Product Information

μSpeed®

Non-contact Optical Length and Speed Measurement

Long term calibrated device with certification of the national metrology institution (PTB – Physikalisch Technische Bundesanstalt)
Safety and Laser Protection

This unit is a class IIIB laser product and complies with EN60825-1:2001. Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

The following safety features required to comply with the Bureau of Radiological Health Class IIIB laser requirements are included:

- Key-operated power switch on controller
- Laser indicator light on controller and laser
- Delayed laser startup-laser indicator light on prior to laser radiation
- Laser beam blocking device
- Interlock capability for remote shut-off

THE INSTRUCTION MANUAL MUST BE STUDIED CAREFULLY BEFORE INSTALLATION AND COMMISSIONING OF THE µSPEED SYSTEM. THE MEASURES AND RECOMMENDATIONS ARE TO BE FOLLOWED.
General Description

The µSpeed® Sensor is a LASER-DOPPLER-Velocimeter for non-contact speed and length measurement to be used for all kinds of material with micro structured surfaces. Its simple use and robust design makes it suitable for a variety of applications in all kinds of industries. Speed and length of material with a length more than 5m can be measured long term with an accuracy, better than +/-0,05%. The laser-doppler principle allows precise measurement on most technical surfaces. The unit's compact design makes it also suited for confined spaces.

There are versions available, for up to 60m/s [11800ft/mn] and stand off distances between 120mm [4,7in] and 500mm [19,6in]. In addition, application-specific modifications and housing protections as well as cooling devices can be asked for.

µSpeed is also available in a certified form with the certification of the national metrology institution of Germany (PTB – Physikalisch Technische Bundesanstalt, Braunschweig).

Measurement Principle

Using two laser beams a stripe pattern is projected onto the object. The intensity of the reflection is modulated by the movement of the object and detected by the sensor. The frequency of the intensity modulation is proportional to the velocity of the object and thus to the doppler frequency. There is no need for markings or reference points on the object.

Applications

Speed and length measurement for
- metals, paper, timber, textiles, non-woven, plastics, rubber
- web material, tapes, pipes, sheets, film, wire, cable, goods in pieces
- cutting length, process control, positioning, dosing, production data acquisition
- speed measurement for process control purpose

Technical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>speed range</td>
<td>0m/min...3600m/min [0ft/mn…11800ft/mn]</td>
</tr>
<tr>
<td>typical accuracy</td>
<td>0,05%</td>
</tr>
<tr>
<td>stand off distance</td>
<td>120mm [4,7in] → +/- 5mm (+/- 20mm) [0,12in (+/-0,7in)]</td>
</tr>
<tr>
<td>depth of field</td>
<td>240mm [9,4in] → +/- 10mm (+/- 40mm) [0,24in (+/-1,5in)]</td>
</tr>
<tr>
<td></td>
<td>500mm [19,6in] → +/- 20mm (+/- 80mm) [0,36in (+/-3,1in)]</td>
</tr>
<tr>
<td>interfaces</td>
<td>1x RS 232 unidirectional for printer</td>
</tr>
<tr>
<td></td>
<td>1x RS 232 bidirectional for PC</td>
</tr>
<tr>
<td></td>
<td>I²C Bus for external keyboard or special applications</td>
</tr>
<tr>
<td>analog output</td>
<td>0...4 V (programmable)</td>
</tr>
<tr>
<td>impulse output</td>
<td>1...10000 Impulses/m (programmable)</td>
</tr>
<tr>
<td>optical isolated outputs</td>
<td>stop contact, pre-stop contact, alarm</td>
</tr>
<tr>
<td>LASER diode</td>
<td>25 mW / 780 nm (class 3b)</td>
</tr>
<tr>
<td>power supply</td>
<td>230V / 50-60 Hz , 110 V / 50-60 Hz</td>
</tr>
</tbody>
</table>

*1) Valid for µSpeed-S1 to – S60
*2) Valid for lengths more than 5m (1σ) / >10m (2σ) / >20m (3σ) → see also figure on page 4
*3) µSpeed adjustment at the extreme range of values in round brackets may reduce measurement accuracy

Specifications are subject to change without notice.
Mounting Layout

Wiring diagramm of the system

Mounting tolerances of the standard system
Sensor Head

Dimensioned sketch of the sensor head

The housing of the sensor head, which is made of aluminium, is closed with 6 screws. The emission of the laser beam goes through a special glass.

