μSPEED - Product Overview

Non-Contact Length & Speed Measurement
Laser-Encoder μSPEED

Product Overview
Q1/2019 - Version 1.0
Product Information

μSPEED gauges are capable of measuring speed and length without contact to the moving material surface. The μSPEED Laser-Encoder systems replace tactile measurement solutions as e.g. contact wheels, which tend to measurement errors caused by slippage, chatter, dirt build-up and day to day wear problems. The maintenance free and long term calibrated μSPEED gauges measure nearly all surfaces without parameter setting.

Most important system features:
- material independent
- long term calibrated
- 0 m/s up to 100 m/s
- bidirectional measurement
- typ. accuracy better ±0.5 m at 1 km
- accredited calibratable acc. MID 2014/32/EU

Benefits

compared to tactile measurement systems:
- self-monitoring
- non-contact, no slippage
- maintenance free and permanently calibrated
- measurement independent from material, surface structur, thickness, elasticity
- can not damage material surface
- high accuracy, high repeatability

 compared to other non-contact devices:
- the most compact gauge in class
- the most easy to handle gauge (plug & play)
- non-contact direction detection
- non-contact zero speed measurement
- no parameter setting necessary
- permanently calibrated
- long laser lifetime
- optimum price performance ratio
- accredited calibratable acc. MID 2014/32/EU
- Made in Germany
Application Overview

There are many different applications for the use of non-contact laser encoders:

Roll / Spool Length / Cut-to-Length Control:
- Web, rolled and spooled materials, coils
- Textile, fabrics, carpet, nonwoven, felt
- Foil, film, tape, membranes, artificial leather, Roof foil, bitumen web, geo textile
- Printed and coated material
- Paper, corrugated paper, abrasive paper, packaging material
- Rubber, laminate, extrusion material
- Tube, hose, profile, bar
- Wire, cable, rope

Discrete Part Length Measurement:
- Plate, panel, tube, bar, profile, rail
- Gypsum board, chip board, MDF panel
- Insulating panel, insulating board
- Wooden beam, panel, KVH structural timber
- Metal- and plastic tube
- Metal sheet and metal panel, slab

Counter / Encoder Calibration:
- Calibration of machine counters
- Calibration of tachometers
- Portable calibration of several production lines

Print Control:
- Printing of length scales
- Printing proportional to length

Pattern Repeat Mark Measurement:
- Packaging film, wall paper, carpet
- Measurement of print pattern distances
- Setting of printing machines

Difference Length / Speed Measurement:
- Speed balancing e.g. for lamination or coating
- Elongation speed ratio measurement
- Slippage detection (Cause study for surface errors, material and web breaks, detection of errors caused by wear and tear)
Application Examples

µSPEED gauges are designed for all kinds of conveying processes, for frequent material starts and stops as well as for changes of material feeding direction.

µSPEED gauges
- work on almost any moving objects, such as
  - Web and coiled material, tube, pipe, rod, sheet, plate, cylinder, roller, profile, wire, cable, yarn, rope
- are suitable for a wide range of applications e.g
  - Continuous length measurement,
  - Cut-to-length control, Portable tachometer
  - Calibration and differential speed measurement, Discrete part length measurement, Control of scale print marks
- can be found in various industrial sectors:
  - Textile: fabrics, non-woven, felt and leather
  - Plastics: film, foil and self adhesive tape, rubber, profile
  - Metal: sheet, web, foil, profile, tube
  - Reel goods: wire, cable, rope, fibre, yarn
  - Paper: print and packaging paper, corrugated products and cardboard
  - Hygiene and food as well as wood, glass and
  - Ceramics and construction industry
  - Machine building: converting industry
**Measurement Principle**

μSPEED gauges operate according to the differential doppler method. Therefore two laser beams intersect at an angle $\varphi$ to the optical axis on the surface of the measurement object. For a point $P$ which moves with the velocity $v$ through the point of intersection of the two laser beams, the frequencies of the two laser beams are doppler shifted.

