning
- System calibration
- Preventative maintenance
- On-site repair
- Depot repair

Some options feature complete cost predictability, with all travel, labor, spare parts, and consumables included.

**Education and training**
We offer multiple training options to help you increase productivity by optimizing the use of your instruments and expanding the skills of your operators. You can receive hands-on instruction in your plant or at one of our training facilities in the USA, Europe and Asia. Our range of courses covers:

- Basic operation
- Calibration
- Routine maintenance
- Troubleshooting
- Certification

We will also work with you to develop a custom program that meets your specific training objectives, often incorporating your own operating procedures.

**Professional services**
Our certified engineers are available to review your process, perform benefit analysis and recommend improvements to help you meet your best-practice goals. We will develop an implementation plan that integrates all Thermo Scientific systems, as well as third-party components including:

- System layout and connectivity
- Software implementation, configuration and support
- Site modifications

You can rely on us to manage the entire installation and start-up if you choose, including serving as a liaison with licensing agencies where necessary.

**Parts and upgrades**
Our spare parts are designed specifically for your Thermo Scientific system, and we make it easy for you to secure high-quality, low-cost replacements by maintaining offices around the world that respond quickly to your phone or online requests. You can also extend the lifetime of your older instruments with our add-on system enhancement and retrofit packages, which adapt your instruments for new uses and eliminate the time and cost to retrain operators on new equipment.
Online solution using industrialized terahertz sensing technology for the measurement and control of single and multilayer gauging applications.

Visit thermofisher.com/gauging or email us at sales.gauging@thermofisher.com