A ready made 3m five-pole cable for the connection of the sensor head and the processing unit is part of the scope of delivery. The voltage of the sensor head is 5VDC.

A two-colour LED at the side of the plug shows the operation status of the laser. Red light means off – Green light means laser on!

Direction for mounting:

The scope of delivery includes also a PVC isolation plate (94x154x1mm) and 6 plastic screws M6 x 12. The customer or integrator has to provide a vibration free mounting plate (appr. 4mm thick) with 6 holes according to the above shown hole pattern. Please consider the mounting tolerances of the µSpeed system mentioned on page 5. Make sure that the sensor head is mounted in a isolated way by using the plastic screws as well as the isolation plate.
**Processing Unit**

**Dimensioned sketch of the processing unit**

The housing of the processing unit is made of a aluminium frame with aluminium side walls. The unit is to be used both as table unit or for mounting into instrument panels. With the delivered clamp devices the processing Unit can be fastened in a cut-out of $138^{*1.0} \times 92^{*0.8}$ mm. Herefore the plastic feet have to be removed.

The front plate carries a foil keyboard including display and four operation keys as well as a key switch.
Front View

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Key switch - is used to switch the LASER beam on/off</td>
</tr>
<tr>
<td>2</td>
<td>LASER ON LED: Lighted if Laser is on.</td>
</tr>
<tr>
<td>3</td>
<td>Left Button: This key is for menu selection or cipher input (left side)</td>
</tr>
<tr>
<td>4</td>
<td>Right Button: This key is for menu selection or cipher input (right side)</td>
</tr>
<tr>
<td>5</td>
<td>Return: Start / Stop function during measurement; Confirmation of selected menu points or ciphers</td>
</tr>
<tr>
<td>6</td>
<td>Escape: Change menu level; interruption of manual input</td>
</tr>
<tr>
<td>7</td>
<td>Status LED: - indicates failure or stand still</td>
</tr>
<tr>
<td>8</td>
<td>Display: 16 letters x 2 lines alphanumerical Display</td>
</tr>
<tr>
<td>Nr.</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
<td>9 Pin Sub-D plug for connection of the asynchronous serial RS232 interface (DTE)</td>
</tr>
<tr>
<td>2</td>
<td>TTL I/O: Impulse output, direction output, DAC-output, Error/Hold. For the connection of the µSpeed-IMP-module</td>
</tr>
<tr>
<td>3</td>
<td>Optoisolated I/O: 10 pole connection device with Input for Start, Direction, Interlock and output for Pre-Stop, Stop and Hold/Error.</td>
</tr>
<tr>
<td>4</td>
<td>Main fuse: M400mA</td>
</tr>
<tr>
<td>5</td>
<td>Power supply (230V/50Hz or 115V/50Hz)</td>
</tr>
<tr>
<td>6</td>
<td>Main switch (Power ON/OFF)</td>
</tr>
<tr>
<td>7</td>
<td>secondary fuse for the auxiliary voltage</td>
</tr>
<tr>
<td>8</td>
<td>connector for the sensor head</td>
</tr>
<tr>
<td>9</td>
<td>9-pin Sub-D-Plug for serial printer</td>
</tr>
</tbody>
</table>
Pin Connection Layout

Description
- **[+7V]** Output voltage is additionally fused with 125 mA. The output is only used for the eventual supply of the optocoupled inputs.
- **Interlock** is used for the remote control of the laser (LASER ON/OFF). Hereby µSpeed can be integrated in a safety circle around a machine or production line.
- **Direction** is used for the change of the counting direction by external direction signal. It is recommended to use the direction port at the µSpeed-IP-module.
- **Gate** takes a mute signal of an external device, for temporary switching the sensor dumb without resetting the measured length. E.g. during the movement of defective material, which has to be cut out later, of a machine if the machine is at a rest. It is recommended to use the port at the µSpeed-IP-module.
- **Start** is used for the external control of the measurement. A start signal results in resetting the unit.