The two laser beams are superimposed in the measurement volume, producing an interference pattern of light and dark stripes. The stripe spacing $\Delta s$ is a constant which depends on the laser wavelength $\lambda$ and the angle between the measurement beams $2\varphi$:

$$\Delta s = \frac{\lambda}{2 \sin \varphi}$$

If a particle moves through the stripe pattern, the back-scattered light from the particle is modulated in its intensity. A photodetector in the sensor produces a signal whose frequency $f_D$ is directly proportional to the speed component of the surface in the measuring direction $v_P$ and:

$$f_D = v_P/\Delta s = (2v/\lambda) \sin \varphi$$

- $f_D$ = Doppler frequency
- $v_P$ = Velocity vector in measuring direction
- $\Delta s$ = Stripe spacing in the measurement volume

The value of $\lambda/\sin \varphi$ is the measuring scale for speed and length measurement.

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**Figures on page 4:**
Example applications of non-contact length and speed measurement: Foil, timber, textile, cable, wire, steel rope, artificial leather, measurement of cylinder speeds
Product Overview

μSPEED-SMART
- High accuracy smartsensor (typ. better ± 0,05 %)
- Mid price category
- For standard rolling/ cutting processes
- Easy electrical and mechanical integration
- Calibratable length gauge acc. MID 2014/32/EU

μSPEED-ECO
Identical to μSPEED-SMART (see above) apart from:
- Mid accuracy (better ± 0,3 %)
- Low price category

μSPEED-PRO
Identical to μSPEED-SMART (see above) apart from:
- Non-contact bi-directional measurement
- Zero speed measurement
- For each kind of process including stop and go
  and direction changes
- Calibratable length gauge acc. MID 2014/32/EU

MID-COUNTER & CONTROLLER
- Display and operator unit and controller
- Control functions for cut-to-length; good/waste
  length counting; internal memory; direct print-
  out control; measurement data logging
- For fix integration into machine or portable use
- For each kind of process including stop and go
  and direction changes
- MID-COUNTER for calibrated length measurement
  acc. to MID/2014/32/EU