### opto-isolated I/O

<table>
<thead>
<tr>
<th>Pin Nr.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>GND:</strong> (Internal 0-Volt)</td>
</tr>
<tr>
<td>2</td>
<td><strong>+7V</strong> (fuse 125mA)</td>
</tr>
<tr>
<td>3</td>
<td>Interlock + Input (min. 2mA/5V, max. 20mA/50V)</td>
</tr>
<tr>
<td>4</td>
<td>Direction + Input (min. 2mA/5V, max. 20mA/50V)</td>
</tr>
<tr>
<td>5</td>
<td>Start + Input (min. 2mA/5V, max. 20mA/50V)</td>
</tr>
<tr>
<td>6</td>
<td>Gate + Input (min. 2mA/5V, max. 20mA/50V)</td>
</tr>
<tr>
<td>7</td>
<td>Stop + Output / End-contact (max 100mA, 300V)</td>
</tr>
<tr>
<td>8</td>
<td>Pre-Stop + Output / precontact (max 100mA, 300V)</td>
</tr>
<tr>
<td>9</td>
<td>Hold/Error + Output (max 100mA, 300V)</td>
</tr>
<tr>
<td>10</td>
<td>Common</td>
</tr>
</tbody>
</table>

Inputs : max 50V / 20mA
Outputs : max 50V / 100mA
\( \mu \text{Speed Accessories} \)

- \( \mu \text{Speed-TUBE} \) Sensor Head Tube
- \( \mu \text{Speed-CMS} \) Configuration & Monitoring Software
- \( \mu \text{Speed-RCS} \) Remote Control & Production Data Acquisition Software
- \( \mu \text{Speed-IMP} \) Impulse Processing Module
- \( \mu \text{Speed-KEY} \) Comfort Keyboard
- \( \mu \text{Speed-LM} \) Long-term Memory
- \( \mu \text{Speed-P} \) Printer
- \( \mu \text{Speed-IMPW} \) IMP Wheel
- \( \mu \text{Speed-DISP} \) Additional Display
- \( \mu \text{Speed-HSE} \) Protective Housing
- \( \mu \text{Speed-TRI} \) Sensor Tripod
Sensor Head Tube  
\(\mu\text{Speed-TUBE}\)

<table>
<thead>
<tr>
<th>Description</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Sensor Head Tube reduces the danger of looking directly into the laser beam.</td>
<td>Heigth: 110 mm</td>
</tr>
<tr>
<td>The standard tube reduces the gap between sensor head and material surface to 10mm only. In connection with other protection activities (light trap, mechanical shutter, manipulation prevention, machine safety enclosure with emergency stop switch) the laser class of the system can be reduced to class 1. Hereby further activities as e.g. the need of an employer who is in charge of laser protection, is not necessary any more.</td>
<td>Width: 20 x 30 mm</td>
</tr>
<tr>
<td></td>
<td>Material: Aluminium</td>
</tr>
</tbody>
</table>
Configuration & Monitoring Software

µSpeed-CMS

Description

The configuration- and monitoring software is installed on a PC or a laptop. By connecting the µSpeed via RS 232 to the laptop, the laptop can be used for monitoring the measurement process or for showing or changing the configuration of the µSpeed system.

All measurement values can be displayed in graphical way.

The software enables the user additionally to memorize to the PC all data or measurement values which were monitored during the connection of µSpeed and PC.

Features

- Number of files: unlimited
- Interpretation: serial, RS232
- Transmission format: binary, ASCII
Remote Control & Production Data Acquisition Software
\(\mu\text{Speed-RCS}\)

**Description**

The software module \(\mu\text{Speed-RCS}\) enables the user to read \(\mu\text{Speed}\) data by a PLC (SPS) or a PPC (PPS) system or any other superior host computer at any time, defined by the host. Additionally the host computer can send data to \(\mu\text{Speed}\). All functions of \(\mu\text{Speed}\), which are available by pressing \(\mu\text{Speed}\) keys can then be operated remote controlled by the host. The module uses the integrated RS-232 interface for communication.

\(\mu\text{Speed-RCS}\) provides/enables:

- To read \(\mu\text{Speed}\) data by PLC (SPS) or PPC (PPS) or any other host computer at any time defined by the host.
- The integration of \(\mu\text{Speed}\) into the data processing of the production.
- To give the possibility to install a user specific visualization (e.g. by Visual Basic).
- To control the \(\mu\text{Speed}\) by external computer or host systems.

The functions of the RCS module can be classified as follows:

- Replacement of the sensor keys
- To request measurement values
- To set parameters

**Eigenschaften**

Interpretation: serial, RS232
Transmission format: binary, ASCII
Impulse Processing $\mu$Speed-IMP

$\rightarrow$ certified by national metrology institution PTB

$\rightarrow$ applied for patent

Description

$\mu$Speed-IMP provides four functions:

a.) direction recognition
b.) start and stop detection
c.) low speed measurement
d.) pulse output

By the use of $\mu$Speed-IMP the signals of an external pulse generator device are processed to achieve the functions a, b and c. The pulse generator device can be either an encoder, which is driven by contact wheel or by transporting cylinder, or directly by an electric drive. The pulse output function (d) operates without any other external device and enables $\mu$Speed to send quadrature pulse signals to replace contact tachometers.

$\mu$Speed-IMP is certified by the national metrology institution PTB (Germany) and has been applied for patent.

For achieving the function a, b and c, two shifted by 90° pulse input signals are necessary, which in general will be provided by a external encoder (contact wheel plus encoder that in most cases is already mounted to the machine). Hereby $\mu$Speed-IMP detects the direction as well as start and stop of the material movement (not machine movement). In addition speed below the measurement limit of $\mu$Speed is measured by $\mu$Speed-IMP. As the external encoder is getting continuously calibrated by $\mu$Speed, day to day use problems as well as material and thickness changes won’t affect the measurement. By using this configuration the complete measurement system is long term stable and long term calibrated.

Connection

The fast and easy connection with $\mu$Speed-IMP is done by plugging in the included in delivery 9-pole Sub-D cable in the $\mu$Speed TTL I/O. The external encoder has to be connected to the corresponding clamp (channel A, channel B) of the $\mu$Speed-IMP. See Figure 1. The pulse output signals are at clamp 9, 10, 13 and 14. $\mu$Speed-IMP is designed to be mounted by top hat rail. Similarly the $\mu$Speed-IMP has to be connected to the power supply (carried out by 24V auxiliary supply). The Grounding of the external encoder has to be the same as for the IMP unit (important: similar reference ground).

<table>
<thead>
<tr>
<th>Table 1: Connector pin assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impulse-Processing $\mu$Speed-IMP</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
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<tr>
<td>3</td>
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<td>13</td>
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<tr>
<td>14</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>16</td>
</tr>
</tbody>
</table>
**Features & Translation**

Channel (Spur)
Ground (Masse)
Supply (Versorgung)...... 8-24V=
µSpeed (µAWS).......... Sensor system
Power consumption....... max. 2W
Inputs.......................... Imp. A
  Imp. B
  TTL I/O
Input resistance.......... 10kΩ
  optional 10kΩ
Pullup resistance
Input - Hi.................... 3-24V
Input - Lo................... <1.5V
Input frequency.......... <10kHz
Pulse resolution......... <4mm/Impuls
Scope of delivery........ µSpeed-IMP
  TTL I/O cable