Accessories
- Equipment for portable use: tripod, fast
  installation devices, case
- PC software for configuration and monitoring
- Differential speed measurement software
- Display-units, counters and operator interfaces
- Accessories for accredited version acc. MID
  2014/32/EU e.g. printer
- Protective housings, air and water conditioning
## Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>μSPEED-PRO</th>
<th>μSPEED-SMART &amp; SMART-ECO</th>
<th>μSPEED-CONTROLLER &amp; MID-COUNTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direction Detection</strong></td>
<td>YES</td>
<td>via external direction signal</td>
<td>acc. to type of gauge</td>
</tr>
<tr>
<td></td>
<td>non-contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Zero Speed Measurement</strong></td>
<td>YES</td>
<td>NO</td>
<td>acc. to type of gauge</td>
</tr>
<tr>
<td></td>
<td>non-contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Material Presence</strong></td>
<td>YES</td>
<td>optional</td>
<td>acc. to type of gauge</td>
</tr>
<tr>
<td></td>
<td>non-contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Accuracy (typical)</strong></td>
<td>± 0,05</td>
<td>SMART ± 0,05</td>
<td>acc. to type of gauge</td>
</tr>
<tr>
<td><strong>(2σ;L&gt;10m/3σ;L&gt;20m)</strong></td>
<td></td>
<td>SMART-ECO ± 0,3</td>
<td></td>
</tr>
<tr>
<td><strong>Repeatability</strong></td>
<td>± 0,02</td>
<td>(except SMART-ECO)</td>
<td></td>
</tr>
<tr>
<td><strong>Gauge / Device Type</strong></td>
<td>Smart Sensor</td>
<td>Smart Sensor</td>
<td>Controller + Display</td>
</tr>
<tr>
<td><strong>Speed-Range</strong></td>
<td>m/min</td>
<td>1 to 6.000</td>
<td>acc. to type of gauge</td>
</tr>
<tr>
<td></td>
<td>m/s</td>
<td>0,02-100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>115=5 (±20)</td>
<td></td>
</tr>
<tr>
<td><strong>Stand-off Distances</strong></td>
<td></td>
<td>120=5 (±20)</td>
<td></td>
</tr>
<tr>
<td><strong>(Tolerances)</strong></td>
<td></td>
<td>240=10 (±40)</td>
<td></td>
</tr>
<tr>
<td><strong>Interfaces</strong></td>
<td>1 x RS-485 or RS-232</td>
<td>Quadratout/Imp. Out</td>
<td>RS-232 Sensor, USB</td>
</tr>
<tr>
<td></td>
<td>alternativ to I/Os: RS-422, RS-485</td>
<td>RS-485 / RS-232</td>
<td>Ethernet, …</td>
</tr>
<tr>
<td><strong>I/Os</strong></td>
<td>1 pls/m</td>
<td>1 to 100.000 (depending on max. speed)</td>
<td>L-Reset, Direction, Gate</td>
</tr>
<tr>
<td><strong>Quadrature Output</strong></td>
<td>1 pls/m</td>
<td>Input: Start, Gate, Direction, Laser Interlock</td>
<td>Status</td>
</tr>
<tr>
<td><strong>Output: Status</strong></td>
<td></td>
<td>Output: Status</td>
<td></td>
</tr>
<tr>
<td><strong>I/O Type</strong></td>
<td>RS-422 level</td>
<td>4 x digital high speed I/O</td>
<td>5V or 24V level</td>
</tr>
<tr>
<td></td>
<td>Laser Interlock (single, 24V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data available</strong></td>
<td>Speed, Length, Signal Quality, Status, Laser Interlock, Valid, Measurements, Material Presence</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fieldbus</strong></td>
<td>Profibus, Ethernet-IP, Profinet (fieldbus optional)</td>
<td>MID-CNT: Available Protocols: SOAP, XML, JSON, UPD</td>
<td></td>
</tr>
<tr>
<td><strong>IP Code</strong></td>
<td>Sensor head: IP67</td>
<td>CONTR. &amp; MID-CNT.:</td>
<td>CONTR. &amp; MID-CNT.:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Front: IP51; Back: IP20</td>
<td>Front: IP51; Back: IP20</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>mm</td>
<td>Sensor head: 154x94x39</td>
<td>CONTR: 236x166x126 mm</td>
</tr>
<tr>
<td><strong>(LxWxH)</strong></td>
<td></td>
<td>Sensor head: 1 kg</td>
<td>MID-CNT: 96x96x160 mm</td>
</tr>
<tr>
<td><strong>Voltage</strong></td>
<td></td>
<td>Controller: 2,5 kg</td>
<td>CONTR: 110-230VAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MID-CNT: 1 kg</td>
<td>MID-CNT: 24VDC</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>kg</td>
<td>Sensor head: 1 kg</td>
<td>Controller: 2,5 kg</td>
</tr>
<tr>
<td><strong>Laser Data</strong></td>
<td>25mW, 780 nm (Laser class 3B)</td>
<td></td>
<td>MID-CNT: 1 kg</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>5 bis 55 °C (41 to 131 °F) non condensing</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td></td>
<td>Cooling/heating required outside this range</td>
<td></td>
</tr>
</tbody>
</table>

Specifications are subject to change without notice.
Fig.:
Sensor head identical measured for all types of sensors
(μSPEED-SMART, -ECO, -PRO)

Stand-off Distance:
SMART + ECO: 120 / 240 mm
PRO system 115 mm
ELOVIS GmbH
Karl-Friedrich-Straße 14-18
76133 Karlsruhe
Germany
Tel.: +49 (0)721 933823 0
Fax: +49 (0)721 933823 23
info@elovis.de
www.elovis.com

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