**Parametrization of µSpeed Processing unit:**

To be set up in the under menu I/O:

a.) pulses/m............... (…)
  → enter 4 times the number of pulses per meter which µSpeed+IMP should send to the machine control
b.) IMP ...................... on
  → to activate the direction, low speed and gate function of the µSpeed
c.) IMP auto............... on
  → to activate the auto calibration function
d.) IMP line periode..... (…)
  → enter the number of pulses per meter which the external wheel encoder sends out (standard: 1000imp/m)
Comfort Keyboard
\( \mu \text{Speed-KEY} \)

**Description**

The comfort keyboard \( \mu \text{Speed-KEY} \) makes data input to the \( \mu \text{Speed} \) unit more easy. The comfort keyboard makes sense, if data input has to be done frequently and manually by an operator – e.g. for typing in length values for cut-to-length applications such as pre length and end length.

Beside the two ARROW keys, RETURN- and ESCAPE-key, 12 keys for typing in numbers and letters are integrated into \( \mu \text{Speed-KEY} \).

As e.g. in mobile phones, most keys are used for multiple input. Therefore text or parameter can easily and fast be changed.

The selection for multiple input of one key is done by pressing the same key several times in a fast way. The respectively selected value is shown in the display.

The \( \mu \text{Speed} \) processing unit identifies by itself that the \( \mu \text{Speed-KEY} \) has been plugged in, and makes the connection and switches the operation itself to \( \mu \text{Speed-KEY} \). The four keys of the processing unit have the same functionality as the according keys of the comfort keyboard.

The comfort keyboard is designated to be installed into a front panel. The connection of the comfort keyboard is done by a 9-pole cable (I\(^2\)C-Bus) to the TTL I/O-interface of the \( \mu \text{Speed} \) processing unit.

**Features**

- **Interface**: I\(^2\)C-Bus
- **Dimensions (BxH)**: 96 x 96 mm
- **Front**: membrane keyboard
  - 4 x 4 Keys
Long-term Memory

µSpeed-LM

Description

The µSpeed-LM long-term memory electronic board (ring memory) is designed to be integrated into the µSpeed processing unit and is used for memorization of up to 50,000 measurement values. The Measurement values can be read out via serial interface and by laptop, PC or any superior host computer.

One data file memorizes not only the measurement value “Length” itself, but also the running memory file number, the date and hour of the measurement, the user name as well as the failure flag which tells about the validity of the measurement value.

Additionally a shift performance counter is implemented into µSpeed-LM, which memorizes the performance of up to 6 working shifts. By this counter, the production volume and the total lengths of each shift can be memorized and then analyzed by a production data analyze software.

The memorized data can be selected and displayed by the operator menu of the µSpeed processing unit and then be sent by serial interface to an external computing system. The data selection can be done by choosing the memory file number or the memorization date of the data file.

The µSpeed-LM long-term memory is a flash-EEPROM with a capacity of more than 50000 data files.

µSpeed-LM memorizes the data in a cyclical way, that means that if the memory capacity has been reached, the oldes data file will be over written by the newest data file and so on. The running file number will count on and on. By the high memory capacity the memorized data files can rest long time in the memory until they will be over written.

It is not possible to delete data files manually (not by accident – and not if wanted!).

Features

File capacity…………………….. appr. 50,000

Data file format….
1. Running file number
2. Failure flag of the measurement value (correct measurement)
3. Date/Hour of measurement
4. User 1
5. User 2
6. Failure flag of data file (correct memorization)

Data reading and analyze: serial, RS232
Printer
\(\mu\text{Speed-P}\)

**Description**

The EPSON TM-U295 printer enables the user to print out measurement values or optionally (by additional ordering) customer specific production data inclusive customer logos into document forms.

The format of the print out is defined by two independent format strings which are memorized in the processing unit.

The print out of the last measurement result starts by receiving the start signal which is given to start a new measurement.

Five different ways of giving the start signal can be used:

1. RETURN-Key of the processing unit
2. RIGHT ARROW Key
3. LEFT ARROW Key
4. External start signal input
5. Printer busy (by inserting paper into the printer)

The operator can select each of this signal sources by menu of the processing unit to combine them with one of the two format strings. Therefore the print out can be controlled very flexible.

Besides logos and texts which can be programed in a fix way, the following running program parameter can be read out:

1. User 1
2. User 2
3. Date
4. Hour
5. Running number of measurement
6. Failure flag of the measurement
7. Formated length measurement value

The printer is connected to the RS232 print out port of the \(\mu\text{Speed}\) processing unit.

**Features**

- **Printing method**................. 7-Pin-Matrix-Shuttle-Printer
- **Size of Paper (WxH)......** 80x69 - 1582x257
- **Characters per Inch.........** 13,5 / 16,2
- **Printing speed...............** 2,1 LPS
- **Life time of cartridge.......** 15 Mio. Characters
- **Interface......................** RS-232
- **Buffer...........................** 512 or 35 Bytes
- **Weight..........................** 1,6 kg
- **Printer size (WxDxH).....** 180x190,5x101,5
- **Supply.........................** 24 V=

(all size units in mm – if nothing else mentioned)

Remark: Also other RS232 printers are available!

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**IMP-WHEEL**

\(\mu\text{Speed-IMPW}\)
**Description**

To recognize the direction of the material movement as well as for measurement of lowest speed (e.g. 5mm/hour), μSpeed-IMPW consists of:
- rubber nib roll with 500mm circumference
- encoder, 10-30VDC, 500imp/turn, push-pull output or contra pulse (alternative: 5VDC, TTL)
- arm with spring

In combination with the μSpeed-IMP, the IMP wheel can be used to send direction and gate signals to μSpeed. The μSpeed IMP Wheel enables also to measure extremely low speed which in general can not be measured by any laser-doppler system.

In combination with μSpeed-IMP and μSpeed basic unit, the μSpeed-IMP wheel is certified by the national metrology institution PTB (Germany).
Additional Display
µSpeed-DISP

Description

µSpeed can additionally be equipped with a alphanumeric size display, which enables the user to read measurement values and status messages over distances of more than 10 m.

µSpeed-DISP in standard configuration is a 8-spaces 7-segment display. µSpeed-DISP can optionally be ordered as a two line display with each 16-spaces 7-segments.

The display scope of delivery includes a mounting plate and connection cable.

Other sizes of displays and more than one or two arrays due to customer specifications, are possible. Please contact us!
Protective housing
\(\mu\text{Speed-HSE}\)

**Description**

The \(\mu\text{Speed-HSE}\) protective housing is used to protect the sensor head against pollution and high temperature.

The housing is standardly delivered with a 5m oilresistant flexible tube for air conditioning. The air with a max. temperature of 30°C has to be delivered by the customer.

According to the temperature of the incoming air, the housing can be used in surroundings with 80°C and more.

By the continuous flowing air, the sensor is also protected against pollution, fog or humidity which could affect the measurement ability of the sensor.

The housing can optionally be equipped with a protection shild (\(\mu\text{Speed-HSEa}\) – see picture below) or with a laser protection tube.
Sensor-Tripod

μAWS-TRI

Description

Aufgrund der geringen Baugröße sowie dem äußerst geringen Gewicht des Sensorkopfes (1kg) kann der Sensor auch portabel eingesetzt werden.

Das Sensorkopf-Stativ μAWS-TRI dient hierbei als Standhalterung. Mittels Galgenausleger und Kugelkopf ist das System nahezu an jeder Stelle einer Produktions- oder Umwickelmaschine innerhalb kurzer Zeit stabil aufgebaut und messbereit ausgerichtet. Durch den Galgenausleger kann der Sensorkopf bis zu 2,5m entfernt vom Zentrum des Stativs justiert werden.
